

Making a CASE for the third space

A study into small group talk in the science classroom

by

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Abstract

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The Thinking Science programme or CASE (Cognitive Acceleration through Science Education) is a sequence of thirty lessons that seek to develop pupil reasoning in the context of secondary science. CASE is based upon the work of Jean Piaget and Lev Vygotsky and was very popular being used by hundreds of schools, both in the UK and around the world, during the 1990's and the 2000's. The lessons and ideas are still in use today and serve as a lasting legacy for the authors: Philip Adey, Michael Shayer and Carolyn Yates. This thesis will present an insider's view of CASE from a teacher who has been using the lessons for 34 years. This perspective will allow the author to articulate an experienced teachers thinking regarding the principles of CASE. Alongside this an analysis of Vygotskian psychology, illuminated by Bhabha's ideas, will be used to present the concept of the third space as a model to visualise the small group talk taking place in the CASE classroom.

Since the advent of CASE much of the language it used to describe cognitive development, such as metacognition, has become common parlance in educational settings. This thesis brings a practitioner perspective to bear on the principles of CASE and the pupil talk it seeks to generate. Seven CASE lessons were taught to a secondary, Year 9, class over a period of six months and video recorded. The resulting lesson plans and transcripts, of small group conversations, enabled the Vygotskian foundations of the CASE programme to be explored. Bhabha's notion of the third space was used to categorise talk in a way that is reflective of the real lives of children and the ideas they carry with them into the classroom. This analysis enabled an innovative, colour, coding system to be developed to illustrate and track the contours of children's talk. This thesis brings a sense of clarity regarding the use of third space theory in educational settings and bridges a gap in this canon as it takes place in the mainstream secondary classroom within the context of a core subject. As a result third space talk has now been described and categorised in a way that allows it to be applied across subjects and in other settings such as special schools.

The Vygotskian concept of a child's lived experience, *perezhivanie*, is used to illustrate a possible route for teacher's to guide the conversations towards the types of talk supportive of cognitive development. This research uses the idea of a trigger to show how appropriate challenge can be used to engage learners and this is uniquely illustrated through the use of a weather map representation of pupil talk. This serves to refresh CASE and will support a new generation of teachers to better manage the dynamics of small group talk at a time when the pressure for children, yet again, to be seen and not heard is growing.

The key findings from this study for classroom practitioners can be summarised using the following headings:

- a) Inclusion,
- b) Professional choice,
- c) Construction talk and,
- d) Hope in the zone.

Inclusion points to the fact that pupil funds of knowledge need to be utilised, in the third space, so that their life-times worth of experiences brought to the classroom are included and acknowledged. This is true for all learners and the potential of this is supported by the fact that majority of the pupils highlighted in the transcripts were categorised by the school as SEND.

Professional choice references the fact that choices are made in the planning and conduct of lessons. To promote thinking teachers can integrate triggers in a way that engages pupils in intellectual inquiry. Triggers can be included in the lesson conduct or in response to the conversational turns taken in real-time. Similarly small groups can be orchestrated to develop construction talk that develops pupils thinking within the two planes described by Vygotsky – the

social and the psychological. If managed utilising the third space then the external interactions with others support and enhance the inner cognitive life of the individual.

Construction talk is a living vocabulary that verbalises the inner thought life and so is one that must be inclusive of all forms of talk. The five talk codes reflect the real, honest, messy and playful conversations taking place in classrooms today as adolescents engage with the cognitive challenges around which CASE is built. The sensitive use of triggers can engage and guide pupils towards forms of talk that activate their funds of knowledge and develop both ownership of their talk and a metacognitive awareness of their thinking.

Hope in the zone – the third space is a theoretical construct that has been successfully used and applied in a range of educational settings. It has been used here to illuminate construction zone activity as a powerful time of developmental potential for children facing abstract concepts in science. Hope in the zone is possible with thoughtful planning and the use of specific classroom management techniques following the clear pedagogical guidelines for such techniques that are provided within this thesis.

The outcomes of this research form a practical and easy to apply guide to the use of the third space as a bridge between pupil knowledge and curricular content and serves to both update and reposition CASE for a new generation of teachers in a way that is inclusive of all learners. The time has come for the third space to become more mainstream curricular vehicle. Historically it has been hard to find and was an idea heavy on metaphor yet light on practical examples of realistic teaching advice. This thesis shows what it looks and sounds like in the classroom in a way that is inclusive of all learners. C.S. Lewis said that children are not a distraction from more important work - they are the most important work. The outcomes of this thesis will help teachers to carry out such work, work that will outlive CASE and last long beyond my life in the classroom.

Acknowledgments

“Many have undertaken to draw up an account of the things that have been fulfilled among us, just as they were handed down to us by those who from the first were eyewitnesses and servants of the word. With this in mind, since I myself have carefully investigated everything from the beginning, I too decided to write an orderly account for you, most excellent Theophilus, so that you may know the certainty of the things you have been taught.”

Luke 1: 1 - 4

The ideas contained in this thesis highlight very clearly upon whose shoulders I am standing. This work was inspired by the educational thinking originally shared with me by Philip Adey, Mundher Adhami, Michael Shayer and Carolyn Yates. They freely gave of their time to tutor me and in the process they opened my eyes to a distant horizon, pointing me to the source of inspiration of this work: the educational theories of Jean Piaget and Lev Vygotsky.

My supervisors Dr. Gwen Ineson and Professor Mike Watts have been steadfast in their support. They believed in me and could see the potential in the part-formed ideas I brought with me. Their sensitive encouragement has enabled me to bring fresh insights into the CASE classroom.

I need to thank my family: Nichola, Flora and Ruby for their patience and understanding during the course of this research. Without the encouragement of my home team I would have not taken the steps that I did over the past few years.

Lastly I am indebted Emma for her work on chapter 6 – it is her illustrations have brought these ideas to life.

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Chapter 1 - Introduction

1.1 Overview

This research is concerned with exploring and categorising the patterns of talk in small groups during CASE (Cognitive Acceleration thorough Science Education) lessons. CASE lessons were developed using the ideas of Piaget who described human thought as something that requires cognitive balance (equilibration). When something takes place that poses a problem that pupils cannot solve with their existing cognitive structures, they experience a cognitive conflict which causes disequilibrium. CASE is designed to confront students' present assumptions and ways of thinking through the presentation of a problem, with the purpose of promoting cognitive development through the resulting disequilibrium. In the context of science, the challenge is specifically designed to promote changes in pupil reasoning with regard to concepts such as ratio and proportion. The individual lessons operate at an appropriate cognitive level in order to challenge 11 and 12 year old students' current ways of thinking. This thesis will explore the types of classroom talk taking place in CASE lessons while also questioning the role of oracy and challenge within the curriculum during a time when the recent focus has been upon acquisition of facts within a knowledge rich curriculum.

I am seeking to position this work within this debate and my personal view is in line with Nuthall (2007) who, after finding very little productive talk describes the type of classroom that promotes pupil talk as one where pupils develop the attitude that enables them to see the classroom and a learning community. Helpfully he provides the following points that feature in any such classroom:

- Activities should be designed with students' memories in mind;
- Students should be able to make connections between different experiences that involve the same concept;
- They should look at key ideas in depth;
- There is a need to develop a culture that entails mutual respect and co-operation, where everyone feels they have something to contribute.

This thesis will highlight the importance of the teacher as a key player in promoting pupil cognitive development and its associated talk. It will illustrate how the CASE approach, including cognitive conflict, is very much under teacher control and as such forms a key aspect of the choices facing anyone who seeks to interact with pupils in the classroom. This work aims to facilitate the decision making process in lesson design through the incorporation of terms such as pupil agenda talk and triggers into the professional vocabulary used to describe how talk can be engineered as part of everyday available classroom practice.

This research has evolved from my long-standing relationship with CASE, a curriculum project first published in 1991, which is actually a sequence of thirty science lessons to be taught over the first two years of secondary science education. As a teacher I have had personal experience of teaching CASE for thirty years and as a consultant working with schools and other professionals for twenty five years. The impact of my early CASE teaching was quite profound and formative. As a science graduate my first love had always been the natural world and I felt that as a teacher I would just pass on that love to the children I would be teaching through knowledge and enthusiasm. In the classroom I quickly realised that the pupils sitting in front of me were not quite like that! It was during this period of reflection that I was 'sent' by my department to find out about something called CASE and since then I have had the pleasure both to teach and help others to use this program of science lessons. After studying Zoology at university, CASE was my first encounter with the practical application of psychology to the classroom. This was in 1992 and the years since

have seen me engage in a positive feedback loop of exploring ideas that support learning in the class that has directly led to the publication of this thesis. Indeed my chosen venue for the research Barry School (pseudonym) was my own school as a child and my involvement with the science department came about from a teacher who had experienced CASE as an adolescent. This journey has only served to further whet my appetite to explore pupil talk in the classroom and how this can be used to inspire pupils to think about the abstract world around them. I have found that the topics of conversation in CASE lessons to be absolutely fascinating, further feeding my desire to use my work to shine a light on the wonderful things pupils say in classroom everyday. Throughout this thesis I will use extracts from real classroom conversations most that were collected during the course of this research but others come from my experiences as a classroom teacher.

1.2 Introducing children's conversations in CASE lessons

The seeds of this research were sown informally some sixteen years ago while I was with teaching in the North East of England. The schools professional developmental focus at the time was pupil talk and teachers were asked to either observe pupils talking or interview them following oracy-rich lessons, which for me were always going to be CASE lessons. I am including two snippets of pupil conversation, and the notes I made, from this time to illustrate my enduring interest in small group talk in CASE lessons. The transcripts below are the ones I anonymised and presented during a departmental meeting in 2008 looking at oracy in science. The aim of doing this is to highlight my personal quest to explore, probe and understand the CASE classroom. As such they herald this study which has afforded me the time to look in fine detail at pupil conversations through the dual lenses of Piaget and Vygotsky.

Conversation 1 - Does Aluminium contain holes?

This lesson was taught to a Year 7 class as part of a sequence of lessons on understanding why models are used in science. Four boys; Rhys, Jake, Toby and Jack (not their real names) were given the challenge explain the difference in mass between aluminium and lead blocks of the same size. Toby spoke quite passionately about using an aluminium frying pan when camping with the Scouts. I noted this and so spent time after the lesson discussing this idea with the group and how the thinking of Toby from his camping experience supported him to explain the difference in mass of the two blocks. The following extract is from the post-lesson conversation with the boys:

AE to Toby - You say a lot about what aluminium is used for, do you know a lot about it?

Toby – No, it's because when I went on a camp with the Scouts we accidentally, after we ate a meal, that we cooked in a pan over a fire, we forgot to take it off and it melted. Then when it cooled down and hardened it had a nail as an eye, a nail as a tail and the rest was just aluminium with some holes in it.

AE - How did that help you in this lesson?

Toby – The Scouts called it ...

AE – How did that experience of camping ... why did you think that was helpful in this lesson?

Toby - Because I found out that it was aluminium and then I heard the word aluminium again I thought I realised that it was what pans were made out of and pans usually let the heat get through them but not too much heat to be able to cook the food inside.

Jack– Yeah, I have got a lot of aluminium pans in the house.

AE – So R was T's idea helpful?

Rhys – Ehm yes

AE – Explain why the aluminium cube was lighter than the lead cube.

Rhys – I thought in my head when I felt it ... the weight. I instantly thought that one could have holes, like when Toby said about the pan to let heat through, but I said it could have like really little holes, not big ones but really small ones to let the heat through. But in lead it's just a solid

block, so that's why I thought the lead was heavier than the aluminium because the aluminium has holes in.

AE - What do you think Jake?

Jake – I thought the aluminium had nothing in it, it was just like (hollow) ... hollow but because you/he said it was full I was thinking 'How on earth is this possible?' I was thinking what if the aluminium is lighter than the lead and the lead is more heavier ... and it's like more filled up ...

AE – Okay Jake what do you think of that?

Jake – I was not thinking about this at the time, now I am thinking that on the periodic table aluminium has a smaller number than lead so I think that must be how much it weighs.

AE – That's a new idea ...

Jake – Yes that's what I was thinking about ... thinking about the periodic table ... just to try and make sure that its right.

Conversation 2 - Wallpaper

This conversation is from a Year 9 class who were working on a lesson similar to the one above. This time I was observing a colleague who had asked me to note down the conversations from two groups of students. The task in question required them to use their understanding of particle theory to explain how we can remove wallpaper with steam/hot water to loosen the glue. The stimulus for this is an image of a couple starting to decorate their home.

Group 1 are talking about their personal experiences of moving house because of the decorating image used in this question.

Lee to Matt – Have you ever moved into a house and removed the wall paper you don't want?

Matt – No

Lee – You get a squirty thing and squirt the walls

Matt – I have chiselled it off

Lee – That's do every time.

Lee and Matt talk but inaudible

Lee – I have actually managed to stay in the house I am in for 4 years.

Harry I was in the same house for 8 years of my life and then we moved to Australia and then I think we have moved like 5 times loads because of Australia ... I have been to 7 different schools

Matt – 3 Schools, 1 house ... I am living the good life

With Group 2 the image of the female in the illustration (wearing a crop top) causes the boys to follow a different conversational path.

Hamish laughs as he looks at the female in the image used on the sheet

Hamish – A, B, C, D, E

Jess – How are we going to draw it?

Hamish – Triple G, imagine if you had triple G tits

Jess to Hamish – What size do you reckon?

Jess whispers to Hamish

Jess – Actual size

Hamish – A, B, C, D

Hamish - bra size

Jess – Triple G

Georgina – No

Jess – inaudible

Hamish to Georgina – Are they like massive?

Jess – I have never seen a G

Joe – I have (laughing)

The interview with group 1 shows the impact that pupil prior knowledge (in this study termed 'funds of knowledge') can bring to pupil conversations. This group were very engaged in the task which was prompted by the very different mass of two cubes of metal the same volume. Intellectual engagement talk then led to a time of personal sharing which then led to Jack reflecting upon the fact the answer might be contained in the periodic table. In the Wallpaper excerpt Group 1's conversation is built around the sharing of personal experiences that were triggered by the use of the decorating image. In this study this type of talk is called type E – personal sharing. Group 2's however is guided by the boy's interest in the image of a female in a crop top and her bra size. In both of these examples the pupil's conversation is guided by the way they respond to the stimulus provided by the teacher and this type of talk is type A – pupil agenda talk. This thesis highlights that in transcripts of classroom conversations all pupil talk must be included and acknowledged regardless of intent and that the focus of the talk can be triggered by the teacher both in the planning process and in their responses to the pupils in their classroom.

These historic episodes of talk are being used to highlight the intellectual interest the CASE approach holds for me. This thesis will enable me to further probe this using the term third space talk as a vehicle to incorporate the full range of talk that occurs when young people converse in the classroom. It will also show how it is possible to engineer the more productive forms and highlighting the importance of Vygotskian psychology as a helpful professional guide for teachers who wish to support pupil conversations as an integral part of the learning process. It is my own personal teaching of the lessons that has resulted in the questions that I am seeking to explore in this study. As an educational professional I act as a consultant supporting others to develop classrooms where children's thinking is encouraged and valued. From this experience, and with the encouragement and support of like-minded colleagues who include the authors of the CASE and CAME (sister project within mathematics) materials, arose the desire to carry out my own in-depth study into the classroom dynamics associated with CASE. This thesis is therefore the culmination of a very personal journey for me and through it I am seeking to highlight the theoretical ideas that have become part of who I am as an educator. It is a journey that began in the 90's and one that comes towards its end with this present study. Such is the association with my personal experiences and the reality of the secondary classroom that I am choosing to adopt a narrative and personal style to reflect the design-based methodology that I have been following. I say this for this thesis is rich in adolescent talk and my own personal experiences in a way that is a true reflection of teachers working in classrooms today. It also contains an appeal - one that demands children's voices are heard for what they are; creative, original, messy and funny. My research is based upon the language of adolescent learners who, once engaged, use talk in fresh and unexpected ways that reflect who they are and those whose words they carry with them from their lives into the classroom. From this point forward the episodes of the real conversations that are used regularly throughout this thesis, and the longer extracts from which they are drawn will be found in the relevant appendix, are the ones captured from the teaching at Barry School (pseudonym).

It is my identity as a reflective classroom practitioner that enables me to articulate the changes that CASE can bring to the science classroom for those who may consider using it following the publication of this research. This study is also my way of paying tribute to the many people who have supported me during this journey. At this point I must pay tribute to Mudher Adhami (one of the authors of the CAME materials and a personal friend for many years) who took the time to support and mentor me during the first part of this century. It was an honour to know him and much of what I am exploring here was stimulated by his mentorship. The majority of those who I am acknowledging are children who will have no idea of the power their words have had upon me. One such child that comes to mind is Darren who, after a lesson on the nature of exponential growth, said, during a period of reflection, with a smile: 'This weekend I am going to ask my mum for 1p pocket money. But next week she has to double it!' It is the subjects of this study, children at the

start of secondary education, that have impacted me the most and it is they who this study is dedicated to. My hope is that they will come to understand, and know, the power that their words have to help them and their peers reach out towards higher levels of thinking and all that comes with this.

My view of CASE was crystalised during my time as an advisory teacher in the North of England where I was employed to help schools use it as an enrichment to their science provision. As a consequence I was able to teach in many science classrooms in a range of different schools. What I began to see was children who were eleven and twelve, taking their first steps on the academic ladder, and who regardless of background or academic grouping were actually very similar in both their levels of engagement and response within CASE lessons. This led me to realise that they actually had more in common than I had previously realised and that their socio-economic circumstances had little bearing on the way they were able to express their emerging scientific ideas. These experiences helped me to begin to see the place of talk in the learning process and how important the ideas of Lev Vygotsky, who I had been introduced to in my CASE training, were. At this point and into this mix I must also reference three other authors who have influenced my thinking namely: Bhabah's (2004) and his idea of translation and Moll's (1999) concept of 'funds of knowledge'. Their ideas have shaped the way that I am coming to understand how CASE serves to support pupil learning and when taken alongside Wegerif's (2005) notion of 'all the talk' has enabled me to rearticulate the place CASE can have in supporting and promoting cognitive development in early adolescence.

1.3 Thinking about construction zone activity in CASE lessons

In CASE lessons the emphasis is placed upon children working in groups to solve a problem through the collaborative sharing of ideas to agree a solution. Much of the lesson guidance regarding CASE presents this in simple terms and as such this sounds pretty straightforward, yet it is quite difficult in practice to engage 25 adolescents in the levels of talk required by such a methodology. I personally found the description of construction zone activity as used by Shayer, see Figure 1, to be something of a holy grail in that it all seemed clear but dynamically in the classroom it was very hard to actualise.

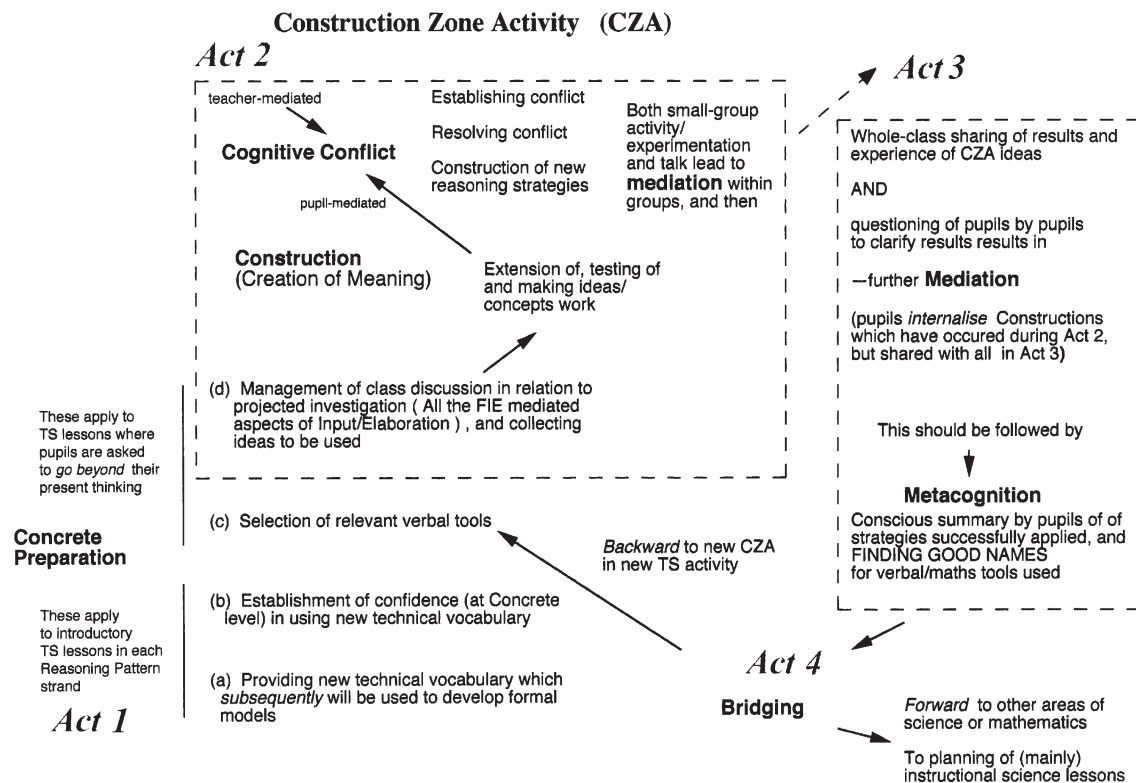


Figure 1 (Adey and Shayer, 1994, p.76)

I first saw a version of Figure 1 in the early 1990s and it fascinated me. At the time, as a new teacher, what resonated was my own personal scientific study and the representations used to exemplify complex processes such as the nitrogen cycle. I found such a diagrammatic way of visualising the lessons I was struggling to teach helpful. This image supported me to break down the lessons into manageable phases or episodes. Looking at each element enabled me to then think more clearly about the behaviours that should be taking place at such times and how I could better promote them. Through this diagram Michael Shayer had begun to make the unseen, i.e. the small group talk, visible in a way that could be described and then replicated. Splitting up each CASE lesson in this way allowed me to begin to focus upon the aspects of my teaching in need of development. For me Act 2, termed construction zone activity, was the Holy Grail of CASE. This knowledge supported me to think about how I could use the CASE processes to develop the pupils' conversation in way that supports cognitive development. This study is therefore the opportunity for me to focus upon the specifics of; how the types of talk taking place at such times can be used to support cognitive development and how the pedagogical approach adopted by the teacher can influence and support this.

The activities planned in this study support the development of a taxonomy to enable a fresh diagrammatic representation of small group talk so it will be possible to update and refresh construction zone activity for teachers who may be new to CASE and also to the ideas of Piaget and Vygotsky. Indeed, my extensive use of video recordings in the late 90s only served to stimulate this interest further and so this research is the culmination of a very personal journey for me.

This thesis has grown from my personal experience of teaching CASE, and it was during my second year of 'CASE' that I began to realise that children would talk about what you asked them to. As a new teacher I had believed that unless I patrolled the classroom work would not get done and as a consequence, I had developed no real practical strategies to support, and facilitate, children to talk in groups. CASE gave me a reason, and enabled me, to include group discussion as part of my teaching repertoire and then to help others to do likewise. But knowing children are talking and

knowing what they are actually talking about are very different sides of the same coin. This study has therefore afforded me the opportunity to listen to them and then to begin to categorise the types of talk that occur during such times. As a science teacher the premise of this study is quite straightforward in that for many years, I have been doing just what this research involves i.e., teaching CASE and listening to children. Looking at this from the point of view of this type of study the problem of multiple and conflicting identities does raise a few issues. Reflecting upon the changes I made during the course of this study I can see that I was operating on a dynamic and fluid continuum with the role of teacher at one end and the identity of researcher at the other. I have had to move between the two to enable me both to teach the lessons and then to transcribe them using my talk codes. This study has seen me in effect adopt a 'sliding' position in relation to my aims. At times I have been acting as an 'ethnographer' with relatively low participation as I observed and transcribed each lesson. At others however I have intervened more actively with a high degree of participation as both a teacher and interviewer of pupils.

This work has seen me on occasion be a relatively passive participant whereas others I have had to be far more active as a researcher. The more active role is critical, and the subsequent influence brought to bear is rather necessary in a study of this type. In the classroom as a teacher when working closely with pupils I have been able to encourage, draw out, help shape their answers, but in a very 'benign' way. The focus of any interaction with pupils was always based around the lesson plan I was following and the desire to encourage the pupils to talk about the resource in front of them or the questions demanded by the lesson script. This has therefore given me the opportunity to discover the true focus of their talk including the types of talk that occur in such small groups. The content of the study is quite simple in that children would be taught CASE as part of their science curriculum and their small group conversations video recorded. This would allow the focus of their talk and relationships within the group to be included in the transcript. The research class were taught CASE by me and the reasons for this are outlined in chapter 3. The practitioner perspective I have adopted was deliberate in that I am passionate for others to experience the benefits that CASE, and CAME, can bring into the classroom in terms of pupil engagement in the learning process. The inclusion of more recent educational ideas, as part of the explanation of CASE, will serve as a bridge between a historical programme and the classroom in 2024. This coupled with a recent and relevant classroom perspective would act as a suitable retelling of CASE for an audience today. Doing this means that this thesis is 'grounded' in real experiences, ones that enable others to realistically adopt the pedagogical principles that underpin CASE. The lesson plans included as part of the transcripts in appendix one clearly show the rigour applied to the development of a classroom environment that develops the CASE approach to make the third space visible – see chapter 6 for a visual representation of this.

1.4 Background to CASE

CASE stands for Cognitive Acceleration through Science Education and comprises a series of thirty prescribed science lessons taught in sequence over the first two years of secondary education. CASE was the product of several years of work by Philip Adey, Michael Shayer and Carolyn Yates and fuller details about CASE can be found in chapter two. At the time of publication in the late 1980's CASE was unique in its explicit focus upon the practical use of the ideas of Jean Piaget and Lev Vygotsky to support classroom teaching in science. The ideas of both were used to devise the classroom activities, and associated pedagogy, to support the aims outlined in the first paragraph of this chapter. In summary Jean Piaget was the inspiration behind the curriculum design of CASE while Lev Vygotsky underpinned the classroom management of the approach.

In revisiting CASE for this study, I have been afforded the opportunity to explore the theoretical roots of the programme in a way that was not possible when I began teaching it. I was particularly

interested in how the ideas of Piaget and Vygotsky are used in tandem to create a dual impact upon the learners in the classroom, with a specific focus upon construction zone activity as described by Michael Shayer (see Figure 1 on page 10). This has enabled me to look in detail at the nature, and categories, of the language being used during times of small group work when the teacher is not present. This focus reflects my view that language is a key tool available for use by teachers to develop the thinking taking place inside their classrooms. In support of this idea Wells (2002) highlights that an important factor in the educational failure that some students experience is due to the manner in which teachers interact with them inside the classroom. Teachers' discourse can often be characterised by the asking of closed questions, and so the students' reaction is to try to find 'the' right answer whilst at the same time avoiding the wrong one. Alongside this the focus of teachers' attention is oriented towards evaluating the correspondence between their questions and the pupils' answers. According to Smith (2004) these patterns of instruction are very different to the conditions that seek to promote a form of dialogue where the goal is the promotion of the collective understanding of the issue at hand. Bakhtin (1986) proposes a form of dialogue called 'dialogic reasoning' that can be used to focus discussion upon the connections between teachers' discourse and the development of more open dialogues within the classroom. He categorises talk of this type as being creative, varied and layered with multiple possible directions. For Bakhtin, the most important objective of such a dialogue is not to reach a common point, but in the promotion of new ideas and thinking, thinking that has its foundation upon a culture of sharing and discussion of different views and perspective.

In her thesis looking at Cognitive Acceleration within mathematics Tornero (2017) provides a helpful summary of how such talk relates to my own area of interest. She clearly articulates the importance of language within any discussion concerning the promotion of thinking within the complex social environment that exists within any classroom.

Alexander (2000, 2005) reaffirms the importance of this type of dialogue inside the classroom, and calls it 'dialogic teaching'. From his point of view, dialogic teaching consists of promoting students' participation in the class conversation, in an influential and consistent way, which will facilitate the attainment of better learning results (Mercer, 2008). Similarly, Paris and Paris (2001) declared that the educational importance of mental discourse resides not only in the understanding of others' beliefs, but also in the promotion of self-regulation and, therefore, self-regulated learning in students. In this sense, if teachers elaborate a discourse that contains a high level of mental content, they are more likely to promote the formation of students who are much more capable of understanding their own and others' opinions.

In this thesis I am seeking to explore these ideas with the following research questions:

- What is the nature of children's talk as they engage in construction zone activity?
- Is it possible to create a model of talk that enables teachers to support small group talk?
- Does the idea of the 'third space' help us to better apply Vygotskian psychology to explain the talk taking place in CASE lessons?

The work of Mercer and Wegerif in particular will be discussed in detail in chapter 2 as their thinking will be used to explore the ideas of Vygotsky used within CASE. Suffice to say that what is emerging is the use of the terms; difference, gap or space to describe the development of pupil thinking. In chapter two I will describe how the notion of the 'third space' as described by Bhabha can be used as a way to capture the moment of movement from spontaneous to scientific thought as described by Vygotsky. Viewing the small group conversations in CASE as a dynamic relationship between peers, one that exists on both the social and the personal plane, requires a model that captures the transient, complex and fluid nature of such relationships in a causal way and the representative talk during such times. This is very much in the style of a weather map that

highlights how small changes in say the direction of the gulf stream can have serious repercussions for the weather in a locality. Many changes that can affect pupil talk in a positive way actually lie in the hands of the teacher and so this will enable them to see themselves as a key player in children's cognitive development via the use of triggers to promote thinking and discussion within their classrooms. In tribute to Michael Shayer I am seeking to enhance Figure 1 to use the idea of 'all the talk' to update construction zone activity and infuse it with the ideas that are now more readily available to teachers in a way that adds currency to his ideas.

1.5 Personal context

Given that this research is taking place quite late in my teaching career, it is necessary for me to share some of my personal history and how this has led me to now position myself as a researcher. At this point it is worth pointing out that I did not fully realise how important my identity as a parent was to my role as a teacher and so to this research. Upon reflection I realise now that my formative teaching of CASE and CAME took place at a time when my own children were between the ages of two and six. CASE and its focus upon a Piagetian view of childhood development enabled me to make some very interesting connections between the demands of CASE within early adolescence and my own children's developing world view. I could see the ideas of Piaget such as object permanence, the ability to order and group, to name but two, play out at home and in the classroom. I say this because I began to realise that some of the children I taught possessed a similar cognitive outlook to that of my six year old daughters. This has shaped this study in the sense that I was able to observe the classroom not through the eyes of a teacher but using the 'eyes' of Piaget to help me better understand the cognitive developmental needs of my science classes. I can now look back and see my personal CASE history acting as a trigger to prompt this study and how that in turn shaped, and enabled me to work as an insider: the researcher in the guise of a teacher. In CASE such a move was possible for it reflects the depth of connection I have with all of the authors of the materials. I had always believed that this work had afforded me a significant insight into cognitive development and so I saw this research as the chance to personally revisit and rearticulate CASE by shining a light upon the application of the ideas of Vygotsky to the classroom as inhabited by real teachers facing the challenge of working with adolescent minds. CASE is part of my personal classroom narrative and as such it reflects my desire to promote real dialogue within the classroom.

In 1992 I started teaching CASE and in 1998 I was seconded by Sunderland Education Authority to expand and develop the teaching of CASE and CAME in its schools. This was prompted in part by an early Ofsted inspection acknowledging the benefit of CASE was bringing to our curriculum offer. Since that time I have been acting in both a teaching and advisory capacity and so given the length of my experience both teaching CASE and supporting others I am happy to be regarded as a CASE 'expert' i.e. someone who is very knowledgeable and has a great deal of experience of, and skill in, teaching the lessons. In addition to this I was fortunate to be able to develop personal relationships with all of the authors of both the CASE and CAME materials. As a result of this Philip Adey encouraged me to co-author a book chapter with him, Mundher Adhami involved me in writing the second edition of the CAME folder and Michael Shayer asked me to write an endorsement for his last book. I am also a founding member of the Let's Think Forum a charity set up to continue the legacy of the Cognitive Acceleration approach now known as Let's Think. Throughout this time I have always taught the lessons and used those 'recent' experiences to mentor and coach others. In 2012 I was working in a primary school and used the principles of the CASE approach, and some of the lessons, to teach science to pupils aged 8 to 11 years old. This caused me to reflect upon my practice and specifically the management of small group work which led in part to the genesis of the questions that form the heart of this thesis.

This thesis is in part a personal inquiry into CASE and as such it affords me the chance to reflect upon and articulate my thinking and by doing so to illustrate the mindset of a practitioner formed by CASE. Coming towards the end of my career, and in the light of 35 years teaching experience, I needed to acknowledge just how I view teaching and learning given that I now spend most of my time in mathematics classrooms and

special schools. Such a study would allow me to clarify my thinking regarding how I am currently using CASE, and its theoretical ideas as a foundation for my beliefs and classroom persona. As an 'expert' teacher I knew that I had an opportunity to explore this some three decades after being first introduced to CASE and this was very much prompted by Mundher Adhami and his wonderful exposition of the ideas of Lev Vygotsky (see page 40).

The research questions (found on page 21) developed to focus this research reflect my main areas of interest which result from three decades of engaging with CASE on a range of levels; as a teacher, a mentor, a consultant and author. I regularly meet people who openly acknowledge the impact CASE has had upon them and so this thesis will also enable me to describe just what it is that is happening and making the difference. The third space was chosen as a vehicle in which I could house such reflections given that the many metaphors used in support of it as a concept have resulted in few, real, practical examples of its use in the secondary classroom so although at first it appeared rather woolly creates a spark of enquiry that CASE was able to fan into flames. The research questions were devised to enable me to explore my teaching and decision making as a teacher steeped in CASE namely:

1. Just what is taking place as they pupils in small groups in CASE lessons i.e. what does construction zone activity sound like?
2. How do I describe and model the talk taking place at such times as I felt the diagrams used to describe construction zone activity needed bringing to life in a way that could inspire others.
3. Just what do the ideas of Vygotsky mean to me and how do they inform my thinking in other settings and curricular contexts. This was very important for me given that I now spend most of my time working away from the science classroom.

The nature of this study i.e. research that involves taking a flexible approach to the capture of real, and messy, conversations between teenagers meets many of the key criteria to enable it to come under the umbrella of design-based research i.e. that it takes place through continuous cycles of design, enactment, analysis, and redesign (Cobb, 2001; Collins, 1992), and is designed to lead to sharable theories that help communicate relevant implications to practitioners and other educational designers (Brophy, 2002). This work took place in a real classroom in a positive feedback loop. As I focused upon transcribing the conversations that took place, I came to focus more acutely upon the very interactions that were refining my understanding of Vygotsky. This in turn further supported my analysis of pupil talk, the role of the teacher in this and the resulting codes that were developed to categorise the talk taking place.

A colour coded episode of talk from lesson 5, concerned with helping pupils think about modelling in science, will be used to briefly illustrate the hybrid nature of classroom talk and to flag up some of the key themes of this work. This particular lesson challenges the pupils to think deeply about the nature of matter and the episode of talk provided below comes from the Year 7 lesson highlighted on page 6. The pupils are triggered to think about the significant difference in mass between two Lead and Aluminium cubes of the same size. Coming at the end of the lesson this example reveals how the talk flows in a short time from intellectual engagement, green, to pupil agenda, blue, to reflection, brown/orange guided by specific input from the teacher (coloured red). There are four children in this group although the teacher does not speak during this part of the lesson. We join them as the pupils are challenged to come up with a diagram that they can use to explain the difference in weight between the two metals.

Gillian – To me everything looks the same

Ron – But what about the one that is more dense, how would we describe it?

Ron – More dense, more atoms, got more atoms or particles.

Gillian – I will put them back in the bag

Gillian – What?

Gillian – Its just one piece of string

Ron ... stabbed

Gillian – I did not manage to get through ... they were sitting with pens, trying to chop a hole in

Gillian - He is putting his coat on no its his jacket, makes more sense ... we have like minutes ... we have 10 minutes left ... 10's not too bad

AE talking to class – 2 minutes, practice what you are going to say etc ... what imagining ... no-one has seen but we have accepted models and theories what is your idea?

Ron – Dense atoms ... Dense atoms

Gillian smiles – I think little particles ... and a little bit more spaced out but not to do with density ... it's the mass ... further apart but in solids they are closer together than in liquids surely ...

Ron – No because liquids are still close together but not as close as in ... because one has more which is why it weighs more ...

Gillian – Has slightly more than other

Ron – A lot more

Gillian – Yeah

This is a typical episode of talk and one that reflects the reality of the conversations in the classroom and also the need to be honest and to include and acknowledge 'all the talk' taking place. Coding conversations in this way will enable me to use the notion of the third space to describe small group talk and also to begin to quantify the role the teacher plays in the development of construction zone activity.

Although this research involves a specific intervention project, it is embedded within a core subject taught at schools, and so cannot stand alone from authentic classroom interactions as managed by experienced practitioners. CASE is based upon specific theoretical claims about teaching and learning and this reflects my commitment to understanding the complex relationships between theory and practice within the ecology of the secondary science classroom. My view is that this work will both contribute to, and enrich, the theoretical foundation of learning and the teacher's role in this and so will therefore reach far beyond the KS 3 science classroom.

This study comes from a desire to better understand of the role of Vygotsky in devising learning environments that are supportive of the development of thinking. I am taking this stance because I think, at times, the ideas of Vygotsky have been used rather superficially and so this work will allow me to explore more fully the role of talk as a medium to develop thinking. In this respect I see myself as a teacher who wishes to have a more research-informed practice but also as a researcher who is then able to share this with other teaching professionals. Just as with fungal hyphae that weave through the soil in a woodland, connecting neighbouring trees via their roots, so I view Vygotsky as the thread that connects many of the descriptors of classroom learning. In chapter two a wide range of ideas will be brought together to illustrate this alongside the many conversations I have had with Mundher Adhami and Michael Shayer the authors of the CAME and CASE materials.

1.6 The study

The research evidence associated with the CASE project is quite extensive (<https://letsthink.org.uk/about-us/our-history/>) but it was the social aspect of CASE and pupil

engagement in particular, that interested me the most as a practitioner. I found that my pupils enjoyed their CASE lessons and I was also told, from observations, that I was using many of the CASE teaching techniques such as; Not following a typical model of talk (question, response, feedback) in my normal, non-CASE, teaching and that I was including more pupils in the discussion by saying things such as, “That’s interesting John, what do others think?” in my ‘standard’ teaching. Similarly I found that as an advisory teacher in Sunderland that it was common during teacher CPD for colleagues to highlight the fact that some pupils spoke more in CASE lessons and that this in turn revealed how good their thinking was. To many this was a surprise and they would comment that they; “Did not expect that from her”. Indeed, schools and teachers regularly report (<https://letsthink.org.uk/about-us/what-schools-say/>) the fact that CASE engages pupils in ways that are supportive of learning.

The transcripts were collected over a seven-month period during which I taught CASE regularly to a Year 9 class where two groups were recorded during small group discussion time. As the teacher in charge, it was the classroom decisions made by me that are central to this study. This aspect of the work is discussed in chapter 3. Despite this I do acknowledge that every decision I made was a professional judgement but throughout I sought to follow the CASE lesson plan, and my design principles, to provide opportunities for the children to talk on their own terms without interference from me. It was, however, the theoretical ideas that underpin CASE, that are explored in chapter 2, that had a significant influence upon this research and it was the lens of Vygotsky that guided my analysis of the transcripts that resulted from the lessons.

At this point I will outline why I classify this work as design-based research as it will also explain my professional motivations for carrying out a study of this nature. Given the on-going appeal associated with CASE and the work of Michael Shayer, I hope that this study will encourage others to explore CASE and the ideas of Piaget and Vygotsky in their classrooms. I aim to use the outcomes of my thesis to develop resources and guidance that will support other teachers who wish to explore children’s talk in the mathematics or science classroom. Further to this, this work has the potential to provide rich set of tools that can be applied to a range of contexts given its focus upon cognitive development and small group dialogue. This is echoed by Brown and Campione (1996) who state that design-based research should involve the development of ways of working and exploring the classroom as opposed to specific ‘artifacts’. Moreover my work is grounded in a real classroom and seeks to provide a lens for understanding how the theoretical claims made for CASE can support learning. At its heart this study is concerned with the application of the ideas of Piaget and Vygotsky to provide curriculum enrichment and the development of a climate where dialogue and learning talk are permissible and actively encouraged. In addition, my hope is that this research will stand alongside other neo-Vygotskian works as its key aim is to explore how his ideas can be developed in classrooms today, even though this was done via the vehicle of a rather ‘old’ intervention project in KS 3 science. This should result in a deeper understanding and appreciation of Vygotsky’s work alongside some real-world rules for its application.

In seeking to highlight both the Piagetian nature of CASE and the Vygotskian underpinning of classroom interactions an updated explanation for the impact of CASE upon student interaction has begun to emerge. These are explored in significant depth in chapter 2 and so here it is worth stating that this aspect of the research is serving to further develop and advance the theoretical claims of CASE. Therefore, I am not simply refining and testing the Vygotskian claims made by Shayer but connecting them to a deeper understanding of Vygotsky as illustrated by the ideas of Bhabha and the term third space. It’s the situated use of Piaget and Vygotsky by CASE that makes this possible. By doing this I can further explore the potential of the design-based approach by investigating the real-world questions that arose for me from the many years of teaching CASE. Such questions have at their heart a desire to explore the theoretical foundations of CASE and to further develop this via the design of classroom situations.

1.7 Research aims

As a teacher I have had the pleasure of teaching many thousands of CASE lessons in hundreds of different schools and so I am seeking to use this research to help me to understand more deeply the nature of adolescent talk in the science classroom. More than this I am keen to explore the nature of the ‘funds of knowledge’ that students bring to the discussion and how we can utilise the knowledge they possess within the science classroom. This work will take place along two main lines of enquiry:

- 1 Personally, to both highlight and shine a light on the learning conversations that adolescents have during CASE lessons where they are given explicit permission to talk with their peers.
- 2 Professionally, to rearticulate the Vygotskian ideas that underpin CASE in a way that renders them useful beyond the intervention classroom and also connects them with other initiatives that are based upon a dialogue-rich environment.

Through an exploration of the social construction roots of CASE, foundations that are embedded with the lesson materials, I am seeking to bring a fresh interpretation of what Shayer calls construction zone activity (see Figure 1, page 10). By doing this I hope to bring clarity and a sense of purpose to those who wish to base the learning of their students upon collaboration and dialogue. As part of this process, I have found the notion of the third space to be a helpful vehicle to support the view of learning that involves the students building upon the ideas they bring with them to the classroom.

As a teacher with experience of CASE, and the impact it can have upon the social environment within a classroom, I feel my expertise can be put to good use to illuminate the process from both the teaching and the learning perspectives. This will serve to shine a light on the engaged, powerful, rich and glorious conversations that young people have, and how they can be engineered, and that such conversations are an integral part of the learning process. Similarly, by taking the perspective of a teacher-researcher, i.e. someone who knows the classroom intimately yet someone who wishes to explore the practical application of Vygotskian psychology to the classroom I feel I am in position of being able to probe the CASE classroom in significant depth. Through exploring the Vygotskian concept of ‘external talk’, talk that takes place between peers and showing how such talk contains aspects of their personal experiences, I have sought to articulate some of the mechanisms of the development of abstract thinking within the secondary classroom.

1.8 Organisation and research questions

This thesis begins with a literature review highlighting some of the research underpinning CASE and the application of the ideas of Vygotsky to the classroom today. This will reveal the gaps in understanding that this research is seeking to explore. The detail of the methodological approach undertaken will be outlined before analysing the conversations that have taken place in my study school.

As a research-based project, my writing necessarily simplifies the complex nature of the classroom and the interactions involved therein. By focusing on CASE I am seeking as best I can to model and articulate the craft of teaching, an art that involves responsive professional decision making on a

moment-by-moment basis. It also reflects the process of using theoretical constructs to support classroom interactions with a desired goal in mind. Despite such a necessary fluid and dynamic approach to the fieldwork and analysis, the key focus of this research has remained consistent throughout and is framed by the following questions:

- What is the nature of children's talk in CASE lessons and construction zone activity in particular?
- Does the application of Bhabha's notion of a 'third space' help us to better understand the place of Vygotskian psychology in CASE lessons?
- Can we create a model of talk, and construction zone activity, that enables teachers to better understand and therefore engineer and facilitate this?

In this examination of the CASE classroom, I am using the term 'third space' as an umbrella term to place over the science classroom to help me explore how the ideas of Vygotsky and Piaget can be used to facilitate small group talk as something called 'construction talk'. To do this in a way that reflects real classroom conditions, a representation such as a weather map is required. Using a weather map analogy will enable the causal role of the many variables operating in the classroom, including the role of the teacher to trigger conversations, and thinking, to be modelled in a colour coded and dynamic way.

1.9 Overview of the chapters

Chapter 2: The literature underpinning CASE, namely the ideas of Piaget and Vygotsky, are examined. The background to CASE is revisited and the ideas behind the evolution of the concept of the third space are outlined and explained.

Chapter 3: My position in relation to CASE and the design of this project are explored. The research design is outlined and the choices made with regard to the school, lessons used, the talk codes are shared and their development explained.

Chapter 4: The transcription process is explained and the un-coded transcripts for the lessons are discussed. The third space talk codes are then applied to the lessons and the implications of this are explored.

Chapter 5: This chapter serves to apply the key ideas such as: a trigger, a merger and the weather map analogy of talk in CASE lessons to explore and revisit construction zone activity.

Chapter 6 – Here an updated model of construction zone activity is presented using the third space colour codes to create a weather map of small group talk.

Chapter 2 - Literature review

2.0 - Overview

This chapter explores the Vygotskian underpinning of much of the educational language used, and many of the pedagogical strategies employed, within classrooms today and as such his ideas will act as a 'golden' thread running throughout this thesis. This will allow me to bring CASE into the current debate concerning the application of his ideas to children's talk within small groups. Further to this I will also argue that Bhabha's (2004) notion of the third space is a valid construct to support such a rearticulation of CASE for a generation of teachers who were not even born when it was first published.

The first section will set the scene by covering some of the wider issues concerning learning within which CASE sits, most notably the environment conducive to collaborative group work- often termed social construction. This will draw upon the work of those who have been influenced by Vygotsky in their studies of classrooms in an attempt to explore the relationships between learning and the types of talk taking place. The second section will examine the CASE project; the ideas that underpin it and the developing understanding of Vygotskian psychology of its main author: Michael Shayer. Finally, the third section will serve to introduce the focus of this work which is a revisiting of CASE through the lens of the third space as a tool that can be used to enrich our understanding of small group talk. Throughout this chapter I will seek to highlight the gaps in knowledge that have emerged since CASE was first published (Webb, 2009, Wegerif, 2008) that relate to the nature of classroom talk. Such a trajectory will enable an examination of CASE through the lens of Vygotsky, in a way that was not possible some 40 years ago. Ultimately it is my hope that a study of talk underpinned by these ideas, and framed by the language of the third space, can provide a way to better understand and visualise what may be taking place within construction zone activity (see page 10) as described by Shayer.

2.1 Classroom talk seen through the lens of Vygotsky

The ideas of Lev Vygotsky are something upon which this study will be built and there are two main reasons for this:

- His ideas, along with those of Piaget, underpin the CASE lessons used within the classroom to encourage, promote and facilitate small group talk;
- His work is proving to be a deep well that many are drawing from in their attempt to provide a fuller picture of the learning that takes place as children talk in groups and CASE deserves a place at this table.

The first section of this chapter will provide an overview of the psychological theories that underpin and support this study of children's conversations within CASE lessons. In the early stages of CASE CPD (personal comment) the rules for talk were not explored fully or made explicit in the way Mercer (2000) does but rather the ideas of Vygotsky and Piaget were used to provide teachers with a theoretical framework for the social construction that was taking place within CASE lessons. Social construction was described as taking place within the 'construction zone' (Adey, 1994) and involved, 'dialogue and action which leads to the construction of a reasoning pattern' and that 'each pupil has the opportunity to build up, bit by bit, the reasoning patterns which will do more powerful work of thinking for them,' (p.66 – 67). These reasoning patterns described are Piagetian and are described in detail in appendix two.

This study is interested in the talk that takes place when pupils are challenged to think and for this I turn to Vygotsky. This point is made by Mercer (2002), who states that the place of language as a tool to explore intellectual activity can be traced back to Vygotsky. Whilst also pointing towards studies of this type that are supporting the exploration of the relationship between language and thinking. Vygotsky's account of cognitive development pays close attention to the construction of knowledge as a social process, one involving human interaction using 'signs.' During conversations, words, i.e. signs, are exchanged between people and understanding occurs in the resulting social interaction and not in the signs in themselves. A sign can therefore be viewed as a vehicle for carrying, transmitting and developing individual and shared meaning. Semiotics is the study of signs and symbols, and semiotic mediation is the term used to describe how signs are appropriated as part of psychological development. Again Mercer (2002, p. 141) articulates this Vygotskian viewpoint clearly;

'There is a close relationship between the use of language as a cultural tool (in social interaction) and the use of language as a psychological tool (for organizing our own, individual thinking). He also suggested that our involvement in joint activities can generate new understandings which we then 'internalise' as individual knowledge and skills.'

This serves to focus attention upon the role words, or signs, can play in the mental life of the learner:

'Just as a mould gives shape to a substance, words can shape an activity into a structure. However, that structure may be changed or reshaped when children learn to use language in ways that allow them to go beyond previous experiences when planning future action . . . once children learn how to use the planning function of their language effectively, their psychological field changes radically'. (Vygotsky, 1978, p. 28).

This thinking is summarised later in the following quote: *'Words can shape an activity into a structure, using language to go beyond and plan future activities.* (Vygotsky, 1978, p. 51)'

2.11 The role of talk in the development of thinking

The ideas above concerning the way words can bring shape to an idea or concept links to that fact that Vygotsky also groups thinking into two categories: spontaneous and scientific or non-spontaneous. Spontaneous thinking describes the (acquired) ideas that pupils bring with them to the classroom, while scientific thinking is that which is promoted through the curriculum and schooling. To support the learning of the formal and examined concepts that are taught in school there is a need to recognise the spontaneous nature of their starting points in pupils' minds. Given the role language plays in the learning process, both collective and individual, as suggested by Vygotsky it is helpful at this point to refer to the ideas of Bakhtin. His focus upon the importance of the use of words as signifiers of meaning helps with the consideration of the role of social interaction in the learning process as, *'Words are half someone else's and only become one's own when the speaker populates it with his own information. Language is populated with the intentions of others.'* Bakhtin (1981, p. 282). He is also pivotal to this study as his ideas pave the way for the concept of the third space that will be introduced in section three. Further to this Halliday (1978, p. 2) highlights the reciprocal and transformative relationship between language and social context:

'If language is seen as a social semiotic it comprises discourse where meanings are exchanged in interpersonal contexts not devoid of social value ... the context plays a part in what we say; and what we say plays a part in determining the context'.

Barnes (1974) uses the term 'exploratory talk' to characterise the talk taking place in the social context of the classroom and feels the cognitive potential of talk is under utilised. His work highlights the importance of the learner being viewed as an active agent in the process of development. Given this, it is no surprise that Wells (1999), focuses upon the importance of the teacher and the choices they make regarding the type of talk that is taking place within the classroom. In chapters 4 and 5 the role of the teacher will take centre stage and a key feature of successful CASE teaching is how well a teacher manages the classroom and that a key part of this is their understanding of potential of cognitive conflict. This thesis will recommend that the term trigger (see page 115) be used to better show how both dynamic and responsive this is at all stages in the process; from lesson design and planning to the choice of anecdotes and examples used in response to the pupils in the moment by moment reactions during the lesson itself. In any discussion there is the opinion to extend a line of enquiry, invite opinion or pursue a further explanation. Such teaching is termed 'interpretive' by Barnes (1976) and is important as it gives the teacher and pupils the power to focus upon the co-construction of meaning. Mahn and John-Steiner (2002) bring a helpful insight to this discussion of the role of language within the classroom. They highlight the role of the social participation in the learning process and the fact that learning is enhanced through interactions that offer reciprocal emotional support to collaborators.

2.12 Perezhivanie and the Zone of Proximal Development

Mahn and John-Steiner (2002) combine the idea of the zone of proximal development (ZPD), the relationship between word meaning and the concept of perezhivanie. The zone of proximal development as originally described by Vygotsky (1978) is the difference between what a learner is able to achieve on their own and what is possible with the help of a more able other. Perezhivanie is a term Vygotsky used to describe the lived experiences that contribute to the development of a learners' personality. By identifying the possible affective variables involved they enable the zone of proximal development to be viewed as a complex concept dependent upon a range of interrelated and interdependent elements that include the participants, signs, and context, and the participants' experience of their interactions within it i.e. their perezhivanie.

A key text drawn upon to enhance the Vygotskian perspective on CASE is Perezhivanie, Emotions and Subjectivity. (Fleer. et al., 2017). Perezhivanie is useful term for it acknowledges the social aspect of the classroom as a key tenant of Vygotsky's notion that higher mental functions initially exist on the social plane, inter-psychologically, before becoming part of an individuals' thinking or intra-psychological functioning. To explain how this occurs he uses the term vraschivanie which might be translated as ingrowing or growing within from outside to reflect the fact that development moves from the social (i.e. the roots of development are outside the individual) to the individual (i.e. the fruits of development are individual psychological processes).

The concept of perezhivanie also enriches the analysis of pupils talking in the classroom and the fact that we need to include 'all the talk' as a true reflection of the talk taking place. This thesis uses perezhivanie to underpin the third space talk codes and could indeed be the true genesis of the idea itself. It is, however, necessary to 'unpack' perezhivanie as there are few equivalent educational terms in common usage and a direct translation is very difficult. Perezhivanie has been described as a special type of psychological process, state of mind, relating to; emotional experience, interpretation, imagination, creativity, perception, living through, meaning making, appropriation, internalisation, understanding, cognition (Veresov. N., p.49). To others, (Fleer. M, Rey. F, and Veresov. N., p.10), it is a conceptual tool for analysing the influence of the sociocultural

environment on the process of development of the individual, described by Vygotsky as 'the path along which the social becomes the individual'. (Vygotsky 1998, p. 198). It is helpful to use it as an umbrella term to unify emotion and cognition, and the individual with their environment to better conceptualise the complex process of human cognitive development. (Mok. N., p.19). Since thought and emotion are so deeply interconnected, *perezhivanie* can be used to acknowledge the role of emotion in the learning process (Mok. N., p.26). This enables teachers to account for the role of the environment of which the social situation is a specific kind which in turn supports the acknowledgement of a child's current and past experiences (including their funds of knowledge), personality, attitudes etc. (Mok. N., p.31). The third space codes are inclusive of the fact that the personal meaning of everyday knowledge supports the development of everyday concepts (Vygotsky, 1994) and this should be dialectically related to school-based concepts. The personal concepts of the child are the basis for the child to function and develop theoretical concepts, which are in some ways met by the specific topics of the educational subjects (Hammer. M., p.77). So there is a tension between what the child brings, with the knowledge traditions found in schools, alongside their lives and a sense of understanding of self.

In explaining this process of development Vygotsky (1979, p. 222) introduces the concept of drama or dramatic collision which means a 'contradiction or clash between the natural and the historical, the primitive and the cultural, the organic and the social'. Due to this it cannot be assumed that development is a smooth process and a simple continuation of the natural development of the child (Chen. F., p.132). Indeed, Vygotsky later claimed that there is no development without contradictions, and that higher mental functions 'can be most fully developed in the form of drama' (Vygotsky 1989., p.59) which can create turning points in a whole course of child development (Fleer. M, Gonzalez. R, Veresov. N., p.249). For Vygotsky drama which occurs among people and other such moments creates the conditions for development (Vygotsky, 1997b, p.106.) This process is inter-mental i.e. on the social plane of mental functions and can be described as a; social collision, contradiction, dramatic event or drama between two people (Veresov. N, p. 59). In CASE such moments take place in an educational setting under the direction of the teacher and are described using the term cognitive conflict. These can occur, or are triggered, at times when the ideas of the 'lesson' are contradictory or far removed from the thinking of a child in such a way that dis-equilibrium occurs. If the gap between the child's current thinking and the ideas they face in the lesson are not too far removed then the difference is primed, according to Bhabha. In this research I am seeking to try and capture the drama, which is a key feature of CASE, of construction talk and to re-envision it using the notion of triggers and the weather map of third space talk.

In Vygotskian terms every higher mental function was originally external because it was social prior to becoming an internal mental function; it was formerly a social relation between two people. (Vygotsky 1997b., p.106). This means that social relations i.e. the real relations of people stand behind all the higher mental functions and their relations (Veresov. N, p. 59). In addition to this we can say that the influence of the teacher is not a direct influence on the child because it is refracted through the child's *perezhivanie*, even though the child is seen to be following the teachers' direction in learning, the child engages in the learning tasks in his/her own way (Hammer. M, p. 72). *Perezhivanie* can also be used to describe a child's personal way of experiencing a dramatic event (Veresov. N, p. 67) and is the form by which the event is experienced and refracted by them. Higher mental functions are a result of dramatic events (inter-psychological collisions) that have happened in the life of the human being and the process of overcoming them i.e. equilibrium in Piagetian terms. CASE is all about appropriate drama, or contradiction, which is why the notion of a trigger is helpful. A trigger is something that is planned and within a teacher's control as part of

the interpsychological, social, plane of the lesson i.e. the interactions taking place during CASE and in particular during construction zone activity.

The use of the term dramatic collision and the concept of *perezhivanie* are helpful when dealing with something that is hard to see, describe and quantify such as cognitive development. If the analysis of the classroom is limited to the naming the types of talk then the complex, creative, collective and collaborative nature of what happens here, something which transcends simple categories and is far more complex, may be missed. Alongside Michael Shayer (see section 2) others have referred to these complex processes as the collective zone of proximal development (Moll & Whitmore, 1993). This view alongside that which sees this zone as a cooperative process, within which knowledge is co-constructed, begins to reveal the complex mixture of variables involved: cultural tools and signs, social construction and interpersonal and intrapersonal scaffolding in the learning process. (John-Steiner and Mahn, 1996; Wells, 1999). The classroom therefore needs to be viewed as a highly complex environment where, if explored using Vygotsky as a lens, social relationships can support the development of an individual's inner voice (Forman and Cazden, 1985). This enables us to incorporate the ideas of Bakhtin (1981, 1986) and the notion of the utterance which further supports the exploration of the three variables that can be used in any analysis of semiotic mediation: dialogue, utterance and voice. The meaning of these within the context of this research will be explored next.

2.13 The role of dialogue

The heart of this thesis stands upon the fact that in CASE lessons understanding develops as speakers orientate themselves in relation to their peers in conversational exchanges (Lee and Smagorinsky, 2000). Dialogue can be viewed as a time where words or utterances from a range of speakers come into contact. Viewed in this way, meaning therefore resides in the meeting and how they are used, developed and applied within particular contexts. From Wertsch voice '*is concerned with the broader issue of a speaking subject's perspective, conceptual horizon, intention and world view*' (Wertsch, 1991, p. 51). Voice in this case can be used to describe the role of language in constructing meaning. From Bakhtin, words (1986, p. 293, 294) 'become one's own when the speaker uses it with sense, his own accent, when he appropriates the word and adapts it to his own semantic and expressive intention.' This links to the notion of 'ventriloquism' as used by Wertsch (1991, p.11) to describe how learners begin speaking in the voices of others that gradually become their own. The evolution of the third space talk codes, described in chapter 3, focuses upon this with a category of talk termed pupil agenda talk, A. This seeks to capture talk that is controlled by the pupils themselves which open up a way to incorporate talk that is 'becoming one's own' into the refreshing of CASE.

Moll (2000) articulates one difficulty facing anyone trying to explore classroom learning; namely the fact that any spoken exchange, as part of the learning process, is composed of layers of

meaning, intention and therefore interpretation. Any study, of this type, is compounded by the inclusion of a third and fourth party: the teacher and the researcher. Gallas (1995) provides a helpful narrative of a teacher turned researcher who uses the ideas of Bakhtin (1981, p.294) to both explore and develop the talk of the children in her charge. She articulates these difficulties as she reflects upon the messy nature of science talk and how this relates to the lives of her children. She appropriates the term heteroglossia, from Bakhtin, to describe the nature of the talk she finds; talk that is both messy in both style and content but which clearly reflects and refracts the life of the children when faced with the challenges she provides during science. Heteroglossia is described as a 'living science language' used by her children to reflect their desire to explore and make sense of the world around them. Building on this and in a move that links back to Vygotsky and the notion of spontaneous concepts Gallas feels that competence rests partly in appropriating language and populating it with one's own intention. The point is being made that 'ownership' of scientific language involves a movement towards, and away from the spontaneous, scientific concepts and an associated taking of control of a new way of thinking and being. One of the talk codes used to categorise pupil conversations, termed pupil agenda (A), is very much concerned with acknowledging the fact that pupils will subvert the talk in the classroom to meet their own needs. Such talk is similarly termed 'counterscript' by Guitierrez (1999) which will be explored in further depth on page 29.

2.14 Incorporating children's prior experience into the development of thinking

Moll (1993) in an attempt to support teachers to facilitate their pupils in moving towards scientific conceptual understanding, argued that children carry 'funds of knowledge' with them into the classroom. Such 'funds' refer to the knowledge and skills, both historically accumulated and culturally developed, that pupils naturally acquire as part of their life experience. The problem many pupils face once they join the school community is that much of the knowledge they are assessed upon comes from that which is presented by the teacher during a limited time within the classroom and does not acknowledge the wealth of life experience they bring. He suggests that teachers need to build pupil-familiar activities in their lessons that can support the movement from spontaneous to scientific understanding.

In collaboration with Esteban-Guitart, Moll (2000) further develops this in a way that illustrates how the ideas of Vygotsky can help to conceptualise the development of identity. He states that when funds of knowledge are used to define who people are, they then become funds of identity. This connects to the earlier idea of 'perezhivanie' or lived experience, and how such experiences can both mediate and organise behaviour. To Moll the development of such an identity involves an active social process and occurs as pupils make personal meaning of their learning and this something that teachers must take into account.

In classroom terms, Moll defines identity as something that is socially constructed, mediated and distributed among people through their social and cultural worlds. This is formed by engaging in social activities and by observing how members, peers, interact. Funds of identity are a dynamic composite of who we are and who we are becoming, based upon what we have learned from both our academic and everyday experiences. Moll suggests that schools should create social contexts for mastery of and conscious awareness in the use of such cultural tools. The result of this is that learning will occur if pupils are involved in classrooms where social and collaborative activities are present to enable them to enact connections between prior knowledge and lived experiences (perezhivanie) and the new information presented.

In Vygotskian terms we can view the development of higher mental levels of thought as a function of involvement in socio-genesis which at its heart emphasises social interaction as a key variable in

the process of cognitive development. The classroom where this is taking place is a complex environment where talk and thinking go hand in hand with the collective experience in which most pupils find themselves. Which is nicely summed up by Serret (2004) who when studying the use of CASE with primary aged children stated the importance of the reciprocal relationship between classroom talk and thinking that can serve to shape thought based upon how others influence what we think and ultimately say. It is therefore important for teachers, who work in the talk-rich interface between the 'emergent schooled concepts and everyday concepts', to mobilise the knowledge the pupils bring with them. Similarly, Luria (1982, p.27) claims that: *'The origins of 'conscious activity' are to be found not in the 'recesses of the human brain' but in the external conditions of life. One must seek these origins in the external processes of social life.'* The foundations of such a perspective is to be found in Vygotsky (1986) and the notion that learning happens on two planes; the social which is between people and the psychological which is internal to the individual. Hasan's (2002) concept of invisible mediation is a label that can be adopted to describe the aspects of the classroom that are pivotal in the development of a culture that is conducive to the creation of such a social environment and can shape dispositions and habits of mind in a way that develops both attention and engagement among children.

It would be remiss not to include the work of Barnes, (1976) and his views on how classroom talk can be developed to support learning, at this point. The labels he uses to describe talk (exploratory talk, action knowledge) allow us to make connections between the ideas expressed above such as funds of knowledge and how this can be perceived in classroom environment. Throughout his seminal work Barnes provides not only a coherent narrative and the tools to support the creation of a learning environment that facilitates the movement from the spontaneous to the scientific without any loss of agency. He is also prescient in that his ideas call for studies of the type taking place here. Barnes provides a bridge to link the theoretical underpinnings of talk to the work of those who seek to investigate and promote it within the classroom environment. From the outset he brings a practical view of the application of the ideas of Vygotsky for the classroom teacher. He helpfully equates spontaneous constructions to existing knowledge while non-spontaneous constructions are used to describe the ideas presented by the teacher. Learning is therefore the process by which the scientific knowledge is incorporated into the view of child which he terms action knowledge. Barnes's strength lies in his descriptions of the characteristics of classroom communication and dialogue that support children to make sense of the scientific concepts they are presented with at school. He advises that time should be provided to allow pupils to explore the connections between their current knowledge and the new being presented to them. With echoes to those who will come decades later he suggest that a classroom in which meaningful learning is to happen should be characterised by more involvement from the pupils. He is also realistic regarding the problems that such an environment brings and suggest that an environment where the teacher encourages pupils to talk, and reflect upon what is being said, is likely to be difficult.

A major focus of his work was a categorisation of the type of talk in which children engage and the role these play in the learning process. Most recently, these descriptors have been explored by Mercer (2000) who sites exploratory talk as a means by which the assimilation and accommodation of new knowledge is carried out. His three main categories of talk that are supportive of thinking are:

Disputational Talk - is characterised by disagreement and individualised decision making. There are few attempts to pool resources, to offer constructive criticism or make suggestions. Disputational talk also has some characteristic discourse features— short exchanges consisting of assertions and challenges or counter assertions ('Yes, it is.' 'No it's not!'). The dialogue is 'closed' in that it does not open up to reasons.

Cumulative Talk - here speakers build positively but uncritically on what the others have said. Partners use talk to construct 'common knowledge' by accumulation. Cumulative discourse is characterised by repetitions, confirmations and elaborations. Cumulative talk is also closed in that it tends to 'protect and affirm the identity of the group' over 'exploring reasons for ideas'.

Exploratory Talk - is a kind of interaction which combines explicit reasoning through talk, involving challenges and justifications, within a co-operative framework of ground-rules emphasising the shared nature of the activity and the importance of the active participation of all involved (Wegerif 1996).

Mercer describes exploratory talk as that in which partners engage critically but constructively with each other's ideas. Relevant information is offered for joint consideration. Proposals may be challenged and counter-challenged, reasons are given and alternatives are offered. Barnes (2008) describes this as an opportunity for a speaker to sort out their thoughts and ideas, see how they sound, receive feedback and arrange these pieces of information and ideas into different formats. Exploratory talk concerns an environment where pupils feel at ease to share ideas and develop understanding, whilst working alongside their peers.

The ideas of Wegerif (2007), a doctoral student of Mercer, have proved to be instrumental to this study and are introduced on page 50 as they have come to play a key role in the categorisation of pupil talk that have been devised during this study. If teachers are to help the children in their charge to move into non-spontaneous thinking, then the learning environment should foster them constructing a bridge between the new presented by the teacher and that which they already know and bring with them from their everyday lives. As such he views the classroom, in Bakhtin terms, as a complex process that involves the interaction of meaning between a teacher and their pupils so a shared meaning is developed. Going further he highlights the importance of the social context in helping to shape the language used to struggle with the tasks set and stresses that communication systems must be influenced by the pupils themselves.

2.15 Classroom environments supportive of talk

The issues associated with the creation of such an environment are highlighted very clearly by Nuthall (2007) whose work shows how rare meaningful talk can be. His careful tape recording of classrooms reveals that very little constructive talk can take place and indeed much of what is said could be termed as unhelpful side talk (see Lemke below). He provides some recommendations for those who wish to develop a classroom culture that promotes the type of talk described above. His advice concerns the creation of a powerful environment that overrides the natural peer culture and that this is possible if teachers are involved in such a culture to manage learning opportunities. Further to this he raises the question of the environment that exists within the classroom and that; *'Effective group work requires students to acquire a set of attitudes and beliefs - they need to develop the classroom as a learning community'*. In a summary of his work Wilkinson and Anderson (Nuthall, 2007, chapter 7) recommend that teachers should:

- Design activities with students' memories in mind;
- Make connections between different experiences that involve the same concept;
- Look at key ideas in depth;
- Develop a culture that entails mutual respect and co-operation, where everyone feels they have something to contribute;
- Support students in learning how to learn and be able to apply this to new concepts.

In an analysis of the science classroom, Lemke (1990, chapter 1) sought to bring a Vygotskian

perspective to bear within the science teaching and consequently suggests that:

'We have to learn to see science teaching as a social process and to bring students into this community of people who talk science. The classroom is not isolated from the attitudes, values and social interests of the local community.'

Lemke's ideas link very strongly with Molls' concept of 'funds of knowledge' and Serret's description of the nature of talk where children interact on a move-by-move basis, whilst grappling with both complex meanings (signs) and expectations. Lemke, in a move that connects to the idea of the 'third space' that this study seeks to investigate, describes how the words that pupils use are actually a hybrid mix of prior learning and spontaneous ideas. : His comments are relevant to this study as he encourages teachers to listen to what their pupils are saying on their own terms including their funds of knowledge. The transcripts collected in Barry School clearly show that CASE teaching involves just these aspects; hearing what they are saying while seeking to activate their funds of knowledge.

These labels have been enriched by Gutierrez (see section 3) who uses the terms script and counterscript or official and unofficial talk. The term side talk is helpful at this juncture as it allows us to classify and identify specific types of, natural, talk within the classroom. Lemke suggests that 'side talk' has valid educational functions and can be a way for pupils to sustain personal relationships whilst also engaging with science. More importantly he suggests that 'side talk'; *'serves the need to talk about what is going on at that moment and often leads to pupil questions'*. Lemke sees side talk as the key to a collaborative classroom as it is an *'adaptive and functional form of behaviour ... and without it there is no true dialogue or cross-discussion, little spirit or enthusiasm and the classroom is characterized by predictable behaviour lacking spontaneity.'* (1990, p.75 – 79) This is supported by Nuthall (2007) who describes the form of pupil-generated learning experience as *'spontaneous peer talk'* and that this is a critical learning activity arising out of, or in parallel with, required talk and occurred up to 25% of the time in some classrooms. In this research the term pupil agenda talk is used to encompass talk that is pupil generated and directed. This view can be summarised as allowing pupils to construct meaning in their own words for these do not exist in the abstract but rather *'are constructed by our speaking and through our use of signs and words.'* And that *'reasoning is a way of talking that is learned by talking.'* Similarly to Nuthall, Lemke provides several features of interaction that should be included in any classroom seeking to incorporate a constructive perspective. Not only should time be allowed for pupil questions and dialogue, but teachers should be tolerant of side talk and allow pupils time to talk free of pressures associated with talking to teachers. Critically in terms of the proposed study the advice to allow pupils to express themselves in colloquial language and to give the benefit of the doubt to pupils who express ideas in unfamiliar ways and enlist the help of other pupils to translate these into more familiar terms is prescient indeed. The creation of such a culture will underpin an exploration of the hybrid features that characterise the overlap between the spontaneous and the scientific and the change that the move towards the scientific requires. Bazerman (2012) describes this as the role of the words used in the classroom having the potential to shape cognitive landscapes that make new thinking possible in a way that can even trigger cognitive development.

The number of publications siting the third space, including the 2012 book by Barton and Tan (Empowering Science and Mathematics Education), are illustrative of how powerful the concept could be. The third space is proving to be a fruitful construct for the exploration of classroom processes previously discussed. Guitierrez (2005) explores the idea of the 'grammar' of the third space as a way of unpicking the nature of discourses involved when pupils are allowed to access their funds of knowledge as part of the learning process. She is interested in the type of environment that enables pupils to re-conceive who they are and feels that the third space provides a window to allow educators to understand why certain contexts are more meaningful than others. In an analysis

that points to some concrete evidence for third space activity they found that moments like these contain a preponderance of modal verbs and questions. They now begin to describe the third space contains a mix of language and practices that are supportive of the social conditions for learning to occur. They state that the goals for a such an environment are: the facilitation of understanding, the reorganisation of everyday into scientific concepts and that pupils should be given the opportunity to redefine the world as it is today and as it could be. The third space will be introduced and analysed in greater depth in the final section of this chapter.

2.2 – The Cognitive Acceleration through Science Education project (CASE) project

The ideas articulated in section 1 of this chapter have their roots within Vygotskyian psychology and in this section an examination of CASE that has a similar foundation will also take place. With science as a vehicle to develop cognition, CASE uses the application of both his and Piaget's ideas to support the classroom management of small group and whole class discussion. This stems in part from the fact that Vygotsky emphasises the interaction of the individual with the outside world in social settings. In the classroom the experiences of the adolescent child are primarily mediated by their peer group and the adults they meet. Such social settings are therefore the main influences that structure the meanings of events in the mind of the child.

2.21 Overview of the CASE programme

This thesis is built upon the analysis of talk in CASE lessons and so it is necessary to provide an overview of the programme: the activities, its theoretical underpinnings and some of the questions that such a use of psychology within the classroom raises. This will allow me to explore of the use of both Piagetian and Vygotskyian ideas by its authors. More importantly this will highlight the developing understanding, of Vygotsky, shown by Michael Shayer as he moved to work within the field of secondary mathematics with Mundher Adhami. Not only is an understanding of the ideas of Vygotsky pivotal to my thesis but the application of this within the classroom is both current and apposite for it carries a message for all those who seek to use small group discussion to support the learning of their students. In the original CASE research the work of Piaget and Vygotsky formed the basis of a theoretical platform on which Adey and Shayer claim to have been able to develop a mechanism to improve student's thinking. There were three ingredients to this;

1. An understanding that higher order thinking can be described by the reasoning patterns of formal operations as described by Piaget;
2. That the development of formal operational thinking occurs in response to a combination of variables including student's maturation, environment and history of development; [11]
3. An acknowledgement that a key factor in cognitive development is social mediation.

CASE (Cognitive Acceleration through Science Education) is a well-known programme of science lessons published under the title 'Thinking Science' (2001). Adey (2012) in one of the last articles he wrote stated that; '*the Cognitive Acceleration approach has been demonstrating big effects for years,*' (p. 211). Here he is looking back on almost three decades of research in education and cites just two of the many reports to support his assertion that measurable cognitive gains are made by

children exposed to the Cognitive Acceleration (CA) approach. This is a bold claim yet since CASE was first published many studies have appeared in support of Adey and his co-author Michael Shayer. A summary of this evidence has been collated by the Let's Think Forum, a charity set up to continue their work, and can be found here: <https://letsthink.org.uk/about-us/impact-evidence/>

In the early 90's as evidence started to emerge of the impact upon attainment by CASE the result was considerable interest among the secondary education community. As a consequence, many schools (Shayer and Adey, 2002, p.13) in the UK and beyond, began to use the materials within their science classrooms. Interest in CASE has continued and this is reflected in the regular conference presentations, articles and publications that come from around the world; Australia (Dullard and Oliver (2012)), Finland (Kuusela et al (awaiting publication)) and Tonga (Finau et al (2016)) from various researchers and institutions who find that these approaches are a valuable addition to the educational diet of the students who experience the activities at the start of secondary education.

CASE and CAME (sister project set within the context of mathematics) consist of exemplar teaching materials for use in Years 7 and 8 that are underpinned by the work of Jean Piaget and Lev Vygotsky. Philip Adey (personal comment) admitted that one of the aims of his work was to give teachers access to a 'theory' and that by doing so such understanding would impact the individual's thinking and practice. Section's 2.32 and 2.33 will outline how the ideas of Piaget and Vygotsky translate into the classroom practice that is encouraged by Adey and Shayer before exploring their use of these ideas in greater depth.

Adhami et al (1998) describes this use of Piaget and Vygotsky as having specific lesson features. At its core is the design of lessons that use a Vygotskian/social constructive perspective to 'move' students towards formal reasoning using a Piagetian, age-stage, analysis of the 'content' of the lessons. He outlines the main features of this approach as: concrete preparation, cognitive challenge, social construction, metacognition and bridging. In the teaching materials specific guidance is given as to the focus and conduct of each aspect of the lesson to support teachers to use the materials and also, more importantly, to develop the Cognitive Acceleration 'approach' within their classroom.

In CASE training these distinct features are often referred to as the five pillars of CASE:

- Concrete preparation: concerns the need to make the task clear so the children are able to work without confusion.
- Cognitive challenge or cognitive conflict: each lesson contains something that puzzles the children and which needs to be solved or answered collectively.
- Social construction: refers to the need for a group of children to discuss and resolve the conflict by the generation of their own solution.
- Metacognition: is the term used to describe how the children are encouraged to reflect upon the thinking used in the lesson.
- Bridging: at some point in the lessons the ideas and thinking are applied into a new or different context.

2.22 The application of Piaget within CASE

The ideas and language of Piaget are woven tightly into the fabric of CASE. Piaget believed that the process of mental development was hierarchical and linked to age. In the light of this he formulated a series of clearly defined stages through which children's thinking moves from the earliest, which is termed sensorimotor thinking, to the most developed, which is termed formal operational thinking. Four decades ago, studies highlighted that when the contents of the science and mathematics curricula were matched with their respective Piagetian levels, that the majority of students seemed to be lagging behind those necessary for the understanding of scientific concepts (Shayer, 1978). CASE was therefore developed as a way to intervene in the cognitive development of students in an attempt to redress this deficiency i.e. to support their understanding of concepts, termed reasoning patterns in CASE. The results, including those for external examinations, produced seemed to support this aim with several studies recording increased student cognitive levels, as indicated by Adey (2012). This 'success' led to the term acceleration being applied in the sense that the pupils who experienced CASE were doing better than predicted.

At its heart the CASE project was built around the term acceleration which describes how, through the medium of a core curricular area, Shayer and Adey were seeking to change a student's 'natural' development processes. The use of the ideas of Piaget enabled them to quantify this as moving thinking through the different stages, towards abstract, logical and multivariate thinking termed formal operational thinking.

Piaget's stages of cognitive development

To Piaget, development and maturation result in cognitive growth and an increasing ability to make sense of and imagine or model the world around us. Underpinning this is the notion that all children pass through distinct stages of cognitive development, described below, which are characterised by specific features that help to describe how a child is making sense of the world around them. The table below contains my own personal take on the descriptors provided by Piaget and forms the basis of the information I share with the teachers I work with.

Piagetian Stage	Features
Sensory- motor (0-2)	A child's thinking is governed by the sensory information that they gain about the world from their actions upon it. They learn to apply the sensory and motor skills/abilities that they have to interact with and learn more about the environment around them.
Pre-operational (2-7)	As they approach school age children become increasingly able to internally represent events, i.e. think and consequently they become less dependent on their actions. Early in the pre-operational stage language is acquired, while their behaviour is mostly egocentric and thought at this stage can be characterised as restrictive and tactile. As they move towards the end of this period the child

	becomes largely communicative and social. Pre-operational children are unable to reverse operations and to conserve.
Concrete operational (7 – 11)	Now a child's reasoning becomes progressively more logical and a range of concepts such as space, time, causality and speed emerge. One of the key features of this stage is the attainment of reversibility and the ability to solve conservation problems. The conservation of number problems are solved at the beginning of this stage, conservation of area and mass problems in the middle and the conservation of volume problems towards the end. As the term 'concrete' suggests, the child's thinking in this stage is limited to and based upon their experiences of real or concrete objects or events. They are unable to apply their thinking beyond the context in which the problem is given.
Formal operational (11+)	In adolescence a child's cognitive structures begin to reach maturity and with this comes the ability to think logically about problems in a way that is not restricted to the context used. The child is better able to organise data, reason scientifically and generate hypotheses. Problems involving combinatorial thought, complex verbal and hypothetical problems, ratio and proportions and conservation of movement are now possible. Formal operational thinking is characterized by the ability to deal with the many abstract ideas involved in mathematics and science. Children become increasingly able to grasp ideas such as those involved in the setting up and testing of hypotheses, the control of variables, ratio and proportion, probability and equilibrium.

Figure 2: Piagetian level descriptors

Of particular relevance to CASE is the fact that Piaget stressed the necessity of concrete material experiences to support children to develop their own hypotheses and then to verify them through their interactions and manipulations (Brown and Desforges 1977). Social interactions also come to play a significant role in cognitive development from the onset of concrete operational thinking which coincides with the start of primary education at the age of seven and eight. Coupled with this change in cognition as children mature most develop the ability to accommodate the views of others and so interactions become invaluable for cognitive stimulation.

Assimilation, accommodation and equilibrium are the three processes that are central to Piaget's theory of cognitive development (Bennet, 2003, pg 24). McCormack (2009) provides a particularly detailed analysis of the CASE project, it's genesis, lessons and data. In her thesis she looks at the impact of CASE across the primary, secondary divide in Ireland, and describes assimilation as the interpretation of new learning experiences within existing cognitive structures i.e. no change in thinking. Whereas accommodation is the modification, or development, of existing cognitive structures to take account of new learning experiences. CASE is seeking to promote the accommodation of new ideas into pupil thinking during early adolescence. Equilibrium is the balance between the two processes and results in cognitive growth or development. If a new idea cannot be assimilated, it therefore must be accommodated and a new state of mind, equilibrium, will occur. In CASE the term cognitive conflict or challenge is used to signpost that this process will deliberately be triggered or taking place. The phrase 'trigger' has been incorporated as a key term in my vocabulary as it encompasses both the thinking needed by teachers during the planning stage, and also the moment by moment classroom management techniques required in the classroom. The term trigger aligns with the idea of Bhabha as he describes the need to ensure the level of 'challenge' supports learning with the term 'priming the difference' (see section 3 of this

chapter). These ideas are introduced and developed as part of the analysis of the lesson transcripts in chapters 4 and 5.

Piaget uses the term schemata to describe the intellectual structures and cognitive frameworks that are used to organise events according to shared characteristics. This sequence holds true for all although their attainment may differ, depending upon features such as intelligence and environment. A key tenant of the work by Shayer and Adey is their claim that curriculum sequences need to incorporate an awareness of the cognitive basis by which children look at the world. Including such a perspective can better support the teaching of the curriculum because it focuses upon the concepts such as ratio and proportion that underpin much of the thinking required by the curriculum. Inhelder and Piaget (1958) believed that formal operational thought was general to all domains, and they proposed that the complete cognitive structure of formal operations includes a set of 10 reasoning patterns, Piaget terms these the 'schemata of formal operational thinking'. With the aim of supporting the development of such thinking CASE lessons were designed and the lessons in the pack collectively address each of the schema of formal operations which cover: the control and exclusion of variables, ratio and proportionality, equilibrium, compensation, correlation, probability, compound variables and the development of formal models. Further details of these reasoning patterns and individual CASE lessons can be found in appendix two.

2.23 A discussion of the use of Piaget within the CASE approach

Piaget used the term 'readiness' to highlight the fact that the acquisition of the thinking at each previous level was necessary for the next one to happen. While some people will naturally move more quickly than others, this is a developmental process through the stages rather than something approaching acceleration. From this perspective CASE philosophy is clearly a departure from the standard understanding of Piaget. It's the application of his perspective to the adolescent brain and the fact that much of his work was carried out with his own, and other Professors' children, in Switzerland. Shayer and Adey (1981) held that Piaget had identified the main stages in development as happening with the most able children and it that their testing revealed the picture for the rest of the population, the other 70%.

This does beg the question of why try to change children in the first place if cognitive development will take its own natural course? The strongly held belief underpinning CASE is that children were not reaching their potential for many reasons and so their, cognitive, development needed supporting in a way that would enable them to better access the curriculum required at the end of secondary schooling. CASE was an attempt to complement and support such development in a way that enriches and brings balance to a diet composed of content and facts to be learned for tests. The higher levels of the curriculum are difficult because they require the application of thinking based upon conceptual understanding such as the need to understand ratio and proportion to carry out titrations and balance equations in chemistry.

Following from this is the view that it might be better to simply wait until young people are ready and design learning that is appropriate to the stage they are at and not the stage you want them to be. In this light CASE should be viewed as a form of cognitive catch up but the term acceleration has stuck. To quote Shayer (personal comment):

“As they move from concrete to formal operational thinking there is a period of integration that provides the child with a richer picture of the world. CASE is targeting this period in early secondary schooling and is concerned with getting children to that transition point at a developmentally appropriate time.”

Towards a Science of Science Teaching (Shayer., 1981) was Shayer and Adey’s attempt to apply Piaget’s ideas to a core curriculum area. Their claim is that Piagetian stages are not simply about sudden jumps but that their application of his hierarchy, within science, has highlighted a graduated series and that the stages, such as concrete generalisation, could be used as descriptive models to enrich the science curriculum. CASE therefore seeks to take pupils close to formal thinking in a way that supports the transition into that stage which Piaget identifies as taking place during early adolescence. The last word on the use of Piagetian thinking, as applied to CASE, can go to Adhami (1998) who reminds us that a key feature of Piaget’s thinking was the need to attend to the readiness of pupils to move higher in their thinking and the need to design appropriate learning situations based upon cognitive challenges.

2.24 The application of Vygotsky within the CASE approach

Given that science classrooms are generally places that contain groups of students and that CASE lessons espouse the use of collaborative group work, termed social construction, we must now turn to the aspect of CASE that draws its inspiration from Lev Vygotsky. In this section I will outline the main ideas of Vygotsky and their application to the classroom and their associations with CASE. Initially when first articulated to a wider audience the focus in CASE upon small group discussion and collaboration was usually (author personal comment) included the following two quotes from Vygotsky (1978., p. 57,162.):

“Any function of a child’s cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people ... and then within the child...”

“Talking provokes a representation of one’s thoughts – a process which inevitably raises them to a more conscious plane of awareness so that they can become the objects of reflection and modification.”

In the 1990’s during this early stage of the training of schools, the quotes were used to focus teachers on the reasons behind the fact that in CASE lessons pupils are encouraged to spend time talking about their thinking as opposed to giving answers to questions asked. Over time more of his ideas began to be articulated most notably; the zone of proximal development; the nature of thinking as described using the terms spontaneous and scientific thought and the role of signs in human cognition. Michael Shayer (2002) explains how Vygotsky was introduced to research in psychology when asked to replicate the Binet test of intelligence in the 1920’s. This led to the development of one of his most famous ideas – the zone of proximal development (ZPD). This ‘zone’ describes the difference between what a learner can do, unaided, without help and what she can do with the help of a more capable other. This concept was very much being developed by Vygotsky during the latter part of his life. and emerged from his involvement with the assessment of children i.e. that with help, a child could do better in the test than on their own and that the difference between the two scores represents the ZPD.

Through his testing Vygotsky (1978) showed that the information obtained in this way is a better predictor of children’s progress in school learning over the following two years than static test

scores. The measure also gives a more helpful clue to the dynamics of intellectual progress, compared with an estimation based upon a written assessment. He was therefore convinced that what children can achieve assisted by an adult tells more about their capacity to learn in the future than tests they undertake in isolation. The idea of such a 'zone' has proven to be very popular in education and has often been linked to the idea of scaffolding by the teacher, but Michael Shayer (2002) provides an interesting point of reflection for he correctly stresses that the term 'more intelligent partners' was used in a speculative way as the testing was only carried out with the psychologist and the child. Also at that stage the application of the concept to the classroom itself is far off but later Vygotsky (1978., p.90) recommends that in the ZPD;

'Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in co-operation with his peers. Once these processes are internalized, they become part of the child's independent developmental achievement.'

Looking at this from a teaching point of view Wertsch (1985) adds that this zone can support teachers' judgements regarding the next learning steps for their children as indicators ahead of conscious understanding.

In his work Vygotsky identifies two distinct paths through which conceptual understanding develops; scientific concepts are those acquired via formal instruction while spontaneous concepts arise through participation in social practices i.e. life and 'lived experience.' Spontaneous concepts are grounded in practical and familial experience and are acquired effortlessly and often without the subject being consciously aware of them. Herein lies the heart of this study: children bring to school a lifetime worth of ideas, words and associated signs, and these underpin their actions in the formal/scientific world of the classroom. It is through the lens of such knowledge that they view, and respond to, the world presented to them within the classroom. In order to better support the learning of the formal, examined, concepts we need to recognise the nature of their acquisition and starting points. This study is therefore attempting to explore the conditions that effect the movement from spontaneous to scientific concepts within the secondary school setting.

Vygotsky's short working life resulted in him not being able to fully investigate many of his ideas. This has led to a whole host of others who have explored the implications of his suggestions regarding the role of talk in the process of cognitive development. Moll (1993) in an attempt to support teachers to facilitate their pupils in moving from spontaneous to scientific understanding, proposed that children bring 'funds of knowledge' with them into the classroom. Such funds refer to the knowledge and skills, both historically accumulated and culturally developed, that pupils naturally acquire as part of their life experiences. The application of his ideas, in this way, can help us understand the importance of talk as part of the learning process and can therefore support the development of a classroom culture that promotes such talk. These funds form the foundations of the spontaneous knowledge, including misconceptions, that children carry with them. It is from such a prior knowledge base that they make sense of and therefore talk about what is happening in the classroom. Vygotsky's (1991) account of cognitive development pays close attention to the construction of knowledge as a social process, one that involving human interaction using 'signs.' During conversations, signs are developed and exchanged between people and understanding occurs in the resulting, social, space and not in the signs in themselves specifically. A sign is therefore a vehicle for transmitting and developing individual and shared meaning. In these terms change occurs through personally appropriating strategies first used in exchanges with others, i.e. 'all that is internal in the higher mental functions was at one time external.' In order to support the learning of the formal, examined, concepts teachers need to recognise the nature of their acquisition and starting points of such thinking. This study is exploring the conditions that effect the movement from spontaneous to scientific concepts within the secondary school setting and to identify which types of talk may be indicative of such moments.

2.25 CASE and classroom management

Despite using quotes that are readily accepted by teachers it was actually quite difficult to apply Vygotsky's ideas to practical teaching strategies and to do this Shayer turned to Feuerstein (1980) for inspiration. Feuerstein found it necessary to develop Vygotsky's concept of mediation to support the materials he developed. Adhami (1998) articulates this and describes that the successful performance 'between people' which provides the opportunity for children to witness, internalise and make their own step in development will more usually be accomplished as a result of the inputs from one of the child's peers. The reason for this is that teacher is too far away from where the adolescent is to know successfully what to offer, and they also may not as readily accept the modelling from an adult as they would from a peer. Based upon this knowledge and in practical terms the teacher, in the CASE classroom, needs to manage the lesson to increase the opportunities each child gets to receive this peer generated mediation, i.e. good ideas delivered in language and symbolic actions which may be only just ahead of where another pupil presently is. The CASE classroom is one where the pupils are mediating each other and the teacher seeks to orchestrate or stage manage the whole process.

Piaget and Vygotsky are often described as conflicting or contrasting and to overcome such a polarised view CASE uses them in a more symbiotic way, one that allows their practical manifestations in the classroom to work in more harmonious relationship. Adhami (1998) describes this aspect as learning where the assimilation (of new experiences into one's own mental structures) and accommodation (of the mental structures to significantly novel experiences) is framed by the mediating role of the teacher and the classroom interaction with peers. The process of using Piagetian levels to decide upon the specifics of the lesson content is termed by Shayer (personal comment) as the 'n + 1' and Vygotsky's (1986., pp. 179-180) advice to teachers is to remain in tune with children's level of mental development and he warns us that:

'Practical experience also shows that direct teaching of concepts is impossible and fruitless. A teacher who tries this usually accomplishes nothing but empty verbalism, a parrot-like repetition of words by the child, simulating a knowledge of the corresponding concepts but actually covering up a vacuum.'

The use of their testing and a Piagetian foundation to the levels of thinking covered in a lesson has enabled CASE to meet another of the key pieces of advice laid down by Vygotsky (1978) as he emphasizes the need to stimulate cognitive growth in the classroom through a teacher providing appropriate experiences that support the construction of higher level thinking by the students themselves. This thesis is developing the application of Vygotskian psychology to re-articulate CASE by incorporating the ideas (see section 1) on dramatic contradictions and perezhivanie to more fully describe construction zone activity. This is the time in the lesson where construction talk takes place and the pupils begin to resolve, then articulate, the conflict they face. At this stage an illustration of how these ideas manifest themselves within CASE will be provided. To do this a summary of a typical CASE lesson will be used to highlight each of the key features as identified by Adhami (1998).

2.26 An overview of a typical CASE lesson

CASE lesson 11 – The Balance Beam or Keeping Balanced

CASE lesson 11 concerns pupils having to balance a see saw (balance beam). The distance of the weight on one of the sides is fixed and the pupils explore the combinations of weight and distance on the other side to balance the beam. The resulting thinking triggered by the combinations of values sees the pupil being to grasp the nature of inverse proportion that underpins this relationship.

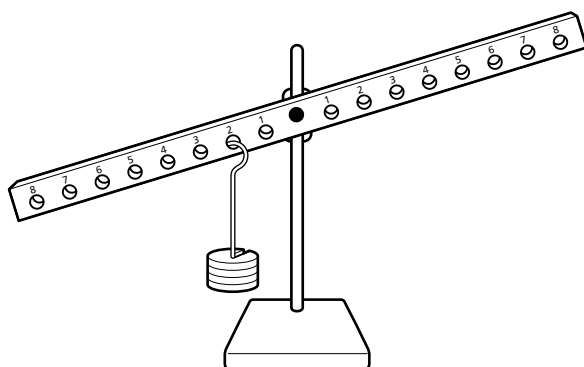


Figure 3: CASE lesson 11 equipment

CASE feature (from Adhami)	Manifestation in CASE lesson 11
The main aim is to support intellectual development and to expose pupils to formal reasoning.	The focus of this activity is to challenge pupils to explore and quantify the nature of inverse proportion that is often found in many scientific relationships i.e. $y = x/m$
The class needs first to become familiar with the nature of the task in front of them (concrete preparation).	The lesson typically begins with an image of two people on a see saw, the adult is lower than child who is also closer to the center. The class agree the variables involved, identify and articulate the problem.
Each intervention lesson has an individual or small-group session of work on task where pupils know the essential thing is to test the ideas and strategies they are using (cognitive conflict leading to construction) and share their ideas with their peers (the Vygotskian/social constructivism perspective).	Children are shown, and given, the balance beam experiment. Their task is to keep the right hand side fixed (400g at hole 2) and thus to find all the possible ways to balance the beam by changing either the mass or the distance on the left. Each group of four is left to explore the beam and are supplied with targeted questions that focus upon the problem.
They know they will be asked to contribute to a whole-class discussion when, as far as possible, everything of note which has occurred anywhere	Each group is given time to prepare for the whole class discussion that is steered, through the careful orchestration of ideas and voices, towards the notion that: <i>'If you move the weight out it has to be lighter to balance'</i> . And then towards the

in class is shared (further construction).	relationship $m \times d$ on left = $m \times d$ on right i.e. <i>'It's the same on each side'</i>
Finally when the new thinking is active in their minds the pupils are asked to find good descriptive names (words or phrases) for the new ideas which they can share (metacognition), and to recall or invent other contexts for their use (bridging).	The lesson ends with the class/groups being asked to share good ways to describe this relationship and also the best words to use to help them remember this idea. They explore and are given other examples/contexts that illustrate the nature of inverse proportionality.

2.27 CASE - a symbiotic relationship between Piaget and Vygotsky

I will now focus upon the dual use of Piaget and Vygotsky in CASE and will do this by looking at how these ideas are expressed by Michael Shayer's main collaborator in his work within mathematics, Mundher Adhami. Viewing CASE through this lens will enable us to see how Shayer has been able to develop his thinking more fully regarding the practicalities of applying the work of Vygotsky into the classroom. This is helpful for when Kozulin (1998) analysed Piaget and Vygotsky's theories he describes their common denominators as a child-centred approach with an emphasis on action in the formation of thought.

Given that Michael's collaborator in CAME, Mundher Adhami, was able to translate Vygotsky from the original Russian I felt it necessary to involve him in my research. I instigated an interview to learn more regarding how his reading of the original work of Vygotsky was able to add to their understanding of the application of his ideas in terms of classroom conduct and management. This was important because of the problems the west has with Vygotsky which are due to the simple fact that the subtle and true meaning of his words is often lost in translation. Hearing this from the horse's mouth so to speak would help me to navigate, and better understand, the language associated with children's talk and thinking. In the interview Mundher reflected upon the problems of using Vygotsky's ideas as teaching advice, his views on the role of language in cognitive development and also the nature of non-spontaneous and spontaneous thought. He was keen to stress that due to the fact that Vygotsky died at a young age much of the essential consistency and coherence are missing from his writing. Such a short career meant that he hadn't had the time to carry out much empirical research, but he needs to be widely acknowledged for recognising that social cognition relies on individual digestion of what is presented. One of the problems associated with translating Vygotsky is that there are many words, in Russian, for social interaction and collaboration between people. Any translation must take care to look at the shades of meaning through the roots of the words. For example, "sovместnaya" is togetherness or related and also in the same place (so=Together, mesto = place). Similarly "Sotrudnichestvo" is working together (truda=work), "cooperativno" seems of a lighter shade of the same, with a Latin root, "collectivno" which refers to an attitude rather than to any sense of work or collaboration. The same reading could result in one person focusing upon a pupils' attitude while another could highlight the need for collaboration or togetherness.

In terms of the nature of higher level or scientific thought, Adhami highlighted the idea that language brings a sense of freedom and that the word, or label, enables you to generalise, free from the initial action, to a higher level of thought. This allows you to leave the context behind and implies movement away from thinking which is restricted to given or specific situations. The focus in CAME and CASE lessons is one in which higher levels of thought are developed through the process of freeing the concept from the context. The words that emerge from the 'context' carry meaning and verbalisation by children enables their use within or in application to a new context outside of the one in which it has arisen. The words pupils use and agree upon are critical as they

allow the child to transcend the context through language leading to the ability to generalise and think at a much higher level.

Mundher acknowledged that Vygotsky pioneered the social side of learning and the notion that the best teaching is ahead of development. This is a dynamic process and something that involves a constant need for the teacher to pitch ideas or work just beyond where children are at i.e. $n + 1$. That implies that teachers need to know the n , i.e. the thinking level of the individual child, and what the $+1$ means. It also implies knowing the cognitive demand level of the task to be handled by the child. This is not an easy task and is why they used a Piagetian hierarchy of levels to support the cognitive development of individuals towards scientific thought in Vygotskian terms.

Mundher was able to shed some light on how this works in practice in the classroom because the best mediation comes through peers and therefore the role of the teacher is to develop and support peer to peer mediation. CAME and CASE lessons allow teachers to form the framework within the zone of proximal development to allow children to see and hear 'successful performances' that are nearer to them than their teachers would be. The teacher needs to be ready to prod or prompt to the next step, but not to tell, in response to the pupil and their peers. While pairs or small groups of children are working on the task, the teacher is required to listen, challenge and support, then to steer them towards manageable conflicts. In CAME the lesson guidance is written in such a way to help a teacher to have an understanding of the conceptual hierarchy and the typical responses of pupils working at each different level within that. He ended by describing how he and Michael condensed this advice into practical advice for teachers of CAME and CASE and the fact that in such lessons a key feature is the need, for children, to be given the opportunity to develop good names or labels to help them remember the key ideas from the lessons. This can be risky for the teacher as initially the 'correct' word may not be used. A personal reflection will serve to illustrate this point. In a lesson on straight lines graphs showing proportional relationships a child, when invited to comment at the end, said that he wanted to call the graph the 'The portion of chips graph, because each time you got the same number of chips'. In that particular activity the gradient was three. From the teachers perspective it is important that they are able to see the meaning in the words pupils use, as their ideas are often part-formed, and link this to the concepts that underlie the lesson they are teaching. There is then the need to make sure that 'good' ideas are shared among the whole class and celebrated.

This background knowledge that supported the development of the CAME project gives an insight into the thinking behind Shayer's later work. Writing (Shayer, 2001) several years after the publication of CASE Michael was open in his views that, "They only had an intuitive grasp of the relevant work of Vygotsky," and how he pointed the way towards the importance of peer-peer collaboration in cognitive development. We can now look at how this understanding has developed in the use of Piaget and Vygotsky by CASE as a kind of pedagogical symbiotic relationship. This can provide a better understand the foundations that underpin the CASE project and more importantly, for this research, how they can be used to shed light upon the third space as an application of Vygotskian psychology to support and develop the mechanics of social construction.

Shayer was practically and necessarily looking forward through a pair of convergent lenses given that Vygotsky did not do any work in school and was also unable to specify the nature, or provide any descriptors, of spontaneous and scientific thinking. In CASE Piaget is therefore used to both describe and quantify spontaneous (i.e. concrete operational thinking) and non-spontaneous or scientific thinking (formal operational thinking) as described by Vygotsky and that it is the latter that is involved in the management or orchestration of the learning that takes place in the classroom. The following quotes from Vygotsky are used to help reinforce the idea of what CASE is seeking to achieve by using the specifics descriptors of thinking as provided by Piaget:

The only good learning is that which is ahead of development. (Vygotsky, 1978, p. 89)

The only good kind of instruction is that which marches ahead of development and leads it: it must be aimed at the ripening functions. (Vygotsky, 1986, p.188)

Deliberate introduction of new concepts does not precede spontaneous development, but rather charts new paths for it. (Vygotsky, 1986, p.152)

We believe that the two processes (the development of spontaneous and nonspontaneous concepts) are related and constantly influence each other. The concepts evolve with the aid of constant mental activity on the part of the child ... (Vygotsky, 1986, p.157)

As children are challenged by new school learning they may be stimulated to re-process the learning in their own spontaneous manner of processing and hence receive a stimulus to further cognitive development. (Vygotsky, 1986, p.152)

These illustrate why it was necessary to turn to Piaget to enable the idea of the zone of proximal development to become a practical reality in the classroom in support of cognitive development. The first three quotes highlight the need to aim the focus of the teaching in advance of where the children are at in developmental terms. The use of the descriptors of formal operational thinking enables this to be possible for children at age eleven and both Shayer and Adhami term this idea $n+1$. The latter two quotes are a helpful way to articulate, how in CASE lessons, the need to stimulate thinking via the pillar of cognitive conflict is achieved. Challenging children in this way facilitates accommodation, as opposed to assimilation, for the nature of the activities is that they are just out of reach of the pupils within a typical Key Stage 3 class. Finally they serve to reinforce the idea that concepts are not acquired by rote but involve serious mental activity on the part of the child.

We can now say that, in terms of its theoretical underpinnings, CASE takes from Vygotsky a description of the relationship between spontaneous and non-spontaneous concepts as an interaction in the process of development. Spontaneous thinking comes before the scientific thinking that is met in secondary school and therefore it could be viewed as acting as a kind of leading edge (Shayer, 2002) impelling thinking forward into more powerful schemes i.e. formal operational thought. In CASE, a dual approach is taken in that Vygotsky helps to focus upon the social dynamics of development (what drives it from spontaneous to scientific levels) whereas Piaget upon descriptors of the specifics of what they are thinking about. Shayer is clear in his use of Piaget to describe the specifics of thinking which can be applied to the zone of proximal thinking in a way that Vygotsky (1978) was unable to do. Indeed, it became clear, to Vygotsky, that the functioning of intelligence depends upon the structure of thought. He said that Piaget's works were the most explicit expression of the concern with the structural aspect of thought in the sense that the end point is formal operational thinking and that at this point scientific concepts replace the earlier spontaneous ones.

In CASE the teacher focuses upon the need for children to become aware of successful performances in their peers who are nearer to their own level of thinking than the teacher. In adolescents this takes on a new meaning for they are in the process of transitioning to the adult world and so the talk of someone closer to them, socially, will be meaningful and more likely to have a powerful impact than that of a successful or polished performer i.e. the teacher who is actually too far removed from the pre-teen learner in both their thinking and language used. This is not about imitating adult thinking but rather developing their own models concerning the world and so someone closer to their present position will command greater attention. Shayer uses the term 'construction zone activity' as a possible way to explain how CASE might work to support

cognitive development. In this the learning activities that should be taking place within the groups and the classroom are described in the following ways:

- Construction of meaning;
- Extension of ideas;
- Small group experimentation and talk leading to mediation within groups;
- Management of class discussion and collecting ideas to be used;
- Selection of relevant verbal tools;
- Establishment of confidence.

As there is little help given to describe categories of talk/conversation, that may be taking place during this time, ones that are indicative of activity at a deeper level, I have chosen to explore the above within this thesis. Shayer (2002) does, helpfully, add that teachers should make good thinking and insights, i.e. successful performances, expressed in their own language available to all in the class. He then begins to expand on the key drivers of cognition and suggests that the key form of mediation for adolescents is their peers, rather than 'scaffolding' by adults i.e. 'How do I know what I think until I hear what the others say?' This implies the response and stimulation of the peer group and the presence of the collective. These quotes, however, are many years old and very little has been added regarding the specifics of CASE classroom descriptors since that time in support of such pedagogical strategies. This current work provides a window of opportunity for a study of this type for in CASE most of the 'activity' takes place in small groups and there is little help for teachers to describe how to identify what 'successful' performances may look and sound like. CASE lessons specifically require an environment of social construction to provide the conditions necessary to support pupils to accommodate new thinking, thinking that only develops because of the cognitive challenges presented to the learners.

I will end this section on the theoretical underpinnings of CASE with a helpful image developed by Shayer (2002, p.192) and his collaborators within mathematics. The metaphor they draw upon is of two vines; one vine represents spontaneous thought growing upward while the other vine, representing scientific concepts, grows downward. Under the influence of instruction (that encourages integration and consolidation) the two vines intertwine and grow together as conceptual understanding develops. It was pointed out that what is lacking here, is a sense of the grafting involved to show how the child is exhibiting formal operational thinking.

2.3 Introducing, and moving into, the third space

In this section the concept of the third space will be explored with focus placed upon the possible manifestation of 'third space talk' in the classroom. I will make frequent reference to CASE and how using this notion supports a revisiting of its pedagogy. This will also serve to trace the development of the third space from its Vygotskian roots and by doing so to highlight its potential as a concept supportive of cognitive development. Finally, this section will enable me to indicate where the gaps are and how this study will explore them.

From the outset it needs stating there are issues with the language used in conjunction with the third space and consequently an overuse of metaphors. The third space is a helpful yet an idealised construct, one which has proved to be a useful talking point but elusive in its manifestation in the classroom. As a result it is something that is actually quite rare in terms of concrete examples provided by its proponents to date. In this section I will frame and align the third space with authors such as Mercer (2001) and Wegerif (2005) who have been successful in providing specific examples to illustrate different types of children's talk in the classroom. This study is seeking to make the third space more practical in its application and this will be primarily done by viewing it

through the lens of Vygotsky as a way to harness its power as a descriptor of the process of cognitive development.

Bhabha (2004) is widely credited as the originator of this term and although not directly referring to the process of education his ideas have been used by many seeking to provide settings that are conducive to knowledge construction. Bhabha explains that the notion of the third space is based upon a translation of ideas and that the difference between two positions primes the mixing of ideas. The term 'third space' has been used to describe the conditions that facilitate the process of the internalisation of ideas that have been discussed earlier in this chapter. The first position or space can be viewed as the ideas and knowledge (spontaneous concepts in Vygotskyian terms) pupils bring into the classroom while the second space is composed of those presented within the classroom (non-spontaneous or scientific concepts). The third space represents, and describes, the meeting of the two. According to Bhabha it is in this space that a process of translation occurs during which the two differing ideas can be transformed using the term hybridity to describe the overlap between the two. In the *Location of Culture* (p. 53 – 56) and echoing Bakhtin, Bhabha states that it's the structure of symbolic representation, in both positions that is critical, and the difference between the two that is key to the development of meaning, and that this is produced when the two ideas pass through a third and in CASE I would view this as equivalent to the $n+1$ term used by Shayer. The third space represents the fact that the act of interpretation is not simply one of communication between two parties, but rather something different; a state where ideas can meet and be open to appropriation, translation and interpretation anew. To Bhabha it is the potential emergence of something new, in the mind of the learner, that gives the third space productive capacities and in an interesting application of positional language uses the term 'liminality' to describe the place that the third space occupies and that construction is based upon difference. His idea of 'translation' is helpful, as anyone who has translated a word from one language to another and then back again using Google Translate will testify to the new that can emerge from the task of translation guided by the interpretation of the translator. The new or hybrid that emerges includes the traces of meanings and discourses associated with such a difference.

Watts (*personal comment*) highlights that, in reference to Bhabha, 'everything is a hybrid and cultures are seldom pure and the vast bulk of social activity is and always has been a cultural composite.' He identifies an important problem that needs to be taken into account when exploring the idea of the third space- the limitations associated with the language used to describe it and an over reliance upon certain metaphors. The third space is regularly described as a bridge, a participation space, a place of crossing over, a place of navigation, a way to leverage funds of knowledge or an opportunity for integration. There is the danger that its meaning could get lost in such descriptions, rather than enriched and specified. The concept of the third space is helpful in that it signifies hybridity and enables the rejection of artificial boundaries, so we can now view the first and second spaces as meeting or combining. This in turn is indicative of the types of dialogues necessary for the development of meaning that take place when this occurs. Hybrid language practices have important social and cognitive consequences as they can mediate the ways that teachers and pupils communicate and interact to foster intellectual development. Watts suggests a particular analogy consisting of, '*parallel-but-potent knowledge systems we call a 'bi-gnostic double helix' and that the two distinct-but-intertwined strands of the helix, are both joined and yet held separate by a series of connective or cultural bonds*', (unpublished communication) to describe the fact that the movement towards 'scientific' concepts is not a linear process but rather one of weaving and patching of two perspectives developing over time. This echoes Shayer's imagery of the twin vines to encapsulate the complex relationship between spontaneous and scientific thinking and the development of the latter.

The concept of the third space has been explored in a range of classrooms by authors such as: Barton & Tan (2012), Emdin (2009), Gutierrez (1999), Moje (2004) and Moll (1989). Many come

from work in schools with large immigrant communities, in particular Hispanic pupils, in America. Such collective explorations have resulted in some significant insights into the learning process that can be applied to those who work in classrooms where race and oppression is not a great issue. Gutierrez (1999) is perhaps the most prolific author currently using the notion of the third space as a lens to explore learning. Her work can be used to provide some key features to help both characterise and describe the third space. Gutierrez points out that groups of people develop scripts and parallel counterscripts, similar to Lemkes (1990) term 'side talk', and that these can similarly be constructed by pupils in the classroom. Counterscripts are described as alternative and competing discourses that can become rich zones of collaboration and learning. Gutierrez associates the overlap or intersection of the pupil and teacher scripts with the potential for pupils to develop understanding thus providing a 'window of opportunity' that enables connections and accommodation to take place. The third space is now being described as a zone that can be promoted by practices that bridge home and school learning and harness the power of the 'funds of knowledge' that pupils bring with them. It is this mix of the two that for her increases the possibility that pupils will participate, and that real dialogue will occur. Gutierrez associates the overlap or intersection of the pupil and teacher scripts with the potential for the development of understanding and views this as the 'third space'. Similarly to Bhabha, she proposes that it is the difference between the two positions, or spaces, that provides an opportunity for connections to be made and accommodation to take place. It is the mix of the two, or the difference between, that increases the likelihood that pupils will engage and participate and that real dialogue will occur. Linking very strongly to CASE, and the pedagogical strategies employed in the lessons, Guiterrez provides some very specific advice about how to engineer classroom of this type. To her it is the resulting discussions that act to scaffold the inclusion of pupil experiences and ideas within the narrative of the lesson. Such scaffolding does need to be explicit in the signposts used by the teacher to facilitate pupils making connections between themselves, their ideas and the world of science. This is done by skilfully weaving their whispered and giggled questions together with the academic language and discourse.

Moll et al (1989) is more pragmatic in his view of how the third space can support learning, as it helps teachers to understand how they can bridge everyday and scientific concepts, be inclusive and allow all voices to enter into classroom conversations. He suggests teachers need to develop classrooms that engage pupils with texts and experiences from many different communities. To do this they must plan learning that is based upon their growing understanding of the pupils in their charge. This in turn is dependent upon careful listening and the need to make it clear that they welcome the many different ideas they bring with them; their funds of knowledge are valued in the classroom. To Moll the third space is concerned with a recognition of the potential to integrate pupil knowledge with that share din school as a means of producing something new.

Moje (2004), in an exploration of how teachers and their pupils might develop a community where various funds are developed in the classroom, found that this requires an integration of funds of knowledge and discourses that support learning. This shift involves viewing the funds that pupils bring with them as a resource to help in the development of a stronger understanding of the world presented to them in the classroom. Such a classroom enables the pupils to begin to see the connections, and contradictions, between the way they and others see the world. Moje (2004) suggests that research is needed to explore the third space as something that permit everyday and academic knowledge to be challenges and new knowledge generated. For pupils to view the classroom as a place where everyday explorations can stand side by side and inform scientific concepts, they suggest that questions and contexts designed to engage are part of such a classroom and that these should be supported, deepened, expanded and challenged by the pupils. If we look at these ideas of through the lens of CASE, we can see similarities between this and Shayer's design of lesson content to bring the zone of proximal development to bear through pupils seeing and hearing successful performances in their peers.

Emdin (2009) identifies the problem as one of agency and she suggests that it is the social/historical processes operating within the educational system that robs pupils of agency to engage in social fields like the science classroom. A whole host of factors are acting against children to become agents in their own right. The focus in many classrooms is upon the dissemination of content knowledge that individuals cannot identify with. Teachers are all-knowing experts and pupils are seen as empty vessel receiving the 'knowledge' flowing from the teacher. Pupils need to be viewed as individuals with thoughts, opinions or ideas. Her ideas are helpful in that they recognise the need for an awareness of how the structures within science classrooms affect the extent to which students exhibit scientific agency and belief in their ability to succeed in science. She suggests that teachers work towards creating classrooms where pupils are free to engage with science and the world around them. Such an engagement demands the chance to be heard and describes conversations that merge in and out of school and everyday language as more complex understanding is created. Emdin envisages a classroom where pupils engage with thought provoking questions that reflect their engagement with the lesson. Emdin's use of agency as a lens to explain the role of the third space brings her ideas into alignment with Gutierrez as learners of this type are characterised as being able to: go beyond the established script, utilising their own culture and funds of knowledge and that their voices being heard, and questions being asked by and of them as indicative of success. Her ideas also link with the concept of pupil agenda talk which will be introduced in chapter 3.

Moje (2004) highlights the importance that discourse (ways of knowing, talking, writing etc.) can have upon pupil engagement with science. Discourses are generated by group practices and here in lies the hope he sees in engineering specific 'funds of knowledge' generated discourses. It is the mediation of social interaction and cultural practices within classroom discourses that often cause specific ways of learning to dominate. As with Emdin, very specific advice is given about how to engineer classrooms of this type; including discussions that recognise the competing viewpoints that are at work. Such discussions act to scaffold the inclusion of pupil experiences and ideas. Such scaffolding needs to be explicit in the signposts used to support pupils making connections between themselves, their ideas and the world of science. A hybrid discourse emerges from the script and counterscript and that the weaving of the two can create a productive environment of collaboration and learning. Moje describes the hybrid that emerges as a place of mediation that contains the necessary tools for further development.

The number of publications siting the third space, including the 2012 book by Barton and Tan, illustrate of how powerful the construct of a third space has become. The third space is proving to be a fruitful concept for the exploration of classroom processes as exemplified by Wallace (2004) who specifically focuses upon language in the third space and aligns herself with Bhabha (2004., p.36), stating that it is the creation of 'in-between' spaces that are the key and that these allow different interpretations (pupil and teacher or curriculum) to be viewed as not necessarily correct or true.

2.31 - Talk within the third space

Wallace (2004) begins to articulate the actual conditions of, and types of, talk that take place within the third space in that, in such a space there is no dominant correct meaning prevailing, instead meanings can be negotiated, co-constructed and transformed in the light of experiences provided by the teacher and the pupils. It is important that within such classrooms the conditions are prevalent so that neither the speakers meaning nor the listener's meaning is the 'correct' meaning, but in which the meaning of the utterance is ready for either co-construction of interpretation or new, hybrid, meaning. In such a classroom learning must involve the negotiation (co-operation or compromise) of meaning until either there is mutuality of meaning or a new, hybrid, meaning is constructed. It is because language is translated in this process that neither the speaker's not the

listener's state of understanding is privileged. In the third space neither one of two different languages are dominant, but the meaning of both may be transformed according to experience.

The notion of hybridity is pivotal here and Bhabha is a helpful guide. Hybridity in this study is limited to the language used in the overlap or intersection of the thought world of the child and that demanded by the science, curriculum. The notion of hybridity also helps as it is an appropriation, linking to Bahktin and ventriloquism (using something before it is fully owned). Such a process is both cumulative and messy, based upon a continual meeting and mixing of ideas from both spaces. This has been referred to by him as the process of transformation or translation, and to many it is this 'meeting' that leads to new learning taking place. One purpose of this research is to develop and shape the notion of the 'third space' into a concept that can provide a useful framework to support the analysis, and development, of collaborative classroom talk. Such a process involves a translation of ideas, which for those in the classroom is dependent upon a difference between the two positions, or spaces. To Bhabha it is the difference that primes the mixing, or development, of thoughts and ideas. Priming is a helpful verb to use in the sense that such, prior, conditions are requisite or necessary to support the future development of something that is new or that facilitates or enables change, in thinking. It can be argued that in the classroom it is the responsibility of the teacher to prime the productive mixing of the first and second spaces through the choices they make. CASE lessons specifically require an environment of reflection, group work and social construction to provide the conditions necessary to support pupils to accommodate new thinking, thinking that only develops because of the cognitive challenges presented to the learners.

In CASE we can now view cognitive conflict in two, new ways:

- As the driver that primes the mixing and;
- As the measure of the difference between the pupils thinking when they enter the classroom and the new thinking it is hoped they will begin to develop as they leave.

2.32 Mergers and classroom conditions

Maniotes (2005) has extensively explored the 'third-space' and the ideas of Guitierrez (1999) in particular. Based upon work in literacy she denotes interactions in the third space as mergers and suggests that during such times the boundaries between the world of the child and the subject meet. When this meeting takes place she, echoing Bhabha, states that translation and transformation are possible. From the outset she highlights the elephant in the room, which is when trying to observe and collect examples of the 'third space' are rarely seen and that the limited number of examples do not offer an opportunity to truly describe and quantify this. In literacy she suggests that a carefully selected series of texts might be a good place to look for evidence of the third space because such writing has the potential to reflect students' lives and can therefore serve to effectively draw them into the process of learning. From working with a single class, she is able to find evidence of conversations that are indicative of the third space, that fit her criteria of mergers. A merger is a way of capturing the collision between the (cultural) world of the students and their teachers. She found that three types of 'third-space' conversation dominate and labelled these as: intellectual enquiry, deep reading and social empathy. These three categories of third space talk taken alongside Oldenberg's (1989) environmental features now provide a fruitful baseline to explore the concept of the third space through the small group talk that takes place in CASE lessons, termed construction zone activity by Michael Shayer. Accessibility, accommodation and culture are features used to describe the third space in the context of meeting places such as pubs and bars where diverse groups of people regularly congregate. Given that this study will take place in the classroom many of the features are actually under the control of the teacher and within their domain of influence and so could be actively engineered to create environments for the third space to flourish. From this perspective there is a choice facing teachers: ignore, challenge or shape the classroom climate into something that transcends traditional hierarchies and serves to create a

‘third-space’. Helpfully Memarovic (2014) has applied these ideas to the classroom setting using the following defining features:

1. Status,
2. Small group conversations,
3. Accessibility and accommodation,
4. Profile,
5. Culture.

Given the problems in actually finding evidence for the ‘third-space’, it was felt that insights into this concept may come from lessons specifically built around engagement, collaboration and discussion in line with the ideas articulated above by Memarovic. The ‘third-space’ concept of talk is both hard to specify and pin down and, in the words of Watts, it could be in danger of being lost in the search for the perfect metaphor (personal comment). Molls’ idea of ‘funds of knowledge’ has proved to be both very popular yet a somewhat elusive quantity. This study therefore seeks to quantify how the ‘third-space’ might actually manifest itself within the classroom and to begin to describe what it is rather than what it could ‘theoretically’ achieve in the minds of the pupils themselves. Hogan (2010) sees the idea of this ‘space’ in Piagetian terms as a process of accommodation - the reshaping, as opposed to filling or assimilation, of the container of the mind and the creation of something new or a shift into new thinking. In this vein, learning is mediated by the experienced quality of a set of relationships; the teacher to the subject and the teacher to their pupils. Within such relationships there is an interplay at work, a dynamic process that involves a distance, or difference, between the parties involved. Critically for this research and the understanding of the third space, Hogan introduces Gadamer (1981) who describes an educational encounter as a process involving an interaction between two viewpoints or horizons:

1. The horizon of understanding brought (i.e. the first space),
2. The horizon of meaning that address the individual (i.e. the second space).

This interaction of horizons (i.e. the third space) is described not as a joining or melting together (a fusion) but rather a to and fro between the learner and the different-ness of that which addresses her. The term fission is used to best describe this. Fission describes the ongoing tension between one’s own ideas or assumptions and those previously un-encountered. During such time differences are uncovered and brought to mind. This is not a simple case of assimilation or joining of ideas but one that involves a change or accommodation. If pupil ideas and thinking can be brought to active articulation, as they are in CASE, then fission can take place. In this vein, classrooms that embody such learning behaviours create a tension that is both internal, to the child and external; between the individual and their peers and between the pupils and their teacher. A key outcome of this thesis will be a re-articulation of CASE pedagogy to incorporate Vygotsky’s ideas of dramatic contradiction and perezhavanie in a new exposition of construction zone activity. This is the time in the lesson where construction talk takes place and the pupils begin to resolve, then articulate, the conflict they face which can now be described using the term trigger.

Given the difficulty in ‘finding’ the third space, it could be said that we are looking for those moments when pupil talk or response signifies a personal connection has been made or a deeper level of processing or thinking is taking place. This can happen in CASE when they struggle with the challenge the teacher wants them to engage with or with the resulting conflicting, or different, ideas of their peers. We are also looking for evidence of this in the words they use and the conversations they have. Usually it is verbal, but it could also be a gesture that signifies thinking. During such times pupils may puzzle, laugh, sing or play with language. They can bounce ideas off each other, share personal misconceptions, views and beliefs and challenge one another. Such talk has degrees of relatedness or separation to, or from, the desired object/focus of thinking, so there is quite a large

area of overlap between this type of talk and when it shifts to becoming unrelated chat. Such engagement could result from a connection made to or a recognition of their own thoughts and views. Pupils may share and volunteer some knowledge or ideas, they could even ask questions, ponder or reflect upon something going on in their lives individually or collectively. Most often it is seen as pupils work together to solve a problem where the answer needs to be constructed by the pupils themselves.

Set in the context of teacher education Woolf (2019) personally explores the pedagogical practices that she claims are informed by third space theory. Which is summarised as a pedagogy that aims to promote discourse and critical inquiry. In her teaching she tries to foster collaborative and dynamic partnerships to stimulate authentic inquiry among her students. This is articulated as a culture that is accepting of the fluid intersections of identity, culture and socially produced knowledge. In the context of secondary science am I seeking to do this in a meaningful way for secondary teachers.

Soja (1996) suggests that there are specific discursive and conceptual strategies, termed ‘thirding’, that support the development of the third space. These primarily are verbally mediated strategies that promote hybridity, as a state of mind, and straddle the two spaces in a way that supports pupils to access their funds of knowledge. This thesis will show thirding in action using CASE as the ideal tool to highlight the discursive and conceptual strategies that form its pedagogy. Such a description, manifest in chapter 6, will enable me to also use third space theory to satisfy my own desire to articulate my own thinking regarding CASE.

2.33 The problem with the term space

In Reason and Creativity Wegerif (2005., p.7)) clarifies his thinking regarding talk of this type, with a category of talk he terms playful stemming from his dissatisfaction with the term exploratory talk: *“Exploratory talk is linked to educationally desired outcomes yet it is not completely clear that the key mechanism is ‘the use of language as a tool for reasoning.’”* He proposes that the ground rules of exploratory talk, such as asking open questions and listening with respect, are the basis for something greater and suggests that talk of this type actually serves to open up, and maintain, a dialogic ‘space of reflection’. It is this space of reflection that may facilitate the emergence of new thinking and that such a space supports the emergence of creative solutions to problems and that playful talk is actually a baseline from which creativity can emerge. Wegerif mentions a ‘kind of resonance’ in which the structure of a narrative account connects with the hearer via similar structures in events read or experienced which can be linked to Molls ‘funds of knowledge’. It is through such ‘resonances’ that children build on each other’s ideas, with new directions for thought emerging as the product of such a dialogue. This strongly links to the ‘third-space’ as described by Guiterrez (1999) who uses the term window of opportunity, one that contains the possibility for the creation of something new. In what could even be a reference to CASE lessons she suggests that the new construction emerges out of an extended dialogue in which the participants are struggling to create shared understanding and find a solution to a problem given by the teacher. This also sounds like Shayer and Adey describing social construction and cognitive conflict which are the key principles in CASE lessons. This also aligns with the very reason Maniotes uses for looking within literacy lessons for evidence of the ‘third-space’. Further to this Wegerif states that it is the reflective use of language that opens up a space between people and that it is this that enables creativity to occur. What is key is the creation of a ‘space’ of reflection between participants in which resonances between ideas, images and signs can occur. It is clear that although this ‘space’ needs to be engineered, it is also dependent upon relations between people, which is where the dispositions referred to by Hogan and the idea of third space talk begin to support the creation of a broader model of constructive talk. This space is internal yet dependent upon, symbiotically, the interaction between teachers, pupils and their peers. Shayer also touches on this as he describes

pupils re-processing learning. It could be that the use of the term ‘reprocessing’ is a description of what is occurring in the third space, when the two horizons meet, and so the ideas of Vygotsky explored earlier in this chapter can now be used to provide clarity regarding the third space.

In terms of the theoretical underpinnings of CASE Shayer draws from Vygotsky a description of the relationship between spontaneous and non-spontaneous concepts as an interaction in the process of development. Spontaneous thinking lags behind schooling and acts as a kind of wave, or leading edge, impelling thinking forward into more powerful schemes; formal operational thinking as described by Piaget. He does say that Piaget did not describe concepts as firmly divided and self-contained whose interaction is impossible. Rather that he was interested in what was going on below the surface with their thinking in an unmediated way. In support of this Vygotsky (1978) describes how serious mental effort is required by the child to acquire conceptual understanding and that this is both related to and influenced by spontaneous thinking. As pupils move from spontaneous to scientific thinking any transitional language will be naturally be dynamic and messy and so the term heteroglossia can be used to describe this. Heteroglossia quantifies the ‘informal’ language use in the movement towards (or transition to) scientific thinking. The word is a helpful term to describe language in the process of movement as expressed through a child’s thinking out loud. Such thinking is articulated by Knain (2015) :

In an act of meaning, students use other texts, so that previous use of the words and their purposes become part of students’ language world. ... (p.43)

Successful learning takes place when the student is using the language of science in a personally meaningful way..... School science curricula must be located somewhere between ‘discipline-based matter and the child’s personal interests’, and continually reconstructed as it moves back and forth between these endpoints ‘Students need space to negotiate such tensions.’ (p.55)

The ideas of Cheyne and Tarulli (1999) can be used to provide clarity regarding the Vygotskian focus of this research and help to tie up some of the loose ends concerning the role of speech in the development of cognition and its connection to the third space. Helpfully they contrast the ideas of Vygotsky and Bakhtin and the nature of dialogue, and how this might work in the zone of proximal development, and so their work can be used to clarify the language used and define the parameters of what is being explored here. Cheyne and Tarulli focus on the fact that for Vygotsky dialogue was the concrete, psychological equivalent of the social nature of the mind and so in Vygotskian terms dialogue is a key feature of human cognition. Similar, to the interview with Adhami, they highlight that much of what we think and know comes from previous assumptions made and similarly they suggest that Vygotsky, if he had worked for longer, would have described inner speech as taking place alongside external social speech. This is pivotal as inner speech serves the purpose of the individual’s activity of self-mastery and so just as action becomes transformed into thought under internalisation, so does language. Citing Wertsch (1991) they argue that a full understanding of dialogue is only achieved through a consideration of the role and status of the ‘other’. This nicely incorporates the idea of the two planes for “the ways in which the dialogic organisation of speech on the intermental (between people) plane is mastered shapes the intramental (within) plane”. Wertsch (1991, p.86)

Running throughout this chapter is the concept of the distance between where children are and where the curriculum desires them to be. Whether discussing spontaneous to scientific thinking, concrete to formal operational thought, the zone of proximal development, priming the difference in the third space or the gap that creates a resonance. We meet this idea clearly in the guise of Bakhtin for it is, “the distance and the difference” of the other that is deemed essential. For it is from such differences in understanding that dialogue and thought are productive- moreover productivity is not necessarily measured by consensus. To my mind, this articulates what has been said earlier

concerning the nature of the third space when they describe a new sphere being conceived from an encounter of differences that carry the potential for inter-illumination among, pupil, voices engaged in dialogue. Similarly, the use of the term inter-illumination could easily be applied within CASE as accommodation in a Piagetian sense. The way mental activity in the zone of proximal development is described as being both ‘dynamic and emergent reflected in a child’s assisted performance on a task or joint collective activity of child and the more competent other’, could be seen as an alternative description of Shayer’s construction zone activity. To Plaincsar (1986) dialogue of this type is the very means by which directive support in the zone is provided and modified, the means, in other words, by which children are provided with scaffolded instruction. Based upon this we can now see new Vygotskian meaning in Shayer’s description of a child seeing a successful performance in another child. This is in line with Foucault (1978) who describes the power of dialogue flowing in a distributive way that is heteronomous, potentially available to all who enter the discursive practices of a culture.

2.34 The possible place for the third space in the development of ‘scientific’ thinking in CASE lessons

The ‘third space’ is an idealised construct; an imagined space not limited to strict dimensions in the way a specific place is. It is something that can be viewed as an educational template that can be dropped over the classroom, and the talk therein, to facilitate meaningful discourse about what is taking place in small groups during CASE lessons. As we explore this ‘space’ boundaries can be developed to shape and view what is within. From the CASE perspective Piaget brings meaningful boundaries that help quantify both the limits of the zone of proximal development and the first space as concrete operational thinking and the second as the formal operational thinking required by the curriculum. The third space (and the resulting hybridity involved) is something that can now be used to explore the movement from the former position to the latter i.e. spontaneous to scientific conceptual thinking in the eyes of Vygotsky. This will enable us to imagine and speculate as to what is happening when such movement happens or occurs. The concept of a trigger is helpful here and becomes a key feature of what is taking place in this view of the CASE lessons taught. It describes the deliberate act of provoking pupil thought and will be explored in depth in chapter 5. To be meaningful, relevant and useful the third space must be able to be delineated, for without a way to measure and distance between two points, or quantified there may be nothing to be found or seen or multiple and contrasting views to be had. CASE helps in this context as Piaget is used to quantify the zone of proximal development with the distance concerned between two points of spontaneous and scientific thinking.

In any learning situation there are always two positions (where they are now and where they need to be) and associated movement between. In reality, this means that we are talking about a continual, hybrid, process of movement. Guiterrez’s scripts and counterscripts help to quantify the talk during this movement as they describe how pupils bridge the gap or narrow the distance. Scripts describe the patterns of talk in science but from the pupils’ perspective it is the notion of counterscript that is important. This is talk that is personal to the pupils and it also captures Bhabha’s sentiments of subversion. This study into the third space focusing upon pupils in early adolescence and CASE lessons is timely for we can:

1. Define the positions in science using Piaget and the quantification of movement from spontaneous to scientific thinking and,
2. Use Vygotsky to shine a light to provide some concrete descriptors, of the space, that may be of use to others in terms of the climate within the classroom and the characteristics of the talk occurring therein.

The term third space is being used to encapsulate the possible moments of movement in pupil thinking and the types of talk that are associated with such a change. It should be viewed not as an overlap, but rather the moment when the scientific comes close to the spontaneous and the children reach out or move ‘upwards’ in thinking. The term fusion of horizons helps to describe this merging of ideas which orally can be messy hence the use of the term heteroglossia to capture this, as they use what they know to move into the ‘new’ and in a merger a hybrid state is created. Maniotes used literacy because of the emotive responses and the connection to her pupils’ lives which is too subjective to reliably quantify. In CASE Piaget helps for the distance between the two types of thought facilitates movement which is driven by ‘mental effort’. The third space is a way to describe the: when, how and the what of this movement and what it looks and sounds like as it’s happening. In CASE it is Piaget who helps to quantify the gap between the pupils spontaneous thinking and the required scientific thinking in the ‘classroom’.

A systematic review of third space theory carried out by Tatham (2023) makes a number of points relevant to the aims of this thesis and the place of third space theory in the classroom. The review is particularly enlightening for it brings a measure of coherence regarding the way third space theory is being used in educational settings. Tatham describes the third space as a meeting space between academic and everyday discourse i.e. a ‘place’ where students can relate, integrate, and interweave science content with their backgrounds. This allows the appropriation of scientific language and the relating of science content to students’ prior experience outside of school i.e. their funds of knowledge. The colour coded transcripts included in this thesis clearly illustrate how this has been achieved this while chapter 6 lays out the rules for this under the umbrella of CASE and construction zone activity.

Still the same problem emerges from this review which again highlights the fact that the concept of the third space is frequently used as a convenient metaphor. Tatham helpfully overcomes this by proposing three ways to describe the use of the third space in educational settings:

1. **Transformative** – a physical space which is concerned with pupil identity and agency than teacher outcomes and expectations.
2. **Bridging** – a space which facilitates a connection between life experiences, i.e. funds of knowledge, and the curriculum. This use of the third space is described as a meeting place between everyday and academic discourses.
3. **Complexity reduction** – where lessons are scaffolded in a way that seeks to move pupils towards the uncontested goal of an academic register where the rules and expectations are set by the dominant values of the educational institution with a total absence of contributions from the children.

To Tatham the third space is concerned with helping pupils to develop a sense of identity and to transform pre-existing discourses into a fluid sense of hybridity where meanings can be challenged and renegotiated. Yet, sadly so, most third space studies are set within the context of literature, higher education, early years settings or those featuring migrant communities. For example in McCauley (2017) the third space is applied to an informal sector involving a primary science outreach project where the project providers create a collaborative environment. In this study the third space is described as an informal sector bridging the gap between school and community. There is therefore a gap involving real classrooms and with secondary aged pupils and this thesis contributes by using the third space as a bridging strategy at a key educational time of transition to more abstract, and examined, curricular concepts. Too often the third space is viewed literally as somewhere physical rather than being applied as a model to describe the psychological processes associated with cognitive development. In this thesis I am using this in tandem with CASE as a representation to describe the gap between non-scientific to scientific understanding in Vygotskian or concrete to formal operational thinking in Piagetian terms.

Tatham (2023) complements the focus of this thesis in the following ways:

- her description of the third space is a vehicle to support pupils to develop their own unique identities from their own understanding. This is especially relevant to pupils in early adolescence and the psychological changes associated with puberty. This study is important as third space studies involving pupils in this age range are almost non-existent.
- CASE and construction zone activity in particular actually involves a process of negotiation to resolve tension resulting from cognitive conflict, dramatic contradiction or priming the difference. The terms others have used to describe such talk i.e. heteroglossia, side talk and counter script talk are manifestations of this and begin to form a language that can be used to describe talk in the third space. The third space talk codes were developed, and form a key outcome of this thesis, to support an exploration of third space talk and as such form a unique contribution to third space theory.
- teachers play an active role in third space construction. The role of teacher choice and the use of triggers lies at the heart of this thesis and is what is highlighted through the lesson plans and the analysis of CASE from an insiders' perspective. The lesson plans show how active the process of incorporating funds of knowledge, to plan for the construction of the third space, is at all stages of the teaching process. The plans show how adapting the core content to encourage pupil participation is a key feature of the teaching involved in this research. This work is clear about the role of the teacher and the engineering of small group talk and as a result, in chapter 6, there is now a clearer view on the rules of engagement for the development of the third space and a description of what is taking place therein.
- third space theory is acting as a lens to enable us to view CASE as a vehicle for the creation of a transformative space. This has enabled me to more fully understand the need for teachers to relinquish control in a planned way that involved the stepping back to allow, and facilitate new forms of knowledge to emerge. The objective of this is to provide students with, during construction zone activity, the freedom to explore their own thinking and guided by Piagetian reasoning strands to develop new ways of reasoning and knowing.

2.35 Summary and glossary

The glossary included in this section summarises the language of my thesis and contains the words that will be used to help me explore and describe the talk taking place in small group work in CASE lessons. The phrases below will be used to align CASE with the multitude of descriptors that have since been used to articulate the link between talking and thinking in a way that broadens the ideas of Vygotsky as used by Shayer. The ideas carried by these words will be used to refresh and update CASE, which is necessary now due to the wealth of ideas now available to us and the somewhat dated feel of CASE approach. This will allow me to deconstruct small group talk in CASE lessons in the light of a rich understanding of the ideas of Lev Vygotsky. Similar to the way that rain begins from the condensation of water vapour onto a small piece of dust then CASE can act as a nucleus to support the seeding of a refreshed explanation of its enduring appeal and the true place of small group talk in cognitive development. Shayers admission (see page 41) is critical at this junction for in true design-based research this study, conducted by a practitioner, is seeking to (for more in this see page 41) bring CASE to a new audience by; extending and complementing the ideas underpinning it, supporting teachers to make responsive decisions and to plan learning based upon the knowledge of their pupils cognitive development, and fostering the development of new and productive constructs. As a CASE teacher my main goal is to better understand how to implement or 'trigger' construction talk as an enrichment to the other experiences of pupils in the classroom.

The literature review that underpins this chapter has afforded me the opportunity to:

- Delve deeper into the ideas of Vygotsky to explore an area of weakness with CASE;
- Update and rearticulate construction zone activity in a way that makes it more readily accessible to teachers today;
- Incorporate the ideas of the third space in discussions of cognitive development to provide an additional way to describe and plan for small group talk;
- Support other teachers to understand the ways they can plan for, manage and structure small group talk and;
- Better understand adolescent talk that is inclusive of the realistic range of the talk that can take place in small groups i.e. 'all the talk'.

The terms summarised below are important to me for they reflect desire to use the many ideas available to teachers today to honestly describe and account for the role of talk in the classroom. Such talk is honest and real, a woven tapestry that is a composite and hybrid mix of ideas, voices and influences. The ideas explored in this chapter allow me to better describe the reality of CASE in the classroom today and to show how secure such a foundation is built based as it is upon the ideas of Lev Vygotsky.

- **Construction zone activity** – is described by Michael Shayer as the time set aside within CASE lessons for pupils to collaborate in small groups to resolve a problem and develop a solution.
- **Construction talk** – an umbrella term used to signify the specific type of talk taking place during construction zone activity.
- **Talk for thinking** – Mercer describes the three types of talk specifically associated with thinking as: exploratory, disputational and cumulative.
- **Cognitive conflict** – a CASE term describing the moment when a child's thinking is challenged in a way that causes them to reassess their ideas.
- **Dramatic contradiction** – a term used by Vygotsky to indicate how a difference or something new can stimulate a change in thinking.
- **Trigger** – this term used in this thesis to signify the moment when a challenge is presented to a child. This can be done by the teacher in response to a child or planned for as part of the material presented in a lesson.
- **To 'prime the difference'** – is how Bhabha describes the conditions that result in the production of new thinking. The difference between the current position and the new or required position must be close enough but not too far away. Shayer uses the term $n+1$ to describe such a distance.
- **Resonance** – a term used by Wegerif to denote an alignment in thinking between people in conversation.
- **Dialogic** - is a term associated with Mikhail Bakhtin and in the context of this work it relates to the fact that everything said is both a response and an anticipation to what has previously

been said. In other words, we do not speak in a vacuum. All language is dynamic, relational and engaged in a process of endless re-descriptions of the world.

- **Discourse** - in this study discourse describes ways of knowing, doing, talking, reading and writing. In the science classroom knowledge production and learning are mediated by social interaction and cultural practice and are also embedded in specific ways of talking. Discourses are also often generated from particular group practices and communities.
- **Funds of knowledge** - are the 'out of school' knowledge, ideas, experiences, heritage and skills that students bring with them as part of their lived experiences. These have been categorised into four main groups by Moje: family, community, peer and popular culture.
- **Heteroglossia** - a term first used by Mikhail Bakhtin in 1934 and means different tongue or language. Bakhtin uses the term to describe the positive power of the coexistence of, and conflict between, different types of speech.
- **Liminality** - a term associated with Homi Bhabha and means 'a threshold'. In this essay it refers to the quality of ambiguity that occurs in learning when participants have not yet begun the transition to competence. In the classroom learners can be viewed as standing at the threshold between their previous way of structuring their identity, time, or community, and a new way.
- **Perezhivanie** – Vygotsky applies this term to describe the ways in which children perceive, experience, and process the, social, interaction that takes place within the classroom. This is dependent upon their 'lived' experience which can change over time.
- **Script and counterscript** - these terms originate from Gutierrez and refer to the particular social, spatial and language patterns used within the classroom plus an orientation that group members come to expect over time. Counterscript describes the patterns of talk employed by the pupils themselves within the classroom.
- **Third space** - originally coined by Bhabha in an attempt to conceptualise what happens when the ideas that students bring with them to the classroom, the first space, meet and interact with those of the formal science classroom, the second space.
- **Third space talk** – the categories of talk taking place at the time when learners engage in conversations during construction zone activity.
- **Merger** – Maniotes describes this as the moment when the thinking of an engaged learner and the ideas of the curriculum meet productively.
- **Utterance** – this is a term associated with Bakhtin and describes how meaning does not simply reside in words but rather how the words are used in particular contexts. In dialogue the meaning of an utterance is given by its location within the dialogue. An utterance may hold one meaning for the speaker, trying to convey an idea, but is open to individual interpretation by the listener.
- **Zone of Proximal Development** - is a term associated with Vygotsky and describes the gap between what a learner can do unaided and what can be done with the help of a more knowledgeable other.

Chapter 3 – The study

3.1 – Overview

This study has developed from a personal desire to explore a programme of intervention lessons called CASE within the secondary science classroom and in particular, how the small group talk it espouses supports cognitive development. The study took place in one Year 9 science classroom over the course of a covid interrupted academic year. Seven CASE lessons were taught by myself to the class and in each video recordings were made of two, mixed sex, groups of four pupils. This chapter will allow me to articulate my reasons for doing what I have done in the way that I have. By doing this I will highlight how my view of the classroom has shaped my research and how my understanding of both my position and my ontological perspective have enabled me to pursue a design-based approach to this research. This chapter will explore how my experience of CASE has shaped my ontological perspective and how this in turn has guided the decisions I have made during this study. Such decisions enable me to explore the two issues below that relate to my research questions found on page 12:

1. How using the notion of the third space can help rearticulate the Vygotskian perspective of small group talk in CASE teaching.
2. Exploring the role of the teacher, and the choices they make, in the development of talk in the CASE approach.

Section 3.2 will deal with how my beliefs concerning children's learning and my desire to listen to the talk taking place in small groups in CASE lessons has enabled me to deepen my epistemological perception of CASE and its theoretical foundations. This will also serve to illustrate the journey I have taken towards becoming a researcher from my starting position as a CASE classroom teacher. Sections 3.3 and 3.4 explore the nature of my position and serve to address the nature of design-based research that has underpinned the approach I have taken. Section 3.5 explains the rationale behind the specific choice of the CASE lessons used while sections 3.6 and 3.7 provide details of the school, its staff and pupils and the ethical considerations guiding this work including the processes used in the recruitment of the class. Section 3.8 briefly describes how the covid pandemic shaped the research and the final two sections will examine my approach to data collection and the genesis and development of the codes I am using to categorise children's talk and how these have been refined and updated in the light of a validation process.

3.2 – CASE and its impact upon my thinking concerning children and learning

I have always been interested in the talk taking place in my classroom, as any teacher should be. It was in CASE lessons when I began to realise that the words that come from pupils' mouths can provide a window into their thinking and once open I could provide better support to move them forward in their thinking. Those early experiences of teaching CASE helped me realise that children can be encouraged to talk about their thinking and that this can have a positive impact upon the questions they ask and the types of conversations that subsequently take place. I saw very early on in this process that my students, not surprisingly, preferred talking to writing in their books and so a pedagogical feedback loop began to occur as I engineered situations where they were required to talk about the ideas present within the lesson agenda rather than provide written answers. As I encouraged children to talk, I began to wonder what types of talk were present and even if a group, seemingly on task, was talking about what I wanted them to talk about. This thesis is my attempt to further explore this as both a teacher and a researcher, and to provide a narrative regarding how my thinking as an educator has developed as a consequence. This chapter is my way of explaining why I wanted to embark on this level of work so many years after the start of my teaching career. As a

teacher I now know that children's talk is a complex composite of different influences, yet I can personally testify that the talk that is realised in CASE lessons is supportive of their learning in ways that are different to non-CASE lessons.

As a parent I had been fascinated with the fact that my own children's talk provided an insight into how they were looking at the world. After following my daughters' development through early adolescence, I became interested in how the children I taught talk about scientific concepts as part of their development. Further to this I was keen to use the lens of Vygotsky to relate this to the movement towards higher level thinking; the type of thought required for scientific success at age 16. I also realised that as a teacher I had little real insight into what my groups had been talking about when I was not there. At the back of my mind was the desire to eavesdrop on such conversations and how I could realistically capture and describe such talk. In the light of these thoughts this research will open a window on the talk that should take place in CASE lessons in a way that will help other teachers develop and promote discussions that are supportive of cognitive development. To do this I realised that I was the one who had to do the teaching for I was experienced with CASE lessons so that my teaching is consistent with its aims, whilst also being reflective of the theoretical ideas that underpin the approach and pedagogy. At every point in this study the choices I have made have been influenced by the understanding that comes from many thousands of hours spent interacting with young people in the classroom. This is clearly a very personal and unique perspective and one that I have tried hard to make as replicable as possible. As a researcher it was clear that these choices had to be supportive of the desired outcome which is to shine a light on the conversations that children have in CASE lessons and the power that these possess to develop thinking. In section 3.3 I will explain how these choices are a product of my positions and then how this necessitated the move towards a design-based focus to this study of the CASE classroom and the pedagogical decisions associated with its use to promote social construction.

Chapter 2 outlined the theoretical foundations supporting the development of my third space codes to analyse pupil conversation and now I reflect upon my ontological position in terms of my teaching with particular reference to CASE. Firstly, I need to declare myself as somewhat of an insider for I am someone who has an in-depth knowledge of the lessons and have earned my living from CASE consultancy work. It is therefore clear that this 'niche' perspective has heavily influenced me and that I have a vested interest in CASE. At this point I think it would be helpful to describe the specifics of what I believe the classroom is like, its manifestation and therefore how I am seeking to capture this as a consequence of videoing my teaching of CASE.

In CASE the ideas of Piaget and Vygotsky are used to provide the operational details for the teaching of the lessons. The biggest impact on me personally as a teacher was the ability to use the dual lenses of Piaget and Vygotsky to conceptualise my science classroom. My perceptions as a teacher also stem in large part from my experience of being a parent and the influence of my wife who trained as a primary teacher. Seeing my children go through a range of developmental stages and relating these to their later intellectual attainment had a profound impact upon my thinking. For example, with my youngest daughter her natal mathematical ability was very Piagetian and how she ordered and sorted the world could then be directly linked to her later work, and success, in school science and mathematics. Piaget's ideas, based upon the direct observation of children to quantify the features of thinking at different developmental stages, resonated with me as a teacher in secondary school for I could see those who struggled to break free of the context in which an idea was taught to them and the concept, such as ratio, that is context free. Those children who could apply the idea into new contexts, termed formal operational thinkers, were those who would be successful in the more difficult exam questions and post-16 scientific study. Such a view of cognitive development is now part of my internal compass, a tool that can help to complement the somewhat arbitrary achievement scales used in secondary school subjects that are often politically

driven or statistically adjusted. Early in my teaching of CASE I was faced with children who at secondary age were well below the age expected level required by the curriculum and therefore struggled to 'catch up' and would become stuck in a lower attaining group. In many schools the antidote is to be given more curriculum instruction to catch up, thus further ignoring and compounding their developmental needs. With CASE I found I was able to support the quality of their thinking to guide the curriculum I would then cover with them. I realised that I was doing with my students what I had done as a parent to support the development of my own children.

CASE lessons present children in early adolescence with problems that are too hard for them to answer individually and without help. The difference between where they are in their thinking and the answer creates a cognitive conflict to stimulate learning in the mind of the child. This aspect of CASE which is controlled by the teachers understanding of the lesson agenda I am terming a trigger - something to be activated by the teacher through their words and actions or via their use of the CASE materials. To resolve the conflict pupils need to work in groups and talk to their peers to develop or construct a solution. Such collaborative work is termed social construction as the pupils need to work without much input from the teacher to develop an answer. This side of the CASE process is very much supported by Vygotsky in that each child has a different 'zone of proximal development' i.e. part-formed, or maturing, thinking that with help from another can result in new or improved thinking. A mixture of different children will therefore enable those with different zones to add the ideas that their peers need to resolve the conflict. Targeted thinking in CASE teaching centres around the type of reasoning that can be found across all scientific disciplines such as ratio and proportion. Ratio and proportion as a concept that features in many areas of science and proficiency in this is indicative of higher level thinkers regardless of whether they specialise in biology, chemistry or physics.

During the lessons pupils work collaboratively in small groups (described as 'construction zone activity') to form a solution ready for sharing with the rest of the class. Such talk is a rich mixture of part-formed ideas expressed in a range of different ways. Viewed through the eyes of Vygotsky, this is where thoughts are shared orally for the first time and opened up to debate and discussion before a much more secure answer is formulated. Vygotsky describes thinking as occurring on two planes: the social and the internal or between people then within the individual themselves. Using a Piagetian analysis of demand, the CASE authors use the term formal operational thought to quantify the scientific or non-spontaneous thinking described by Vygotsky. The term 'third space talk' will be used to signify and identify the moments of construction zone activity in CASE lessons. Metacognition is now a well used educational term that the authors of CASE introduced many years ago. The term tries to capture the type of thinking processes that signifies times when an individual is standing back from the solution, and reflecting upon the thinking associated with the process of resolving the conflict and what they learned. In CASE the resulting application of thinking into new areas is termed bridging. The term third space talk will be used as an umbrella term to classify all such construction talk taking place in CASE lessons. The key descriptive terms that I am using to conceptualise and describe the CASE classroom can be summarised as: engagement, cognitive conflict, trigger, reasoning patterns, social construction and third space talk.

Such a view of the classroom is clearly based on visible signs that inform and support my belief that these aspects are real and can be captured, and quantified in some way, as part of this study. The five descriptive terms mentioned earlier are the labels I use to explore the complex environment that is the KS 3 science classroom. In one sense it is easy to do this for the focus of my research is the talk that is taking place in small groups, and it is obvious when talk is taking place. Such dialogue is relatively easy to capture as others have previously shown. One factor in my favour is that as an experienced teacher I have developed a professional intuition that informs my view of the classroom. It is a lifetime of interacting in the classroom and the many thousands of times that I have taught CASE that is allowing me to name and describe these processes and features more fully

and to share these with others during my consultancy work. The language of CASE has been shown to be professionally useful by many others and so is helping to build shared meaning around the thinking processes of pupils in science. To do this I am informed by my time prior to teaching working for the RSPB. In birdwatching the term 'jizz' is used to describe the essential characteristics of a species that enable its identification when someone is unable to see the whole animal for long enough to describe it fully. My professional intuition, based upon thousands of hours of classroom interactions, enables me to read a class using gesture, sound, movement and then to use words such as engagement to describe the scene or an aspect that I specifically notice or highlight.

A key phrase that will be used to track pupil engagement and interaction is the idea of a trigger. A trigger is something that is designed to cause a reaction among the pupils and that this often associated with an emotional response. As mentioned above in CASE the idea of cognitive conflict can be viewed as a trigger and is something that needs to be managed by the teacher as they plan, and through the questions they ask and resources they use. The ideal scenario is where the specific choice of trigger chosen by the teacher connects to the pupils in a way that causes them to become engaged with the task and results in talk that moves them towards a solution. More can be found on this in chapters two and five in the discussion of the third space and the way it can be engineered via the careful selection of resources that are meaningful to the pupils involved. My personal experience of behaviour during such times is that when the challenge is too hard then pupils will respond emotionally in a way that disengages them from the task and can result in negative behaviour patterns. If the opposite occurs and the challenge is too easy the pupils will become bored, go off task and may become similarly disruptive. If the challenge is appropriate and in the words of Michael Shayer at $n+1$ (pitched just beyond where the pupils are) then they will engage with associated behaviours such as laughter, an alignment of body position, talk that involves questions, ideas, answers and a general positive energy and mood. At this point I will provide additional supporting evidence in the form of a professional teaching anecdote to highlight how judgements, based upon CASE processes and the terms used above are made almost on an intuitive level but involve a similar 'reading' of the classroom and the behaviours therein. These are based upon my experience of teaching pupils aged six to eighteen years of age in a range of different schools and countries that I am now using to confirm and support the reality of features of the classroom that I am seeking to describe.

One particular Year 7 class, taught by a supply teacher, comes to mind to illustrate the difference between pupil thinking, reasoning in CASE terms, and curriculum coverage. I had visited the school to carry out a Piagetian thinking assessment to get a benchmark level of thinking prior to the school using CASE. The teacher in question shared the teaching that they had been doing and mentioned that she had recently taught them density. The assessment activity was actually based upon density and asked the class to say how much water a 60cm^3 piece of plasticine had displaced when it was lowered into water in front of the class. They could see that the cylinder was full and the water spilling over as the plasticine entered the water. In that group only two pupils correctly answered that question. This class may have been taught density, but their understanding of the concept was far from secure and so with this knowledge we agreed that they would benefit from some practical experience of displacement. To illustrate the idea of the zone of proximal development, social construction and conflict, a Year 7 class looking at ratio and scale come to mind. One of the tasks in CASE lesson 7 requires the pupils to write the scale for a range of human embryo drawings none of which are life size. The challenge comes in them realising that the way we write the scale for something that is smaller than life size is different to that for something that has been enlarged. During the feedback they all correctly worked out the two answers for the drawings that had been made larger but became very quiet during the discussion of the drawing that was much smaller than life size. This silence was important as an indicator of them trying to resolve the conflict they faced. At one point I saw a small girl who was moving as if something was bothering her. When invited to

share she said very tentatively; “Could we swap the numbers round?” To this she was referring to the scale and once she said this another voice said, “Yes, its smaller than life size so the numbers are different.” Another chipped in with, “If it were life size the scale would be 1 : 1.” The ideas began to flow from the class and my role became one of orchestrating the feedback so we could capture the thinking and to clarify the answer and the new thinking that was emerging.

3.3 – Navigating the minefield of positions

In thinking about the context of my ‘position’ within this study, I have come to view it as a relational variable that influences and is influenced by the varying contexts in which I operate. This is something that is both dynamic and difficult to quantify but this awareness is critical. It has enabled me to understand the influences I bring with me to this research. Ultimately it helps me describe how I am defined and influenced by my location and who I am (i.e. white, middle class, degree educated) and the range of other social dimensions: parent, teacher, researcher, observer, that have a bearing upon this study. My work stems from a real and lasting interest in what children say and think, for CASE really did open my eyes to the field of pupil cognition and its relevance to their learning and my teaching. This thesis and the thinking it will generate is my tribute to Philip Adey, Mundher Adhami, Michael Shayer and Carolyn Yates. It has been an honour to develop personal relationships with the four people who have had the greatest impact upon my teaching career.

A serious issue arises from the fact that I am personally generating the data that I am going to analyse. Again, my supervisors have been invaluable here as I was able to check the codes described in section 3.9, derived before using them in any analysis prior to starting any observations. This ensured I had developed an impartial tool for use when categorising talk within the CASE classroom. From a research perspective I was able to develop the tool first and then to refine it within the classroom and more importantly through the validation process described in section 3.9.

At this point I will take time to address the issues I faced as a researcher working in the secondary science classroom. Throughout this study, the fact that I am a teacher has always been uppermost in my mind. This knowledge has enabled me to, as I would in the classroom as a teacher, respond to the evidence in front of me and make the decision I feel is right at that point in time. What has guided me is a desire to understand the thinking of the children I teach, and this study seeks to categorise the words they say that are indicative of just that- their thinking. I am not seeking to make any significant claims about exactly what specific pupils are thinking or their motivations, rather I am simply working with their utterances to try and make explicit some of the implicit thinking that underpins what is said in a desire to explore cognitive development in the adolescent child. I am looking to do this with pupil talk because I am following the lead provided by Wegerif (2005) and Maniotes (2005). As a teacher who has experienced great joy in the classroom I am keen to shine a light on pupils and their thinking. My own identify with CASE affords me the opportunity to work towards the following two outcomes: a deeper understanding of CASE and better ways that I can support and develop children’s talk in my classroom.

From the outset, I was keenly aware of the need to navigate the tricky position I would find myself in during this study. Although I see myself primarily as a teacher, I am more than that for I have been acting as a consultant for many years and recently I have come to inhabit the new role of a doctoral researcher. Due to this, a ‘teacher’ is not how others see me and my chosen subject of study, the very pupils and lessons I am close to, simply adds another layer of complexity and potential confusion. Indeed, there have been many times during the study that I have asked myself; ‘Who am I now?’ Due to such factors, it was always going to be difficult for me to be fully

impartial as a researcher when I was teaching the lessons myself. This gave rise to a deeper and more fundamental question for me. In researching something that I am very close to and part of, would I be able to be impartial enough? That was a key aim in me embarking on a piece of work at this level so late in my career. My identity as a teacher is secure, but as someone who has been challenged to inhabit the world of educational theory I think this, and my experiences as a parent, has actually enabled me to use a different set of lenses to observe, explore and to understand the classroom. The role of educational consultant means that I am used to, and comfortable with working with a range of unfamiliar schools, teachers and pupils and with a wide range of behaviours and differing levels of engagement. This has developed in me the ability to withdraw myself from the equation and look more impartially at what is taking place. This also means that I am also used to collecting data from the classroom and that I have the ability to observe and make notes to look for deeper meanings in what might be taking place. It is this preparation that has paved the way for my latter move to that of a researcher. This role requires me to ask questions, look for and collect data without any preconceptions and is one which the range of identities that make up my professional life have supported, and challenged me, to adopt during this study.

There are times when the perceived power imbalances could have caused problems. As a consultant I am regularly seen as an 'expert' by both teachers and their pupils and as a rare visitor I can bring novelty which may result in children not behaving 'normally' with me. This study requires the teaching of special lessons that may be different in content and demand to the normal classroom diet experienced by the pupils. It could be that this is asking the participants, or indeed forcing them, to do something different and as a consequence, some may react negatively or positively and this could also be the same with the teacher. CASE, in its demands for group work and dialogue, may be alien to them and so they may take time to adjust, or they may simply react in a way that is not a true reflection of their normal classroom life. A significant problem inherent in this specific study is that I am essentially doing something that is very close to my 'day job'. Would such familiarity limit my perspective and blind me to what might be taking place? Would I find it hard to step into researcher mode, especially where the development of relationships in the classroom is concerned, for I will be acting in a researcher who is primarily their classroom teacher for a short time? As a visitor will the pupils perceive me in a positive light because of the infrequent nature of their interactions with me? The latter question is one I regularly address as it is similar to the reaction I get as a consultant, who often visits schools infrequently, often once a term. This will therefore be a strength of the study and enable the pupils to behave in a way that will enable them to enjoy the experience.

I have fully embraced the range of identities I am bringing to this study as this is a personal quest for me; the questions I am seeking to answer have arisen from my time working with children and teaching CASE. This study will allow me to explore things that I have been recently been seeking to investigate that are not possible in the role of a consultant or a classroom teacher. As a researcher I will be able to explore small group talk via careful video observation and transcripts in ways that are not possible as a classroom teacher. Without the need to focus upon covering the curriculum and preparing pupils for tests I can look at and explore the type of teaching skills and strategies that may not be used because of the performance and accountability demands in school. Children's talk is at the heart of this study and the messages regarding this contained in these pages are something that is needed more than ever in the classroom. In many respects it was advantageous that this study was not seeking to look for anything specific for its primary concern is to categorise the types of talk that may occur. This focus has emerged from years of personal experience and so to this end the study was devised to try and pin down the types of talk taking place within small groups. The outcomes of this study, in terms of how to both engineer and decode the talk that takes place within small groups, will be used to support others who are seeking to harness the power of dialogue as part of the learning process.

The multiple roles I have been able to adopt during my career, prior to embarking on this thesis, enabled me in the early stages, in consultation with Professor Watts, to engineer the classroom to better help me explore pupil talk. This decision required me to use my skills as an experienced teacher to unearth and highlight the talk that is present within CASE lessons. This process allowed me, in feedback from the camera and transcripts, to fine tune my teaching to gain insights into small group talk that normal teaching would not afford. Being a teacher/researcher enabled me to devise contexts to showcase the pupils because of the immediate feedback this process allowed. As such I had insider knowledge which gave me an opportunity to engineer the classroom to support the exploration of my research questions. With the chosen focus of my study this is especially tricky as I am exploring the impact of introducing CASE and therefore the actions of the teacher to influence pupil talk.

It is worth identifying some of the times when changes were made to the practical aspects of this study. The regular conversations with my supervisors were key here as I was able to reflect upon the motives behind any changes so that they were made in order to better help me to explore children's talk in the science classroom. This whole thesis reflects the flexibility in approach that is adopted in any study involving real classrooms. The various identities have helped support and develop this research in order to provide the insights that it has. Four examples of changes that were made in reflection are given as examples.

Example 1

Two groups of four pupils were identified for recording at the start of the research. It was envisaged that only one group would be videoed each lesson and the second the lesson after. It became clear that this would limit the amount of data available for analysis and so it was a simple decision to video both groups each lesson. This was also advantageous in that the groups could be compared given that they were both participating the same lesson.

Example 2

About one month into the study, it was felt that the children needed more specific guidance upon how to talk as a way to supporting their independence and autonomy. A series of questions were devised and shown during times of discussion so that they would clearly understand what was required, and permitted, of them during the small group work. It was felt that this was the most open and honest way to facilitate the discussion among the children within the class.

Example 3

With the support of my supervisors, I was able to better inhabit the role of a researcher and move away from the identify of a teacher when it came to the analysis of the lesson transcripts. Listening to pupils on camera and transcribing their conversations was a very new experience for me and one the was enhanced by the reading prompted by Mike Watts and Gwen Ineson. Where the identities did interact in a positive way was down the fact that having taught the lessons, I was able to answer the questions concerning lesson conduct and management during the transcription process.

Example 4

There were many questions I had to reflect upon during the lead up to this study. The fact I would be working 'close to home', so to speak, as a researcher was the main one. Would I be able to demark the role of teacher and researcher while in the school? Would the fact I was working in a school where I already had an established relationship cloud the picture? Have I chosen to work in a school that will show my ideas in a good light and give me the data to support my assumptions? It may be that I am too close to this work and not impartial enough so that I end up seeing what I want to see and confirming my own bias. Hopefully I overcame these by allowing the pupils to talk in groups without mediation. I have engaged in a process of recruiting critical friends to support video observation process and the development of the codes I am using to categorise talk.

Very quickly the students got used to the camera and often freely admitted that they did not know it was present and so spoke in an unbiased manner. Working in this way is quite challenging for as a teacher, I have a duty of care to the pupils in front of me and so I cannot be a completely impartial observer. There is always a delicate balance to be struck in ensuring that science is taught, behaviour is good and that children are safe in the science lab. Uppermost in my mind, however, was the need to show respect to the children and their views. By being open and honest I was able to reinforce the focus of the research- their talk- and highlight the fact that I am not their teacher but that I still operate by the same rules that govern the science laboratory in any school. Children respect such honesty and so they were able to respond in an open way that enabled a true reflection of their talk to be captured.

In any secondary classroom teachers face the struggle inherent with interacting and getting to know a large group of adolescents. On the one hand there is the natural desire to be liked so the pupils would freely co-operate, while on the other there is the need to establish a calm, safe and ordered environment for learning. For me, I wondered if this would generate a conflict between the need for the pupils to be honest and open in their talk and also the desire to be a teacher. There are certain boundaries I would not want them to cross, which in turn could limit how open their discussions are. Many of the potential problems that could have beset this research did not occur because of my knowledge of teaching children of this age, and the ability as a teacher to create an environment where they would talk. As a researcher it was clear that I would need to gain the trust of the participants but that is the same issue facing any class teacher working with a new class. I would be able to use the same skills I would if were teaching them and the fact that I would be teaching them CASE meant that there would be no conflict. As a CASE teacher I would be able to model the behaviours I expected my students to exhibit- asking questions, thinking out loud, reflecting, making connections with their own life experiences etc. First and foremost, in teaching CASE I am able to work to a specific lesson structure as I follow the prescribed plan. In addition to this as a teacher I will be able to act in accordance with my identity as an educator which involves making moment by moment decisions based upon the science needs of the children that arise in response to what they say. Due to this although following a script I would always have the children's educational needs uppermost in my mind. I do not want them to talk out of respect for a visitor but because as a teacher I can focus upon the classroom conditions engendered by CASE.

This study reflects my professional desire to produce meaningful change in the context of the classroom and the development of pupil thinking through talk. To achieve this I have been explicit in my concerns regarding engineering/facilitating specific types of beneficial talk among students. It is also clearly focused upon changing the classroom culture and influencing the choices teachers can make regarding social construction in their class. This view of positionality could also be imagined as a mixture of interacting currents that guide me at both a conscious and unconscious level. My personal story and my links to the area (I live very close to Barry School) are less important, although significant, than my CASE story. This thesis reflects my professional interest in children and their thinking, a knowledge of the wonderful conversations they have and as a researcher the application of theory to use as a lens when exploring the classroom. Due to this hierarchy, I also find the image of a dart board of influences with a centre and margins a helpful representation. At the centre is my dual identity of teacher and researcher, as this research has required the need for both identities to work in tandem. Moving outwards the other aspects of my identity come to bear but have a weaker influence upon the science classroom which is the focus of this research. I am keenly aware that all this can bring an element of bias but at every stage my study has been filtered through my supervisors to assess the impact of what I was seeking to do upon the validity of my research. As a consequence, my professional identity has changed and I am no longer the teacher I was. This is the result of an interaction between my previous persona of classroom teacher and the new perspectives I was challenged to adopt in the doing of my research.

The impact is that I realise now that I have insights that come from using the lens of the teacher-researcher, someone who is best placed to navigate the complex environment that is the secondary science classroom, especially that of the Year 9 child. Such a role has facilitated the engineering and analysis of the classroom when it comes to children's talk and CASE. This knowledge brings with it an awareness of the subtle power dynamics associated with using different identities to create the conditions demanded by this research and one question I did ask concerned the fact that this could be viewed as a rather manipulative process. For as a teacher there are certain skills that can be brought to bear to ensure that children will talk. To counteract this, I have always sought to focus as much as possible on what is important in CASE lessons and the need to allow the activity to stimulate and generate talk so that as a researcher I am able to observe and categorise the results of this.

3.4 Research design and the study of talk in the CASE classroom

This work meets many of the key criteria to enable it to exist under the umbrella of design-based research:

- It takes place through continuous cycles of design, enactment, analysis, and redesign (Cobb, 2001; Collins, 1992);
- It is designed to lead to sharable theories that help communicate relevant implications to practitioners and other educational designers (cf. Brophy, 2002);
- It took place, and evolved, in authentic settings and focused upon interactions that refined my understanding of the issues involved in the classroom.

It also involves an intervention that is embedded within KS 3 science and one that therefore cannot stand alone from authentic classroom interactions as managed by experienced practitioners. The work is based upon specific theoretical claims about teaching and learning which reflects my commitment to understanding the complex relationship between theory and practice and the ecology of the secondary science classroom. My view is that this work will contribute to the theoretical foundation of learning and teaching and will reach far beyond secondary science. I am clear in my view that, alongside Barab (2004), I am seeking to update the CASE approach in a way that will produce meaningful change in the science classroom. This is also clearly focused upon changing the classroom culture and influencing the choices teachers can make regarding social construction in their classrooms. In this respect, and its link to a well-known intervention programme, it has clear potential to generate a deeper understanding of the science classroom and will hopefully generate an account of the classroom that could form the basis of future work (Levin & O'Donnell, 1999). The incorporation of the concept of the third space and its associated theory base will enrich and lead to an improved theoretical account of teaching and learning in the CASE classroom.

Collins (1999), characterised the features of design-based research projects that resonate strongly with the focus of this work in that this is set in the messy context of the real-life classroom, a setting that contains complex social relationships and where the variables are hard to quantify and control. On the cognitive level the focus is upon the place of talk in the move from concrete to formal operational thinking in Piagetian terms. In addition to this the Vygotskian take on talk enables the fusion of the ideas of both psychologists that will enrich our understanding of the classroom.

Within the context of CASE this research satisfies many of the points diSessa (2004) makes in his appeal for work that will:

- Be useful to help others, to use CASE/CAME, and all those who wish to explore the place of talk in the learning process;
- Extend and complement the ideas underpinning CASE and to link them with those that are used to develop talk in the classroom such as those of Mercer and Wegerif. It could also be seen as a retelling of the application of theory from a practitioner perspective;
- Promote the grounding of theoretical constructs in real-world experiences. The outcomes of this work will enable teachers to make responsive decisions and to plan learning based upon the knowledge of their pupils' cognitive development. It also contains a positive message for teachers regarding the power of children's talk and the nature of trust;
- Foster the development of useful constructs. As a teacher my primary goal is to better understand how to 'trigger' construction talk as an enrichment to the other experiences of pupils in the classroom.

A key outcome for this work will be the view that the third space is a concept that can be applied to any classroom, in support of the development of a learning environment that relates to different subjects and ages, is one that is open to interpretation and further refinement. The idea of refining rather than changing CASE has always been of interest to me. As a consultant supporting people to understand CASE a key feature of my work has always been supporting other to articulate their own understanding of CASE and how this relates to classroom behaviours. This research therefore naturally rests under the design-based research umbrella as a key outcome will be the sharing of CASE theory with a new generation of teachers who are now more familiar with the focus upon dialogue and oracy in their classrooms. In addition to this the fact that much of the teaching concerns my adaptation and annotation of the CASE lessons plans to illustrate my teaching choices means that I am certainly reapplying CASE theory from a practitioner perspective.

The focus upon applying Vygotskian psychological to construction zone activity was only realistically possible for an experienced CASE practitioner. The aim of CASE is not to teach but rather to develop pupil thinking and so much of the 'teaching' involves supporting small group discussion and so any teacher unfamiliar with CASE would face a conflict of interest because of the need for perceived curriculum coverage. The nature of the niche that is being explored here required that I act as both teacher and researcher in this exploration of the parameters of CASE as a vehicle to engineer children's talk. Further to this a specific choice was made with regard to the lessons to be used in that it was necessary to use activities that would both appeal to and allow Year 9 pupils to engage in construction zone activity. This was solely based upon both a working knowledge of Year 9 pupils and a familiarity with CASE lessons. This aspect of the research design was very much a cherry-picking exercise based upon my personal and professional judgement. CASE was originally designed for Years 7 and 8 and so the lessons chosen had to be appropriate in both their appeal and cognitive challenge for older pupils.

There are two related questions that need addressing in this section, which concerns why I did what I did and why I felt this was the best way. In order to get the most out of the pupils in CASE, which is to talk in small groups, there was a need for an experienced practitioner who knew the lessons in great detail to do the teaching. This level of experience and familiarity would enable the planning and teaching of the lessons to focus upon construction zone activity. The lesson plans included, in appendix one, exemplify and highlight how the CASE activities picked for use in this study were amended to focus upon the need to encourage pupils to talk. The following section provides the rationale for the individual CASE lessons used in this study. In the end it was decided that I had to do the teaching because no-one else is as experienced in CASE at the school, so it would not have been possible to focus in this way on this subtle side of the classroom management. The seven CASE lessons used in Barry School were delivered in such a way as to explicitly focus upon, make time for and to value this. The lesson plans therefore act as a narrative highlighting how the methodological approach used aligns with this view of the classroom. This is very much a chicken

and egg situation as what I see, as a teacher researcher, is very much changing how I view the world which is why this is a design-based project. This project is inextricably linked to how CASE has supported my perspective and fostered a personal need to explore it further based upon my growing understanding of the theoretical applications, used by the authors, and the current prevalence of the ideas of Vygotsky in education.

3.5 Overview of the CASE lessons taught and rationale for their use

The CASE lessons taught at Barry School were:

1. Introductory lesson (not recorded) – Gears cars and dolls
2. The Pepsi challenge
3. Exponential growth
4. Sampling beans
5. Does it work?
6. Models
7. How many are there?

There are 30 CASE lessons published in the Thinking Science file (see appendix two for specific details) and so the selection of only a fifth of these for use in the research was always going to be a subjective and a numerically exclusive process. The lessons were chosen pragmatically, based upon 30 years of teaching CASE, to ensure that each activity:

- Would be practical and hands on in order to stimulate students to readily talk in the presence of an unfamiliar teacher;
- Was not dependant upon a written outcome so adequate time could be allocated to small group conversation and whole class discussion;
- Would be suitable for Year 9 students given that CASE was originally intended for use from Year 7. In effect the lessons were cherry picked so they would be of interest, and would engage, a group 13/14 year olds;
- Would encourage students to talk about topics of relevance to their lives;
- Could easily be adapted to included real life and current issues and;
- Would afford a glimpse into pupil thinking and enable an insight into the notion of a merger (where the lives/thinking of the pupils merge with the subject matter) as described by Maniotes, see chapter 2.

The thinking behind the inclusion of the each of the seven lessons above is summarised below:

Gears, cars and dolls

In this lesson the concept of ratio and proportion emerges from an exploration of and interaction with toy cars and dolls in a way that that has been found to engage pupils.

The Pepsi challenge

The use of popular soft drinks and a simple coin tossing activity draws pupils into an exploration of the ideas of probability that develop their understanding of the application of chance within a scientific context.

Exponential growth

A simple doubling activity with real corn helps pupils visualise exponential growth and how that relates to the other areas of the science such as the use of the 'r number' during the covid pandemic.

Sampling beans

The measuring of real broad beans leads to a data interpretation challenge and a discussion of the problems associated with sample size.

Does it work?

The use of everyday and familiar treatment and effect contexts challenges pupils to think about the concept of fair testing and proof.

Models

The use of a mystery black box introduces pupils to the true nature of modelling in science and the limitations of the models they are often presented with as scientific fact.

How many are there?

Many adolescents care about the environment and so in this lesson, the context of an endangered species, was used to introduce the thinking that underpins mark/recapture sampling techniques.

3.6 Barry School description and pupil information

This study took place in 'Barry' School which is a mixed community comprehensive school for pupils aged 11 to 16. Positioned near the coast in the North East of England, students generally live quite close to the school, although a small but significant number do come from beyond the natural catchment area. Around four-fifths of the pupils attend four primary schools in the neighbourhood with the remaining from about 20 other schools. There are 1032 pupils on roll, making the school about the same size as other secondary schools nationally. Pupil attainment upon entry to Barry School is broadly average.

Barry School was opportunistically selected partly because it reflected the type of school in which I had carried out most of my CASE teaching. My last formal teaching of CASE was done in 2014 in a struggling secondary academy in Sunderland. This example is being used to illustrate the kind of incident that regularly occurs in CASE lessons and why it can be used as a tool to help us better visualise how third space theory can be practically applied within mainstream secondary classrooms. At that time I was using a Year 7 class to try out some of the new CASE images I was developing and something interesting happened with one particular pupil that had a significant impact on my thinking and consequently this study. I had been teaching the class for a few months and because they were struggling to understand the difference between independent and dependent variables I decided to use the CASE materials to help them. In this class was a very troubled young man who came from challenging home circumstances and as a result was regularly removed from classrooms for disruptive behaviour. In the first CASE lesson I used a series of simple coloured cartoons, free of text, to help the pupils talk about variables as something that can be changed in experiments. One of the images I used that lesson showed a series of nappies, their price and the amount of liquid they would hold. The image was devised to show a no relationship between the independent variable, price, and the dependent variable, amount of liquid they could hold. The boy in question had just had a baby sister and he had heard his mum talking about the price of nappies. I could see he was taking the lead in his group's discussion and so invited him to share with the class - an opportunity he readily took. He spoke very animatedly regarding the fact that although nappies from Aldi were cheaper that did not matter because this image had resonated with him. The whole class smiled with him as he stood up to talk and talk and talk about the price of goods in the shops. I relate this incident because it shows that it is CASE as an approach that engages pupils in early adolescence in a way that is quite unique at times. It is this aspect of the approach that is at the heart of the many positive anecdotes related by teachers when talking about CASE lessons. One aim of this thesis is therefore to articulate how CASE, and its associated classroom dynamics, shapes and facilitates learners' access to curriculum content in an engaging way. Using third space theory will enable me to reframe the ideas of Shayer and Adey into a new construct, one that clearly articulates

how important it is to provide opportunities for pupils to engage in science lessons by drawing upon their own experiences without teacher prejudice. This latter aspect is clearly shown in the final lesson transcript shown on page 152 where Trevor, a similarly challenging pupil, engages and re-engages with the task.

Barry school is situated in a former coal mining area and many pupils come from homes of relatively low socio- economic circumstances. Unemployment in the area is above the national average and roughly five per cent of pupils are from minority ethnic backgrounds although very few of these have English as an additional language. The number of pupils on the school's register of special educational needs is below the national average, as are the number with statements of Special Educational Need. One significant factor regarding the attainment distribution of pupils at this school is that a feeder school, Barry Juniors, which contains pupils who perform significantly above average at the end of primary schooling only sends roughly 10 percent of pupils to Barry School. This means that a significant proportion of high attaining pupils in the catchment area do not attend Barry School, this is a historical trend that is hard to reverse due to children following their siblings into secondary education.

When it came to decide upon which class to use in the study the primary concern was that the pupils involved would meet the following criteria to enable the questions to be answered:

- a willingness to talk and share their ideas,
- a familiarity with working co-operatively in small groups,
- being comfortable with a new teacher working with them infrequently over a period of time and,
- a positive attitude to science and learning.

At no point was any assessment data used in this process. The subject lead felt that pupils in Year 9 would be mature enough to be involved and a short staff meeting was held to discuss which class might be suitable. The acting subject leads class was volunteered and a visit was made to observe them, to help select the two study groups and to explain the process to the pupils themselves. The attainment information included below was only received following the receipt of signed permissions from the pupils themselves.

Eight Year 9 pupils from Barry School, two groups of four, were involved in the recordings.

Group 1: Mike, Alan, Gwen and Shelia.

Group 2: Trevor, Ron, Gillian and Emma.

The reason for their selection is outlined in the section below. The Year 10 science targets for these pupils are that seven of the group were predicted to be at level 4/5 and one, Alan, is predicted a level 6. Five of the pupils are in receipt of pupil premium funding and four are eligible for free school meals and one pupil, Emma, is non-white. Four of the pupils have received SEN support in Years 7 and 8 while three currently have SEN support in Year 9. The target group of pupils are representative of the overall school profile with 50% receiving free school meals and 63% being in receipt of pupil premium funding and so can be classed as coming from deprived home environments. Generally, 88% of these pupils currently have or have received SEN support and these pupils are targeted to get a grade 4/5 at the end of KS 4.

The implications of the attainment data above form a key narrative regarding the suitability of CASE for secondary aged pupils. For although SEND was not one of the areas of focus for this study it happens that the majority of the pupils involved in the transcripts are those who come under its umbrella. This therefore reinforces the importance of CASE as a vehicle for inclusion and the

implications of this are that oracy and taking the time to engage pupil funds of knowledge (i.e. the lived experience that is promoted by CASE) can support the cognitive development of all pupils. The transcripts shared on pages 99-104 and 116-131 highlight the SEND learners' engagement and subsequent successful thinking within the lessons under study.

3.7 Ethical considerations

This section will outline the ethical considerations that have shaped this study. All research was conducted in line with, and adherence to, Brunel's ethical guidelines. In addition to this the fact that I was an experienced teacher meant that the work in Barry School was conducted in accordance with the professional standards expected of any member of the teaching profession. Many of the issues that could have arisen when seeking to address the criteria set out in BREO (Brunel Research and Ethics Online) did not occur as barriers because of my position as a teacher, one who was seeking to explore an aspect of professional practice, meant I was familiar with both classroom and work of this nature. The consent forms used, with the pupils and their parents, as part of this process can be found in appendix three.

This study involves the analysis of pupil talk in the classroom and it is something the staff within the school were also interested in. Barry school readily agreed to be part of the project as many of the teachers were familiar with me from my previous work and so good professional relationships were already in place. The research only involved one class and those who wanted to participate. This was made very clear to them alongside the fact they were free to withdraw at any point in the study. It was felt by the subject lead that despite the fact the class would respond positively to a new teacher that an extra, unrecorded, CASE lesson should be taught before the involvement of the camera in the classroom. This lesson served to introduce me to the class and vice versa and also to enable the correct choice of recording groups to be agreed. The week prior to this lesson the class teacher explained the aims of the research to them and I was also present to explain the reasons for the study and their involvement and to give the pupils an opportunity to ask questions.

Throughout the study there was regular and ongoing dialogue with the teacher with respect to the involvement of the pupils. The pupils themselves were asked at the start of each lesson if they were happy to be involved but by lesson three, they simply took the camera and switched it on themselves as an indicator of how settled they were with being both involved and recorded. It was decided to use videos to record the groups as this would better enable conversations, and their focal points including objects of interest as this is taking place in a practical subject, to be recorded and tracked. Talk of the type that forms the basis of this study is essentially a social process, so eye contact and body language form important cues to help analyse the talk taking place. Two groups of four pupils from within the class were videoed- eight pupils in total were involved. These children form a sample of convenience because of the purpose of the video recording i.e. the children selected must talk within the lessons. Therefore, the children chosen to be recorded were those who the teacher felt would be able to talk and share their ideas in this context. For the purposes of this study a random sample would not have been suitable, so an opportunistic one was taken however the selection process was carefully carried out under the guidance of the class teacher and the subject lead so that the children involved did not feel under undue pressure to take part and based upon their knowledge of the pupils and safeguarding regulations. The sample chosen includes an equal gender split, pupils who were confident enough to talk and those willing to take part in the research. At all times school guidelines with regard to safeguarding were followed and the recording did not involve any pupils who the school saw fit not to be involved for whatever reason. Only pupils who consent were involved in the research and all were given the option of withdrawing from the study as their involvement was in a voluntary capacity.

One risk inherent in this work is the recording of pupils and the distress that this could cause to those involved. During the lessons the camera was not referred to, nor were the study pupils singled out in any way to draw attention to the video. The pupils were familiar with me and the fact that I am an experienced classroom teacher from this part of the country. At all times I consulted the class teacher regarding any issues that arose in a particular lesson and took my lead from them, and their knowledge of the pupils involved. At all points during my time at the school I made sure I abided by the schools safeguarding procedures. This aspect was raised at the start of the research and was also mentioned in the permission letter and all pupils were made aware of this from the outset. As a practicing teacher and a regular visitor to schools I always seek to exemplify the highest professional standards. The pupils were aware that in the case of anything being disclosed that the schools designated a safeguarding matter then the relevant officers would be informed.

3.8 The impact of the covid pandemic upon the research

For the duration of the CASE teaching in Barry School the country was in the grip of the covid pandemic and as such was under the restrictions in place following the first lock down. This meant that only seven lessons could be taught as limitations on visiting and other covid-related issues reduced the number of times that teaching could take place. Six lessons were recorded as the first was an introductory lesson to enable me to get to know the pupils. Due to the climate at the time many pupils regularly chose to wear face masks which served to restrict the audio quality of the recordings at times.

3.9 The development of third space talk codes for use in the analysis of small group talk

This study documents my professional quest to explore small group conversation in CASE as part of a revisiting of its Vygotskian roots. This thinking was further crystallised by Mundher Adhami who pointed to the fact that any translation into English from Russian carried nuanced meanings that must be acknowledged and explored (see Section 2.27, page 40 for details of the interview with him). This coupled with my own reading around talk led me to the ideas of Bhabha and the notion of a 'third space'. Helpfully Memavoric has clearly articulated the classroom features that promote such talk, which also links to Maniotes and her work on mergers, of which she describes three. My talk codes evolved into five as it was necessary to include aspects of CASE such as social construction and metacognition and also the ideas of Guiterrez concerning counterscript and Wegeriff's use of playful talk (outlined in figure 5 on page 75). The five categories of talk outlined below were developed to support the analysis of small group talk following the validation process outlined in section 3.10.

- I - intellectual engagement,
- E - empathy and personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda.

Maniotes (2015) is a researcher who has been using the idea of the third space to explore talk and promote learning and it is worth referencing her as she articulates why the notion of a third space is a helpful construct. She is also pragmatic in her view that unless the conditions are correct then, like many others before, the third space will remain a useful but elusive construct. Her main line of argument comes from the fact that children need to be engaged in order for real learning to occur

and feels that the emotional draw of carefully chosen texts, in literature, will facilitate the emergence of the third space. In Guided Enquiry Maniotes outlines the importance of this thinking to both teachers and their pupils:

- The teacher can facilitate the intersection of home and school knowledge in a way that enables the pupils to draw upon their own experiences to allow them to make connections with the subject (p.9);
- Pupils should be supported to draw upon their funds of knowledge to help them make sense of the curriculum (p.20);
- The third space is a hybrid product that results in merged conversations between the pupils' funds of knowledge and the curriculum (p.25);
- Third space mergers are characteristic of true dialogue and the real questions that result in the construction of knowledge. She identifies three kinds of academic interaction that happen within such mergers (p.27):
 1. Intellectual enquiry- they want to know more and seek help and use sources to answer;
 2. Deep reading- delving into a text more deeply to gain insights and meaning;
 3. Social empathy- the text triggers an examination of peer relationships or causes a display of empathy.
- Talk is key- the teacher must provide encouragement to enable the students to talk to one another in meaningful ways that merges curriculum goals with things that matter in, or come from, their lives (p. 27);
- Real questions reflect a desire for knowledge and ownership and should be based upon personal ideas and experiences (p.29);
- Relationships are also important to enable the exchange of ideas between peers and between the children and the teacher. The teacher must promote and model: the ability to make personal connections, provide a safe atmosphere, accepting various points of view, listening to and considering ideas, the creation of a safe atmosphere (p.31).

Maniotes in choosing literacy, is clear that she has done so because it engages pupils has therefore been successful in capturing examples of pupils bridging between their lives and the curriculum. Much of what she identifies can be applied to CASE including the classroom conditions and the focus of CASE upon social construction. In addition to this the language of CASE can help us further develop her notion of a third space merger (or academic interaction) into five categories of talk.

Maniotes	Edmiston	Notes and references including CASE
Intellectual inquiry	I - intellectual engagement	In CASE construction zone activity is the engaged work in groups to resolve the conflict and may involve further reading to solve the challenge.
Deep reading		
Social empathy	E - empathy and personal sharing	Bridging, metacognition
	R - surprise or reflection	Metacognition and bridging
	P - playful	Metacognition and bridging Wegerif
	A – pupil agenda	Metacognition and bridging Gutierrez and counterscript Lemke and side talk

Figure 4 table showing the development of the third space talk codes

The five codes above seek to incorporate all the main types of talk that may occur in CASE lessons where creative adolescents work together collaboratively. There is the need to acknowledge the nature of their talk, the role of mirth and the playful nature of any group of humans. Wegerif's (2005) use of the term playful talk is also helpful, and it resonates with Dehaene's description of the role of mirth in learning;

"A uniquely human emotion that guides learning and a mirth reaction triggers us to revise our mental models or thinking. Important in this case because it's a contagious social response that draws attention to the unexpected piece of information. Laughter during learning seems to increase curiosity and enhance subsequent memory." (Dehaene, 2020, p.189).

Pupil agenda talk (code A) is a key feature of this in that it signifies when the pupils take control over the conversation and steer it in a new direction or away from the task they have been given.

The five talk codes support the capture of those moments in conversation when children open up, discuss, reflect, ponder or share their thinking and inner thought life. The aim is that this will help to include the moments when their talk or response signifies a personal connection has been made or that a deeper level of processing and thinking is taking place. This can happen when they struggle with the challenge the teacher wants them to engage with or with the resulting contrasting ideas of their peers. We are also looking for evidence of this in the word's pupil use and the conversations they have. Usually, it is verbal but it could also be a gesture that signifies thinking. During such times pupils may puzzle, laugh, sing or play with language. They can bounce ideas off each other, share personal misconceptions, views and beliefs and challenge one another. Such talk has degrees of relatedness or separation to, or from, the desired object/focus of thinking, so there is quite a large area of overlap between this type of talk and when it shifts towards becoming unrelated chat.

Such engagement could result from a connection made to or a recognition of their own thoughts and views. Pupils may share and volunteer some knowledge or ideas, they could even ask questions, ponder or reflect upon something going on in their lives individually or collectively. Most often it is seen as pupils work together to solve a problem where the answer needs to be constructed by the pupils themselves. Detailed descriptions of the five third space talk codes used in this research can be seen in figure 5 below:

3S talk types	Description	Possible examples
I - Intellectual engagement	When engaged in a task, pupils will explore and try things out, experiment, pursue ideas and thoughts. This may include them going beyond the question as they explore and develop their ideas. They may also share their thoughts and questions triggered by the activity. They pursue an answer because they are engaged and genuinely interested and will often come up with personal solutions that fit the evidence. They regularly speculate and suggest explanations and good ideas that seem to fit or help with the 'answer'. They may use and apply facts they already know to help them. Pupils work together to support each other's ideas and to develop solutions to solve the problem. They may go off track to pursue such new ideas or thoughts. This type of talk which signifies engagement in the task will result in other related forms emerging such as: R, E and P. A can occur as a consequence or can be unrelated. I is the starting point of a developing conversation between pupils. Key – pupils share ideas and knowledge or experiment with resources to construct/explore/develop an answer or solution. They often collectively using the knowledge they have as part of the learning process.	If we hang this weight here it will ... Do you think that if there was another world, there would be another you? That watch is made of cow skin ... what's actually in it? We went camping and the frying pan melted and I wondered how the heat could get through. I thought there must be little holes in it to allow this to happen. I looked in my planner at the periodic table and saw that lead and aluminium have different numbers. There must be something inside ----- there must be something to allow the friction to stop it.
E – Empathy or personal sharing	Some talk is concerned with peer relationships and the emotional connection between group members. Pupils may also make a personal/familial connection with the lesson and/or subject matter. They may also question their peers as to aspects of their personality, character or lives. Pupils may share personal information or ideas in a way that triggers a, thoughtful, conversation. They may share or reveal some fact that their peers are unaware of. Key – sharing or revealing something personal either as part of developing relationships as in connection with the task. This often involves the discussing issues of concern or interest, asking questions to elicit ideas, knowledge or reaction from their peers.	We have got some beans that's all you vegies eat isn't it? Did you know I have three kidneys? Yesterday my Gran was kicked by a horse Did you see that video I watched the xxxx last night. You can drink alcohol at 5 if your parents are with you. On TV it said catfish could weigh up to 250 pounds. Do you ever eat leaves?
R - Surprise or reflection	Often pupils share real surprise related to something in the lesson or as they try to get a deeper insight into the problem or issue. They may re-assess their ideas about an issue or concept as they move forward in their thinking and possibly change their minds. It can also involve them sharing things they used to think when younger. They often ask questions of themselves and their own understanding when challenged and this is linked to questioning own understanding. They often wonder out loud and go off at tangents. They may stare into space and reflect and or ask questions. This is often linked to statements regarding what they thought were true that may not be the case now. They may be uncertain and hesitant as they pausing and taking stock of their thinking. Key – asking questions, exclaiming or reflecting in a way that highlights/illustrates their thinking. They will also ask questions of themselves that indicate how they view the world.	My goodness, that's how big a baby is at 12 weeks! I was in the shower and I thought ... How do I know that shampoo really works? But I thought everything was made up of particles? I thought there were actual atoms, things. I used to think there was a Giant who held up the sky. I used to think mums ate babies and then were sick and that's how babies were born.
P - Playful	This is possibly the hardest category to describe as it involves the creative playing around with ideas and words, which often involves fun or humor. Wegerif believes that new ideas emerging from the process of playful talk. The sound of the word to the pupils is often a source of fun and they can be 'silly' as they play with an idea or word. They may make up or invent new descriptive words. A humorous comment can trigger a discussion of this type. Key- this type of talk is often associated with humor and fun. It is regularly linked with a change in voice tone and the use of silly voices and singing.	Keratin - that's what nails are made out of. Wouldn't it be fun if my hair were made of nails? They may simply 'play' with resources, throw, catch and fiddle. The seeds look like brains, they are nutty Do you like ice-cream water? 'Yes I do, yes I do' , 'No I don't, no I don't'. Ours is called the 'Mish-method'
A – Pupil agenda	Here the pupils in the group take ownership of ideas and steer the conversation away from the task at hand. It can be linked to the group identity and things they have in common or with individual pupils that trigger a move away from the task towards something they find more stimulating. They may divert away from the task to discuss something of interest to them such as relationships or alcohol. Three forms of this type of talk are emerging: Negative A – this form hinders their engagement with the task and can be disruptive and negative in its emotional tone. It usually tends to be of great interest to the pupils and usually has nothing at all to do with the task at. This also includes talk where they go off on a tangent and something distracts them from the task at hand. It can be happy and feels playful but is not linked in any way to the task. It can require a fine judgement call. neutral A – short incidents of off-task talk that regularly occur as they get temporarily distracted but they soon return to the task. This can also happen at the start of a task before they begin and at the end when they finish. Positive A – a line of talk that is triggered by the activity that sees them move away from the task at hand to discuss something of interest to them that is positive and can be related. This is similar to I, in that they are intellectually engaged in a similar way, but the content of the talk is unrelated to the focus of the lesson or task. Key – this type of talk is linked to their control and ownership of the thinking, ideas, activity and engagement. They are often on task, but they have transformed it to meet their own agenda as prompted by the activity. They are now not simply completing the task and are moving (intellectually) in a new or different direction.	Positive A This can also be linked to group dynamics where the pupils organise themselves to remain on task. See transcript for exemplar material that highlights the link between -ve and +ve A talk. Negative A L – Phenomenon L – What is that word (hits table with hand) M..... says a made up word to L twice H – We need to ... L – What is that word ... I have never been able to say it L repeats this M –Phenomenon L – Phenomenon ... I cannot say it L to A – Do you know how to say it? H – Phenomenon or what? L – Phenomenon H – Phenomenon L – That word ... what words can you use to describe this phenomenon H – Phenomenon L – P ... I cannot say that ... there are certain words I just cannot say H spells it put for L who tries and laughs H – I cannot say it now A – Phenomenon The above was triggered by the use of the word phenomenon in the task set to the class.

Figure 5 The five third space talk codes

Of the five talk types it may be that the latter two (Playful and Pupil agenda) are less frequently encountered. It could be that these are symptomatic of real connections being made and significant development occurring as they are one-step removed from task completion and the pupils themselves are applying their own ideas and thoughts in this moment. They seem to point to a real involvement of the pupils' own thoughts and ideas as they seek to divert the focus away from the 'answer' and towards their own trains of thought or interests. These two talk types point strongly to the notion of ownership and link to the idea of the translocation and transformation of ideas and language as part of the development process. It is probably the case that former three provide the intellectual stimulation that causes the 'ownership' of ideas to be manifest in the latter two forms of talk. This is similar to the idea of playful talk emerging from exploratory talk.

Although all connected as talk that is symptomatic of a movement in thought a helpful image at this stage is that P and A are the tip of the third space iceberg and are indicative of real and new learning taking place.

Non-verbal cues

The five categories of talk suggested above are associated with specific non-verbal cues and behaviours. Due to the poor quality of the video recording, it is not possible to neither devise nor differentiate a categorisation system that can reliably link specific non-verbal cues to each of the talk types. At this stage it is sufficient to list the 'probable' associated non-verbal cues that are indicative of the below the surface thinking that is associated with talk of this type.

Possible generic non-verbal behaviours associated with third space talk:

- Eye contact with peers often associated with smiles, laughter and common communication techniques (high fives or other physical signs);
- Facial gestures such as; eye movement, twiddling thumbs, rubbing and moving hands together, biting lip, staring into space, fingers in mouth, head nodding, confused looks, smiles, frowns and grimaces, mouth open and finger in air, staring into space while lips move;
- Thinking sounds as they lean forward, heads together;
- Sudden noise and movement when the penny drops and they have a realisation moment;
- Discernible thinking time before they speak and putting head down before speaking;
- Playing, touching and examining physical resources;
- Manipulating resources as they talk or in preparation to talk.

3.10 Outlining the transcription process at Barry School

Both groups were recorded using small GoPro cameras placed on the table and positioned to include, as far as possible, all of the group members. GoPro cameras were used to make the recording process as inobtrusive as possible. The limitations that the use of these cameras brought were that:

- Not everything that was said was recorded and so there are gaps in the conversations;
- The sound quality of the recordings was poor at times which meant that all dialogue could not be fully heard or understood;
- At times some of the pupils wore face masks which further affected the sound quality;
- Some of what the teacher said to the class can also not be discerned.

As this study concerns the categorisation of talk, the actual meaning or motive behind an utterance is not really required. This means that at times there are gaps in the transcript, such as those

described above, but due to the nature of the categorisation process these are less problematic than might have been the case when capturing conversations in this way. It is not necessary to hear everything that is being said to associate the talk with one of the five talk codes. Notes were made during the teaching and each video was watched soon after the lesson was taught, all dialogue written down, later transcribed and finally colour coded. The final stage involved supplementary details being added that would enable any reader to understand what the lesson entailed and what was taking place. Each transcript therefore includes an overview and summary of main stages from the CASE teachers' notes and a commentary on how that lesson was adapted to update it to make it suitable and relevant for this particular group of students. The following four codes are regularly used as annotations in the transcripts:

- *AE* - denotes Alan Edmiston the researcher /teacher;
- - denotes a pause in the talk or when the talk is inaudible (length is not specified);
- *Feedback* – a time for each group to share which often begins with a key/focus question provided by the teacher;
- - denotes the start of someone talking.

There are four sections in each transcript: A – timings, B – talk code, C – transcript and D – explanatory notes. Section A provides a timeline that links the verbalisations to the time they took place using the timings from the video recording. Section B is only annotated during the coding stage of the transcription process. Section C includes, as far as possible, everything said by the pupils. The final section D is where notes are added to reference the stage of the lesson and to add a commentary to provide the details required so the reader can discern what is taking place in terms of unseen behaviour etc. The notes section is linked to the time of the utterances and is used to explain some of the behaviours that result in the specific conversations shown in section C.

To illustrate this, the transcript from Lesson 6 'How many are there?' for group two will be discussed. The transcripts need to be viewed in the light of the pedagogical structures underpinning CASE which means that each of the lessons has been divided into a number of stages, usually four or five. These stages reflect, and capture, progression through the lesson agenda and exposure to the CASE features of concrete preparation, cognitive conflict, social construction, metacognition and bridging. The notes included in the last column illustrate the thinking that took place in the planning of the lesson and reflect the decisions, or choices, made by the teacher at this early stage in the teaching process. As far as possible each camera recorded the full lesson, but the pupils often switched the camera on or off depending on whether they were talking or not. This often means that stage 1 of the lesson that includes teacher instructions may not be fully recorded. In addition, the aspects of the class, i.e. stages 4 and 5, times of whole class reflection and plenaries may not be fully captured in the transcript. The main point is as far as possible all the small group talk was recorded.

3.11 Checking the code's validity and reliability

To check the reliability of the five third space talk codes, a process of code validation took place. It was necessary to check how easy the codes were to use as a tool for categorising talk prior to their use in analysing the Barry School lesson transcripts. This would also enable me to see how applicable and replicable they are as a tool to support the analysis of small group conversations. To do this I enlisted the help of four critical friends (CF) to try using the codes to transcribe one of the CASE lessons taught at Barry School. Given the widespread appeal of CASE and its academic pedigree it was necessary involve people who were reflective of this breadth. The CFs were therefore selected from colleagues I had worked with over the years to make sure that a range of educational backgrounds was included in the process:

CF 1 – a colleague of many years standing, working in Wales, who is very familiar with CASE from the 1990's;

CF 2 – a primary school deputy head teacher, working in London, who is familiar with primary CASE;

CF 3 and 4 – two university colleagues, from Canada, who share the ideas of CASE as part of their undergraduate teaching programme.

The validation process itself involved the following four steps:

Step 1- CFs use the codes to annotate two, 20 minute, transcripts of talk,

Step 2- The CFs coded transcripts were compared with my own and differences noted,

Step 3- The CFs were then interviewed (two on video) to discuss and reflect upon the codes in relationship to CASE to explore the similarities and differences between mine and their use of the codes;

Step 4- In the light of the feedback, updates were made to the code descriptors to ensure consistency in the application of the codes. The resulting code descriptors are to be found on page 75.

Reflections upon the validation process and the refinement of the third space talk codes

The main issue highlighted by this process was a lack of clarity regarding the exemplification of talk in each of the five categories and that more detailed examples were needed for the codes to be applied consistently. The overall feedback was that the codes do allow the categorisation of talk and five categories are enough to capture and represent the different types of talk taking place in this context. I and E are clear to code but R, P and especially A needed further clarification and refinement. One issue that emerged was the need to account for engagement and enthusiasm within I as part of pupil engagement with a task. When engaged pupil conversations often shows enjoyment and aspects of what could be called P but we do not categorise them as P. Code P is also not a joke and so humour in itself does not indicate a movement away from I when pupils are engaged in solving a task or discussing something or sharing ideas and solutions etc.

Based upon this process, R (reflection/surprise) was the hardest to discern, at times, which stems from the fact that R actually seems to take place during a period of engagement (I) and may be linked to the nature of task which is hard to isolate from a transcript alone. R is also interesting in that it is also linked to metacognitive thinking and so needed detailed exemplification to help define it more clearly. The questions raised by this are:

- Does the statement by a child of 'I am ...' i.e. without really sharing their thoughts indicate R or do they need to qualify it?

- Can R manifest itself as an exclamation related to the task and act as a sign of an internal dialogue?
- Similarly can R take the form of a brief utterance- a word or single short sentence, and act as a kind of tip of the iceberg that is indicative of inner speech and thinking. Often such utterances are not followed up with more extensive articulations yet are indicative of deeper processing and so should be viewed as a sign of thinking.

Comments upon type A (pupil agenda) talk

The validation process resulted in a major redefining of code A (pupil agenda talk). This code is a way to include both disruptive talk and times when pupils go off on tangents or simply come to the end of a task and chat about something that is on their mind or is of concern to them from outside the lesson. Guiterrez and Lemke term this type of talk ‘side talk’ or counterscript which describes when pupils subvert the normal script of the classroom. There are three issues with talk of this type in that:

- Some off-task talk is related to the focus of the pupil engagement i.e. bridging where talk follows an train suggested by the pupils and leaves the lesson agenda behind;
- Some is neutral and part of normal talk i.e. ‘What lesson do we have next?’;
- Some is negative and can be disruptive.

Due to this and as a way to include ‘all the talk’ in an honest and open acknowledgement of adolescent talk code A has been subdivided into three types: Positive A, Neutral A and Negative A. Exemplification of these is provided in the final version of the codes found on page 84. These three aspects of code A reflect the fact that when an engaged conversation is directed by the pupils because of an interest in that aspect of the lesson, i.e. it’s their agenda, it would come under the Positive A grouping and in CASE this is termed bridging. Bridging is the application of thinking into a new area, but it is directed by them yet is supportive of the lesson agenda. Negative A on the other hand is off task talk that diverts pupils away from the lesson. Neutral A includes talk that is similarly unrelated to the lesson and are usually associated with pupils who are bored or are simply waiting while unengaged.

Chapter 4 Transcribing the talk in Barry School CASE lessons

4.1 - Overview

This chapter will introduce the lesson transcriptions from Barry School and through them focus upon the following three aspects:

- 1 – a discussion of the transcription process as used in Barry School,
- 2 – the initial findings concerning talk in CASE lessons including an analysis of lesson structure,
- 3 – the analysis of and outcomes from applying the third space talk codes to the lesson transcript.

4.2 Some initial thoughts and observations on transcript 6.2, uncoded

Lesson 6 is called ‘How many are there?’ and was chosen because it was the last lesson taught to the class and therefore shows them talking at a time when they are most familiar with the approach taken in this study. 6.2 indicates that group 2 are involved. Three short episodes of talk are being used to highlight the talk that is taking place before the third spaces codes are applied in chapter 5.

All of the transcripts act as a window into adolescent conversations taking place among pupils while involved in their classroom tasks. They provide a snapshot into the genuine talk taking occurring for, by this stage in the process, they are ignoring the camera. It clearly shows when on they are on task and how engaged they actually are – which in many cases occurs for lengthy periods of time. It also reveals their interests and how engagement ebbs and flows. For example in episode 1 they begin to discuss their science homework and the disruptive behaviour of Trevor in other lessons. They love to talk and share which is exemplified by Gillian and the problem she has with her eye drops (underlined) and this begins to dominate the conversation. They also willingly share personal information about their lives which occurs in this lesson as they discuss their grandmothers which is triggered by a slip of the tongue from Ron (underlined).

Episode 1

Ron – Calculator

Gillian – I had my calculator open

Gillian - You know the science homework – when is it in?

Ron – Science homework – 14

Gillian – You know last night I ... rushed around

Trevor – You got science homework ..

Ron - Yeah we do

Trevor – When?

Ron – We had a lesson

Emma – I’m going ..

Gillian – I don’t really ... this one

Trevor – The yellow booklet

Gillian – Matthew was off because he pulled the roof down

Ron – Ah yeah

Trevor – What, was that on Monday?

Emma – You were the one who did that

Ron – Ahh ... there is always

Trevor – What date did we get that?

Ron – That must have been the Monday Tuesday

Trevor – I was in the base unit on Monday

Ron – You were, we watched you get taken out of the lesson

Emma – You were the one who pulled the roof down!

Ron – What happened was, he pulled the roof down then exactly one week later Rees flooded the bathroom
Trevor – I helped him and the roof looks clean
Emma laughs
Gillian – Who ...
Ron – So basically they gave him the last two weeks of half term
Trevor – We the hand drier
Gillian or Emma – We had one
Ron – We are waiting to find out what happens this Friday
Gillian – I picked up the wrong one ...
Ron – I'm waiting to find out what happens this Friday
Gillian – I am supposed to give myself eye drops

Episode 2

Ron – Why Nan
Emma – Did you just say ... your Nan
Ron – Nan
Trevor – Yeah, because who does not have a Nan
Emma – I don't have a Nan
Gillian – I don't have a Nan
Trevor – I cannot afford a nun then
Emma laughing – Nun
Gillian – All I know is that my Nana is 93
Emma – My great Grandad
Gillian – That's nice 93 is still alive ... I hope I don't get to that age
Ron – It would just be boring
Gillian – I hope I ... 23 .. I wonder if I'll die from alcohol poisoning ... I lived the good life

Ron - My pen (to Emma)
Gillian – I have literally
Ron – I had eyedrops 2 years ago
Trevor – Yes it is, give it back then
Ron – How have you ...
Trevor – Under your seat
Emma – I'm proud of you for putting your eye drops in
Emma – My eyes are always swollen ... I just deal with it

At times the talk is disjointed because not all dialogue is picked up, thus it can be quite hard to follow the conversations. The notes in the lesson transcripts themselves help to paint a picture of what is taking place and to connect the talk to the specific stage of the lesson. The transcripts have been annotated to show how the lesson is progressing through the planned agenda. The transcript reveals a composite of on task and other non-relevant talk such as at when Gillian references how she sits. There are gaps that indicate when no dialogue of any note is taking place. The full transcripts, see appendix one, reveals a rich mixture of talk and how important distraction is in serving to move pupils off task. In this lesson at Trevor is being silly with the beans and this causes the group to move into off-task talk and behaviours. The talk is actually a hybrid of utterances and reveals how on-task and other talk are sandwiched together. At this point the pupils begin discussing their primary school experiences (underlined) while completing the task but with time the former dominates and they move off task.

Episode 3

Ron – What did you do
Gillian – At primary ... you just get your medicine

Ron – They gave me some ...
Gillian - ... they are not allowed
Ron - They basically did They just threw it at me (laughing) in my mouth

Ron – What

Trevor – People throwing stuff and you catching it in your mouth ..
 Ron – It does not make me like a Chihuahua ... most dogs do that
 Gillian – I cannot do it when people are looking
 Ron – Well don't .. just do it in the bathroom
 Trevor – Turn around
 Ron – Between lessons
 Gillian – But if I die ...
 Trevor – Turn around
 Ron – Do it in the bathroom between lessons
 Trevor – Get Emma to do it
 Ron – Do it at dinner

Talk can also be tracked through the lesson and times of on-task or off-task talk can be observed. It is also clear that the teacher is part of the talk and this will also be highlighted to help explore any causal links between the teacher and the resulting pupil talk. The transcript, although a factual record of what is said, lacks clarity and it is hard to spot any patterns without the addition details of the codes and their associated colours.

4.3 Analysing the stages emerging from the transcript for lesson 6

Within CASE lessons four or five distinct stages of engagement can be seen as outlined below and are exemplified in the lesson plans included as part of the uncoded transcripts. This is an important feature of the approach as it highlights how the structure of CASE lessons allows the CASE processes to manifest themselves in the classroom. This structure enables the idea of the third space to be similarly applied to the CASE approach.

Stage	Details	Comments on 6.2
1 Lasts for around 7 minutes.	An everyday scenario is used to introduce the problem of estimating animal populations.	Starter questions serve to engage and focus the pupils.
2 Lasts 10 minutes.	Pupils are introduced to the technique of mark/recapture which is used to model real and unknown/hidden animal populations.	The video clip generates a range of associated talk.
3 Lasts about 21 minutes.	Each group carries out the mark recapture procedure which results in three values for them to use in estimating the original population.	They become distracted by the beans and disruption slowly creeps in. There is general engagement with the task but too long is spent on this stage.
4 Lasts about 6 minutes	Pupils share their answers/strategies and the focus upon ratio emerges from this.	There is an overlap between this and the previous stage. The pupils begin to struggle with the underlying concept of equivalent ratios. They are still generally engaged.
5	A very short stage which is not fully addressed. The	At this stage much of the talk is now off task.

	concept of ratio in this context is applied to other scenarios.	

Group 1

Stage	Comments on 6.1
1	General engagement in the task and starter questions which is driven by Mike who tends to dominate.
2	Engaged by the video clip that stimulates a range of talk including the practicalities of having a baby tiger as a pet.
3	Lots of on-task talk as they work on the sampling problem. For a large proportion of the time, they are distracted by a toy cow that one of the pupils brought into school.
4	Pupils switch the camera off before the end of the lesson so no stage 5 for this group. Little engagement in the task at this stage and most of time is spent sharing their primary school experiences of signing in the school choir.

Summary comments for lesson 6

Generally, the pupils are on task for more than half of the lesson (in both groups), but there are differences as each group responds in differing ways to the stimuli used by the teacher. Both groups go off task for around 25- 30% of the recording. At such times, which occur at different points for both groups, the pupils tend to drift into talk controlled by the participants themselves- termed pupil agenda or A talk. A general pattern of on-task talk is emerging which arises from pupil engagement with the task. There is a mix of engagement and off task/personal talk throughout the period of recording. The application of the third space codes is necessary to bring the differentiation required to the specifics of on-task and off-task talk that will allow the clear tracking of engagement and how the stimuli, or triggers, work to generate involvement.

Summary of the stages for lessons 1 - 5

Lesson 1 – The Pepsi challenge

Stage	Details	Comments on 1.1	Comments on 1.2
1 Lasts 3 minutes.	A cartoon image is used to explore understanding of probability in everyday life.	High level of engagement driven by their understanding of the use of ‘probability’ in everyday contexts and its relation to language.	General engagement with the starting image but distracted by Trevor.
2 Lasts 12 minutes	The context of a blind taste test involving soft	Very engaged in the task and Mike is involved in the taste test.	Very engaged in the idea of the taste test – Trevor

	drinks develops this as a focus for this lesson.		is unable to divert them away from the test.
3 Lasts 6 minutes	The taste test is modelling with a coin tossing activity.	High level of engagement.	High level of engagement with the idea of using coins
4 Lasts 12 minutes	Pupils carry out the coin tossing activity.	High level of engagement in the task. Mike is obsessed with winning the coke as a prize. Talk includes some lengthy periods of discussion relating to the experimental nature of the probability in this context.	The nature of the coin tossing task does distract them. Engagement continues with the experimental probability results. Trevor manages to distract his peers towards the end of this stage.
5 Lasts 14 minutes	Experimental and theoretical probability are explored graphically.	High levels of engagement in the graph and the application of probability into the context of health via the use of a pet dog.	Generally engaged in the task and the contrast between the experimental and theoretical probability and how this is expressed graphically.

Lesson 2 – Exponential growth

Stage	Details	Comments on 2.1	Comments on 2.2
1 Lasts 8 minutes	A cartoon image showing speed as a distance time graph is used to trigger thinking.	Camera problems – this stage is missing.	Very engaged in the starting graph of the balloon and rocket.
2 Lasts 2 minutes	A story is used to introduce the concept of exponential growth.	Camera problems – this stage is missing	Engaged and amused by the story used to introduce the main activity.
3 Lasts 27 minutes	Pupils carry out a doubling activity with corn which leads to very large numbers.	High level of engagement helped by Mike who focuses the rest of the group when engaged.	Mix of engagement and off task talk due to the disruptive nature of dealing with real pieces of corn. Incidents of throwing corn at other pupils occur
4 Lasts 6 minutes	Exponential growth is explored in a range of other	Low levels of engagement.	Very engaged as they apply the concept to other areas of life.

	scenarios including the r number.		

Lesson 3 – Sampling beans

Stage	Details	Comments on 3.1	Comments on 3.2
1 Lasts 13 minutes	Pupils discuss the meaning of sampling in a range of contexts.	Simple stimulus ‘sample’ generates interest and engagement.	Two minutes of animated discussion as the group wait for the lesson to start. Very engaged in this stage which results in lots of conversation tangents.
2 Lasts 6 minutes	Pupils explore the variety in a sample of broad beans.	Very engaged with the sample of beans – results in a mix of on and off task talk.	Very engaged with the physical aspect of the task involving real beans. Trevor is easily distracted by them.
3 Lasts 27 minutes	Pupils measure the beans to split them into two categories – small and large.	Less focused and this results in lots of playing with, and conversations related to, the beans. They do engage in the task to collect the data required.	Engaged but they easily move off task. The beans really do generate lots of related interest.
4 Lasts 8 minutes	Different sample of beans are used to explore the effect of sample size.	Lower level of engagement in this aspect of the lesson. More off task talk creeps into this stage.	This stage may be too obscure as there is visibly less engagement now.
5 Lasts 2 minutes	The concept of sample size is applied to other contexts in particular the US election.	Alan drives the engagement here due to his interest in the recent US election.	Little evidence of engagement with this stage of the lesson.

Lesson 4 – Does it work?

Stage	Details	Comments on 4.1	Comments on 4.2
1 Last 5 minutes	A popular advert of vitamins is used to generate discussion regarding claims of impact or effectiveness.	The context of a familiar advert promotes talk, but Mike distracts for about ½ of this stage.	Find the contexts very amusing so engaged – works well to focus and motivate.

2 Lasts 21 minutes	The context of parsnips and the impact of a new fertilizer is used to focus upon control and experimental testing.	Very engaged, the novel context including real parsnips works to introduce the concept of control verse's experimental and the four trials takes time.	Very engaged as something seems to resonate with this group which results in period of humour. Much of the talk is triggered by the activity yet directed by the group to explore areas of interest to the pupils themselves.
3 Lasts 19 minutes	Pupils sort cards to look for treatments that work.	The card activity works to engage the pupils but now they are following own agenda now because of context of steroids and muscles.	Engaged with the cards which facilitates a mix of talk. Large amount of personal talk about peers towards the end.
4 Lasts 5 minutes	The notion of correlation is used to apply the same principles into other scenarios.	The contexts of folic acid and smoking cessation generate real interest. There is some personal talk related to the two contexts	Pupils carry on in same vein and this results in sharing personal smoking issues.

Lesson 5 – Modelling in science

Stage	Details	Comments on 5.1	Comments on 5.2
1 Lasts 5 minutes	Pupils discuss the meaning of the word 'model' when used in the context of science.	High level of intellectual engagement with little off task chat.	Little response to the ideas put forwards – limited chat, hard to hear. Trevor is off today which may be a key contributory factor.
2 Lasts 15 minutes	Pupils play with a mystery box that cannot be opened and have to image what is inside.	High initial engagement but drifts into off task chat before re-engaging with the mystery box. Very involved in trying to work out what is in the box	Very engaged, throughout the whole lesson with the box.
3 Lasts 6 minutes	Pupils discuss models of the solar system.	Mike leads this chat with Alan showing greater involvement.	Gillian is still talking about the box. There is general engagement with the solar system task
4 Lasts 14 minutes	Pupils develop a model to explain the difference in weight between	Only 1 minute recorded for this group.	Still talking about the box! Do engage with the density cubes but only

	aluminium and lead cubes.		for the second half of this stage.
5	Pupils reflect upon a similar use of models in their lives.		Not addressed in this lesson due to lack of time

The activities are all following a similar structure, one that involves four or five distinct episodes or cycles of activity and talk. In each group key individuals tend to ‘control’ the talk and whether it stays on-task or veers into talk controlled by the pupils themselves without any regard for task completion. Engagement, and therefore talk, seems to flow from the gaining of attention and that this is a consequence of using concrete resources and familiar contexts to generate interest. Resources, such as corn and beans, can lead to disruption and so must be taken into account. The full transcripts for lessons 1 - 5 can be found in appendix one as only excerpts will be used to illustrate specific points of interest from this point forward.

4.4 Applying the colour codes to explore talk from a third space perspective

Without annotation the transcripts are simply like reading a play composed of blocks of dialogue without punctuation or grammar and as such they are devoid of emotion and excitement. There is a need to bring the transcripts to life so that the talk can be explored and orientated to support the analysis of the reality of third space in the CASE classroom. To do this the five codes and six colours (red being used to indicate when the teacher is talking) will be used to help differentiate the types of talk that are taking place and to navigate the rainbow of colours this will create.

In section 3 of chapter two the ideas of Maniotes (2015) which underpin this research were outlined. These ideas were more more fully developed by her in Guided Enquiry where the three categories of ‘merger’ are further exemplified. This work also describes some of the classroom features that support pupils to move into the third space and to draw upon their own thinking as they make sense of the curriculum they encounter in school. Based upon her work, in literacy, she is able to identify and describe three categories of merger:

1. **Intellectual enquiry** involves the pupils wanting to know more and so may seek help and use other sources to answer,
2. **Deep reading** that involves the ‘delving’ into a text more deeply to gain insights and meaning,
3. **Social empathy** which results from the text triggering an examination of peer relationships or causes a display of empathy.

To Maniotes, the third space is a ‘hybrid product that results in merged conversations between the pupils’ funds of knowledge and the curriculum’. This idea of a merger has been developed and expanded here to enable types of talk that may be taking place in construction zone activity to be included. This has resulted in five categories of third space talk:

- Intellectual engagement;
- Empathy and personal sharing;
- Surprise and reflection;
- Playful talk;
- Pupil agenda.

An overview of the interrelationship between these ideas was summed up in the following table from chapter 3:

Maniotes	Edmiston	CASE notes and references
Intellectual inquiry Deep reading	I - intellectual engagement	In CASE construction zone activity refers to work in small groups to resolve the conflict. This may involve further reading or research/experimentation.
Social empathy	E - empathy and personal sharing	Bridging, metacognition
	R - surprise or reflection	Metacognition and bridging
	P - playful	Metacognition and bridging Wegerif
	A – pupil agenda	Metacognition and bridging Gutierrez and counterscript Lemke and side talk

Figure 6 – factors influencing the talk codes

The third space talk codes have been drawn from innumerable examples of personal teaching experience. They serve to reflect the ways young people engage in discussions in CASE lessons. To check the reliability and application of the codes a four-stage process of validation was undertaken which is outlined in chapter 3. The outcome of this collaboration is clarity regarding the fact that these codes do capture the essence of talk in CASE lessons which are being termed third space talk. The two key outputs that emerged from this process were:

- The codes allow small group talk to be categorised and five categories are enough to capture and represent the different types of talk without being too onerous or difficult to use;
- Code I and E were clear to use but A, R and P required further clarification and exemplification.

In response the criteria were updated to provide greater clarity and make them easier to use. This is important given that there will always be shades of grey as to what pupils say but it is now clear that there are key defining features that enable an episode of talk to be placed into one category or another. A summary of the key features of each of the talk codes are described in the table below.

Code	Colour	Summary of the key features
I - intellectual engagement	Green	Talk that involves the sharing of ideas and knowledge or experimenting with resources to construct/explore/develop an answer or solution. Pupils will use the knowledge they have as part of the learning process.
A - pupil agenda	Blue	Here the talk is linked to their control and ownership of the thinking, ideas, activity and the direction of travel. They may be on task but have transformed it to meet their own agenda as prompted by the activity. They are now not simply completing the task and are moving (intellectually) in a new or different direction. This category also include talk that is not related at all to the focus on the lesson which may be disruptive.

E - empathy and personal sharing	Yellow	Sharing or revealing something personal either as part of developing relationships which may or may not be connected with the task. This can involve a discussion of issues of concern or interest, asking questions to elicit ideas, knowledge or reaction from their peers.
R - surprise or reflection	Orange, brown	This talk involves asking questions, exclaiming or reflecting in a way that highlights/illustrates their thinking or their surprise. They may also think out loud and ask questions of themselves that indicate how they view the world.
P - playful	Purple	This talk is linked with the development of new ideas or thinking and is linked to an ownership of words and language. Playful talk can be associated with mirth and fun and linked to a change in voice tone, the use of silly voices and singing.

Figure 7 **A summary of the Third Space talk codes**

The codes serve to include, and broadly account for, the main types of talk that may occur in CASE lessons where creative adolescents work together collaboratively. The reasons why the specific code was applied is explained in the notes section of each transcript. The codes reflect the fact that there is a need to both include and acknowledge the full range of adolescent talk including the role of mirth and the playful nature of any group of humans working in this way. Wegerif's (2005) use of the term 'playful talk' resonates with Dehaene's (2020, p. 189) description of the role of mirth in learning;

"A uniquely human emotion that guides learning and a mirth reaction triggers us to revise our mental models or thinking. Important in this case because it's a contagious social response that draws attention to the unexpected piece of information. Laughter during learning seems to increase curiosity and enhance subsequent memory."

4.5 What the colour codes reveal when applied to transcript 6.2

The colour coded transcripts for all of the lessons can be found in appendix four. For the purpose of this thesis key extracts will be used from this point forward. The use of colour enables the talk categories to be visually represented, serving to bring the conversations to life. The addition of red for teacher talk helps to include the element of causality and to focus upon the impact of the choices the teacher makes during the lesson. This will be explored further in chapter 5 using the idea of a trigger to illustrate this. The addition of colour serves to clearly demark the talk and show how quickly talk can change from one type to another (and back again) and how I (intellectual enquiry) and A (pupil agenda) dominate. Using colour enables the codes to act as traffic lights indicating changes in the type of talk taking place. It also allows the tracking of talk, for example, following any teacher interventions and indeed how the pupils themselves effect the talk. The use of colour in this way clearly shows how talk flows and shifts over time and includes a range, and mix, of different talk types. The coded transcripts reveal a rich tapestry influenced by both the teacher and the specific elements of CASE lessons- such as cognitive conflict. The talk is fluid with a mixture of ideas bouncing around, punctuated with laughter, as pupils dip in and out of the conversations. The transcripts reveal a regular hybrid mix of I and A and even when the pupils are on task A is present which points to the fact that this talk may show the natural balance/frequency for adolescents engaged in their work. There are periods of engagement interspersed with bouts of talk

controlled by the pupils themselves, in order to draw out the key features of the talk, as revealed by the codes, a sample of the colour coded conversations from the other transcripts is now included.

Sample 2

Lesson 2 – Group 1

In this lesson the context of doubling of corn placed on a chess board is used as a concrete representative to support pupils to think about the reality of exponential growth.

Time	Code	Transcript
7.04.07		AE – Key Q's: Why done this? Anything else like this? Any words help?
7.04.59	I P	Sheila – I just think lockdown Mike – Guys its Harry Potter and the goblet of corn Harry Harry you touched the goblet of corn Gwen – You are talking absolute potatoes Mike – No its corn not potatoes Gwen – Can you imagine corn that pops and makes a potato? Mike – You mean like popcorn Gwen – Lobster and potato x 2 Sheila – Is that a thing? Gwen – A Pink potato Sheila – A blue carrot Mike – Hey guys its me, Mobster 1, 2, 3
7.06.07		AE conducts feedback using register to pick names. Can you decide who is talking etc, What is going on here etc. 1 minute to agree
7.06.29	I	Mike – So this man is obviously very wise and I don't know why he picked corn, he could have picked wheat to get a bunch of bread but ...
7.06.45	A	Sheila – You can get popcorn, sweet corn, corn on cob
	E	Mike – You could get bored with corn everyday but wheat Could make different types of bread
7.06.57		Gwen – What if he was gluten free like Emily Mike – Lactose intolerant Sheila – Yeah, that one Gwen – Wheat, gluten, lactose, dairy Gwen – Wheat and gluten free
7.07.20		
7.09.02		Feedback
7.09.16	I	AE now writes 'exponential' on board – What comes into your mind? What make you think more about? Gwen – Exponential Mike – I think Alan can do the speaking for us Gwen – Experience Mike to Sheila – Since you are such a genius at everything Sheila – I never said

7.09.46	A	Sheila to girl trying to say exponential and both laugh Mike – Give me my corn back Gwen, I dare you Alan – inaudible
7.10.07		Mike – Classics kernels AE now write r number on the board
7.10.25		Gwen – What's the r number Mike – The thing you put in front of movies
7.10.51		AE input on r number – The government want to get it below 1 Mike – Money
7.11.17	A	AE – Covid – if the r number is 2 what does that mean? Talk about that Mike – Higher Gwen I can see your corn ... I like to see your kernels have you got none
7.11.36		Gwen pulls face Mike – Oh my Alan, did you actually write all of the numbers.
7.12.13		AE stops
7.13.13		Mike – Shhh AE points to news and gives examples AE – Why might this help someone understand how dangerous the virus is?
7.13.28		AE – Anything else like this?
	A	Gwen – Talk ... about the virus Mike – Talk Mike – Gwen how many cobs do you have? Sheila – Thank you so much Mike – You like my cobs?
7.14.13		Alan makes some comment Mike – Alan Best to try Sheila – No-one can beat me Mike – Determination is the key Gwen and Sheila chat
7.14.36		Mike – Is Gwen secretly bugged? Sheila – No she has a hard kick Mike to Sheila – Why are you so Gwen – It really hurts when you kick people apparently AE now mentions politicians and D Trump in this context

Comments

This ten-minute episode of talk shows a mixture of different talk types, including personal sharing (E) and playful talk (P). It reveals little meaningful intellectual engagement (I) talk and also limited off task, or pupil agenda (A), talk and as such this episode serves to help to build a picture of the hybrid mix and the 'pattern' to the talk taking place. The emergence of A talk is very much linked to context and, in this case, the use of real corn is a cause of potential disruption and so this may serve to prime less I talk than would normally be the case. At 7.09 the use of the word 'exponential' by the teacher results in I talk which reveals the potential of the teacher to influence and steer the talk taking place. Later clips will show how the appropriate talk from a teacher serves to trigger a response from the pupils and how this can be used to steer the pupils into I talk.

Sample 3

Lesson 4 - group 1

Lesson four involves pupils thinking about the need to include both control and experimental tests when trying to decide upon the effectiveness of any treatment such as do fertiliser give you bigger parsnips etc.

46.20		AE shows the grid and the four options 'Does this help? Talk about that
47.17	I	Mike – If the point is to make the parsnips bigger then surely the evidence
		New girl – Why are we and that group being recorded?
	A	Sheila – I don't know
		Alan – inaudible
		Mike – What .. Sheila wake up
		Sheila laughs
		Gwen – I'm not a dog
		Mike – A duck
		Sheila – Quack, quack
		Mike – Woof
47.51		Sheila – It helps because
		Mike – You can see how many are bigger
		New girl – They are all similar size ..
		Mike -
		Sheila – Yeah, what Kyle said
48.08		Mike – How many got bigger how many got smaller
		Mike – Hannah how many got bigger? X 3
		Gen replies in kind and Mike laughs
48.15		
48.41		AE feedback
		AE – does this help, how help? (refers to grid)
48.53		AE – think of something to say
		Mike – Could help, maybe ... the results are too diverse to be put into a linear table .. you have to have multiple sets to get it right
49.02		
		AE feedback + shows perfect results (treatment + effect = 15 and no treatment and no effect = 15
53.00	A	Mike utters a word 3 times Wagam?
		Mike to Sheila – Stop looking at the lights
53.11		
		Sheila – We read about that in English
		Mike – Yeah
		New girl – What Macbeth?
		Gwen – inaudible reply
53.23		Mike – Weird, why are they trying to eat a woman?
		Sheila – Reads from Macbeth poster (or work on wall) for 10 seconds

54.56		AE uses the numbers from the slide 20 : 10 (prove to disprove) ‘Is this strong enough evidence?’ AE also mentions head and shoulders Sheila – I have dandruff, I don’t use Head and Shoulders Gwen – inaudible reply Sheila nods in agreement
55.20		AE – Talk about that now Mike – No Gwen and Sheila carry on talking about shampoo (price or size of the bottle!) Mike – Test over and over and over again .. on average you would set after set Trial 1, 2, 3, 4 Sheila - A big white bottle
55.38		New girl talks to Alan – inaudible because of masks Gwen – Shampoo last ages Mike – What are you two talking about Gwen – Shampoo and conditioner Mike – Does not sound like parsnips
55.50		Gwen- Charlotte makes potions AE can be heard talking Gwen - makes potions with all shampoo and conditioners Mike – So you are a witch
56.03		Sheila – You would have stones put on you and thrown into the river Mike – Stones put on you Sheila nods to Mike Gwen – Its break time
48.34		AE – put hands up if think enough evidence? AE – never get perfect results – what results are enough evidence? Now refers to covid vaccination process
49.06	I	After break – clip 3 – camera switched on late as pupils working on fish oil tablet card sort activity Mike – This is a set of results, look at all the frowns Sheila – They all look the same New girl – No they are not Mike – We also have a couple of smiley faces Sheila – Smiley face, smiley face x 5 (she does this as she places down the cards)
49.13		Sheila – Ahh I am going to separate into smiley faces Mike – so smiley face with and without pill ... so remember that with and without pills are different New girl – Okay so if take drugs you are happy and if you don’t take drugs you are not happy

49.54	Mike – Yeah, yeah, yeah, that’s how they do it on tiktok Sheila – Smiley face (said as puts cards down) New girl – Ah look Mike – Ah, all these men all taking roids New girl – Its just Mike to Sheila– You need a smiley face pill, smiley face not pill Mike – No I literally just Been putting them in groups Mike – Stop mixing them Hannah – we need to put into groups Sheila and new girl laugh Mike – Smiley face, pill, smiley face without pill are different This one had the pill and still did bad
50.16	Mike – Give us the cards, you cannot just hold them Sheila – I’m holding the cards Mike – More smiley faces with pill You have to ...
50.35	Gwen and Sheila– Just fly away ... Mike – Smiley face without pill and smiley face with pill Sheila – I will sort them Mike – Gwen we are 5 miles an hour x 2
51.01	New girl – I think ... Mike – Smiley face with pill, smiley face without pill ... unhappy without pill, happy with ..
51.16	New girl – Pills make you happy Sheila – Looks like they are nuts Mike – They are not nuts they are fish oil pills happy with pills Alan – Why are they happy with pills
51.41	New girl Only ... happy with pills – go for it Mike – The evidence would show that has more effect on men New girl – Drugs help men Mike – Grrrrr (clenches fist) .. happy with pills, happy without pills. So men are dumber but when take pills they are smarter
51.53	Mike – Men are dumb but when take drugs are smart Alan – Happy women will not take pills Mike – Took pills, no all men who succeeded took pills so females succeeded without help from pills Sheila – Mike is my dad! Mike – Don’t take the men with pills Mike – For the rest of the rest of this lesson you have to talk like a ... man Mike – Just count how many in your pile and what gender they are
52.20	Gwen to Mike – inaudible Mike – No, I refuse Sheila – Not allowed
52.33	Mike – 9 men succeeded overall and all 9 took pills Sheila to Gwen – That’s yours there you go Alan to Gwen – inaudible New girl – I’ve got 10 women who are upset because they did not take pills Sheila – I have 11 women who are happy to take drugs

53.02		New girl – They did not take them and failed Mike – She has women who are unhappy they took drugs Mike – Maybe The pill works better on men Gwen – So why is she smiling when New girl – Harvey What did yours look like because we got these? Inaudible chat follows Mike – men are happy that they took drugs Maybe this suggests that the pill has better effects on men than women New girl – They are the same ones Mike - Might effect women in the reverse New girl pills .. Alan – Teeny, weeny, teeny, weeny
53.25		Mike to new girl – inaudible then ‘Look at those unhappy men because they did not take drugs LSD before the test Mike – Poppy you are ruining the evidence Sheila – Poppy you are ruining everything Mike – Me and Gwen have taken a lot of time and been careful about everything
53.45		Gwen – inaudible Mike – Sheila, all your women took drugs and now they are upset Sheila – Gwen Mike – My men took a lot of drugs and they are very happy Okay this is what happens when you do roids
54.00		Inaudible Mike – This is what happens when you take roids – you get happy Alan - Inaudible
54.20		Mike – You win the physical fitness test look at all those happy women Gwen – I would not say I normally get drunk Mike – So would the data show that women are unhappy when they take drugs?
54.33		Alan – I’ve got Mike – Look at all those men, they failed because they did not take drugs al the men that won took drugs New girl – Same as us (to another group)
55.17	A	AE stops and asks to swap cards with another group Sheila and Gwen – inaudible chat Gwen – I will just go round Sheila – I don’t James and ... Mike – Remember your numbers for the drugs and the How many ... I’ve got 9 Sheila – James texted New girl – Mike you need them all Mike – Remember your number Gwen, remember your number Gwen – I did not count them Sheila – You had 11 Gwen – I had 8

		Mike – So 8 women who were happy they took drugs, this is like when anti-depressants depress you Jade needs to take her photo ... do you know this Tamsin Alan – Mike, the bag New girl – What are you doing?
55.52		New girl – He has a new bag Alan – Ahhhh
56.00		New girl – Ahhh ... I am so sorry Sheila – Poppy Mike – Do steroids make you buff? Mike – I'll take the men with drugs Sheila – Wait a minute I am doing this Mike – I'll get the men who took drugs Alan – I want to write something Sheila – Write a number on Mike – You have to be able to tell if they are buff or not
56.38		New girl – my boy is buff Alan – I want women who took drugs New girl – I want my independence Mike – they are frowning if they are weak virgin men Sheila – Write your number on there Mike – My what
56.56		Sheila – Your number Alan – Mike, you really Gwen – How many cards do we have? Sheila – Come on Kyle 1 to 10 ... 9 men and what I noticed was that ... Mike – The women who took fish oil tablets all failed. The men who took the fish oils succeeded ... only the ones who took the fish oil pills New girl – I've got the guts who ... Gemma – Does that prove anything? Mike – You would have to do it about 15 times Alan – Wrong person (?) Mike – Fish oil This has been shown to help with brain so I would not be that surprised if you know its not that far off Look at all these .. so the men who succeeded ... most of them did not no, no, no, thats a fail Sheila grabs cards – I want these Alan – I don't have any ...
57.41		Mike – I have the weak people who took drugs New girl – I have the strong ones Sheila – Strong ones who took drugs Mike – Strong females who took drugs Sheila – Didn't Mike – That's a weak virgin woman ... weak You're a virgin Kyle Alan ... ahh wait I forgot you are not

57.59	Alan – I forgot you were not a virgin Inaudible
58.13	Mike – Don't you mean my sister ... Laughter Mike – Why are you looking at my sister Alan? Gwen – Your sister is in my sisters class in school Mike – Wow New girl – I don't have a sister Sheila – Sisters class in school Gwen – His sister is in my sisters class in school
59.00	Mike – Miss Is it true that the men who took failed? Inaudible Sheila – Ahh the disrespect Mike - repeats Alan – I only had 2 again Gwen – I had 22 Gwen – I had 2 Mike – So 12 men failed AE stops – This is difficult, like juggling etc New girl – I can juggle AE – Like juggling with things in your mind Control and experimental
59.55	Gwen – I don't understand why Sheila - Someone Both girls laugh Sheila looks embarrassed – I didn't ... Alan – What are you two on about? Both girls laugh again Alan – Yes Gwen – Sheila is not a virgin Sheila – I am a virgin (said v quietly) Sheila smiling – Gwen's not Both girls laugh Sheila – You are not Gwen – I am Sheila – No you are not (They both repeat this to each other)
12.06	Alan – inaudible Gwen – I got a paper cut Sheila – Really..... Mike – So men who took drugs died but when women took drugs they are happy Sheila – Happiness Mike – Depression New girl – I got Sheila – I mean I probably would Mike to Sheila – Look at that Sheila to Gwen– You folded them
12.33	Mike – Women who take drugs and now they

		Clip 4
12.43	I	Gwen – You weasel Mike – No drugs, weak (to girl 1)
12.53		Sheila – Have you written your number down New girl – Yeah, 22 Sheila – Do you remember what it was? Mike to new girl – Kyle could not find me Sheila – Well the other one was New girl – How many had drugs
13.22		Alan - ... flick you on the nose and you would feel it Mike – 9 men who took fish oil pills won and 12 men who took drugs failed The fish pills ..
13.40		
	E	Mike – I mean fish improves your brain so it would not be far off for pills ... my Grandad always told me that cod fish helped. Sheila – They make you smart She Alan – No-one cares about your Grandad New girl – My grandad died Alan – My dad Mike – OMG Alan – I remember when I was a kid, on the news saying my dad had died saying that I needed friends ... that was really depressing Mental instability
14.01		Sheila to Gwen – Well she felt They need to tell each other
15.12		everything
16.30		AE – Put the cards in the bag Mike – If I put the cards in the bag how can I understand that men New girl – You wrote it down ... Sheila – She said ... ohh shut up
		Mike – Wait a minute 12 men no drugs. Men are just naturally amazing at getting buff. 22 men no drugs.... That does not make sense, men who don't take drugs are naturally buff Sheila – Well she said she might ...
18.15	A	AE stops class Mike to Gwen – Why are you doing stupid Tictok dances? Sheila laughs Gwen – Cause (raises hands)
18.40		AE manages feedback but calling out random names AE stresses how talking helps your thinking Feedback takes place Gwen to Sheila – Shut up (she is embarrassed)
19.07		Sheila whispers to Gwen – Keep ... you're a virgin

Comments

This episode was purposely picked as it includes two very long periods of talk of what are proving to be the main categories which are intellectual engagement (I) and pupil agenda (A) talk. There is a mix of other types but these two dominate. This episode confirms the typical pattern of talk: one where I and A are the most frequent types and are interspersed with episodes of the other talk types. This begs the question, does CASE provide room for the other types of talk? How much is this down to the role of the teacher to allow and promote a range of talk? These questions will be explored more fully in chapter 5.

This episode of talk takes place over 30 minutes and illustrates the pattern of talk across many of the lessons. It highlights how talk type I can be more prevalent in the earlier stages but here which drifts into positive A talk which is primarily due to the engagement of the pupils with the cards. In their minds this shows a link between steroid use and exercise. Something similar also occurs at the end as the pupils share their views on smoking which derives from the teachers linking of the lesson agenda to a smoking cessation trial. This clearly illustrates the value of differentiating A talk into positive, negative and neutral. There are two triggers here one relating to the lesson agenda/content and the other which derives from the teacher's own choice of related context. The triggers result in real engagement from the pupils during which they follow a line of conversation that is of interest to themselves, steroid and smoking. Due to this the code positive A is applied to these episodes of talk. The lesson ends with a period of negative A talk as the pupils begin to discuss a fight that almost happened after school. Towards the end there is also an interesting period of personal sharing (E) triggered by the lesson context the use of fish oil tablets which links to his personal experiences of his Grandfather.

Initial conclusions from the application of the codes to the CASE transcripts

The colour coded transcripts show just how useful the codes are as a tool to support the practical analysis of pupil talk from a third space perspective. They are indicators that enable the exploration of construction zone activity as I seek to make sense of my CASE experiences. The codes are a working model that can be updated with use and, as they attempt to make the third space visible, they will enable me to build upon the work of Maniotes and also to apply this to other curriculum areas.

4.6 Paired comparisons from the same point in the lesson

We will now look at a comparison for both groups from the same point in the lesson. The reason for doing this is to explore how the groups respond to the same stimuli. Lesson 6 will again be used as an example before samples from the other lessons are shared.

Talk comparisons from lesson 6 – How many are there?

Comparison 1

Taken from the first 2 minutes of the lesson when each group has been given a different starter question.

Group 1	Group 2
Alan – Oh my ... I have not even Mike – Each year Mike – This is tripe ... Alan – I fractured my fingers Gwen – Ahh, have you Sheila pulling face – Ahh Mike – Each year Sheila – It moves backwards how? New girl – Mine like that Gwen – Mine don't even go forward, never mind back Sheila – I can do that ... Mike – Guys look, guys look at this finger, fingers on your hands! Sheila – I can bend this one Alan – I fractured these two fingers Sheila – What does it say? Mike – I'm reading it Sheila - I was trying to read it Mike – I was reading it out loud Sheila – I don't like listening to people read aloud I cannot read out loud, I'm dyslexic Sheila – Each year Mike – I thought you said you were dyslexic Sheila – When people are reading it out I cannot read it New girl – it confuses people Sheila – How many are there? New girl – 7 Sheila – 6 million Mike – This is tripe Are they allowed to decide how many fish we can catch Its disgusting. Sheila – What? New girl – I think its 6 million Mike – I'm glad we left the EU Sheila – 6 million Gwen - what are you talking about? Sheila – Fish Mike – Basically ... there is a big evil government in Europe ... that say you	AE – Here is yours okay. Trevor (grabs it) – What is this? Ron – How many are there elephants Emma - because you wont know where they all are because Gillian – What Trevor – Ace question Alan – You don't know where all of them are Simple. Alan – Why have you got a book? Trevor – inaudible Alan – Why have you got a book? Trevor – They are all the same book Gillian – They are not Ron – They are Gillian – They are not all that book Emma – I have not seen an elephant before Gillian - I have only ever seen one once Trevor – I went to a zoo Gillian and Emma – inaudible Ron – I saw a video of one Trevor – I smell quavers have you been eating quavers? Ron – Well I saw a video of two doing Emma – inaudible Trevor – How many are there? Gillian – One elephant Gillian – Lots Emma – Hundreds, there are a couple of hundred ... did you just ... elephant Trevor – they are probably owned by some (slave) company Gillian – inaudible Ron – No it's a slave company Emma – Are we going to watch Gordon Ramsey? Gillian – Its something else

are only allowed to catch a certain number of fish New girl – Its says how do they know that the number is rising or falling it does not say you need to like guess a number Sheila – I'll guess a number Mike – I reckon it's the birds ... they have cameras in the birds ... because the birds work for the bourgeoisie. New girl – Its rising because of more birds Gwen – The government see ... Mike – The government have camera's in the birds that's why zoos never have any birds because they are out doing their job	Trevor – Uganda Gillian– I sit in the weirdest Trevor – Gordon Buchanan (struggles to pronounce) Gillian – I sit in the most awkward positions ever Trevor – I thought Gordon Ramsey because he could not cook an elephant

Comparison 2

Follows a story told by the teacher about using a camera trap as shown in the video clip the pupils watch.

Group 1	Group 2
AE – I did that in my garden the other day guess what I saw? Sheila – A hedgehog Alan - Rat Mike – Rats no AE tells story (something eating food in garden etc ... saw a cat and two rats and got rid of them) New girl - Them tigers Mike – My cat brings in rats everyday man AE – I trapped them Mike - You have to keep him locked up because if he gets in the kitchen there will be a rat there. Sheila – You have rats in your kitchen! Mike – Yes, he brings them in Sheila – I think your cat has issues. AE can be heard talking Sheila – I thought you stabbed your cat with a fork Mike – No my sister stabbed my cat with a fork its not dead! Alan - And put in a blender	AE – I did that (camera trap in garden), guess what I saw? Trevor – Tiger Emma – Frog Trevor – Worried there AE talks to the class and answers questions re the rats in his garden Trevor – Trap to kill them Trevor – Catches them, starves them and they run out of food Gillian – That's disgusting Trevor – You know how people are Gillian – Trevor look .. AE – He spotted one tiger Gillian – And cries AE – How could he use this evidence to get a sense of how many there are – talk about that ... Gillian – How does he not count the same tiger many times? Emma – They could follow it Ron – It's night time Trevor – How is he going to follow it?

Mike – No my cat got its foot in a blender AE – My question to you and what I want you to think about he spotted a tiger So how would he get a sense of how many there are? Mike – He should strap cameras to himself and stand in the same area to see if it comes back. Sheila – He could run after the tiger to see where it goes. Mike – No see if it comes back to the same area New girl – They do that actually Sheila – I’m so smart Gwen – How is your cat not dead Mike – I fork is not going to kill a cat ... my cat is not dead AE – Can I have the questions back please? Sheila – I thought you said your sister stabbed your cat with a fork Mike – It depends how hard you stab it ... my sister was , you know five New girl – Were getting recorded and you I got stabbed in my leg Sheila – You don’t know how funny ... Alan – If she stabbed it in the head would it get brain damage? Mike – what? Alan – If she stabbed it in the head would it get brain damage? Mike – This man just hates my cat so much Gwen – Your sister is in the same Sheila – What if you stabbed it in the abdomen? Mike – What if Carl Ferguson bought my cat a lollipop what would happen? Gwen – Well your sister is in my sisters class at school AE – Okay New girl – You had better ... Mike – What? Gwen – Your sister ... AE – You will never, ever, ever Know how many of a species there are a giant otter popped up on my phone	Trevor – If the tiger went of camera how would he follow it? Emma – The tigers live Gillian – I’m just concerned what if he counts them and counts the same one again Yeah I saw that one yesterday and I counted it again! Trevor – What if one comes up behind him, what happens then? Trevor – what is going on? ... I liked that piece of paper Trevor to Ron – Do your arms ever get sweaty wearing that? Ron - (inaudible) Gillian – It does look breathable Ron - ... I am used to it Trevor - ... Ron – I’ve worn them since Trevor – What breathable AE input – never, ever know how many Mentions Galapagos tortoise that had been in the news

after being found in Argentina. hopefully use skills to estimate	

Comparison 3

Following a carefully chosen anecdote shared by the teacher concerning some research showing that snails have a homing instinct.

Group 1	Group 2
AE – You could actually spray an animal talks about homing experiments with snails putting tipex on them ... its possible to mark an animal AE – Which idea that you have heard could help Mike (to the class) – You could microchip them with a gun AE – Like you do with a dog Mike - Yeah New girl (to group) - ... camera and attach it to them Mike (laughing) – ... and put them in a van till you are done New girl - no you them Sheila – You would have to put it round their necks New girl – inaudible Mike – you are not going to get a baby tiger with that attitude Sheila – I want a baby tiger Gwen – inaudible	AE now tells the snail story about a guy marking snails to see if they would return. Trevor – They spray painted a snail! AE – Animal migration is fascinating Trevor – Is it! Trevor - Snails are magnetic! AE – You have homing snails Trevor – Homing snails - ... can they follow stuff? AE – You know how to get home, maybe snails do Gillian – Not really I get lost Trevor – I just walk I happily follow my nose Mike (rom group 1) shares – You could microchip them Trevor – Ahh, see Gillian – But that can ... Emma – That’s inhumane Trevor – Its not inhumane ... it does not hurt them Gillian and Emma – inaudible response Gillian- Yeah you are shooting them Trevor – You do it with dogs Gillian – My dog ... Emma – You cut open its skin and ... Trevor – Dogs get chipped Gillian – that’s because its illegal not to Trevor – You don’t have to its not a legal ... Ron – It’s a safety thing Gillian - Trevor – It’s a safety thing in case it gets lost

	Gillian – But it's a wild animal ... ahh yeah just going to shoot it! Trevor – So .. Gillian - Trevor – Shut up

Comparison 4

Here the pupils come back to the class and begin to work following morning break which in this period splits the lesson into two.

Group 1	Group 2
Mike – Would you say you are a big fan of New girl to Alan – Put the cow in front of here Alan – Hello (with the cow) New girl – Sexy cow Mike – So would you guys say there is a big red combine harvester New girl – No Mike - Basically so do I replace with 17? New girl – No we have already have G ... leave the beans alone Mike – I'm just touching the beans I'm allowed to touch the beans my beans AE – make sure you have all done the first part, then stop I had 50 Mike – It turns out that my 52 was closer ... New girl to AE – Do you put them back? AE – Yes you put the new ones back New girl to AE - Yeah, okay AE to class – You have replaced them Mike – OMG, I have turned all these beans into 1 bigger one! I have made a big beans Sheila – OMG It lights up New girl – Its really blinding Mike – Stop messing about with the camera Gemma moves towards the group	Ron – I'm next to Max next lesson I'm next to Max AE – While we are waiting Trevor to Gillian – You are a racist you are racist AE recaps Gillian – 23 Ron – What did we do again? Gillian – Wait ... Trevor – I don't like beans ... I don't like beans Ron – By the way there are 24 as I picked one off the floor Ron – I don't trust you, I don't trust you AE – Did you do it, how many did you take out ALL – 23 Ron – 24 Gillian – Shush Gillian – If you hit me I swear I will smack you Gillian – Ow, you Ron – I was scared for my life ... I was scared for my life He could have killed me. Trevor – I am the bean master Gillian – Does it actually hurt? Ron – I'm doing basket ball AE – Okay Year 9 Gillian – You know when you play basketball, is it not really difficult? Aren't you really bad at it because you are small?

Mike – I had 52 but they did not want to do that last New girl – We did it with 17 look into it its bloody blinding Gwen – Let me have a turn Ahh Mike – What’s the point of having a baby tiger if you cannot see one Sheila – I can see two dots New girl – Mine are there AE claps hand - Year 9, listen up, shush Sheila – Ooooooh I love it, it makes a sound to Alan – You can have it if you want Sheila – I love it, can I actually have the cow that lights up and makes a noise ... I love it	

Comments upon the comparisons from lesson 6

Comparisons one and two reveal what is proving to be the standard pattern of talk; a fluid mix of types I and A. Comparison one shows a mixture of type I and positive A that is indicative of intellectual momentum as both types of talk relate to the task the pupils have been given.

Comparisons two and three highlight the role of the teacher in steering the lesson agenda towards I and positive A talk which the task itself caused in comparison one. In comparison two, Group two do talk for longer than Group one and similarly in Comparison three, Group two show evidence of I talk for much longer than Group one, the opposite of Comparison one. In contrast, Comparison four highlights the fact that without any teacher input or structure, negative A begins to dominate. This clip is from the second half of the lesson when the pupils return from break and before the teacher has re-focused the class. Break causes a loss of intellectual momentum within both groups which is the opposite of the pattern of talk in the first three clips. This is indicative of the pivotal role that the teacher plays in steering, promoting and engineering classroom talk. The addition of red to code for teacher talk enables us to explore causality resulting from their input, allowing us to focus upon the impact of the choices the teacher makes during the lesson. Comparisons two and three clearly show this and illustrate how the talk changes in response to the teachers input. From these episodes we can see how the teacher can actually promote specific types of talk- I am calling this influence a trigger to reflect the fact that the words used by the teacher clearly elicit a positive and desired response from the pupils.

The colour coded episodes of talk shared thus far reveal how varied and diverse classroom talk is, and that I and A are emerging as the most frequent forms of talk. The transcripts show that the third space codes can (following the validation process outlined in chapter 3) be applied consistently to analyse the small group talk taking place. They provide an effective means of capturing the talk that occurs whilst also revealing how unique the talk, shown here as colour palette or rainbow, among any group of adolescents is. Despite the differences between groups the patterns in their talk are clear and similar and so the codes enable us to look common threads running through the talk occurring in CASE lesson regardless of which group is recorded.

4.7 Emerging findings – exploring talk through the lens of the third space

The colour codes are proving to be a way to make visible the different types of talk taking place in CASE lessons. They are proportionate in that they enable a range of talk types to be incorporated into the discussion regarding ‘construction talk’. In addition, they can be used to show the interactions taking place between the talk types, and how these ebb and flow in a natural setting as part of the bigger picture of how talk develops and morphs throughout the course of a lesson and the role of the teacher in this process.

I propose to use the colour coding to construct an oral talk map of classroom conversations. In the same way that weather maps include the range of variables that make up the resulting ‘weather’ such as wind speed and direction, temperature, amount of sun or rainfall, cloud cover etc. As such, all of these are used to describe, and predict, the ‘weather’ including time of year, prevailing winds and the direction of the jet stream. The colour codes allow something similar to be done with classroom talk. Instead of prevailing winds influencing the weather in a particular region (classroom), we now have the notion of a trigger, a stimulus often used by the teacher in CASE, to shape and influence talk. This raises questions regarding causality in talk just as pressure systems, wind and prevailing winds can be used to predict the weather, including the chance of rain. This will be applied to gain a better understanding of the influence of triggers upon the classroom and chapter 5 will explore this in detail.

Thus far we have seen that without the addition of the codes the transcripts are simply a factual record of what was said. Some form of differentiation is required to help describe the types of talks taking place and the possible causal factors that influence the oral environment within the classroom. Using the codes, and their colours, makes the creation of a pictorial representation, a weather map if you like, of the talk taking place possible. Having a clear way to see the talk enables us to reflect upon the following questions:

- What are the most frequent types and patterns of talk?
- How does A manifest itself with the lesson (i.e. positive A, negative A, neutral A) and what is the impact of this? Can we use A to quantify how successful the talk is and what are the factors that cause a shift to negative A?
- Are there any differences between/across each of the six lessons?
- What about E, P and R – how frequent are they?

Using the colour codes clearly illustrates how varied, complex and interwoven talk is. The codes facilitate an exploration of how connected to the teachers talk, including the choice and use of triggers, pupil talk is. They do, however, serve to highlight how hard it is to make simple predictions about talk such as exploratory talk. Wegerif (2005) raises the following point that the inclusion of the category ‘playful talk’ will enable the further development of ‘exploratory talk’ to develop a broader model of construction talk that is inclusive of the full range of adolescent talk. His reference to ‘a broader model of constructive talk’ resonates with this study for the third space colour codes reveal, in a very visual way, what the rich tapestry of adolescent construction talk looks like. A key aim of this research is to spotlight talk in CASE lessons and the codes facilitate this. In line with Wegerif, as a CASE teacher, I too am seeking to trace the connections through the transcripts including the teacher and lesson design to investigate their role and the value of triggers. Not only do the codes support my exploration, but they also help to shed light upon the nature of ‘construction’ talk and so therefore provide a useful lens to probe more deeply into the patterns within the CASE transcripts. In reality all talk, whether in CASE lessons or not, is a hybrid mix of resonances in the words of Wegerif, a translation in the words of Bhabha (2004), a heteroglossia in the words of Bakhtin or a merger in the words of Maniotes (2005). The third space codes, especially the inclusion of A, bring a sense of reality and show what real talk is like and how fluid, dynamic

and responsive it is. In addition to this the causal role of the trigger can help show how conversations can be shaped into forms supportive of 'construction' talk. This is very much a counter to Nuthall who found very little meaningful talk in classrooms. In CASE lessons we have learning encounters that are designed to promote social construction through the medium of appropriate conflict, here termed a trigger, to engineer meaningful, or constructive, talk.

The codes themselves are simple descriptors but they enable the grouping of talk into five simple categories. The inclusion of the teacher talk, red, enables us to focus on the possible causal factors (triggers) and the role of teacher choice in the lesson itself or in the planning stage. This leads to the emergence of a possible pedagogical strategy to promote talk – pulling the trigger. My position is that talk, in CASE, can be viewed as being generated by triggers and that the nature of CASE supports and facilitates this. The key idea after this brief look at the colour coded transcripts is that the cognitive conflict or a trigger (or the difference that is primed in the words of Bhabha) can steer and guide classroom talk. So in CASE lessons triggers have a pedagogical role to play as they fit into the weather map model of classroom talk to help view and account for classroom talk/behaviours in general.

Chapter 5 Introducing the weather map, the forecasting of pupil talk and the teacher's role in shaping it

5.1 Introduction

This chapter will focus upon:

1. Using the colour coded transcripts to develop the 'weather map' model of small group talk and;
2. The role of triggers as a strategy (both in lesson design and as a pedagogical technique) to influence and shape the 'construction' talk taking place in the classroom.

These two focal points will support the re-articulation the CASE approach and classroom, one where construction zone activity is engineered to develop a climate of thinking through small group talk. Such talk has been termed 'construction talk' by Wegerif (2005) and the conversations therein, categorised as third space talk here, are ideally achieved via the merging of a pupil's life experiences with that of the curriculum as presented, and chosen, by the teacher. This chapter will use a 'weather map' as a visual representation to show construction zone activity. This coupled with the notion of a trigger will support the wider exploration of classrooms underpinned by the ideas of Vygotsky and Piaget. In chapter 2 the term 'perezhivanie', a Russian educational phrase with no real English equivalent, was introduced. To Vygotsky this phrase encapsulated a learners' 'lived experiences' in a way that acknowledged their contribution to the development of a learners' personality. In chapter 2, section 2.12, I argue that an updating of this concept will support 'a new direction to apply psychology in terms of drama' (Vygotsky, 1989, p. 71) and indeed to show how this can shed greater light upon the engineering of construction zone activity.

There is a need to provide a realistic categorisation of small group talk that includes 'all the talk' and reflects the everyday conversations of adolescents and the third space talk codes can help in this regard. The inclusion of codes A and E bring a sense of reality whilst allowing the range of the different types of talk to be included and represented as part of the construction talk taking place. Further to this Vygotsky's notion of a collision is supportive of Maniotes use of the term merger and both are dependent upon the interaction of two ideas and that this is key aspect of what is taking place, theoretically at least, in CASE. Construction talk, as occurring during construction zone activity, therefore needs to both include and reflect all the talk taking place within the social plane. In order to support the move to the internal intra-psychological plane, they need to be expressed, modelled and validated as valid forms of classroom talk. Any 'merger' resulting from a carefully planned trigger and how this is refracted by the child can be picked up by the codes. Much of what is being said in chapter two seems to have been neglected in many of the discussions concerning the application of Vygotsky's ideas to education. The ideas of 'dramatic contradiction' and 'perezhivanie' are foundational to this study and the exploration of construction zone activity. This is also being done in a way that reflects the real-life experiences of the many 1000's of pupils I have taught. The concept of perezhivanie may be the 'holy grail' regarding the analysis of classroom talk and could be viewed as the glue, so to speak, that hold everything together as a unifying thread linking Vygotsky to the third space and CASE through construction zone activity and 'all the talk' taking place therein.

The third space codes, especially P, E and A, are a way to include the oral expressions of a learner's lived experiences during 'construction talk' taking place. This will bring an understanding of 'prezhivanie' to the attention of the wider educational community. 'Prezhivanie' aligns with the notion of the third space as, in the words of Moll et al (1989), something that supports learning by enabling teachers to bridge (or merge) every day, and scientific concepts and allow all (pupil)

voices to enter into conversations. To support such an environment Moll suggests that teachers create learning experiences that engage pupils through carefully listening and by making it clear that they welcome the many different ideas they bring with them. This is the value of talk codes E, R, A and P as they bring a recognition of the value of integrating the knowledge pupils bring with them into the classroom as a means of developing new understanding. It is the focus of this chapter to show just how the conversations as revealed via the weather map provide an insight into 'construction talk' - the very talk that populates construction zone activity. Nuthall provides specific advice for those seeking to create a classroom where teachers are more involved in the culture of their pupils as part of the development of learning experiences. This aspect resonates with the use of triggers to engineer talk and the focus in the transcripts upon pupil agenda A talk and its differentiation into positive, neutral and negative. Nuthall's descriptions (see chapter 2 page 28) of the attitudes and beliefs students need sound very much like the key features of the CASE approach which further supports the use of these lessons as the focus of this study. Moreover, it serves to highlight the gap I have identified in terms of how to describe what is taking place in construction zone activity and that the concept of the third space can support our understanding of such. Lemke (1990) feels that science teaching should be seen as a social process and one that connects to the attitudes and interests of the local community. The third space talk codes are therefore a useful route to explore construction zone activity as represented through a weather map. The result is a more detailed picture of construction zone activity that actually relates to the lived experiences of pupils i.e. 'prezhivanie' and its oral expression as represented by the five talk codes.

To Bhabha (2004), it is the potential emergence of something new in the mind of the learner that gives the third space productive capacities. Talk codes A and P support his idea of translation whilst enabling the inclusion of the range of pupil talk associated with any group of adolescents, which in turn supports the differentiation of this talk type A into three categories. To Bhabha, the creation of a third space is dependent upon a difference, between the two positions or spaces, existing in such a way that primes the development of thoughts and ideas. Vygotsky describes this as aiming and the buds of development rather than the fruit and priming is a helpful verb to use in the sense that such, prior, conditions are requisite or necessary to support the future development of new thinking in the mind of the child. It can be argued that in the classroom it is therefore the responsibility of the teacher to prime the productive mixing of the first and second spaces through the choices they make as they both plan and teach. CASE lessons specifically require an environment of reflection, group work and social construction, termed construction zone activity, to provide the conditions necessary to support pupils to accommodate new thinking, something that is possible because of the distance between the thinking of adolescent learners and the focus of the CASE lessons and its cognitive challenges.

The weather map model will allow an analysis of the transcripts to:

- Explore causality in talk;
- Look for patterns between both groups and across the lessons;
- Include and show triggers in action and the implications of this as a classroom management strategy.

5.2 Using the codes to illuminate construction zone activity

This research stems in part from Michael Shayer's admission of only an intuitive understanding of Vygotsky at the time when CASE was first published (see page 41). This study is therefore revisiting CASE based upon the hindsight afforded by teachers (like me) who have explored the pedagogy of teaching CASE with regard to the application of the ideas of Vygotsky. It has become clear to me as both an experienced teacher and someone who mentors teachers that CASE is giving permission for a certain type of culture to operate in the secondary science classroom. This is commonly seen in the positive teacher and pupil voice regarding CASE (personal comment by the author and used with permission) often used to describe the impact of CASE upon their practice. The email below was received by me at the time of writing and can be used to exemplify this:

Hi Alan,

I am a retired Science teacher and fondly remember using CASE worksheets during my career.

I would like access to the CASE worksheets and am also interested in the other materials you make available e.g. CAME, etc. Am I right in thinking that I can join your organisation and have online access to the variety of material available? It would only be used for my own interest and possibly with my Granddaughter!

Kind regards,

Andrew

The use of the word 'fondly' by Andrew signifies that he is clearly aware of something positive, and that different rules of engagement seem to be at work in these lessons. It is into this discussion I am bringing the 'weather map' model of third space talk, including triggers, to help explore what may be occurring. One issue with the use of the word 'fondly' and other such positive adjectives could be that the CASE lesson guidance does not fully describe and set out how teachers are to create and manage such a classroom and thus giving them a vocabulary to specify what this difference is in terms of construction zone activity.

The excerpt below is from the CASE lesson plan (Shayer., 2001, p. 156) relating to lesson 6 'How many are there?' used in this study:

This requires formal operational thought so is difficult. It requires 'seeing' all four numbers in two sets of ratios..... It will cause cognitive conflict as pupils try to hold ideas of ratio, sampling and probability together at the same time. Be patient, keep probing as you go round the groups. If a few pupils in a group seem to 'grasp it' stop the whole class and ask them to explain what they think to everyone (construction). Don't worry if many pupils do not understand this relationship, as in all Thinking Science lessons it is the mental struggle that is important, not the correct answers! There is no need to give an algorithmic formula to 'solve' the problem as this 'short circuits' the effortful thinking being required. (10 minutes)

You may want to do this as a whole-class discussion to draw the lesson to a close. There are no 'right' answers to the questions in Activity 3. Use them to emphasise two important notions in sampling – the bigger the sample the better, and random distribution. Ask the groups to spend 2 or 3 minutes discussing the assumptions they must make if this is to be a useful method of estimating populations in 'real life'. Get each group to contribute one assumption to the whole class, write them up until all can be reviewed.

This guidance, taken from the third edition of CASE, references a mixture of behaviours and strategies, highlighted in red, such as being patient, probing, going round the groups, 'grasping it', no right answers and 'do this as a whole class discussion'. In themselves these are sound pieces of advice but they don't fully describe what construction zone activity looks and sounds like in the depth required for teachers to successfully recognise and promote it. Such advice does not add the necessary fine-grained detail to unpack these statements to help focus teachers on the appropriate rules of engagement and as such they are open to a range of interpretations and could therefore essentially mean all things to all people. The use of the colour codes brings a fresh perspective as to what construction zone activity actually looks like and also the types of talk taking place during such times. In addition to this the idea of a trigger can provide the management techniques to better promote and develop this type of environment. Describing construction zone activity in this way

will enable CASE, and the other CA projects, to contribute to the debate championed by Mercer regarding the role of talk as a key driver of cognitive development. For example, Mercer (2000) when describing how students talk with each other places their talk into the following categories: disputational, cumulative and exploratory. These categories, although helpful, do not fully account for all types of talk taking place during construction zone activity or indeed in any real classroom discourse involving pupils. They do, however, serve to effectively describe the types of interaction occurring during a very specific type of talk – the talk whilst learners are actually engaged in solving a classroom task. The five talk code categories used in this study are seeking to describe the full range of talk whilst at the same time aligning Mercers talk types with the key features of CASE (see chapter 2). Disputational, cumulative and exploratory talk are actually a supportive and insightful way to describe the talk occurring during times of intellectual engagement, code I. Figure four, from chapter 3, has been amended to include Mercer’s three types of talk.

Maniotes	Edmiston	Mercer	Notes and references
Intellectual inquiry Deep reading	I - intellectual engagement	Talking for thinking includes: • disputational, • cumulative and, • exploratory talk.	In CASE construction zone activity refers to work in groups to resolve the conflict. This may involve further reading or research.
Social empathy	E - empathy and personal sharing		CASE terms: Bridging, metacognition <i>Perezhivanie</i>
	R - surprise or reflection		CASE terms: Metacognition and bridging <i>Perezhivanie</i>
	P - playful		CASE terms: Metacognition and bridging Wegerif <i>Perezhivanie</i>
	A – pupil agenda: +ve, -ve, Neutral.		CASE terms: Metacognition and bridging Gutierrez and counterscript Lemke and side talk Bakhtin and Gallas – heteroglossia <i>Perezhivanie</i>

Figure 8 – the talk codes including Mercer’s categories of talk for thinking

This study is seeking to deepen our understanding of construction zone activity which is Shayer’s way of describing the time when construction talk is taking place. Internal triggers (see 5.2) are an important element of this because they are a key feature of CASE lesson design and delivery. These serve to acknowledge the importance of the teacher and the choices they make which is why the notion of a trigger is such a critical pedagogical strategy. To provide a more in-depth picture of construction zone activity, and an oral signpost so to speak, the colours that make up the weather map can be used provide a glimpse into the world of heteroglossia as described by Gallas in chapter 2. This is real talk that is messy in both style and content, but which clearly reflects and refracts the

life of the children when faced with the challenges she provides during science – another description of perezhivanie.

5.3 The nature of a ‘trigger’

The idea of trigger took shape because the colour coding, using red for the teacher, revealed an often marked response in pupil talk following a teacher intervention. The colour codes enable conversations to be tracked and causality to be explored and the talk, that takes place as a result to be highlighted. In this section I will outline the nature of a trigger in such a way that will enable me to introduce the term ‘pulling the trigger’ as a pedagogical strategy to enrich CASE practice and indeed lesson design in general. In CASE talk can be initiated and engineered by a teacher aware of the power of ‘triggers’ and this builds upon Shayer’s description of talk in CASE lessons by deepening our understanding of the role that cognitive conflict or priming the difference (both in the planning and teaching process) plays in this. The concept of a trigger focuses upon causality in a way that will help teachers better understand this aspect of the approach. A trigger is a causal strategy that can be employed, to a greater or lesser extent, in the planning stage and as part of their repertoire of classroom management strategies. Triggers are not limited to CASE, but the phrase helps to encapsulate the causality that exists at its very core and to connect this to the ideas of Bhabha. He talks of priming the difference to support translation as a means of generating new thinking. In CASE, a trigger can serve to generate a cognitive conflict; something that unsettles thinking and results in the need to talk. Triggers are therefore a way for me to articulate my thinking regarding something I do unconsciously as a teacher whilst connecting this to Maniotes idea of a third space merger as a valid construct for use in analysing the CASE classroom.

In addition to enriching the Piagetian nature of cognitive conflict with the operational term trigger we can also enrich it with the inclusion of Vygotsky’s notion of dramatic contradiction (see section 2.12). Vygotsky states that ‘higher mental functions can be most fully developed in the form of drama’ (Vygotsky 1989, p.59). This concept is not mentioned anywhere in CASE literature and so when applied in this context we see further equivalence between the two theoretical foundations of the approach. Cognitive conflict and dramatic contradiction can be viewed as one in the same if we apply Vygotsky’s term drama within an educational context. The incorporation of the notion of a dramatic event or contradiction enriches the description of the ‘event’ that promotes change. It allows me to use the term trigger as a lens through which to look at the impact of the design of learning in CASE lessons. Trigger is the overarching term I am using here to indicate the aspect of CASE pedagogy that results in a merger.

Two categories of trigger are emerging from the transcripts: internal and external.

Internal triggers

Internal triggers are cognitive in nature and are experienced as part of the lesson design, which is described in CASE as the cognitive conflict that pupils will face. They are linked to the theoretical underpinning of the approach (the ideas of Piaget and Vygotsky). Cognitive conflict results from the associated difficulty of the conceptual demand presented to the pupils which is a deliberate aspect of the approach. CASE seeks to move pupils, in Vygotskian terms, from non-scientific to scientific thought which at its core involves abstraction and symbolic reasoning, reasoning that is not tied to the original context of the initial experience. In lesson 6 ‘How many are there?’ pupils face the concept of ratio and proportion and how this, expressed through equivalent fractions, underpins the sampling techniques used to estimate wild animal populations. The conflict is generated from the application of proportion in one sample of beans to the unknown population and then the use of the same thinking to calculate how large the population is. This lesson requires pupils to ‘see’ three, of four, numbers arranged as two ratios where the fourth, missing, value is the

size of the unknown original population. To summarise, the two areas of conflict (internal triggers) in this particular lesson are:

1. The use of proportional reasoning to see that the two sets of data are equivalent i.e.
 $15/? = 4/32$;
2. The application of this knowledge to new contexts such as animal populations that involve the mark and recapture of elusive individuals that generate data that can be used in the same way as point 1 above.

External triggers

External triggers are sociocultural in nature and pedagogical in practice because they are strongly associated with the choices teachers make as part of their classroom management strategies.

External triggers can be placed in one of three groups:

- **Focusing triggers** which serve to focus pupils on the task and are part of the scaffolding teachers provide as they respond to their pupils during the lesson. This is very much part of a teacher's craft, art, skill and experience and can be seen as a way of generating engagement;
- **Responsive triggers** are based upon in-the-moment feedback and questions supplied by the teacher or peers in response to, and during, the discussion and behaviours. The suitable choice of a recent/relevant context to align the learning within pupils' lives and experiences also supports this;
- **Social and peer generated triggers** come from, and reside with, the pupils within the class or group.

External triggers also relate to a teacher's management of the learning including the contexts picked to personalise the lesson for a particular group of learners i.e. the;

1. Contexts, anecdotes and examples chosen to engage the class;
2. Images chosen to be used and presented as part of the lesson;
3. 'In the moment' decisions made in response to pupil engagement/interest that helps the lesson stay on track.

In lesson 6 the following are all examples of external triggers:

- The choice of starter questions involving animals and sweets in the jar;
- The use of colourful and simple images, tigers and camera traps, of familiar animals that directly relate to the content of the lesson;
- Use of Youtube video clips, here the video footage of Gordon Bunannon a well-known television personality directly relates to the lesson and is used as a narrative to underpin the lesson;
- The use of a range of personal stories and facts that relate directly to the lesson and the underlying thinking. Here the teachers personal use of a camera trap and own research experience as an undergraduate were all carefully used throughout the lesson;
- The inclusion of pupil ideas through which to apply the thinking into other contexts such as the US election involving Biden and Trump.

The former two external triggers (focusing and responsive) come under the teacher's direct control and choice whereas the latter falls into the domain of the classroom climate. Responsive triggers can however incorporate elements, and indeed are shaped by, of the internal triggers as they are based upon a teacher's understanding of the cognitive agenda of the lesson and how this will appear

in the moment in the responses, and behaviours, of children. Internal triggers, those that are part of the lesson design, can therefore be refined/adapted in the moment and such 'trigger contexts' are in part associated with both the cognitive and social aspects of the lessons.

Internal and external triggers serve to effect and form what I am describing as the 'weather' currents or prevailing wind within a classroom. They can be viewed as strategies for use in the generation of 'positive' weather, responses, from learners i.e. intellectual engaging (I), positive pupil agenda and E, R and P talk. The colour codes make the identification of such responses possible and also enable the identification of changes in the type and patterns of talk as is the case in weather forecasting. This use of the triggers and colour codes allows pupil talk to be connected with both lesson design and teacher choice in a way that can bring clarity into the teaching of CASE lessons. This has not always been easy for teachers new to CASE as the rules of engagement were often not very clear (see page 125) from the lesson information alone. There seems to be a gap here regarding the need for guidance, rather than just generic advice, in the form of concrete examples for individual lessons and common strategies that can be employed. The following is an example of such 'generic' advice to be found in the CASE teachers guide relating to the general conduct of the lessons:

"One of the key factors of the programme is the way in which the teacher changes his role from that of a good instructor to that of a 'manager' who provokes peer interaction between pupils and cognitive challenge. The technique relies on the teacher having high expectations of what the pupils can do, even when these expectations are not necessarily met at the time. The teacher needs to develop a range of sophisticated questioning and listening techniques, and a sophisticated understanding of group dynamics. The teacher has to manage the classroom so that the interplay between group work and whole-class teaching maximises the likelihood of the pupils engaging with particular ways of thinking. The lessons involve pupils in lots of discussion and activity, but are still structured to follow the teacher's 'thinking skills' agenda. All this has professional development implications. The transition of a teacher from a position of ensuring pupils are 'comfortable' with what they are trying to learn, to one where the teacher deliberately pushes pupils into their 'discomfort' zone, is not easy."

The red text has been highlighted to focus upon the advice given regarding the pedagogy required by CASE and as such it points to behaviours that are both complex and nuanced. These classroom management techniques require further exemplification in relation to the specific lesson contexts. Such advice in regard to 'sophisticated questioning and listening techniques' does not provide the necessary detail to help a teacher new to CASE understand how to manage this, let alone construction zone activity, effectively. The following advice, in italics is helpful as it gives some concrete advice regarding the words that should be highlighted during the lesson.

The key words given for each lesson should be practised by pupils and their use shaped by the teacher so that a richer meaning grows in the pupils' minds. The development of a shared language between teacher and pupil is critical to the success of the development of thinking in the lesson. This requires a lot of questioning, both in discussion with the whole class, and with individuals and small groups as they work. There are often points during the activity when it is necessary to call the whole class together, to summarise what has been done so far, consolidate observations and start to speculate on explanations, or on what will be the best way to proceed. At the end of the lesson, plenty of time should be left to summarise the meanings which have accrued to new words, to let as many individuals as possible tell you about the method or relationship which they have been using, and to link the work to other experiences in the school curriculum and in everyday life.

It is important to promote cognitive development by encouraging pupils to become conscious of, and articulate about, the sort of thinking they are employing to solve different problems. Thinking back and reflecting aloud helps to develop this consciousness.

The text in red containing advice such as 'consolidating observation' and 'speculating on explanations' again is vague and does not provide the clear signposts and cues that teachers require

to manage a classroom in this fashion. The final aspect of the teachers guide, however, is honest in its appraisal of the task facing those who wish to use CASE!

Considerable time has to be invested by teachers in 'thinking through' how they will teach each lesson.

Note

The original CASE file is now out of print and the activities have been made available on line. The above guidance can be found here: <https://community.letsthink.org.uk/case/chapter/the-teaching-model/>

The lesson plans found in appendix 1 and illustrated in chapter 4 are an exemplification of this. When taken alongside the weather map and the inclusion of triggers, the lesson plans can be used to provide the necessary support that will enable teachers to use CASE as an effective tool to both promote and develop scientific reasoning.

5.4 Triggers in action in lesson 6

One purpose of this chapter to explore the role triggers play to enable a class to attend to the planned object of thinking which facilitates an engagement in construction zone activity. In CASE a trigger is closely associated with cognitive conflict and the resulting construction zone activity as characterised by construction talk. This is underpinned by Vygotsky's idea that learning occurs on both the social (between children) and the psychological (within the individual child) planes. This can be therefore be thought of as the sociocultural driver, integral to CASE, which supports the move from non-scientific to scientific thought in, Vygotskian terms, as described by the Piagetian reasoning strands that underpin CASE lesson. Cognitive conflict, or a trigger, in CASE is designed to provoke an oral response because learners are expected, in CASE, to talk in order to sort out their ideas as they respond to the tasks and each other. Triggers can therefore be used to 'steer' a class or group of children in a particular direction chosen by the teacher.

Lesson 6 will be used for the purpose of exploring the impact of triggers on the talk taking place. For both groups, the triggers will be highlighted, categorised and the resulting talk compared and analysed.

Lesson 6 - How many are there?

Group 1

- 15 triggers - 4 internal and 11 external
- 7 resulted in A talk: 2 +ve, 5 -ve
- 5 resulted in I talk

7/15 triggers resulted in I or +ve A talk = desired talk

5/15 triggers resulted in -ve A talk

3/15 triggers had a nil response

Group 2

- 20 triggers – 6 internal and 14 external
- 9 resulted in A talk: 2 +ve, 7 -ve
- 10 resulted in I talk

12/20 triggers resulted in I or +ve A talk = desired talk

7/20 triggers resulted in a -ve response

1/20 triggers had a nil response

Trigger analysis for lessons 1 – 6

Lesson	Triggers	Internal	External	I	+ve A	-ve A	Nil	% desired talk in response to a trigger	% -ve A talk
1.1	7	6	1	7	0	0	0	100	0
1.2	9	7	2	8	0	1	0	89	11
2.1	6	3	3	3	1	1	0	66	33
2.2	10	8	2	8	0	2	0	80	20
3.1	10	3	7	6	1	2	1	70	30
3.2	12	5	7	6	0	6	0	50	50
4.1	8	4	4	5	2	1	0	87	13
4.2	11	2	9	5	2	4	0	64	36
5.1	6	3	3	6	0	0	0	100	0
5.2	5	3	2	4	1	0	0	100	0
6.1	15	4	11	5	2	5	3	50	50
6.2	20	6	14	10	2	7	1	60	40

Figure 9 – trigger analysis for lesson 6

Discussion of the trigger analysis

This analysis shows how ‘desired talk’ is impacted by the presence of triggers within CASE lessons. Although there is some variation between lessons and groups, there are clear signs that triggers, when viewed in this way, can play a significant role in the promotion of desired, or construction, talk. In 10 out of the 12 transcripts, desired talk (I or +ve A) following a trigger occurs more than 60% and for six out of the 12 for more than 80% of times following a trigger.

5.5 Introducing the weather map of pupil talk

Three samples of colour coded talk from both groups, from lesson 6, will be used to illustrate the weather map. The ‘weather map’ in this case is a descriptive model that includes ‘all the talk’ and how the various types interact and flow as a consequence of the triggers present within the lesson. The pattern of talk and how this changes and morphs during the lesson, under the influence of triggers, is critical to this study. The weather map includes ‘all the talk’ as a coloured jigsaw of five different types of talk. This ensures that all types of talk are acknowledged, included and given space within any analysis of small group conversation. The colours are a visual cue illustrating the reality of talk in real classrooms - warts and all. Including ‘all the talk’ in this way enables us to look for causality and ultimately how such a model can be used to develop classrooms where the words of the child, containing their ideas and knowledge, are valued and an integral part of the learning.

The following episodes of talk, from group 1 and 2, are all taken from lesson 6.

Group 1 Sample 1

The episode of talk below highlights how the talk changes from negative A (blue) to intellectual engagement (green) following a trigger – the starter question given out by the teacher. The final aspect is interesting for it indicates how the talk move to positive A as the pupils begin to discuss zoos and the use of cameras.

Mike – This is tripe ...

Alan – I fractured my fingers

Gwen – Ahh, have you

Sheila pulling face – Ahh

Mike – Each year

Sheila – It moves backwards how?

New girl – Mine like that

Gwen – Mine don't even go forward, never mind back

Sheila – I can do that ...

Mike – Guys look, guys look at this finger, fingers on your hands!

Sheila – I can bend this one

Alan – I fractured these two fingers

The starter question is given about now

Sheila – What does it say?

Mike – I'm reading it

Sheila - I was trying to read it

Mike – I was reading it out loud

Sheila – I don't like listening to people read aloud I cannot read out loud, I'm dyslexic

Sheila – Each year

Mike – I thought you said you were dyslexic

Sheila – When people are reading it out I cannot read it

New girl – it confuses people

Sheila – How many are there?

New girl – 7

Sheila – 6 million

Mike – This is tripe Are they allowed to decide how many fish we can catch Its disgusting.

Sheila – What?

New girl – I think its 6 million

Mike – I'm glad we left the EU

Sheila – 6 million

Gwen - what are you talking about?

Sheila – Fish

Mike – Basically ... there is a big evil government in Europe ... that say you are only allowed to catch a certain number of fish

New girl – Its says how do they know that the number is rising or falling it does not say you need to like guess a number

Sheila – I'll guess a number

Mike – I reckon it's the birds ... they have cameras in the birds ... because the birds work for the bourgeoisie.

New girl – Its rising because of more birds

Gwen – The government see ...

Mike – The government have cameras in the birds that's why zoos never have any birds because they are out doing their job.

Here, the starter question (red) moves the pupils away from negative A talk into intellectual engaged talk i.e. from blue to green. There is a small episode of E, personal sharing, resulting from the fact that Sheila comments upon reading out loud which in itself is a consequence of the task they are given. The talk moves to I as a consequence of a trigger (the question 'How many are there?') which serves to focus the pupils. It ends with the emergence of positive A as the discussion moves onto include a related idea of interest. This allows us to track the ebb and flow of the conversations and include all of the talk.

Sample 2

This sample shows how one type of talk, negative A, begins to dominate, as the pupils move off task. The trigger in this case is a small toy cow, whose eyes act as a torch. The pupils call this Betty, and it is the root of the cause of the pupils moving completely off task.

AE – How can we work out the population at the start using these three numbers? Off you go.

Mike to new girl – How many of them beans

Sheila – I love it!

Mike – Get a handful now count the number you don't have to ... she took out a normal handful

Alan – Can I take a handful, I want to try

Mike – I'm not going to touch those beans

New girl – Put some of them back, that's too many

Alan – Leave it not its not

New girl – You dropped some of them

Gwen – Is your cow a boy or a girl?

Mike – Stop being

Alan – They are being so ...

Sheila – it has boobies

Mike – All cows have boobies

Sheila – How do you know?

Alan – Why are you looking then.

Sheila – Stop presuming my cows gender

New girl – Can I have your cow for a second

Mike – I thought it was heterosexual – I apologise

Mike – Hey stop

Gwen – Lets hope the people watching don't have

New girl - does same

Alan – I think we should put more of the other beans in

Sheila – My cow is a girl and my cow needs a name

Mike - No we should not manufacture a scoop – it was a natural scoop

AE – You get what you get That's important

Girl 2 – I want I want cow

Mike – Alan stop re-scooping

Alan – I want to re-scoop

New girl – Re-scoop them

Mike – You don't have to re-scoop them

New girl – It needs to be more diverse

Mike – No it does not

New girl – Yes it does

Mike – More diverse does not mean better

Alan – Well yes

Mike – No

Gwen -What does diverse mean?

New girl – Diversity

Mike – Different

Sheila – My cow is a girl My cow is called I need a name

Alan – Betty

Mike – Betty – we both said the same

Alan – I don't want Betty now

Sheila – Betty

Alan – Call it Bartholomew Barth

Mike – A truce

New girl – What do we do now?

Mike – That's a bears name not a cows ... have you never read Bedtime with Bartholomew the book?

New girl – What about the beans?

Mike – It's a book about a bear in space

This sample begins with I talk, which is related to the impact of the internal trigger, then quickly moves to negative A. This is caused by a toy cow torch shown by one of the pupils, Alan.

Following some teacher input, red, the talk moves back to I but with time negative A begins to dominate because of the popularity of the cow torch.

Sample 3

Taken from later towards the end of the lesson this episode captures the moment the pupils engage in reflective talk, brown, resulting from their intellectual engagement with the task.

AE mentions maths skills and models his numbers: 'Took out 50 then 40 and 15 were marked ... the population never changed. What could we do with the three numbers to work out the population? Get ready to talk in 3 minutes.'

New girl – Sheila is going to explain

Sheila – I need to explain

New girl – You are going to explain it to people I don't get it

Sheila – I can explain on the paper

Mike – There must be an easier way to figure out how many there are

New girl – I do get it I just don't know how to word it ...

Mike - literally yeah, just count them

Alan – Well you count them

Sheila – Say if we had a different perspective and we were trying to figure out the number of cows Say we were trying to figure out the number of cows in the world you are not going to sit and count them

Mike - Probably thousands ask the farmers who own the cows how many they have.

New girl – You could not they

Sheila – You cannot count all the cows in the world

Mike - You could if you were dedicated enough

Sheila – You would have to use the ratio method to figure it out

Mike – If I had Jeff Bazos's money I would

New girl – No G you would be dead ... you would not be in hundreds of places

Sheila – Why

Mike - Texas, Texas is a great place probably one of the best states.

New girl – The cow works it works

Mike – These are some smelly beans

Gwen – Both of them

Sheila – What's his name?

AE – Year 9

Gwen – Sxxx, what's his name?

This extract highlights the impact of an internal trigger causing I that results in R as the pupils apply the thinking into another context. The talk then moves back to negative A because of the dominant impact of the cow torch that first emerged in the second sample of talk.

Group 2

Sample 1

This sample clearly shows the impact that a teacher can have upon pupil engagement. Each utterance, in red, of the teacher triggers a response from a certain pupil, Trevor.

AE now mentions the earnings from a boxing match at the weekend

Trevor – Logan Paul ... (laughter) ... obviously does not know who he is Big man Alan does not I actually watched the fight ... I did not watch the end but watched it ...

Gillian – I didn't ... I was out

Trevor – Who won?

Trevor to Ron – Do you know who won the fight?

AE – Who got the fish one?

Trevor – Fish Le poisson (laughs)
Ron – Why are you speaking French
Trevor – Fish is boring
AE mentions fish quotas
Emma – That's ridiculous.....
Trevor – Who can estimate this? Do people sit and count
Group 1 give feedback, via Mike, on their response to the fish problem

Trevor – There were more fish so people catch more fish
Trevor laughs at Mike and AE comments on Google boats
Trevor – What a submarine? Girl 1 laughs
Emma – Submarines go under water
Trevor – Just use a submarine
Gillian – Just don't count fish
Trevor – Just put some however many ...
Emma – You're a fish (to boy 1)
Trevor – You're an elephant

This sample shows the impact of external triggers upon an individual pupil, Trevor, which results in positive A talk among the group and then I. The talk moves back to positive A because of animal references within the lesson and their impact upon the pupils within the group. This episode is highlighting the positive impact of teacher choice through the use of a trigger to engage with lesson agenda.

Sample 2

Sample two further illustrates how the engagement of a key pupil, Trevor's level of engagement, is a direct consequence of the triggers employed by the teacher. Each time the teacher uses a trigger there is a marked response from Trevor.

AE – I did that (camera trap in garden), guess what I saw
Trevor – Tiger
Gillian – Frog

Trevor – Worried there
AE talks to the class and answers questions re the rats in his garden
Trevor – Trap to kill them
Trevor – Catches them, starves them and they run out of food
Gillian – That's disgusting
Trevor – You know how people are
Gillian – Matthew look ..
AE – He spotted one tiger
Gillian – And cries
AE – How could he use this evidence to get a sense of how many there are – talk about that ...
Gillian – How does he not count the same tiger many times?
Emma – They could follow it
Ron – It's night time
Trevor – How is he going to follow it?

Trevor – If the tiger went of camera how would he follow it?
Emma – The tigers live
Gillian – I'm just concerned what if he counts them and counts the same one again Yeah I saw that one yesterday and I counted it again!
Trevor – What if one comes up behind him, what happens then?

Trevor – what is going on? ... I liked that piece of paper

Trevor to Ron – Do your arms ever get sweaty wearing that?
Ron - (inaudible)
Gillian – It does look breathable

Ron - ... I am used to it
Trevor - ...
Ron – I've worn them since
Ron – What breathable

This extract again shows the impact of an external trigger in promoting I talk. The extract ends with an episode of unrelated positive A. A talk is part and parcel of the classroom talk and is something that can be changed into positive A if the correct trigger is applied.

Sample 3

This sample further reinforces the impact that triggers have upon pupil engagement and also how this results in a typical sandwich of talk composed mainly of intellectual engagement and pupil agenda talk.

AE now tells the snail story about a guy marking snails to see if they would return.

Trevor – They spray painted a snail!

AE – Animal migration is fascinating

Trevor – Is it!

Trevor - Snails are magnetic!

AE – You have homing snails

Trevor – Homing snails - ... can they follow stuff?

AE – You know how to get home, maybe snails do

Gillian – Not really I get lost

Trevor – I just walk I happily follow my nose

Mike (from group 1) shares – You could microchip them

Trevor – Ahh, see

Gillian – But that can ...

Emma – That's inhumane

Trevor – Its not inhumane ... it does not hurt them

Gillian and Emma – inaudible response

Gillian- Yeah you are shooting them

Trevor – You do it with dogs

Gillian – My dog ...

Emma – You cut open its skin and ...

Trevor – Dogs get chipped

Gillian – that's because its illegal not to

Trevor – You don't have to its not a legal ...

Ron – It's a safety thing

Gillian -

Trevor – It's a safety thing in case it gets lost

Gillian – But it's a wild animal ... ahh yeah just going to shoot it!

Trevor – So ..

Gillian -

Trevor – Shut up

AE introduces the main task by telling woodlice story

Trevor – Trying to eat woodlice!

AE explains talks with beans to represent woodlice

Trevor – You are going to give us bugs!

AE shows tubs of beans

Trevor – Beans again

Gillian – It says do not ..

Trevor – Ahh, they are raspberries

Ron – Did you see?

Trevor – It says raspberries on the tub

Ron – I think he said ...

Trevor – Raspberry flavour ..
 Gillian to Trevor – Trevor would you like to eat one of them now
 Trevor – Yeah ... I will do it ... I will .. miss are they raspberry flavoured?
 Gillian – Often ...
 Trevor – Ahh yeah
 Emma – Eat one
 Ron – Are we ... count them ... Trevor count them
 Gillian – I say 100
 Ron – I'm saying 62
 Emma – Look he is putting them into a bag
 Trevor (counting the beans in the pot) 30, 35 or like 40 round there
 Ron – Well I said 62 so ..
 Trevor – Beans! No, no, no, no
 Trevor – They are my beans
 Trevor – What is that going to do(he laughs) I can count as well Beans
 Ron – 15, 42
 Gillian - its you with the tranquilizer
 Gillian – Pass it here
 Trevor – Heinz, means beans
 Gillian – Just take it off him
 Trevor to Ron – I am bigger than you get off
 Trevor – Just waiting for you to drop it

This extract of talk illustrates what is emerging as the typical pattern of talk which is I following an external trigger with elements of positive A emerging as the talk progresses over time which can be viewed as sandwich of A, I, A, I, A talk. In this extract the A talk is instigated by Trevor following the external trigger and ends with a shift into negative A. This is in part due to the fact real beans are used which proves to be highly distracting to the pupils.

5.6 Showing the weather map of pupil talk for lessons 1 - 5

An illustrative sample from both groups from lessons 1 – 5 will now be included.

Lesson 1 – Pepsi challenge

This sample shows intellectual engaged talk arising as a consequence of pupil engagement with the task which includes a trigger concerning being able to tell the difference between Coke and Pepsi.

Group 1

AE input – Does he know, how find out if guessing?
 AE – How do we find out the chance of guessing? What could we do to find this out?

Mike – All I am saying is that I have failed?
 Sheila – Its about the taste
 All keep discussing

AE feedback – In science we model Smoking and chance

Mike – plan seeds

AE – how can a coin help?
 AE – models 5 coins as a trial
 Mike – I know He chooses If we win

Mike - I know how to do this (shows rest how to draw a graph)
 Mike – we make a scientific graph

The group now toss their coins – lots of I chat

Mike – Do you see a pattern?

Mike – 4H & 1 T – improbable results

Mike – We can win, put in as much effort as possible

Mike - 5 H – super improbable

In the first lesson one pupil, Mike, dominates the talk and models both I and positive A talk to his peers. He is engaged in response to the task as a consequence of the appropriate level of challenge which arises from the choice to create a positive invitation to engage with the challenge present within this lesson.

Group 2

This episode comes from the ‘data collection’ phase of the lesson where the pupils are required to throw sets of five coins to model the five drinks involved in the taste test from the start of the lesson. This is an active part of the lesson which can give rise to opportunities for negative A talk and disruptive behaviour.

AE directs the class to answer the questions

Gillian – $\frac{1}{4}$ 2 out of 10

Trevor makes some comment in rhyme about the cup

Trevor – Who made this cup? Angela .. she drew the tree the same size as the bird

All laugh

Emma comments

Trevor to Ron – My cup I’ll

Gillian to Emma – This is really hard

Emma – What’s the probability?

Gillian – 2 out of 10 or $\frac{1}{5}$

Emma – So its $\frac{1}{5}$

Trevor plays with cup

Ron – Trevor stop

Trevor carries on and the rest of the group disagree with him

Trevor trying to throw the cup and coins, Boy 2 tries to take it off him

Trevor offers it to Emma and both laugh

Trevor – You want it back he talks to camera ‘She is stealing the 2p’s’

Trevor to Ron – Put it back

Trevor – I am a hobo, put the money back

Ron – He is homeless, give him the money

Ron puts a coin in the cup

Trevor to Ron – Thank you kind man

Trevor still throws the cup

Gillian – These ones come up 4 times, they were the most common

Trevor throws cup ‘I’m just here for entertainment

Gillian - 3 out of 5 or 2 out of 5 $2\frac{1}{2}$ out of 5 one half

Trevor – Why did we just not Why did we not do the 2ps like this?

He throws cup and coins

This episode shows the typical pattern of talk based around the responses of a key individual (Trevor) exhibiting negative A talk and moving the group into off task talk. Over time this can change and by lesson 6 the pupil in question can be seen responding in a very engaged way to the triggers present within the lesson.

Lesson 2 – Exponential growth

This short episode shows how the range of talk types can ebb and flow and blend together in a short period of time. This includes an incident of playful talk, prompted by the story used in the lesson introduction and the term war.

Group 1

Sheila is playing with corn

Mike – It means that this king is rolling in corn he has a bath of corn

Sheila – I can juggle with corn

Gwen – We did not have that much corn ... I did not have 400 million

Mike – We did not do every single one ... this is what the kings has, this is what the wise man wants.

Gwen – I want that many

Mike – You did not help to win a war

Gwen – Ehh?

Mike – The war against Sheila's silliness

Gwen – Yes exactly, I won that war

Mike - If someone commits a crime (corn pun by the way) do you call the cobbers

Gwen – laughs – Where has all the corn gone?

Sheila – I have 3 corns

Mike – What do you call a Jewish alcoholic? He brew

Both girls laugh

Mike – Silly joke – am I right?

Inaudible chat

Mike – This study is into how children naturally speak so I am going to speak the way I normally speak shush, you cat like a 5 year old, my little sister is more mature than you.

AE stops

Sheila – I walked behind your sister on the way to school brother

Mike – My brother is

Gwen –

Mike - 400 million that's the end – he forfeits his kingdom to the wise man.

AE stops to focus on the 3 feedback questions

Sheila - I don't like big numbers

Mike – Put all of the corn. ... this man is going to have so much corn he will feed

Sheila – Corn he is going to feed the whole world

Mike – Corn ... you need a microwave don't you They had those back in the medieval times.

Gwen – It will fire and go poooof!

This episode has been chosen as it shows all the types of talk. This is rare but comes as a consequence of engagement associated with the appropriate use of the riggers to support construction zone activity.

Group 2

This short episode reveals how fleeting some incidents of talk, here reflective talk, can be. The reflective talk by Gillian is sandwiched between some negative A talk originating with Trevor.

AE - How does this help you to understand the virus?

Gillian – Shows who it really infects
AE - 2 questions: How help understand? Where else might this apply?
Gillian – Not just about the virus ... any infection really
Gillian aghast – He hit me in the throat
Trevor – Do you want a thing in your throat?
Gillian – He thought, you thought
Ron – What are you two talking about?
Trevor – Something
All laugh now because of innuendo
Ron – Its one of the two things I am thinking about
Trevor gently throwing corn – Death by corn
Ron – I don't feel safe here

AE – Anyone think of anything like this etc?
Gillian (in feedback) – When you see a number you don't really think of people but seeing the corn really helps

This excerpt shows reflective talk from Gillian while the rest of the group are engaging in negative A talk. This could easily have been hidden among the negative A talk triggered by Trevor. This extract can be used to show how the colour codes are able to capture moments of reflective talk emerging from previous engagement when the group may have been considered to be off task.

Lesson 3 – Sampling beans

Similar to the excerpt above, this episode captures some personal sharing between Sheila and Gwen. This illustrates how often the transcripts capture just a small part of what is clearly a longer conversation almost like the tip of a conversational iceberg.

Group 1

AE – Can we decide? Where is the cut off point between small and large?

Alan – What are we doing again, what doing again?
Gwen holds the beans
Poppy – Going to make a bean camera

Sheila – I have mixed emotions (repeats)
Gwen – You have what?
Sheila – About things
Alan – Why?
Gwen – You have messy emotions
Gwen – I know what things
Alan – Just kill people
Gwen – I heard she Inaudible
Sheila – That was a lot of my problems
Gwen – So most of them though ...
Alan – Oh no, he is eating the beans
Sheila – What do you think?
Alan – You made him uneat the bean ... get in

AE stops
Girl 1 – The guy over there?
Girl 2 smiles
Girl 1 girl 2 nods in agreement

Alan – Get away

AE – Where put the cut off point?

Feedback

The group suggests that the sample (size) effects it

AE uses Eve's idea about exam marks

AE – If you get 1 mark below an 8 should you be given an 8?

Sheila – No

Gwen – No

Alan – Yes

Poppy – Did not deserve it

AE – Talk about it

Sheila – No because you did not deserve it

Alan – Only 1 mark

Poppy – I don't care, you did not earn it

Sheila – You did not get it so why should you be given it?

Poppy – Exactly

Alan – It would be the same if it were

Sheila - ... no you did not deserve it, say you got one mark above

Gwen – You did not get high enough to get it so don't deserve it.

As with the previous episode this shows how E talk could have easily been missed and the fact that different types of talk can pop into conversations as pupils engage with the task as signified by I talk. The occurrence of different talk types is hard to predict and so the weather map can be used to illustrate how fleeting different types of talk can be. They do however signify that third space talk reflects the reality of pupils thought lives which are a composite of talk types.

Group 2

This extract of talk reveals a long episode of positive A talk triggered by the word 'sample' which is coupled with the use of a range of images designed to resonate with the life experiences of the pupils.

AE – Take a sample, where have you come across that before?

Trevor – Eating food ... free sample .. when they come out and say 'Do you want some sausage?'

Emma – Covid test

Gillian – Dixons (she laughs at this)

Ron to Emma - ... into a shop .. on the table ... free sample

Emma – Soap as well, moisturizer, when they put it on your hand

AE shows images of 'sampling' and gets feedback

Emma – Trevor, are you being serious when you say that God was

Trevor – inaudible

Emma – Not really

Trevor – Its all to do with balls This world is a ball, humans come out of balls

Emma – No they come out of the uterus

Gillian and Emma – inaudible

Trevor – Ovary, egg ball

Gillian - no not a ball

Trevor – Sperm comes out of the balls ... the balls

Emma – Would someone like to explain this to him.

Emma – inaudible

Gillian – laughs

Emma – Personally would not work

Gillian – It does actually

Emma – Guys, turn around

AE – Music

All – Yes

Trevor mimes being a DJ

Emma – Finish your sentence

Trevor – She does not

Trevor – inaudible

Emma – It's a ball not a golf ball
 Gillian – I don't think it was the big bang ... just so cold that everything was stuck together
 (Emma replies inaudible)
 Gillian – Yeah but what if God I love how God can talk about popcorn.
 Trevor – Beans, beans
 Emma – Say you are right ... layers come together what do you
 Trevor to Ron – Who do you think created the earth
 Trevor – The earth was created by beans
 Emma – Everything living on the planet has to be ... so if you are right ... it would be empty.
 Trevor – Sir, I want the beans
 Ron – You are not having the beans, you will
 Trevor – I will not
 Gillian – Unless God made a mistake ...
 Emma – Don't give it to him
 Gillian – Dog food?
 Emma – Can we have another one?
 Emma – Trevor is going to ..
 Trevor – I did not know what I was doing
 Ron – These are beans?
 Emma – Beanstalk

Trevor (funny voice) – Beans
 Emma – They look like the magic bean but anyway ... how did humans behave then?
 Gillian – God knows I
 Gillian – Ahh yeah ..
 Trevor – Are these edible?
 Emma – No I dare you, I dare you yes, yes, eat it
 Ron – No eating the beans
 Emma – Eat the magic bean
AE stops class – How many variables?
 Gillian – What's a variable?
 Trevor – Shape, colour, shell ...
 Gillian – Size

Emma - Anyway Gillian, what happens when we die?

Trevor – These are my beans
 Gillian – That one feels like
 Emma – What if I could not ...
 Trevor – Beans
Ron – You just die and become beans
 Emma – Why are we here in the first place if just going to die?
Gillian – I said to my mam the other day ... I did not ask to be born
 Trevor – That is the most perfect bean
Emma – You did not I did not want to celebrate my birthday, I did not want to be born
 Emma – This one I want to keep this one for the rest of my life
 Gillian – In a box

AE – feedback on variables

Emma – Guys I can lift it off Trevor
 Gillian – Do you think all teachers write their Z's like that?
 Trevor – Speed
 Gillian – It's a ...
 Trevor – Spinning force
 Emma – Momentum
 Gillian – I think that one went smaller
 Trevor – Beans, beans, my beans
 Gillian – That's was so exciting, can I have my bean back please?

This episode illustrates how one type of talk, here A both negative and positive can dominate based upon how they respond to the trigger. With the clip below the trigger results in a significant period of I talk with limited A and also incidents of E talk.

Lesson 4 Does it work?

At times the transcripts capture extended periods of talk and this episode reveals a lengthy period of intellectually engaged talk.

Group 1

Mike – This is a set of results, look at all the frowns

Sheila – They all look the same

New girl – No they are not

Mike – We also have a couple of smiley faces

Sheila – Smiley face, smiley face x 5 (she does this as she places down the cards)

Sheila – Ahh I am going to separate into smiley faces

Mike – so smiley face with and without pill ... so remember that with and without pills are different

New girl – Okay so if take drugs you are happy and if you don't take drugs you are not happy

Mike – Yeah, yeah, yeah, that's how they do it on tiktok

Sheila – Smiley face (said as puts cards down)

New girl – Ah look

Mike – Ah, all these men all taking roids

New girl – Its just

Mike to Sheila– You need a smiley face pill, smiley face not pill

Mike – No I literally just Been putting them in groups

Mike – Stop mixing them Hannah – we need to put into groups

Sheila and new girl laugh

Mike – Smiley face, pill, smiley face without pill are different This one had the pill and still did bad

Mike – Give us the cards, you cannot just hold them

Sheila – I'm holding the cards

Mike – More smiley faces with pill You have to ...

Gwen and Sheila– Just fly away ...

Mike – Smiley face without pill and smiley face with pill

Sheila – I will sort them

Mike – Gwen we are 5 miles an hour x 2

New girl – I think ...

Mike – Smiley face with pill, smiley face without pill ... unhappy without pill, happy with ..

New girl – Pills make you happy

Sheila – Looks like they are nuts

Mike – They are not nuts they are fish oil pills happy with pills

Alan – Why are they happy with pills

New girl Only ... happy with pills – go for it

Mike – The evidence would show that has more effect on men

New girl – Drugs help men

Mike – Grrrrr (clenches fist) .. happy with pills, happy without pills. So men are dumber but when take pills they are smarter

Mike – Men are dumb but when take drugs are smart

Alan – Happy women will not take pills

Mike – Took pills, no all men who succeeded took pills so females succeeded without help from pills

Sheila – Mike is my dad!

Mike – Don't take the men with pills

Mike – For the rest of the rest of this lesson you have to talk like a ... man

Mike – Just count how many in your pile and what gender they are

Gwen to Mike – inaudible

Mike – No, I refuse

Sheila – Not allowed

Mike – 9 men succeeded overall and all 9 took pills

Sheila to Gwen – That's yours there you go
 Alan to Gwen – inaudible
 New girl – I've got 10 women who are upset because they did not take pills
 Sheila – I have 11 women who are happy to take drugs
 New girl – They did not take them and failed
 Mike – She has women who are unhappy they took drugs
 Mike – Maybe The pill works better on men
 Gwen – So why is she smiling when
 New girl – Harvey What did yours look like because we got these? Inaudible chat follows
 Mike – men are happy that they took drugs Maybe this suggests that the pill has better effects on men than women
 New girl – They are the same ones
 Mike - Might effect women in the reverse
 New girl pills ..
 Alan – Teeny, weeny, teeny, weeny
 Mike to new girl – inaudible then 'Look at those unhappy men because they did not take drugs LSD before the test
 Mike – Poppy you are ruining the evidence
 Sheila – Poppy you are ruining everything
 Mike – Me and Gwen have taken a lot of time and been careful about everything
 Gwen – inaudible
 Mike – Sheila, all your women took drugs and now they are upset
 Sheila – Gwen
 Mike – My men took a lot of drugs and they are very happy Okay this is what happens when you do roids
 Inaudible
 Mike – This is what happens when you take roids – you get happy
 Alan - Inaudible
 Mike – You win the physical fitness test look at all those happy women
 Gwen – I would not say I normally get drunk
 Mike – So would the data show that women are unhappy when they take drugs?
 Alan – I've got
 Mike – Look at all those men, they failed because they did not take drugs all the men that won took drugs
 New girl – Same as us (to another group)

This episode shows an extended period of I talk resulting from engagement with the trigger used to introduce the task. In this case it is the use of cards that show pills being taken. The pupils relate this to steroids and they start to explore their own questions and this reveals that high levels of engagement are possible if the correct external trigger, relating to the pupils own lives, is employed.

Group 2

From the same lesson this excerpt reveals a significant period of playful and positive A talk. The engagement was triggered by the image of parsnips used during the first part of the lesson.

AE – What would convince you to invest some money in fertilizer?

'Proof' - Unsure who says this

Trevor – Poop buying poop ...

Emma – Low cost

Emma – Are you for real Trevor?

Trevor – I am not going to pay a tenner for poop

Emma - Its not poop

Trevor – Yes, fertiliser is poop

Emma – No its not

Trevor – It is

Emma – Are you for real?

AE now shows image of the treatment

Trevor – Gropar water

Emma – Not at all (laughs)

Trevor – Why are they so sharp, like knives

Ron - parsnips

Trevor – Someone tries to break into a farm so he puts his hand into the ground and pulls up a knife (very animated)
 All the group laugh
 Gillian – A parsnip (mimes having a dagger in hand)
 Emma – Framers have lots of knives
 Trevor - every parsnip is secretly a knife
 Emma – Okay, that’s smart hiding a knife inside a parsnip
 Trevor – You could hide lots of weapons around the farm, you could put a grenade in the ground as a pumpkin
 Laughter
 Ron – So someone comes in and you just blow them up
 Trevor – Yeah ... you start throwing pineapples and you just throw a grenade
 Emma – You don’t have pineapples on farms
 Trevor – You do, they grow from bushes
 Emma – No they don’t
 Trevor – Yes they do, pineapples grow from bushes
 Ron - South America
 Ron – They grow on islands and South America, they don’t grow here
 Trevor – They grow from bushes
 Emma – Exactly, exactly, tell him
 Ron – In South America
 AE claps hands, boy 1 is inaudible

Emma – That’s not how it works you actually Gosh
 Trevor – Put some sun over it
 Ron – Its too cold
 AE comments can be heard
 Emma – Low cost, cannot be expensive

AE input – encourages to always ask questions etc + former pupil who has done well at Nissan
 Emma – True
 Trevor – A lot of people are more clever than me
 Trevor – Ow
 Trevor – Director?
 Trevor – I’ll keep it
 Gillian – Fencing!
 Trevor – I’m keeping this
 Emma – No you are not
 Trevor – Yes I am!
 Trevor – I don’t want it, don’t like pens
 Trevor – Pineapples
 Emma – Grenade
 Ron – Some with water are big

This excerpt reveals an episode of playful talk resulting from pupil amusement at the parsnip images used in the lesson. The playful talk ends with a time of positive A talk where the pupils discuss where pineapples grow.

Lesson 5 - Models

Group 1

This episode reveals how a seemingly innocent use of slang, ciggi for cigarette, triggers a period of negative A talk.

AE – No think about it over break, what thinking that made them come up with this model? Were they wrong or stupid? Why did they think this? Have a chat before break.

Sheila – Right we need to have a conversation ... being quiet ... get your head off the table (to girl 1)
 Mike – The way they saw it, heaven was just another earth, around the earth ... like you look at the diagram there is just another earth with its ocean ... something to hold it up around ...

Sheila – What?

Mike – The reason there were pillars is that they did not believe it was round ... they believed it was a semi-circle Init!

Sheila – Stop saying Init Its getting aggravating now

Mike – It's my blooming vocabulary

Sheila – Not even vocabulary ... do you think you should talk like that ...

Gwen ciggi

Mike – Ciggi Cigarette ...

Alan – Wow , where's me bacci?

Alan – Where's me bacci?

Mike – Fag

Gwen – You know you would not be allowed to say that word unless you are part of the LGBT

Mike - Its another word for cigarettes

Gwen – inaudible

Mike – It is if you ask someone for a cigarette

AE recaps on thinking task for over break

Mike – There is nothing in the box, is all a big ploy.

In this episode negative A talk overrides because of previous conversations taking place before the lesson. It highlights how classroom talk, unless impacted by triggers, can be guided by the pupils' own agenda and steered, or dominated, by a single individual. The transition from one talk type to another can occur at any point and is very hard to predict.

Group 2

This episode is included as it typifies construction talk in CASE lessons. During the early part of the lesson period of engaged talk leads to a time of reflection as the pupils share their thinking around the fact that air is a mixture of different substances.

AE gives them the boxes

Emma – Small box for a small mind

Ron – How are you meant to guess what's inside?

AE shows how to play with the boxes

Gillian – Nothing, its empty

Emma – Is there something inside?

Amma – Small box for a small

AE encourages to explore and play

Emma – I think there is nothing in it

Ron – I think there is string inside

Emma – If you shake it

Ron – It reminds me of one of those things children use

Gillian – Its getting

Emma – If you do it that way ...

Gillian – Only goes one way

Ron – Its because Just let go if you don't

Gillian – You have to pull it tight

Ron – No I think its because if you do it tight ...

AE – Year 9 but what's inside that causes it to stop ..

Gillian – Air (whispered)

AE – Can you imagine draw what you think is inside the box

Gillian – Just draw a box

Ron – Just draw anything nothing

Gillian – Its kind of hollow

Ron – Nothing inside

Gillian – Could put like a little thing of glue in and so they say 'See there is something in there!' Oxygen, that's in there.

Ron – Air
 Gillian – Atoms, like all that shizzle
 Ron – There has to be something inside ... it would not be able to stop
 Gillian – A scrap of paper ... the whole point is you don't actually know
 Emma – You could say anything but we would not know if he is lying ...
 Gillian – You had better open one

Gillian – I am only now realizing how Trevor is so ...
 Ron – Trevor is always talking about potatoes
 Gillian – He brings up such random stuff and makes it funny Otherwise you are just sat here ...
 Ron – All he does is talk
 Gillian – At least I don't think like Trevor ... and it still manages to work out better
 Ron – Its because he talks
 Ron – He probably would have ripped it open.
 Gillian – Do you think if we say oxygen she will Let us have it?
 Ron – Are you just going to put
 Emma – Well there is oxygen everywhere
 Gillian – Exactly, so she cannot say it's not in the box
 Emma – True
 Gillian – Brain cells

This episode shows the impact of an engaging trigger to engage the pupils which results in a period of I talk which ends with a short episode of R talk.

5.7 Comments upon the extracts of pupil talk from the transcribed lessons

I to A or A to I is very much the standard pattern of pupil talk and as such forms an engagement sandwich of talk within the lessons. Triggers can be viewed as causal factors impacting and contributing to this talk and it is the external, teacher, triggers that serve to direct the talk into I or positive A whereas those originating among the pupils themselves often result in negative A talk. The biggest difference between the two groups in these extracts is Trevor in group 2 in that he responded far more to the external triggers provided by the teacher and it can clearly be seen how these had a significant impact upon his engagement with the lesson and the talk within the group.

The other three forms of talk (E, R and P) although present are far less frequent than the codes I and A. Pupil agenda talk, A, is very much part and parcel of talk at all points and the inclusion of this category helps to acknowledge its presence and prevalence. There is often a fine balance between positive and negative A talk and the shift from one to another can be fluid. A key message emerging from the differentiation of A into positive, negative and neutral is the fact that talk which may have been perceived as not relevant or off task talk, positive A, is actually a key part of construction talk as it involves the pupils discussing related topics that are of interest to them as a consequence of the way they refract the stimulus i.e. their *perezhivanie*. This is important because there is a need, in Vygotskian terms, to account for the impact of the social plane of development that exists between individuals, and this is a key feature of lessons such as CASE. The talk codes A, E, R and P all acknowledge and link with, and to, the emotional experiences of the pupils, their funds of knowledge. The term positive *perezhivanie* can now be applied to learning contexts that engage the pupils in third space talk, because it is refracted by the experience in a way that acknowledges what a child brings to the classroom. This is what Maniotes is referring to by her use of the term *merger*-the two spaces, or worlds collide, in a way that is supportive of, new, learning. All the talk and construction talk are never going to be tidy, and the third space codes are inclusive of the fact that the personal meaning of everyday knowledge supports the development of everyday concepts (Vygotsky, 1994) and this should be dialectically related to school-based concepts.

The use of colour to code the different categories of third space talk show how fleeting and unpredictable this can be- without the weather map an example much of the variation could easily

missed. This shows how helpful the weather map model of small group talk is as a tool to investigate construction zone activity and small group talk more generally. Both groups do show a range of talk but they do not respond in the same way to the triggers and so it is probably more helpful to view construction zone as a form of dialogue rather than a fixed time of talk. In line with Wegerif's (2005) time of resonance (see chapter 6) it's the creation of conditions conducive to third space talk that is important. In line with the advice of Nuthall it is such conditions that allow the participants to open up with a mix of talk that reflects their lives and utilises the funds they bring, from their lives, with them into the classroom. The analysis of the triggers, section 5.3, reveals how they can influence the talk taking place. In the weather map triggers form the prevailing currents that shape the talk taking place and therefore the engagement of individual pupils such as Matthew from group two. External triggers, such as ones that acknowledge the way science underpins everyday life, can have a significant impact upon pupil engagement (see Trevor above) as indicated by the amount of I or positive A talk taking place as a consequence of their use.

Triggers can now be viewed as a pedagogical tool that is both planned (internal) and responsive (external) and are helpful for they link to both the cognitive aspect and the funds of knowledge pupils possess and bring with them; the social aspect of CASE. The term aspect is being used as it connects to the idea of weather systems (prevailing winds etc) and the teacher, and the use of triggers, can steer (or not) or change the direction of the talk such as the move away from A to I as a desired form of talk. In the weather map model, triggers act as prevailing winds to affect the talk such as moving between green and blue and also between positive and negative A.

The colour codes are therefore serving as a navigational tool when it comes to a complex environment such as a classroom as they can be used to show the causality in operation- just as pressure systems are used in meteorological forecasting. The codes themselves are just simple descriptors, but we can use them zoom in on the effect of triggers that highlight causality and the link to teacher choice and use of triggers as a pedagogical strategy and the dynamic and fluid nature of real talk. My argument is that talk can be driven by triggers and the specific nature of CASE supports, facilitates, allows and indeed makes space for this. The colour codes can be used as a diagnostic tool to identify when children are going off task and track back to see the causes. Plotting talk as a weather map allow us to see the whole in terms how adolescent talk ebbs, flows and morphs from one type to another. A key message here is that weak weather systems don't need to last for long and can be adjusted back into desired talk via the use of appropriate triggers to re-engage the pupils. The strength of trigger could be viewed as a pressure system causing desired 'talk' move to fill the space created by the trigger as a consequence of priming the difference. In the words of Wegerif triggers can create (provoke as in cognitive conflict) resonances that reveals how talk can be 'engineered'. This is a next step for this work i.e. looking at longer term changes in the role, expectations and view of talk, for in this study only six lessons, broken by covid, were taught and this is simply not enough to show long term changes in thinking and patterns of talk. The variables involved are complex and the two groups are simply cameos and a reflection of how complex, and messy, 'all the talk' actually is.

5.8 Side by side comparisons of both groups in lesson 6

The same episode of talk, from both groups, will now be compared. Doing this will provide a more detailed picture of the talk occurring at the same point in time. Such an analysis will enable any common responses to be identified and to provide a sense of the specificity of the talk which is actually based upon group make up and dynamics. A snapshot of talk at the same point in time also provides an interesting insight into individual pupils, especially Mike and Trevor, both of who are seen as disruptive and how such 'behaviour' is reflected in the codes.

Lesson 6 Does it work?

Episode 1 – first 2 minutes of the lesson, each group has a different starter question

In this extract both groups show a mix of I and both negative and positive A talk in response to the trigger (written question) used to start the lesson.

Group 1	Group 2
Alan – Oh my ... I have not even Mike – Each year Mike – This is tripe ... Alan – I fractured my fingers Gwen – Ahh, have you Sheila pulling face – Ahh Mike – Each year Sheila – It moves backwards how? New girl – Mine like that Gwen – Mine don't even go forward, never mind back Sheila – I can do that ... Mike – Guys look, guys look at this finger, fingers on your hands! Sheila – I can bend this one Alan – I fractured these two fingers Sheila – What does it say? Mike – I'm reading it Sheila - I was trying to read it Mike – I was reading it out loud Sheila – I don't like listening to people read aloud I cannot read out loud, I'm dyslexic Sheila – Each year Mike – I thought you said you were dyslexic Sheila – When people are reading it out I cannot read it New girl – it confuses people Sheila – How many are there? New girl – 7 Sheila – 6 million Mike – This is tripe Are they allowed to decide how many fish we can catch Its disgusting.	AE – Here is yours okay. Trevor (grabs it) – What is this? Ron – How many are there elephants Emma - because you wont know where they all are because Gillian – What Trevor – Ace question Ron – You don't know where all of them are Simple. Ron – Why have you got a book? Trevor – inaudible Ron – Why have you got a book? Trevor – They are all the same book Gillian – They are not Ron – They are Gillian – They are not all that book Emma – I have not seen an elephant before Gillian - I have only ever seen one once Trevor – I went to a zoo Gillian and Emma – inaudible Ron – I saw a video of one Trevor – I smell quavers have you been eating quavers? Ron – Well I saw a video of two doing Emma – inaudible Trevor – How many are there? Gillian – One elephant Gillian – Lots Emma – Hundreds, there are a couple of hundred ... did you just ... elephant

Sheila – What? New girl – I think its 6 million Mike – I’m glad we left the EU Sheila – 6 million Gwen - what are you talking about? Sheila – Fish Mike – Basically ... there is a big evil government in Europe ... that say you are only allowed to catch a certain number of fish New girl – Its says how do they know that the number is rising or falling it does not say you need to like guess a number Sheila – I’ll guess a number Mike – I reckon it’s the birds ... they have cameras in the birds ... because the birds work for the bourgeoisie. New girl – Its rising because of more birds Gwen – The government see ... Mike – The government have camera’s in the birds that’s why zoos never have any birds because they are out doing their job	Trevor – they are probably owned by some (slave) company Gillian – inaudible Ron – No it’s a slave company Emma – Are we going to watch Gordon Ramsey? Gillian – Its something else Trevor – Uganda Gillian – I sit in the weirdest Trevor – Gordon Buchanan (struggles to pronounce) Gillian – I sit in the most awkward positions ever Trevor – I thought Gordon Ramsey because he could not cook an elephant

Episode 2 – an external trigger provided by AE about using a camera trap in his garden

This extract illustrates how important the relationship is between a teacher, the lesson content and pupil levels of engagement.

Group 1	Group 2
AE – I did that in my garden the other day guess what I saw? Sheila – A hedgehog Mike - Rat – Rats no AE tells story (something eating food in garden etc ... saw a cat and two rats and got rid of them) New girl - Them tigers Mike – My cat brings in rats everyday man AE – I trapped them Mike – You have to keep him locked up because if he gets in the kitchen there will be a rat there. Sheila – You have rats in your kitchen! Mike – Yes, he brings them in Sheila – I think your cat has issues. AE can be heard talking Sheila – I thought you stabbed your cat with a fork Mike – No my sister stabbed my cat with a fork its not dead! Alan - And put in a blender Mike – No my cat got its foot in a blender AE – My question to you and what I want you to think about he spotted a tiger So how would he get a sense of how many there are? Mike – He should strap cameras to himself and stand in the same area to see if it comes back. Sheila – He could run after the tiger to see where it goes. Mike – No see if it comes back to the same area New girl – They do that actually Sheila – I’m so smart Gwen – How is your cat not dead	AE – I did that (camera trap in garden), guess what I saw Trevor – Tiger Emma – Frog Trevor – Worried there AE talks to the class and answers questions re the rats in his garden Trevor – Trap to kill them Trevor – Catches them, starves them and they run out of food Gillian – That’s disgusting Trevor – You know how people are Gillian – Matthew look .. AE – He spotted one tiger Gillian – And cries AE – How could he use this evidence to get a sense of how many there are – talk about that ... Gillian – How does he not count the same tiger many times? Emma – They could follow it Ron – It’s night time Trevor – How is he going to follow it? Trevor – If the tiger went of camera how would he follow it? Emma – The tigers live Gillian – I’m just concerned what if he counts them and counts the same one again Yeah I saw that one yesterday and I counted it again! Trevor – What if one comes up behind him, what happens then?

Mike – I fork is not going to kill a cat ... my cat is not dead AE – Can I have the questions back please? Sheila – I thought you said your sister stabbed your cat with a fork Mike – It depends how hard you stab it ... my sister was, you know five New girl – Were getting recorded and you I got stabbed in my leg Sheila – You don't know how funny ... Alan – If she stabbed it in the head would it get brain damage? Mike – what? Alan – If she stabbed it in the head would it get brain damage? Mike – This man just hates my cat so much Gwen – Your sister is in the same Sheila – What if you stabbed it in the abdomen? Mike – What if Carl Ferguson bought my cat a lollipop what would happen? Gwen – Well your sister is in my sisters class at school AE – Okay New girl – You had better ... Mike – What? Gwen – Your sister ... AE – You will never, ever, ever Know how many of a species there are a giant otter popped up on my phone after being found in Argentina. hopefully use skills to estimate	Trevor – what is going on? ... I liked that piece of paper Trevor to Ron – Do your arms ever get sweaty wearing that? Ron - (inaudible) Gillian – It does look breathable Ron - ... I am used to it Trevor - ... Ron – I've worn them since Trevor – What breathable AE input – never, ever know how many Mentions Galapagos tortoise that had been in the news

Episode 3- an external trigger, in the form of a personal anecdote, provided by AE

In this extract both groups engage with the trigger provided by the teacher but the amount of I talk from group 1 is significantly less than groups 2.

Group 1	Group 2
AE – You could actually spray an animal talks about homing experiments with snails putting tipex on them ... its possible to mark an animal AE – Which idea that you have heard could help Mike (to the class) – You could microchip them with a gun AE – Like you do with a dog Mike – Yeah New girl (to group) - ... camera and attach it to them Mike (laughing) – ... and put them in a van till you are done New girl - no you them Girl 2 – You would have to put it round their necks New girl – inaudible Mike – you are not going to get a baby tiger with that attitude Sheila – I want a baby tiger Gwen – inaudible	AE now tells the snail story about a guy marking snails to see if they would return. Trevor – They spray painted a snail! AE – Animal migration is fascinating Trevor – Is it! Trevor - Snails are magnetic! AE – You have homing snails Trevor – Homing snails - ... can they follow stuff? AE – You know how to get home, maybe snails do Gillian – Not really I get lost Trevor – I just walk I happily follow my nose Mike (from group 1) shares – You could microchip them Trevor – Ahh, see Gillian – But that can ... Emma – That's inhumane Trevor – Its not inhumane ... it does not hurt them Gillian and Emma – inaudible response Gillian - Yeah you are shooting them Trevor – You do it with dogs

	Gillian – My dog ... Emma – You cut open its skin and ... Trevor – Dogs get chipped Gillian – that's because its illegal not to Trevor – You don't have to its not a legal ... Ron – It's a safety thing Gillian - Trevor – It's a safety thing in case it gets lost Gillian – But it's a wild animal ... ahh yeah just going to shoot it! Trevor – So .. Gillian - Trevor – Shut up

Episode 4 – the period of time immediately following break as the lesson restarts

This extract needs to be viewed in the light of episode 1. This particular lesson is split by a break and so the lesson restarts halfway through. Without the use of a trigger the pupils naturally drift into negative A talk.

Group 1	Group 2
Mike – Would you say you are a big fan of New girl to Alan – Put the cow in front of here Alan – Hello (with the cow) New girl – Sexy cow Mike – So would you guys say there is a big red combine harvester New girl – No Mike - Basically so do I replace with 17? New girl – No we have already have G ... leave the beans alone Mike – I'm just touching the beans I'm allowed to touch the beans my beans AE – make sure you have all done the first part, then stop I had 50 Mike – It turns out that my 52 was closer ... New girl to AE – Do you put them back? AE – Yes you put the new ones back New girl to AE - Yeah, okay AE to class – You have replaced them Mike – OMG, I have turned all these beans into 1 bigger one! I have made a big beans Sheila – OMG It lights up New girl – Its really blinding Mike – Stop messing about with the camera Gemma moves towards the group Mike – I had 52 but they did not want to do that last New girl – We did it with 17 look into it its bloody blinding Gwen – Let me have a turn Ahh Mike – What's the point of having a baby tiger if you cannot see one Sheila – I can see two dots New girl – Mine are there AE claps hand - Year 9, listen up, shush Sheila – Ooooooh I love it, it makes a sound to Alan – You can have it if you want	Alan – I'm next to Max next lesson I'm next to Max AE – While we are waiting Trevor to Gillian – You are a racist you are racist AE recaps Gillian – 23 Ron – What did we do again? Gillian – Wait ... Trevor – I don't like beans ... I don't like beans Ron – By the way there are 24 as I picked one off the floor Ron – I don't trust you, I don't trust you AE – Did you do it, how many did you take out ALL – 23 Ron – 24 Gillian – Shush Gillian – If you hit me I swear I will smack you Gillian – Ow, you Ron – I was scared for my life ... I was scared for my life He could have killed me. Trevor – I am the bean master Gillian – Does it actually hurt? Ron – I'm doing basket ball AE – Okay Year 9 Gillian – You know when you play basketball, is it not really difficult? Aren't you really bad at it because you are small?

Sheila – I love it, can I actually have the cow that lights up and makes a noise ... I love it	

Comments on the paired comparisons of talk in lesson 6

Extract 1

Here the talk results from an internal trigger in the form of a prepared question. For both groups the interplay between I and A is very different but in both there is a similar proportion of I talk. It also reveals how the use of an appropriate trigger, here a written question to gauge pupils thinking regarding sampling, can focus and engage pupils at the start of a lesson.

Extract 2

Here the external trigger takes the form of a related, personal anecdote shared by the teacher. The response from group 1 is mainly positive A while group 2 engage in I talk. Both group however engage in periods of talk as a direct consequence of the triggers being used by the teacher.

Extract 3

As in extract 2 the external trigger takes the form of a related, personal anecdote shared by the teacher. This time both groups respond with I with group 1's response being far stronger.

Extract 4

This episode captures the time when the pupils return to work following break time. There is no obvious trigger as it is coming to the end of the lesson and most of the talk is negative A with little evidence of I talk. This extract nicely mirrors extract 1 where the talk is largely I as a consequence of the trigger being used to foster positive and engaged talk.

It is interesting to note the impact of the triggers upon two individuals in both groups: Trevor and Mike, both respond well to the triggers but the impact upon Trevor is quite profound in that he responds to every trigger used by the teacher and as a consequence a mixture of A and I talk is the result. Trevor has a reputation as a disruptive student and it is interesting to note how his talk is often a consequence of an external trigger provided by the teacher. When stimuli of this kind are absent his behaviour does often result in negative A talk among his group.

Overall comments on the side-by-side comparisons

The most frequent types and patterns of talk are proving to be a shift from I to positive A as a consequence of a trigger. Regularly there is a shift backwards and between A to I, and vice versa, in a kind of engaged talk sandwich. When engaged (I) the pupils do move into other categories of talk such as E, R, P as they engage with the task but these are less frequent than the I to A shift. Often pupil agenda talk (A) will shift from positive to negative A as the pupils go off task without the focusing ability of an appropriate external trigger.

The five talk codes include category negative A which could be described as 'off-task' talk or 'low level disruption' and 'banter'. Pupil agenda talk is a strong feature of the talk in the lesson transcripts and manifests itself throughout all of the lessons. This form of talk, quite naturally, is influenced by the presence of external triggers (teacher or peer generated) and the transcripts highlight how much of this is under teacher control and how it shifts following a trigger.

5.9 Closing comments

This chapter uses a weather map model of ‘all of the talk’ taking place in small group work to re-visualise construction zone activity as described by Shayer. The use of the notion of triggers allows us to incorporate Bhabha’s (2004) idea of priming the difference into CASE and construction zone activity as aspects of a pedagogical approach that are under the control of the teacher as key elements of the weather analogy described here. Triggers can influence and shape pupil talk towards or away from desired forms and are an important manifestation of the advice given by Nuthall regarding the features of classroom culture that can engineering learning in a way that allows teachers to manage learning through their involvement in peer culture. The weather map model links CASE to the work of Bhabha and Wegeriff, bringing a deeper understanding of Vygotsky’s ideas and aligns the language we can use to describe ‘construction’ talk in a way that provides a deeper insight into construction zone activity. The five talk codes used to analyse pupils talk reveal similar, fluid, patterns of talk influenced by the CASE approach and teacher choice, triggers, across all the lessons. The final chapter will discuss each of the codes in detail. What is emerging is that much of the pupil thinking, incorporated into CASE lesson guidance, expressed orally is rare. The phrase tip of iceberg has been used to indicate this, but significantly more examples of third space talk have been captured than both Maniotes (2005) and Moll (1993), indeed the latter could not evidence any examples of third space talk at all.

Triggers can be used as a vehicle to further highlight the importance of Vygotsky’s idea of *perezhivanie* i.e. the lived experience of the learner. The descriptions of dramatic contradiction in classroom talk, signposted by the term trigger here, can now be seen in action alongside the fact that the lives of pupils are being refracted through their conversations in a fluid mix of third space talk types that can be steered by the prevailing wind, i.e. the teachers use of triggers, to move them away from the less desirable forms of talk which has been classified as negative A.

Chapter 6 - Conclusions

6.1 Introduction

This study has described the use of a new, third space, lens to re-describe the CASE approach and to generalise its salient features, supported by a fresh articulation of Vygotskian psychology, for a wider audience beyond the science classroom. The diagrams presented in section 6.5 visualise this as a series of accessible recommendations for classroom practitioners. CASE is a tried and tested vehicle for the successful teaching of science yet the theme running throughout this thesis is the desire of a CASE expert of get to the heart of its principles of classroom management and curriculum offer in a way that have enabled him to successfully bridge into other curriculum areas and school settings. The hope is that others will begin to use the diagrams as a pedagogical guide to develop their classrooms and practice in a way that is supportive of ‘construction talk’. The diagrams serve to show how the principles of CASE have been distilled into a practical set of advice that exemplifies and successfully describes third space theory in a way that is of use for the wider teaching profession.

The key findings from this study for classroom practitioners can be summarised using the following headings:

- a) Inclusion,
- b) Professional choice,
- c) Construction talk and,
- d) Hope in the zone.

Inclusion points to the fact that pupil funds of knowledge need to be utilised, in the third space, so that their life-times worth of experiences brought to the classroom are included and acknowledged. This is true for all learners and the potential of this is supported by the fact that majority of the pupils highlighted in the transcripts were categorised by the school as SEND.

Professional choice references the fact that choices are made in the planning and conduct of lessons. To promote thinking teachers can integrate triggers in a way that engages pupils in intellectual inquiry. Triggers can be included in the lesson conduct or in response to the conversational turns taken in real-time. Similarly small groups can be orchestrated to develop construction talk that develops pupils thinking within the two planes described by Vygotsky – the social and the psychological. If managed utilising the third space then the external interactions with others support and enhance the inner cognitive life of the individual.

Construction talk is a living vocabulary that verbalises the inner thought life and so is one that must be inclusive of all forms of talk. The five talk codes reflect the real, honest, messy and playful conversations taking place in classrooms today as adolescents engage with the cognitive challenges around which CASE is built. The sensitive use of triggers can engage and guide pupils towards forms of talk that activate their funds of knowledge and develop both ownership of their talk and a metacognitive awareness of their thinking.

Hope in the zone – the third space is a theoretical construct that has been successfully used and applied in a range of educational settings. It has been used here to illuminate construction zone activity as a powerful time of developmental potential for children facing abstract concepts in science. Hope in the zone is possible with thoughtful planning and the use of specific classroom management techniques following the clear pedagogical guidelines for such techniques that are provided within this thesis.

The thinking shared in this thesis is the outcome of a pedagogical feedback loop that has left me as fascinated as ever by the wonderful conversations taking place in CASE lessons. It was this interest that underpinned the desire to use this research to shine a light on the discussions taking place between the adolescents who are the focus of this study. Ten years ago, this led me to the place where I needed to unravel the vines, as describe by Shayer, to help me better describe for myself the CASE theoretical paradigm with regard its Vygotskyian roots. The twin vines metaphor was used to represent the dual, and interwoven, influence of Piaget and Vygotsky upon the cognitive acceleration approach and lessons devised by Philip Adey, Michael Shayer and Carolyn Yates. One vine represents spontaneous thought growing upward while the other, representing scientific concepts, grows downward and under the influence of appropriate teaching the vines intertwine and grow together as conceptual understanding emerges from spontaneous thought. The vines also serve to capture the symbiotic relationship between the two psychologists in that in CASE the movement towards Vygotskian 'scientific' thought is structured through curricular content derived from Piagetian reasoning patterns. This aspect of CASE is distinctive and easily discerned from the teacher's guide. The pedagogical management of this in the classroom however, as achieved through something called construction zone activity, is less clearly exemplified. The actual mechanics of how children's talk is structured to make such activity possible stands upon a Vygotskian foundation and it is this aspect that has been investigated here.

From the outset this thesis has been guided by the following questions:

- **What is the nature of children's talk in CASE lessons and construction zone activity in particular?**
- **Does the application of Bhabha's notion of a 'third space' help us to better understand the place of Vygotskian psychology in CASE lessons?**
- **Can we create a model of talk, and construction zone activity, that enables teachers to better understand and therefore engineer and facilitate this?**

My research questions are answered collectively in section 6.5. This approach supports the creation of a wholistic and cohesive model of how CASE for the 2020's and beyond. The three perspectives that form the basis of this section are being used to do this and so to present the CASE approach in a manner that supports its further use and development from this point forward.

6.2 Emerging themes

An important outcome from this study is that CASE and its associated descriptive terminology (construction zone activity, cognitive conflict etc) has been redescribed and updated in the light of extensive teaching experience and this is shown in section 6.6. This gives the seminal work of Philip, Carolyn and Michael the currency needed for its use in classrooms today. Ideas formed in the 1990s have been connected to those of Mercer and Wegerif which are currently in vogue in educational circles. As the instigator of this study, I am confident in my ability to apply the outcomes of this research as an educational consultant supporting a range of institutions, including special schools, in areas far beyond the reach of a set of thirty science lessons.

There are three broad themes emerging from this research:

Theoretical

The aim of this work was always to give Vygotsky greater prominence in a way that is inclusive of his current level of influence, as seen through the work of the many authors cited throughout this study. This has provided a wider platform that is more reflective of how his ideas might apply in the classroom and the practical application of his work has been realised through the concept of the third space. The third space and its manifestation in the 'weather map' of small group talk reflects the reality of dialogue, and the power of social construction, in classrooms today. Such a gleaning of the golden nuggets from CASE, those that have stood the test of time, reveals that it very much a human endeavour, one that works on the interpsychological plane. Most importantly the umbrella term *perezhivanie*, i.e. a child's lived experience, provides hope for change and the role of ongoing experiences and the power of the classroom environment through the social plane of interaction.

Linguistic

The third space talk codes provide a realistic tool that enables the categorisation of pupil talk in a way that captures, and is inclusive of, 'all the talk'. The colour codes show how talk is influenced on a moment-by-moment basis by other pupils, and more importantly the teacher through the use of carefully chosen triggers. The third space acknowledges the funds of knowledge pupils bring, the first space, while it also enables the visualisation of the conditions that are supportive of new learning, termed accommodation in CASE. This thesis has resulted in a classroom friendly tool kit of ideas focused upon the development of dialogue and its power to support cognitive development.

Pedagogical

This exploration of CASE has resulted in a model of cognitive development that can be used by teachers to encourage construction talk and a respect for the lived experiences and funds of knowledge that all pupils carry with them. The third space as presented here, is actually a pedagogical tool that can be used to support both teacher creativity and social construction. This is not a recipe or formula, but a working representation that reflects human creative expression. The weather map model of pupil talk is inclusive and respectful acknowledging the value of what pupils carry with them into the classroom. Pupil agenda talk is a way to both understand motive and experience and its role in classroom dialogue. This work has shown how it is possible to design classrooms to engage pupils and that the third space is a valid construct that can be easily applied and incorporated as a tool to support both the planning of learning experiences and the moment-by-moment decisions made live in the classroom.

6.3 Reflecting upon chapter 2

As a practitioner, this study has enabled me to re-examine the theoretical underpinnings of CASE, and CAME, in fine detail alongside the outworking of these ideas in the classroom. This thesis is an articulation of this and as such, provides a pedagogical foundation upon which many more teachers can build classrooms where talk and thinking flourish. It can support them as they seek to engage pupils in their classrooms – even the Matthews (one of the pupils in group 2) of this world! This has been done by updating the language and ideas used to describe CASE. The use of the third space has enabled me to draw together the different strands into a unifying whole. Building a consensus as to application of Vygotskian psychology, most notably his idea of the two planes, provides a realistic and usable tool for teachers. The third space talk codes account for and include a range of different ideas such as heteroglossia, side talk, counter script, including all the talk, and the weather map with the inclusion of triggers which provide an easy-to-use visual representation of social construction. This shows how it is possible to both manage and develop productive classroom talk in a way that is inclusive of all learners. The model gives a face to the rather metaphoric terms used when discussing the third space which has become problematic. The notion of the third space has

been applied in such a way to provide an updated and visual description of construction zone activity that puts flesh onto the bones as provided by Michael Shayer. In addition, the weather map model serves to update the ideas of Piaget, such as cognitive conflict and accommodation, with the advent of the term trigger which presents his idea as a simple to use pedagogical strategy.

This study has the practitioner at its heart, a perspective that weaves the authentic voice of the classroom teacher throughout its pages. The ideas contained here are practical in nature and theoretical in inspiration as they seek to contribute to the pedagogical subject knowledge of other professionals. As a consequence, the CASE approach has been updated and refreshed for a new generation of teachers. The gap between the application of Vygotsky now and the less than robust application of his thinking in the early version of CASE has diminished. In support, the weather map model of third space talk serves to remove much of the mystery surrounding the teaching of CASE and the language used to describe this teaching approach. The model puts power into the hands of the classroom teacher for it highlights and supports professional decision making in the classroom. The model represents Vygotsky in a way that goes beyond semantics and makes his thinking a reality in the classroom, helping teachers understand and explain the roots of what they are being asked to do when involved in generic projects such as 'Developing Oracy' in mathematics.

This study was limited in its scope as it only involved eight pupils from one Year 9 class. This, however, became a strength as it allowed the practitioner perspective to be heard loud and clear. The lesson transcripts and plans clearly capture the thinking of a teacher in both the planning and the teaching process. In order to analyse the lessons in the depth required, to support the re-examining of CASE, an experienced CASE teacher was required to probe the theoretical foundations and the associated pedagogy. Personally speaking, the talk that is captured is representative of my own experience teaching CASE. Having two groups within the same class provided an insightful window into 'all the talk' without being too intrusive or invasive. It became clear in the lessons that from about halfway through the study, the pupils themselves both forgot about the camera, and also took control by switching it on and off. Its use was clearly an effective way of recording small group talk and having two groups enabled the capture of realistic talk that is representative of real classrooms. The validation process helped fine tune the codes and the development of the transcripts. There are clearly gaps in individual transcripts and times where the talk is not audible, but the codes allow the broad categorisation of talk, meaning that it was possible to capture enough to enable an exploration of the third space to take place. The patterns in talk are clear over time, and between both groups which is illustrated by the parallel transcripts highlighted in section 5.8. What is missing, however, is any insight into what the pupils themselves thought about the process and the CASE approach in terms of its cognitive aims. Any future work should involve a greater range of pupils and use structured interviews to probe their understanding of how the demands of the approach affects their thinking and supports their cognitive development.

This study has only served to whet my appetite regarding the further exploration of the third space and the weather map of third space talk. There is a need to probe small group talk to find and extract more examples of reflective and playful talk and to involve the pupils in this process. Interviews would find out what pupils think about this, and coaching could be provided to train them to distinguish between the different types of talk in a way that is supportive of cognitive development in both science and mathematics. This raises several questions concerning how the weather map develops over time, with pupils of different ages or in different subjects. There are a multitude of further research possibilities looking at both CASE and CASE lessons and the difference between primary and secondary pupils in relation to the weather map model of talk. In addition, a major focus could be an exploration of the value of the weather map model of talk as a tool to support teacher development. As an educational consultant, I am confident that the findings

of this research can be readily applied to develop a series of practical tools to support the many schools that are making the development of oracy and metacognition a priority. The weather map model of third space talk provides an easy-to-use visual representation that allows teachers to visualise how these ideas might apply to their classrooms, thus enabling them to better understand how they can make the necessary changes to adopt such approaches. CASE was the initial vehicle used to develop the weather map model of third space talk, yet because of its Vygotskian and Piagetian foundations it can be easily applied to all classrooms. The five categories of third space talk provide a simple tool, one that is broad enough to capture a wide range of talk, that can be used to support both the analysis of small group talk and the development of construction zone activity.

This thesis is a very personal story, one that illustrates a teacher's desire to probe deeply into their classroom as they struggle to articulate and apply a theoretical perspective to illuminate the rules that govern cognitive development. This study has achieved its primary purpose of updating CASE as an approach, rather than a simple series of lessons, built upon a foundation of ideas that can be applied more widely. The thirty CASE lessons embody an approach that opens the eyes of many teachers to the transformative power of the ideas of Piaget and Vygotsky and their role in the creation of the classroom environment that many remember with great fondness. This study shines a light on the power of pupil dialogue and its true place in the classroom today. It argues that classrooms need to contain the time for pupils to express their thinking, thus providing the, third, space to enable the transition towards the specific knowledge required for success in terminal exams. Indeed, for those professionals interested in the practical rules that can be used to develop a classroom based upon the ideas of Vygotsky, this thesis contains a cry for pupils to be respected and given the space to think in an overcrowded curriculum. It contains a simple model to explain the drivers of cognitive development in easy-to-use language alongside the tools for use in the classroom today.

It is at this point I will revisit the phrase 'all the talk'. This is a key aspect of this research, for classroom conversations are essential fluid and dynamic, rarely following a logical sequence of thought, full of a hybrid mix of words and influences. In addition, there is a need to account for the talk agenda of the pupils themselves and, in the process, to both acknowledge and incorporate the range of talk taking place in the real conversational mix of utterances that is the reality of small group talk in any secondary classroom. We need to include the pupils themselves, and the ideas they bring, and the motivation to communicate and share as an important and yet often unacknowledged variable that is a key influence on classroom talk. This chapter seeks to present construction zone activity as a construct that has updated and refreshed to better help us visualise the complex world of classroom talk.

Neither can we simply limit ourselves to a specific type of talk- such as Mercer's (2002) 'talk for thinking' and its three categories: cumulative, disputational and exploratory. Classroom conversations do not occur in a vacuum. They have they been described by Gallas (1995) as a 'heteroglossia,' a 'living science language' which is used by children to reflect their desires to explore and make sense of the world around them, necessarily including the experiences and ideas they carry with them as part of their 'lived experience' or *perezhivanie*. In the words of Moll, pupils bring to the classroom a whole host of ideas and experiences, termed funds of knowledge, that shape and guide their levels of engagement and conversational responses. To explore and update the concept of construction zone activity there was therefore a need to re-describe the talk taking place and to incorporate a wider range of influences such as those of Bhabha (2004), Moll (1990), Gutierrez (1998), Maniotes (2015), Wegerif (2005), Gadamer (1981) and Mercer (2002). These ideas were not readily available to Shayer and Adey during the early years of CASE and their inclusion will serve to enrich its Vygotskian roots. Figure 8 below, originally shared in section 5.2, shows how the key influences have been included as part of the process of re-imagining construction zone activity through Bhabha's lens of the third space.

Maniotes Types of Third space merger	Edmiston Types of third space talk codes	Mercer's Talk for thinking categories	CASE terms
Intellectual inquiry Deep reading	I - intellectual engagement	• disputational, • cumulative, • exploratory.	
Social empathy	E - empathy and personal sharing		Metacognition and bridging
Deep reading	R - surprise or reflection		Metacognition and bridging
	P - playful		Metacognition and bridging
Deep reading	A – pupil agenda: Positive, Negative, Neutral.		Metacognition and bridging

Figure 8 – factors influencing the third space talk codes

Notes on figure 8

All aspects of talk are shaped by the lived experience of a child and so the term *Perezhivanie* can be applied as an umbrella term over construction zone activity and the talk therein. One outcome of this thesis is a re-articulation of CASE pedagogy to include Vygotsky's ideas of dramatic contradiction and *perezhivanie* in an updated description of construction zone activity. In CASE, construction zone activity refers to work in groups to resolve the conflict and this may involve further reading or research. Deep reading has therefore been incorporated into this and other types of third space talk.

Playful talk – Wegerif (2005) coined this term in his desire to account for the process of how talking supports new learning.

The third space talk code A (pupil agenda talk) acknowledges the work of Guterrez and her notion of pupils developing their own talk script, in contrast to that of the teacher, termed counterscript. Similarly type A talk enables the incorporation of Lemke's notion of side talk and the use of the term *heteroglossia*, used by Bakhtin and Gallas, in the desire to capture the rich mix of influences that is real classroom talk. Similarly, the use of the Vygotskian term *perezhivanie* to encapsulate how experiences both shape and enable the child to be shaped by talk captures the sense of refraction- change through experienced shaped by on-going experiences.

6.4 The place of a 'merger' in the third space – 'To merge or not to merge!'

I have adopted the term merger, as suggested by Maniotes, as it effectively captures the notion of the third space; the merging of two spaces resulting in the creation of a new or third space. In terms of the 'elusive' third space, this is something that so many of the authors mentioned in this thesis have tried to describe. This study brings clarity as to its nature to enable it to be applied both in and beyond the CASE classroom as an entity in its own right. Alongside this, the interaction of viewpoints (or horizons), as described Gadamer (1981), are an additional way to view this merging of 'spaces'. The viewpoints in question are:

- The horizon of understanding brought by the child (the first space) and;
- The horizon of meaning that addresses the child (the second space).

This interaction is described, not as a simple joining, but rather a 'to and fro' between the learner and the different-ness of what they encounter in the classroom. Importantly this references Bhabha and the idea of priming the difference between the two positions and the term fission is used by Gadamer to describe the process. Fission captures the ongoing tension between one's own ideas and those previously un-encountered in the classroom. In CASE this is termed cognitive conflict and

occurs when children operating at concrete operational thinking meet challenges that require formal operational thinking. A merger is not a fixed entity but rather an active hybridisation and a remarkably similar process described by Wegerif as involving resonances but without fully capturing the idea of a merger, accommodation or fission as describe above. His ideas regarding the creation of a space for reflection and to enable resonances to occur provide an additional way to view this (mysterious) process.

In this research, the term trigger has been used to help describe something termed cognitive conflict in CASE or by Vygotsky as dramatic contraction. This is not a simple case of assimilation but one that involves a change or accommodation. If pupil ideas and thinking can be brought to active articulation, as they are in CASE, then this process can take place. Classrooms that embody such learning behaviours create a tension that is both internal, to the child, and external, between the individual and their peers and between the pupils and their teacher, via the content that is being taught. This is the time when construction talk can take place and the pupils begin to articulate and resolve the conflict they face. What is clear, is that this is something that can be promoted and engineered, as part of CASE pedagogy, but it is also dependent upon relations between people, i.e. teachers and their pupils. This form of experience is clearly lived, is inclusive of Vygotsky's planes and is summed up rather nicely by his term *perezhivanie*.

Any process involving hybridisation, which this does, is seeking to quantify something that necessarily involves a process of transition, or change, from one space or state to another. Such 'movement', when involving adolescents, is clearly a dynamic process, yet is one that I am keen to better describe in terms of the conditions supportive of the move from spontaneous to scientific thought. The word liminal has been applied to intermediate or transitional states such as those described here. Similarly using the terms resonance and merger help to give voice to better define the change we are seeking to explore, all of which are essential to the re-analysis of construction zone activity.

6.5 The three perspectives

This research has been a personal journey and one that is subsequently influencing and guiding the narrative that I now using as an educator. With the benefit of the hindsight afforded to me by this research I am able to marry the knowledge I have now acquired with the need to view the reality of adolescent talk in the classroom as a rich mixture of influences both positive and negative. This is something that can be shaped and developed by those who understand the rules that govern small group talk. In keeping with the narrative style of this thesis for the rest of this final chapter I address my research questions from three different perspectives. Each of which encapsulates a different area of impact and therefore relevance to the teaching profession. They will also provide a means by which I can provide advice to my younger teaching self, so to speak.

Perspective 1: the theoretical underpinnings of CASE and redescribing construction zone activity

At the heart of this research is the desire to redescribe talk in CASE lessons in a way that is more inclusive of the real conversations that take place among groups of adolescents. Children do not talk in isolation from the influences prevailing upon them from both in and outside of the classroom. As a regular visitor to a range of schools, I wanted to paint an honest picture that is inclusive of the 'messy' talk taking place between real people- something that the term heteroglossia sums up nicely. This research has enabled me to probe deeper into construction zone activity to develop a representation that is inclusive of the influences of Bhabha (2004), Mercer (2002), Wegerif (2005), Moll (1990) and Guitierrez (2005). I feel this must also acknowledge the work of Maniotes and how

helpful the term merger has proved to be. It has enabled me to re-description the CASE classroom in a manner that celebrates the practitioner perspective in a way that also permits a deeper reflection upon the outcomes of the work of Nuthall.

The original diagrammatic representation of construction zone activity is shown as Act 2 in the diagram below:

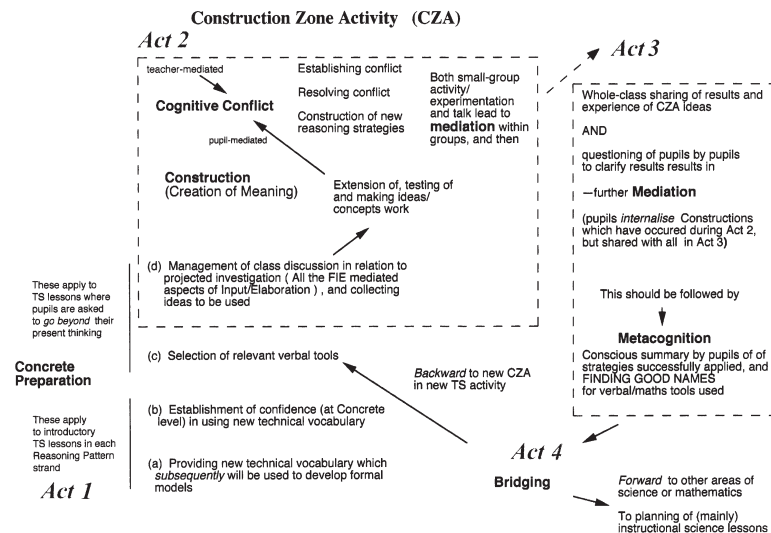


Figure 1

To better understand the way in which I am updating construction zone activity we will now isolate the following variables from within Act 2 from the perspective of the third space:

1. Construction and creation of meaning;
2. Cognitive conflict – establishing and resolving conflict, teacher-mediated and pupil-mediated conflict and;
3. Development of new strategies.

These aspects of construction zone activity can now be described in the light of this research and articulated in a way that reinforces their relevance to the classroom today. The language and ideas of the third space can be brought to bear in a way that will enable teachers to see this in their own classrooms and to better plan for it. I will now redescribe the key features of construction zone activity from the perspective of the third space:

“Construction and creation of meaning”

I am introducing the phrase ‘to prime the difference,’ as a way of highlighting the teacher’s roll in this aspect of cognitive development. It helps to explain how the ideas of the child meet those of the curriculum (the second space) and set in motion a train of thinking that may result in a (place of) merger between what the child brings and what is presented in the classroom. This merger of ideas is dependent upon the difference being just enough to enable fission (or resonance) to take place. In CASE, the difference relates to the concrete operational thinking which characterises early adolescent in contrast with the more formal, abstract, thinking required for success in formal examinations. This is being termed as the third space, for this captures the moments of merging, accommodation in Piagetian terms, where understanding of the new, or second space, begins to develop, within the child, from the old or first space. The term merger is pivotal here as it describes the fact that, in Piagetian terms disequilibrium must take place for a change, in thinking, to occur.

“Cognitive conflict”

In terms of the inclusion of the concept of the third space into CASE terminology, the phrase ‘priming the difference’ is critical. Cognitive conflict occurs when the difference between the first and second space is close enough to enable dis-equilibrium to occur. This is built into the very fabric of CASE, yet it is something that is also quite subtle. It is described by Vygotsky as a ‘dramatic contradiction’ deriving from content aiming at the buds of thinking not the flowers of thought. The term trigger will be used to describe the time when the conflict is introduced and established either as part of the lesson plan and as an explicit teaching strategy. The use of the term ‘trigger’ helps to illustrate that this is something that is both planned for and actively managed during the lesson. It is not something left to chance, for it is responsive to the children and needs to be thought of as being managed, controlled and applied when a teacher discerns it will be most effective. This captures the active role of the teacher in the ongoing decisions that need to be made regarding this and is well described by the term ‘priming the difference’. A conflict arises due to the difference in the two spaces, or two horizons as described by Gadamer, which in CASE is the need for formal operational or abstract thinking as required by the secondary science curriculum. Although built into CASE, this aspect is very much under teacher control and is where the idea of imagining the talk taking place during construction zone activity is helped through the use of the weather map model, including prevailing winds, of small group talk.

Here we come to the heart, and purpose, of construction zone activity and the fact that the talk taking place at such times, described as construction talk, is actually a complex and interacting range of different talk types. Wegerif describes the need to account for ‘all the talk’ taking place at such times and the table below shows how the five third space codes support this. In terms of the third space this is where mergers occur, and the pupils activate their funds of knowledge. The third space talk codes have been able to capture talk that reflects all the talk or construction talk. The most frequent type of talk, intellectual engagement, allows the inclusion of Mercer’s talk for thinking while the category of playful talk addresses some of the issues raised by Wegerif concerning playful talk. The other talk codes can be used within the weather map to begin to flesh out what Wegerif describes as the creation of space as a clear way to help teachers visualise this process.

Classroom talk is a hybrid mix of both utterances and influences- a rich blend of the personal, social and cultural. Any analysis of talk will highlight this and how fluid and dynamic classroom talk is. Guiterrez’s idea of pupil talk scripts, and Lemke’s side talk, countering those of the teacher, do help us to see the need to guide and support their conversations. Classroom talk, however, does not move from one type to another in a seamless fashion, rather there is a constant, and dynamic, mix of talk containing a range of types. There will be times when the pupils control the agenda of the talk termed Pupil agenda or type A talk. Such talk is under their control and ownership of the thinking, ideas, activity and engagement. During type A talk they may be ‘on task’ but they have transformed it to meet their own agenda as prompted by the activity or another trigger. Here the pupils are not simply completing the task but may be moving (intellectually) in a new or different direction. Pupil agenda talk has been categorised in the following ways:

- **‘neutral’**- involves instructions and short incidents of off-task talk that regularly occur as pupils work. They may get temporarily distracted but they soon return to the task. This can also happen at the start of a task before they begin and at the end when they finish;
- **‘negative’**- hinders engagement with the task and can be disruptive/negative in its emotional tone. It can be of great interest to the pupils and usually has nothing at all to do with the task set. This includes talk where they go off on a tangent because something distracts them from the task at hand. It can be happy and feels playful but is not linked in any way at all to the task;

- **‘positive’**- a line of talk that is triggered by the activity but the talk moves away from the task at hand to reflect topics of interest to them that is positive and can be related back to something triggered in the content of the lesson or by the teacher. This is similar to I in that they are intellectually engaged but the content of the talk is unrelated to the task set as part of the lesson agenda.

The ideas above in relation to type A talk helped me to plan lessons that address the advice given by Nuthall that aligns peer culture with their lesson objectives. The lesson plans written as part of this research, and found in appendix one, can be used to show how such experiences were built into CASE lesson to include the cultural capital that was relevant to the pupils’ lives. This aspect resonates with the use of triggers to engineer talk and the focus in the transcripts upon pupil agenda A talk and its differentiation into positive, neutral and negative have been used to show how Matthew, in particular, in lesson 6 constantly engages with the triggers provided by the teacher. This highlights the need to support pupil involvement based upon ideas that are familiar and within their realm of experience. In CASE the route to higher level thinking always emerged from careful, concrete, preparation that promotes engagement both with the context of the task and the challenge to come.

Figure 12 is taken from figure 1 and shows the diagrammatic representation of construction zone activity as originally presented by Shayer;

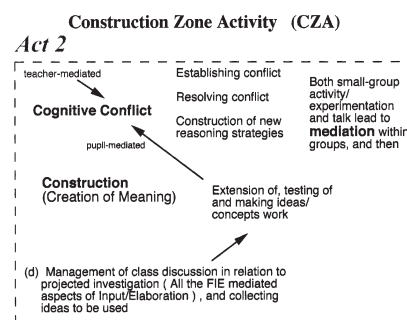


Figure 10 – construction zone activity

Perspective 2 – the diagrammatic representation of CASE pedagogy

The images below comprise my representation of construction zone activity developed to include the concept of third space talk. The diagrams incorporate the key ideas explored in this thesis namely the weather map and the use of the terms trigger and merger to re-position construction zone activity to stand more firmly upon the Vygotskian foundation of perezhavanie. This re-presenting of construction zone activity can be used to illustrate the manifestation of classroom talk through the lens of the third space including how small group talk can be developed over time. Together these images provide a visual representation of the key elements of construction talk and how each might look in the classroom.

Perezhivanie

The shows how the lived experience, the dispositions, experiences, or funds, a child brings into the classroom with them, refracts any current experience resulting in a range of different responses such as negative pupil agenda talk, A, or intellectual engagement talk, I. This also points to the fact that this process is not fixed and so opens the possibility of new ‘experiences’ shaping a more positive, or desired, response from the learner.



Figure 11 Perezhivanie

Cognitive conflict

This has been updated to include the ideas of Bhabha and Vygotsky to help deepen and enrich its utility for classroom teachers. The use of ideas such as priming the difference, 'n+1' and dramatic contradiction enables teachers to get a sense of how thinking can be developed or provoked in a way that link to curricular aims through the use of engaging or challenging stimulus known as a trigger.

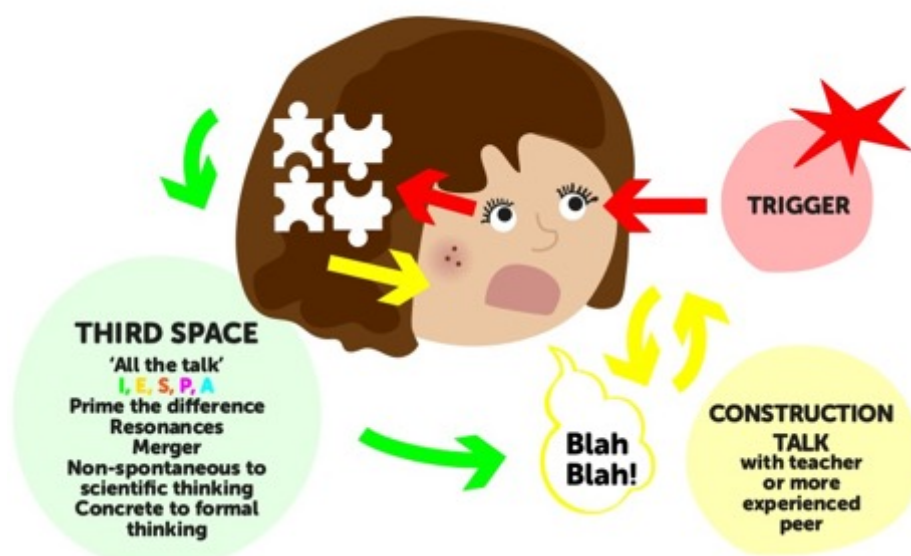


Figure 12 Cognitive conflict

Construction talk

This image a rich and realistic representation of the features of that are conducive of construction talk, talk that reflects the hybrid nature of any small group conversation and includes a sense of ‘all the talk’ involved, warts and all. The term ‘all the talk’ reflects the reality of children’s talk as a playful mix or ‘heteroglossia’ which enables us to move beyond simple descriptors such as exploratory talk. This diagram seeks to show the key descriptors of such talk including the role of triggers.

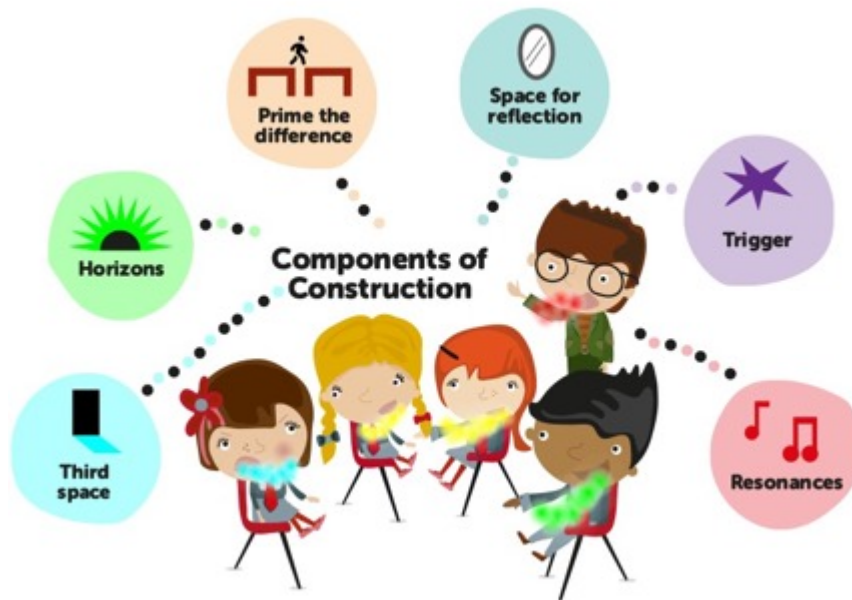


Figure 13 Construction talk

The third space

This image provides a representation of how Bhabha’s notion of the third space, and translation, help us to visualise the features of accommodation in Piagetian terms.

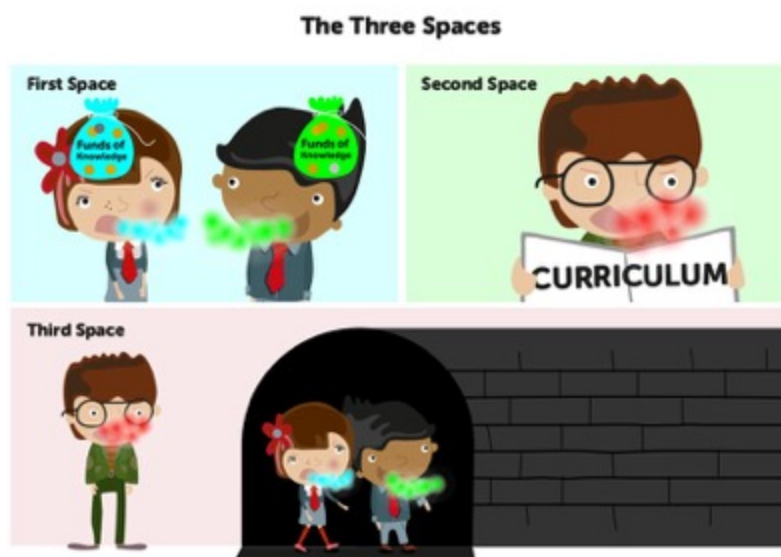


Figure 14 The third space

Tatham's (2023) description of a 'bridging' third space as a place where different discourses are allowed to meet and where mutual understanding can develop is one which I am aligning CASE and this thesis with. I am applying the notion of the third space to CASE lessons with the purpose of describing them as a suitable curricular vehicle to show the practical application of third space theory. The ideas contained in this chapter illustrate what this might look like in the secondary classroom and beyond.

Ferrari et al (2021) state that the creation of a third space requires certain key elements of classroom practice to be present. These mirror those I included as part of my CASE practice such as: using small groups work to promote debate and discussion, creating conditions that activate peers as critical friends, the sharing of meaningful experiences lived by students and the provision of space that is inclusive of a playful and creative approach. Based upon the outcomes of this thesis this chapter will show how this looks within the classroom and begins to map out how this can be an inclusive part of a teachers curricular goals. This perspective regards the third space as an inclusive pedagogy rather than just an add on and by using the weather the map to represent this we now have a set of rules by which others can operate promote similar classrooms. The lesson plans and the resulting transcripts provide the ground rules for a pedagogy of the third space. The following short extract from group two in lesson six shows how Trevor engages, in such a playful and creative manner, with his group as a consequence of the use of a range of engaging contexts, termed triggers, by the teacher:

AE – It might be like a comedy tiger

Trevor – Comedy tiger Hah

Gillian – It might be like me, it might just like photos

AE – Let's keep that thought – it could be the same animal

Gillian – Trevor ... you might ...

Trevor – What's with the tranquilizer

AE - ... there's one, there's one

AE - maybe it has a piece bitten out of its ear

Gillian – Like my guinea pig

Trevor - normal?

Another pupil – You know what they do with sheep

Trevor – I actually think that is what they do ... they put chips in to track them ...

Gillian– Spray paint is probably better

Trevor – No spray paint damages fur

AE now tells the story about a man marking snails to see if they would return.

Trevor – They spray painted a snail!

AE – Animal migration is fascinating

Trevor – Is it!

Trevor - Snails are magnetic!

AE – You have homing snails

Trevor – Homing snails - ... can they follow stuff?

AE – You know how to get home, maybe snails do

Gillian – Not really I get lost

Trevor – I just walk I happily follow my nose

The weather map of third space talk

The 'weather map' of third space talk illustrates how this looks in the classroom as part of the pedagogical process. It highlights how teacher choices regarding the development of construction zone activity can be supported by an understanding of the third space to dynamically affect the talk taking place therein. A key feature of this is an understanding of the importance of triggers, both planned and responsive, to guide children's talk.



Figure 15 The weather map model of third space talk

These new diagrammatic representations update and enhance the concept of construction zone activity, as described by Shayer, while still holding true to his ideas. It allows the incorporation of the ideas such as dramatic contradiction that were not available at the time CASE was first published. The cornerstone of the updated model of construction zone activity is *perezhivanie*: the lived experience of a child. This is a fluid concept and one that develops through experience, for better or worse. In a classroom that facilitates mergers drawn from a child's fund of knowledge then the third space can become something that allows us to better describe and explore learning. The weather map analogy supports this as it illustrates how the five talk codes are inclusive of a realistic range of talk types i.e. all the talk – the talk that forms 'construction talk'. It also reveals how the teacher and the use of triggers can provide experiences that utilise pupil funds of knowledge in a way that steer them towards intellectual engaged talk, talk that results in a merger and a change in thinking. The key to this is an understanding of the potential of pupil agenda (A) talk and the promotion of positive A within the classroom. This can be seen in lesson 6 and the impact that the triggers employed by the teacher have upon Matthew and his level of interest and engagement. The transcripts reveal how talk is directly impacted by the contexts chosen by the teacher to support their teaching. There has never been a simple answer here or a formula to follow, yet we can now point towards the essential features of the classroom; the ingredients that can be put in place to facilitate 'construction talk'. The model on the previous page shows that, as a consequence of the right conditions, pupils will engage in talk that support a change in thinking. We are now able to describe the type of classroom that embodies the ideas of Nuthall, Moll and Guiterrez. Such a classroom strongly features desirable talk yet includes a range of realistic talk (all the talk) which is captured by the five third space talk codes.

Perspective 3 - articulating CASE for future generations

The use of the ideas of Piaget and Vygotsky by Shayer and Adey in the 1980's to develop the CASE programme have proved to be prescient in that they sought to provide both a pedagogy and a theoretical foundation to the idea that classrooms are vehicles that should support and enhance the

cognitive development of pupils. This study has sought to enrich CASE through the introduction of a range of thinking that allows teachers to better design classrooms that begin to address the advice given by Nuthall (2007) who states that any group work of this type requires a specific attitude, one that sees a classroom as a learning community. Helpfully he provides the following points that need to be part of any such classroom:

- *Activities should be designed with students' memories in mind;*
- *Students should be able to make connections between different experiences that involve the same concept;*
- *They should look at key ideas in depth;*
- *There is a need to develop a culture that entails mutual respect and co-operation; where everyone feels he or she has something to contribute.*

The lesson plans and the rearticulation of CASE here using such terms as the third space, merger, funds of knowledge, weather map and triggers help to show the reality of this. It is clear to see that 'construction talk' (the talk that takes place in small groups as pupils work on problems) is actually a range of fluid and interdependent talk. It can be influenced by triggers and the lives of the pupils themselves to promote the kind of talk that promotes cognitive development. Nuthall used the term the 'hidden lives of learners' to encapsulate how much of this is unseen. Similarly, this research uses the notion of perezhivanie to illustrate the importance that the, equally unseen, lived experience of learners impacts learning and how this can be changed through the adoption of an environment that allows learners ideas to merge with those of the curriculum as presented in the classroom.

CASE, according to Philip Adey (personal comment), was actually concerned with giving teachers a theory to support their professional decision making. In CASE and CAME the ideas of Piaget and Vygotsky have been successfully applied to the teaching of two core subjects. It is this theoretical underpinning of teaching that has enabled me to further enhance and develop CASE in this vein to support and enhance teaching and learning in a more general capacity. The focus I have taken to explore the notion of the third space, in support of the ideas of Bhabha and Moll, also shows how the ideas of Nuthall can become a reality in the classroom. The use of the term third space brings a new dimension and application to CASE that illuminates and quantifies dialogue and small group discussion in the classroom. This focus address two areas that face any teacher namely:

- The inclusion of pupil ideas in a productive way into the teaching agenda and,
- The role of the teacher in creating a classroom environment that is supportive of dialogue, small group discussion and the promotion of the third space.

The language used here to describe construction zone activity serves to shed new light on classroom talk, opening it up to the further development of the ideas contained in this thesis. In addition, this places power into the hands of teachers to support them to design learning experiences that are meaningful and engaging and how they, through the use of tools such as triggers to facilitate and rebalance talk, can promote the types of talk that are linked to cognitive development. These ideas have the potential to be developed into a more general model of small group talk, one that is applicable beyond the focus of this study: CASE. Currently the term 'adaptive teaching' is in vogue and, to me, this describes the role of a teacher to, through the words a child uses, gain an insight into their current level of thinking and then responding in a way that supports them to reach out to a higher level of thought. A key outcome of this study is to highlight the classroom where the power of the merger is employed by teachers to engage children in learning and to promote deep thinking. To return to perezhivanie we begin to see how the promotion of third space talk, with an emphasis upon the value of pupil agenda talk, can shape a child's experience of talk for the better through a supportive positive feedback loop.

I will close this thesis, thus ending my reflections, by looking at my current practice through the lens of the weather map of third space talk. For the past three years I have had the great pleasure of working in many special schools. The nature of the learners I am now working with means that many of them are unable to access activities such as the CASE lessons that were the focus of this study. The encounters with the pupils from Barry School have enabled me to reflect upon the ideas of Piaget and Vygotsky and to view them as streams flowing together to support a deeper understanding of how to engage, and include, all children in the classroom. This understanding has been catalysed by the very special pupils I am now teaching many, many years after experiencing my first CASE lesson.

In special schools it is clear that the classroom norms present in mainstream schools do not work. I have now seen many incidents where the ‘funds of interest’ that pupils bring with them enable lessons to be tailored to meet their needs and to engage them in a learning journey. The weather map model of third space talk works perfectly well in these settings and the result is often pure joy and engagement in a way I rarely observe in the mainstream secondary classroom. I have seen more unfiltered joy and experienced so many fist bumps in the past three years than the previous twenty and this level of enjoyment is making me seriously take stock of my classroom practice. This thesis forms the foundation of a call for change to the classroom environment knowing that a child’s *peretzivanie* is not fixed but is shaped by current experiences, experiences of the kind espoused by the CASE approach. A child’s ongoing experience can bring change for the better and in the words of Vygotsky (2004, p.14) the richer, the better:

“The creative activity of the imagination depends directly upon the richness and variety of previous experience because this experience provides the material from which the products of fantasy are constructed. The richer the experience the richer the material the imagination has access to.”

I will close by saying that my hope is that many more teachers will come to see that we can change the lives of children for the better. It is possible to provide a way for them to both access the curriculum and engage with its content in a way that facilitates cognitive development and the ideas contained in this thesis begin to provide the very tools to do this.

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Appendix 1 – Lesson plans and uncoded transcripts

1a – group 1

1b – group 2

Barry School – Group 1

Lesson 1 – CASE lesson 18 also known as the Pepsi challenge

Lesson overview

This is a lesson on probability and is specifically linked to blind taste tests. The concept is explored through the reality of theoretical v's experimental probabilities and how the latter can differ widely from the actual, experimental, probability as calculated by the pupils. The chance of guessing is modelled with a coin toss (either heads or tails i.e. right or wrong) before a graph of the experimental probability against increasing sample size is plotted. The data and the line they draw slowly approaches the probability of 0.18 for guessing 4 or 5 correctly as all the data is cumulated.

The main stages in this lesson can be summarised as:

Stage 1 – the lesson begins with an introductory discussion exploring pupil understanding of probability, chance, in the context of everyday events.

Stage 2 – a blind taste test is used to contextualise the nature of chance (here 50:50) prior to a volunteer actually carrying out a taste test involving five taste samples. The key question; 'How can we know if they were guessing?' is used to bring focus and to challenge their thinking.

Stage 3 – coins are introduced as a tool to help explore the nature of guessing in this context i.e. you are either right or wrong and to model how we can actually calculate the chance of something occurring.

Stage 4 – pupils carry out a coin tossing activity to model stage 2 and they are required to work out the probability of guessing 4 or 5 right.

Stage 5 – the range of answers is explored and then the class data collated and used to show the cumulative impact of increasing the sample size on the probability. This data is plotted as a graph to show that the experimental probability only approaches the experimental data when the sample size is large enough. On the graph this is shown by the line levelling at around 18% which is the actual probability of guessing 4 or 5 correctly.

The stages above are personalised in this lesson in the following ways:

Stage 1

A cartoon showing the headline '1 in 100 year flood' is used to explore the everyday language of probability and chance.

Teacher comment: The headline was chosen as the phrase has been used within the memory of these pupils to describe flooding. Such a start enables the language used by the pupils to be focused upon the deeper idea of how probability underpins many real life events.

Stage 2

An image showing a blind supermarket taste test is used to focus attention on the main activity to come.

Teacher comment: This is a warm up activity to provide a concrete bridge between probability and the way it will be developed in the blind taste test. The pupils are being set up to use the data derived from the simple tossing of a coin to explore the difference between theoretical and experimental probability – this is new for many pupils and the lesson tries to make that as real as possible for the pupils.

Stage 3

A pepsi/coke challenge is carried out involving a pupil from the class during which they are given a sample of five drinks to taste. The class are asked how many they need to get right before we know they are not guessing. The class choose the order of drinks while the volunteer is out of sight.

Teacher comment: this is a very engaging activity that uses the simple task of tossing a coin as a model to enable a deeper exploration of probability.

Stage 4

Pupils are introduced to the fact that a coin can be used to model stage 3. Five coins are used to replicate a large number of trials during which the pupils have to calculate the chance of guessing 4 or 5 correctly.

Teacher comment: the data collection activity acts as a bridge to move the task away from the concrete towards an abstract discussion of probability. In stage 5 the cumulative data is expressed graphically, showing that it approaches the true probability, which is something that is new for most pupils of this age.

Stage 5

The differences in pupil answers (the probability of guessing 4 or 5 correctly typically ranges from 0 to 40%) and is used to trigger a discussion concerning the need to use the cumulative probability to illustrate what happens as the sample size increases.

The cumulative data is plotted as a line graph that levels out. Probability and pet health is used as a new context through which to apply the learning from the lesson.

Teacher comment: the simplicity of this activity and the range of data produced serves to make the pupils think more deeply about the apparently simple idea of a 50% chance. This part of the lesson pushes their thinking will into formal operational thinking. The link to pet health that is sometimes used at the end serves to both apply the idea of the true meaning of chance to an area of importance and also to illustrate how helpful this thinking is in everyday life.

Lesson context

This is the first CASE lesson (following an initial introductory) lesson with this group but the pupils in this group are familiar with each other. There are 4 pupils in this group; 2 x female and 2 x male.

Clip $\frac{1}{4}$

Time	Code	Transcript	Notes
		The pupils discuss the starting image on the screen the 1 in 100 year flood news headline.	
5.30		Mike and Gwen argue about the force of the rain in the image Gwen – Heavy rain Mike – English rain, we don't have strong rain like Russia All laugh	Stage 1
6.30		Mike – Its like telling someone without a house to get a job	Not sure where this is from!

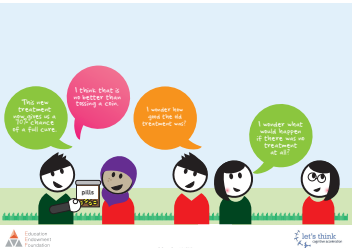
7.30		Girls in group chat AE – wonders out loud what they think and if have heard such a phrase before AE – What's the picture got to do with probability? Lots of talk follows associated with probability.	AE stops the class because he heard someone in the room use the word probability Feedback from the groups begins
9.09			
9.13			
9.30			
10.00		Taste test image on board now	
Time	Code	Transcript	 Notes
29.01		AE shows bottles Mike – You could see it Sheila – I am stronger than average Mike – that's more than average Mike – I am stronger than average Mike and Sheila – look at the gloves!	Stage 2 AE wears gloves to handle bottles for the
10.38		Mike is tasting and gets 5 out of 5 right Mike – Blindfold – force them to guess ----- probably Mike – so confused !! you said 3 Cohen and Sheila Mike – we are on a roll, we are getting the coke Sheila – definitely yes Mike – that's more than average Mike – I am stronger than average Mike and Sheila – look at the gloves!	Stage 3 AE wears gloves to handle bottles for the
29.38		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
10.45		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
30.23		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
31.40		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
13.39		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
14.28		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
15.00		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
15.09		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
32.19		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
32.47		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
33.23		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
33.35		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
34.26		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
35.06		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
35.30		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
36.05		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the
36.49		AE now shows the 5 shot glasses – What think? AE input – Does he know how find out if guessing? Sheila – I want to speak AE – How do we find out the chance of guessing? What could we do to find this out? Mike – Did you say peoples Group feedback on how to do this test. Mike – Ah I am saying is that I have failed?	Stage 3 AE wears gloves to handle bottles for the

37.25		Mike - 5 H – super improbable	
		All chat – most probable, least probably	
38.15		Mike – I am proud to have got that ... Jesus is reigning down	Is Mike like this because engaged in the task?
38.22		AE input to guide and support talk ... What is the probability?	
40.10		Mike – Look at me, I have a special purple pen Gwen – Its mine ~~Mike – So why are you not using it ... she is taking advantage of you~~	
Time	Code	Transcript	Notes
52.36		~~Mike – We use me I will have the bug~~ Mike – We use me I will have the bug	Mike shows compulsive hand rubbing behaviour
40.30		Mike – Tranquilize the cat and we will put it in the bag	
52.52		Mike – We do not need to continue, finish first, we are the best. Mike – Why doing random religious symbols?	
53.05		Mike – Do you want to summon the Lord Jesus?	
		Mike – I don't think that Ian over there cares if its pretty ... pity, its not going to get me the coke man. Gwen – just have fun Mike – Because I am a logical person	
53.31		AE gives time warning to focus ready for class feedback Shelia - You can explain it to me Mike – If I use really long words it sounds as if I know what I am talking about	Task focused with minimal other chat
55.00			
55.00		Feedback AE – No-one wrong ..how work out the answer	Stage 5 beginning about now
55.25		They discuss the fact the answers are all different for the probability for 4/5 right	
56.50		AE - If no-one is wrong why are the results so different? What is the probability? Why can we not get an answer?	
59.14		Mike + Sheila – If want all then ½, ½, ½, ½, ½ Its impossible because it changes all the time?	
59.30		AE now shows cumulative probability AE – What are the numbers telling us? Why do they do that? I again	Hard to know who is speaking at this point.
60.00		Mike – Just random chance!	

63.30			

Clip 4/4

Time	Code	Transcript	Notes
1.16	A	AE – Is there a pattern? What happens if I keep going? Class told to sketch graph of this data - What’s happening?	Cumulative data shown to class
	I	Mike examines the coke bottle – he thinks they are going to win and is excited Gwen – So Mike – Not getting Dominoes Sheila – I love cookie dough Mike – We are going off in a tangent Mike – What are we all thinking? The group discuss the graph	They all laugh
1.18		Mike – I need to pay my taxes this week Alan and Sheila discuss drinks	
1.18.26		AE – reviews + revisits graph and gives 3 questions: 1 – What are the numbers telling us? 2 – What is the chance? 3 – What will happen with more coins?	
1.19.30		Mike – He is examining his prizes again They all laugh and one of the girls talks to the teacher “Examining those calories Sir!” Mike – He wants to know which one is healthy Mike – Its red, back the red my man republican Mike – That attitude is not a coke winning identity	He refers to the class teacher (supply)
1.20		They argue about a pen and one of the girls swears. They all laugh because she was caught on camera.	
1.20.45		Feedback – sharing views on graph	All very engaged
1.22		AE asks to vote on which option for the graph they think is correct	AE draws the 3 possible for the path of the graph
1.24		Mike tries to explain	

1.25		AE introduces the idea of the theoretical probability AE moves to a time for questions re probability when applied to health (pet) 70% chance of full cure with the new treatment	 Off task and talking to another group
1.26		Mike – How apply the treatment? Gwen – Could it get worse? Mike – Side effects or another ailment – mercury poisoning	
1.26.52	-	They now talk to another group 'You are such a bing bong' The next bit is unheard	
		Mike – Keanue Reeves ... What is someone invented a gun you could plant an entire field! Sheila – I would not do it Mike – 70% is fine but not to take AE input re ideas + discusses out of license drugs Mike – I am excited, want to know who wins!	

Barry School – Group 1

Lesson 2 – CAME lesson 27 Exponential growth with corn

Lesson overview

A (CAME) lesson on patterns of mathematical increase that uses the context of pieces of corn to introduce the pupils to the special case of exponential increase. The aim here was to specifically link this to the covid outbreak that was affecting the country at the time of teaching. It was hoped that this would support their understanding of the meaning of the R number and the restrictions arising from this relating to the spread of this disease.

The main stages in this lesson can be summarised as:

Stage 1 – an introductory activity that challenges the pupils to visualise two different kinds of increase graphically. They have to imagine what the graph of a balloon and rocket will look like before seeing the graph of distance and time.

Stage 2 – a story about this wise man and a king who had lots of corn is used to provide the context for exploring a doubling increase.

Stage 3 – here the pupils physically count and place corn onto a chess board to explore the nature of exponential growth. During this stage they shift from corn to actual numbers and then to rounding involving two significant figures as the corn becomes too large for the chess board. The pupils then convert the corn grains to its mass and they find that by square 32 the king has run out of corn.

Stage 4 – the importance of exponential growth is applied to many other biological contexts including the spread of covid and the significance of the r number.

The stages above are personalised in this lesson in the following ways:

Stage 1

The balloon and rocket are introduced via cartoon images and with reference to a local fair. The actual graph of the balloon and rocket is only shown for a very short time as a way to trigger their thinking and to promote discussion.

Teacher comment: This is a powerful thinking activity for pupils of this age as they have never been challenged to think about the real life contexts in which linear and quadratic graphs apply. The context of fairground rides motivates and engages them to consider the real-life meaning of $y = 6x$ and $y = x^2$

Stage 2

A story about a wise man helping a king and asking for corn as a reward is used to engage the pupils. The visual prompts of a real chess board and corn are used to support the concrete nature of this part of the lesson.

Teacher comment: a very simply story and a very concrete context are used to think about the reality of what large the numbers get when simple doubling is involved. This is important preparation if we want pupils to develop in their thinking and also to realise the role that simple words, such as more, play in abstract thought and how valuable graphs are as a tool to show different patterns of mathematical increase are.

Stage 3

Groups are given a cup full of corn and a chess board drawn on flip chart paper. The large size enables them to both physically place the corn on the 'board' and then also to write down the very large numbers involved here. No work sheet is given as all numbers are written on their chess board as a way to help them articulate the specific nature of this type of mathematical increase. It is important to allow the pupils to physically see how large the numbers actually get by say 32 squares from a starting value of 1 grain of corn.

Teacher comment: Starting with actual corn provides a concrete link to the maths involved later in the lesson when the idea of exponential growth could be shown graphically. Using corn and then writing the numbers on the paper makes the rounding and the use of significant figures a meaningful strategy if we are to get a real sense of the different types of mathematical increase involved.

Stage 4

Various cartoon examples are used to help the pupils see that this type of increase is very common in the natural world. In this particular lesson it was planned to look for the opportunity to bring up the covid outbreak and the fact that when the r number is 2 then the rate of covid infections is growing at the same rate as the corn.

Teacher comment: this stage of the lesson is designed to show how common exponential growth is and that this type of increase underpins many of the practical experiences of growth (or more) that the pupils have experienced. It also seeks to show how applicable the maths skills they are acquiring are to real life scenarios. The use of the r number is a deliberate trigger by the teacher given that lockdown one had recently ended in the UK

Lesson context

The second CASE lesson with this group of 2 female and male students. Also the timings on this camera do not reflect the start time. The first clip starts with the corn on the table – they switched the camera on when the group began to work. Very concrete start – aiming to make link with covid spread. The use of real corn increases the risk of off-task behaviour and disruption.

Clip 1/3

Time	Code	Transcript	Notes
6.17.20		Gwen – 16 so 40 Mike – Yes, yes Gwen – they don't stay in place ... I need glue Mike growls Gwen – How many will be next 32 Sheila – You will never get 32 in there – you are mad Mike – Excuse me, don't call me that Gwen - 8 9 Sheila – 32 Gwen – Well I got 9 in so shut it	Stage 3  Lots of corn counting to place on correct squares.
6.17.37		Mike – Count these Sheila – You are not going to	
6.17.47		Gwen - ... Try some participation 10, 11, 12, 13	
6.17.57		Sheila – I have 28 laughs Mike – Take away 3 from that and I can just Sheila – You have 28 Gwen – I have a whole cup of corn Sheila laughs because the corn wont fit into the square.	
6.18.12		Gwen (upset) What are you doing Incapable Mike – Ahh ... Gwen ... You are the one who is having romantic times with Sheila and you have done the least	
6.18.24		Sheila – I have done the second least ... you have 28 bits of corn.	
6.18.42		Mike – Don't take my autism pen ... that's not how you write with it. Sheila – Why have you written upside down ... Tamsin look Mike – No wonder I am not the last, I have a 6 th head so I must have a 6 th brain Gwen – 32 64 Sheila – I'll put it back in the cup Mike – We had a disaster with the kernels so back to the numbers Gwen – incapable Mike – I am not Sheila to Gwen – inaudible	
			Gwen now moves the corn out of the square (so they can write numbers instead) They all laugh and she takes Mike's pen. No idea what this is referring to AE walks past so Mike says this to him.

	Mike to Sheila - just sat there critising everyone. Mike – You are bringing negative vibes to this group Sheila – You sound like a parrot Mike – Me sound like a parrot	All chat at this point but this is inaudible
6.19.28	Gwen – Keeps doubling Mike – I’m not a fan of good vibes ... but you are being really negative even though most of the negativity should be towards you. Sheila – inaudible Mike – Gwen I have for you Sheila asks Gwen to smell the corn Sheila – Let me smell	
6.19.51	Mike – Why don’t you round it up to 41,000 so then we can make 82, 000 – if we round it. Gwen – What will we round it to?	
6.19.51	Mike – 82,000 Mike now sings ‘I got a gift, I got a gift, I got a kernel of popcorn	Sheila takes the popcorn as a gift and laughs
6.20.20	Gwen - 16,000 20, 000 Mike takes the cup of corn to get kernel from girl 2 Gwen – Is it 20,000? Sheila grabs corn	
6.20.27	Mike – No, what have you done ... kernel on floor Get off my finger Gwen Gwen talks to Alan about the numbers and keeps counting	
6.20.32	AE stops class to focus Mike to Sheila – You are such a cob Sheila laughs Mike to Sheila – No what have you done, there is corn all over the floor Sheila – let go of my finger AE stops to focus again Mike – He is such a cob Sheila laughs and then drops corn slowly on the floor	
6.21.41	AE shares an anecdote about his children.	
6.21.58	Sheila is being silly with corn. Mike – Shut up you cob	
6.22.05	AE now gives out info re converting grains to weight. Sheila plays with the cup of corn, tipping it on her hand Sheila throws corn	
6.22.55	Both girls now tip the cup of corn onto paper Mike – Someone has committed a crime called the cobbers Gwen and Sheila spread out the corn and laugh Mike – Sheila no	

6.22.39	Gwen Inaudible Mike – It was you, Gwen would never do anything like that Mike – Sheila you are a bad influence on her you are a bad influence.	
6.22.50	Gwen uses A3 sheet to put the corn back Mike – Great idea	
6.23.01		Gwen laughs as she pours the corn into the cup. Alan spills corn and all three put it back.
6.23.19		
6.23.39	Mike – So he has 400,000,000 grains of corn He wont be able to pay the wise man ... the wise man has more than he requires. The wise man will have food for the rest of his life, he is going to have infinite corn. Gwen now reads the questions Mike – He has 400 million, I have already calculated it Sheila – 400 million Mike – Yes, 200 tons Sheila – Has anyone ever Mike – 200 So its 400, 000,000	
6.24.09	Sheila plays with corn Mike – It means that this king in rolling in corn he has a bath of corn Sheila – I can juggle with corn	
6.24.19	Gwen – We did not have that much corn ... I did not have 400 million Mike – We did not do every single one ... this is what the kings has, this is what the wise man wants. Gwen – I want that many Mike – You did not help to win a war Gwen – Ehh? Mike – The war against Sheila’s silliness	
6.24.37	Gwen – Yes exactly, I won that war Mike - If someone commits a crime (corn pun by the way) do you call the cobbers Gwen – laughs – Where has all the corn gone? Sheila – I have 3 corns	
6.24. 53	Mike – What do you call a Jewish alcoholic? He brew Both girls laugh Mike – Silly joke – am I right?	
6.25.02	Inaudible chat	
6.25.16	Mike – This study is into how children naturally speak so I am going to speak the way I normally speak shush, you cat like a 5 year old, my little sister is more mature than you.	

6.26.30		AE stops Sheila – I walked behind your sister on the way to school brother Mike – My brother is Gwen – Mike - 400 million that's the end – he forfeits his kingdom to the wise man.	
6.26.53		AE stops to focus on the 3 feedback questions Sheila - I don't like big numbers Mike – Put all of the corn. ... this man is going to have so much corn he will feed Sheila – Corn he is going to feed the whole world Mike – Corn ... you need a microwave don't you They had those back in the medieval times. Gwen – It will fire and go pooof! Sheila – Put it in Gwen – They did not have them then	Says something, child-like, about numbers in a singing voice.
Time	Code	Transcript	Notes
6.40.30		Mike – You two stop it Gwen – Its socialism – everyone deserves a little piece of corn Gwen – disrespectful Sheila and Gwen – Inaudible	Gwen turns the camera onto Mike
6.27.22		Sheila – I did not want them to look at me Sheila – I want corn – thank you Mike – You have been disrespectful and now your face is on police report. Sheila – Do you reckon this actually is Mike – Hey you Mike – Gwen do you see this ... Gwen – Stop being a disrespectful specimen Gwen – 205 million Gwen and Sheila now play on the fact that they cannot say disrespectful specimen AE stops class Sheila – You chicken nugget Gwen carries on – 763,006,000 Trillion AE comes on Mike – Sir, this man is going to have a lot of corn All the corn in the city Gwen – million ... laughs Gwen and Sheila both talk and laugh - inaudible AE begins feedback prep and ask	
6.40.45		Mike – Why are you laughing, what say? Tell me what you said. Mike – He was wise	Sheila now moves camera to show Mike
6.27.57		AE - 3 minutes to decide which question to share Sheila – Stop kicking me ... not sure who He is not She now laughs Sheila plays with Gwen's hair Mike – You do not realise that I still have motion in my legs, can pause and start again, I am not a machine Mike in American accent Look at those corns over there!	In a high pitched voice Gwen and Sheila use high pitched voices here
6.28.01		Alan – Lets work out the Mike – Alan Gwen – What am I working out Sheila laughs Alan – Give me my corn Mike – Tell me what you said Mike – Its my corn now Sheila – He said he is not an oiled machine Mike with accent – Give me my pen It cost like £15. Mike – Tell me what you said to Gwen You are basically the same person Give me the Alan – My corn back	Gwen and Sheila are hard to hear now.
6.41.39		Mike – Your corn does not cost	
6.28.04		Mike – You are actively starving the homeless people by Sheila – Technically if that doubles that's x2 x2 that doubles Gwen to Alan – Man, cannot even keep to his own promises	

6.43.13	Mike – You are just a bit laboured	Checks something on calculator
6.43.17	Sheila to Mike – Can I just try your pen? Mike – No you cannot Gwen – How come apparently	
6.43.34	Mike to Sheila – I want to write like this but parents want me to write like this. Sheila – I have one is it Mike – Yeah (laughs) Mike – Gwen, threw my corn Alan to Sheila– 13120	
6.43.45	Mike – I am Captain Corn Gwen – What am I writing? Mike – What’s my maiden name?	
6.44.01	AE begins feedback Sheila to Gwen– I’ll just write it (whispered) Mike gets pen back from Sheila AE input – Need a word to help retrieve a memory	
6.45.25	Gwen to Alan– I know what I will say Gwen to Sheila– We are ... Mike to Sheila – I am going to show you a magic trick	
6.46.38	AE gives 1 minute countdown Gwen – I’ll speak Mike – I will I did most of the Last time we had Alan, I think I should do the talking Sheila has not really given any input.	
6.46.46	Gwen – Alan did all of this with his brain Mike – A calculator Sheila – There is no Around it Mike – You mean the bright pink thing ... you can see clearly	
6.46.56	Mike (back to trick) – I’ll prove I cannot do it Mike – I’m disabled Sheila – He did this before with me ... fell on the floor	
6.47.06	Mike – One’s attracted to me (ref to corn) + also whispers about the trick. AE – When does he run out of corn? Sheila – You have a corn magnet inside of you	
		He picks up corn by pressing down on it with his hand. Alan is writing all the time.

6.47.33		Mike – Mmmm ... Ben's Corn Alan to Gwen – He runs out .. Mike – When he does AE – He has 200 tons that's loads of corn When does he run out? Alan – He runs out Counting now Mike – Lots of corn	200 grains weigh about 100 g So 2000 grains weigh about 1000 g = 1 kg and 2 000 000 grains weigh about 1000 kg = 1 tonne A large lorry carries about 50 tonnes.
6.47.55		AE - The King runs out ½ way through the chess board	
Time	Code	Transcript	Notes
6.48.05		Alan to respond to Sheila: It would just sink Mike – Lots of corn	Gwen and Sheila chat quietly
7.04.59		Sheila – I just think lockdown Mike On language can't be a problem is it? Lots of corn. This is a massive number you couldn't hear. 400 million grains on the board is quite a bit – its hard to picture, some people can	
6.49.45		Gwen – You are talking absolute potatoes Gwen – No it's corn not potatoes Sheila to Can you imagine corn that pops and makes a potato? Mike = Gwen laughs (she laughs) Sweet corn and potato x 2 Sheila I am not sure if there is enough corn to fill the chess board Gwen – A Pink potato 6.50.13 Mike – Sheila it's the goblet of corn Mike to Sheila – Given me corn now	Girls laughing Mike fills pen lid with corn
6.56.07		AE There is a pattern and writes 2 x 2 x 2 on board. Can share how much it takes to make a loaf of bread on here etc. 1 minute to agree Sheila and Gwen chat	
7.06.29		Mike So this man is obviously very wise and I don't know why he picked corn, he could have picked wheat to get a bunch of bread but ...	
7.06.45		Sheila – You can get popcorn, sweet corn, corn on cob Mike – You could get bored with corn everyday but wheat Could make different types of bread Gwen – What if he was gluten free like Emily	Gwen talks to girl on other side of classroom
7.06.57		Mike – Lactose intolerant Sheila – Yeah, that one Gwen – Wheat, gluten, lactose, dairy Gwen – Wheat and gluten free	Both girls quietly chat and pick up corn
7.07.20			

7.09.02	Feedback begins	Stage 4 begins now
7.09.16	AE writes 'exponential' on board – What comes into your mind? What make you think more about? Gwen – Exponential Mike – I think Alan can do the speaking for us Gwen – Experience Mike to Sheila – Since you are such a genius at everything Sheila – I never said	
7.09.46	Sheila to girl trying to say exponential and both laugh Mike – Give me my corn back Gwen, I dare you Alan – inaudible	
7.10.07	Mike – Classics kernels AE now write r number on the board	
7.10.25	Gwen – What's the r number? Mike – The thing you put in front of movies	
7.10.51	AE input on r number – The government want to get it below 1 Mike – Money AE – Covid – if the r number is 2 what does that mean? Talk about that	
7.11.17	Mike – Higher Gwen I can see your corn ... I like to see your kernels have you got none Gwen pulls face	
7.11.36	Mike – Oh my Alan, did you actually write all of the numbers. AE stops	
7.12.13	Mike – Shhh	
7.13.13	AE points to news and gives examples AE – Why might this help someone understand how dangerous the virus is? AE – Anything else like this?	
7.13.28	Gwen – Talk ... about the virus Mike – Talk Mike – Gwen how many cobs do you have? Sheila – Thank you so much Mike – You like my cobs? Alan makes some comment Mike – Alan Best to try	
7.14.13	Sheila – No-one can beat me Mike – Determination is the key Gwen and Sheila chat Mike – Is Sheila secretly bugged Sheila – No she has a hard kick	
7.14.36	Mike to Sheila – Why are you so	
		Much is inaudible

		Gwen – It really hurts when you kick people apparently AE now mentions politicians and D Trump in this context	

Barry School – Group 1

Lesson 3 – CASE lesson 13 also known as Sampling beans

Lesson overview

This is a lesson on biological sampling that uses broad beans to illustrate the range of variation that can be found in any population of living things. The pupils meet the idea of stochastic variables i.e. there are a range of values yet a central tendency can be picked to represent the whole. An additional challenge comes as the pupils consider the problem of sample size when trying to pick a representative sample from a large population.

The main stages in this lesson can be summarised as:

Stage 1 – an introductory discussion exploring the meaning of the term ‘sample’ in real life and science.

Stage 2 – broad beans are used to help pupils consider the large number of variables present within any group of living things.

Stage 3 – size is chosen as a key variable and pupils measure a large number of seeds to decide upon what makes a bean small or large. This is discussed and a collective decision is made as to the cut off between large and small beans is made.

Stage 4 – the problem of choosing a representative sample of living things is explored through a range of bean ‘samples’ being given to the pupils where the sample size and proportions have been rigged. The size of the samples they are given ensures that different groups pick different values and that a full range of data is needed to make a correct decision. This stage introduces pupils to the notion of a fair sampling and how other, smaller, samples taken from this may vary.

Stage 5 – the problematic nature of sampling is applied to the issue of sampling involved in political elections.

The stages above are personalised in this lesson in the following ways:

Stage 1

A range of real-life contexts in which sampling is a key part is used to open up the discussion and to draw out their thinking and ideas. In this particular lesson the use of the term sample is applied to the topic of bodily fluids.

Teacher comments: this approach has proved to be very engaging to 14 year old pupils and a good way activate any knowledge the pupils have at the outset. It also airs areas of uncertainty that can be explored during the lesson.

Stage 2

The pupils are given a large sample of broad beans to explore and investigate. Many pupils have no experience of such large seeds and so find them interesting and time was given to allow them to become familiar with them.

Teacher comments: time was given to allow the pupils to explore the beans to try and make a concrete link between the numerical aspect of the task and its relation to real population sizes.

Stage 3

A real packet of broad beans is shown to focus on the fact that each would need to contain a range of beans and not just large ones. Pupils measure a large number of their beans and pick two small and two large measurements to share. These are written on the board to show both the range and the variation and overlap in what some groups consider small/large to be. The pupils are challenged to use their own data to decide where the cut off point should be. During this stage links are made to the age of people involved in the roll out of the covid vaccination process and the allocation of grades in exams.

Teacher comments: many pupils experience of data involves the simple calculation of some form of average and often involves 'tidy' numbers. Here the use of real data (measurements) and the variation that this contains really challenges the pupils to develop their data handling and manipulation skills.

Stage 4

Sample bags containing a 'handful' of beans are given out. These have been 'picked' from a fair sample for size but what they do not know is that each bag has been doctored (different proportion of large to small and different amounts) with only about 1/10

being an equal split of large:small. The size value agreed in stage 3 is used by the pupils to explore the proportion of small to large beans in each sample and to consider why a small sample can differ so widely.

Teacher comments: the bags are doctored as a deliberate trigger to challenge the pupils to think about how sample size can effect the proportions involved and so lead to bias. The way this is done, with the whole class, enables them to see how the variation effects each groups results and that they have based their individual conclusions upon a sample that is not representative.

Stage 5

The recent US election is used as a suitable context to apply the ideas on representative sampling discussed in the lesson.

Teacher comments: a very recent, real, example of the problem involving sampling (the US election results involving Biden and Trump) was chosen as a suitable context to apply the thinking explored in the lesson.

Lesson context - the final lesson before Christmas and Mike is off and his place is taken by a new girl.

Clip 1/5

Time	Code	Transcript	Notes
8.14.49		.	As the register is taken the children chat with the class teacher (supply).

8.16.00 8.16.43 8.16.58	AE introduction including a brief recap on previous lessons (Pepsi challenge and Exponential growth). - Have you had any thoughts/made connection after the lessons? Have a chat about the two last activities, have they made you think about?	They chat about a new boy in the class, much is inaudible but includes chat with the class teacher. Stage 1  This is one of the images used to promote discussion. AE makes joke about the size of the sample and the size of the bottle
8.17.04 8.17.48 8.18.03	Sheila – Hi guys So what AE – Stop the important thing is that you think and talk AE – Anyone had any thoughts important to think and speak when things are hard to understand.	
8.17.37	AE starts lesson – I had to take a stool sample from someone who was ill. What am I talking about?	Stage 2  This shows a typical sample given to each group of pupils.
8.18.44	Alan – That’s minging AE – Faecal sample sometimes	
18.49	Alan – Poo	
19.03	General laughter	
19.11	AE – Common occurrence to take a sample, where else have you heard or come across this? 2 mins to chat	
19.26	Sheila – inaudible	
	Sheila – Sample of fruit	
	Sheila ... chocolate ... ice cream sausages ... that was so random	
19.50	Gwen – inaudible	
	AE mentions the pictures on screen	
	Gwen – Food make up	
	Girl 2 I ... on my face colour match	
	Poppy talks about sample from space	
20.47 21 .30 21.54	Alan – Blood sample	
	AE mentions anthrax and Scottish Island etc	
	AE now shows beans	
	Alan – I want a bean Can I eat the bean?	
	Gwen – I don’t think you can eat the beans.	
	Alan – I want to eat the beans.	
	Poppy – You cannot eat the beans	
	Gwen – That’s a lot of beans	
22.07	All laugh Gwen mentions Mike Gwen – They are green Sheila – Green beans ... split cup bean Gwen – If I put in soil will it grow into a bean stalk?	
22.33	Gwen grabs cup from girl 2 and beans spill onto desk Alan – We did not knock it over	

22.49		Alan – Silly beans Gwen – Silly bean Sheila - It's a white bean (laughs) Gwen – Looks like a tooth Sheila – A black bean Gwen - Looks like a dinosaur its does look .. Sheila – Don't you dare put it in your mouth AE mentions the term variable and writes questions on board Gwen - They look like beans and ... AE – How different are the beans? What variables can you see? Poppy – What's a variable? Sheila – Something different Gwen – Colour, size, shape, weight Sheila – Everything comes in shapes and sizes AE – Just like us Gwen – Yeah Sheila – Look even them ones are completely different – shape, heaviness, colours	All chatting – hard to hear, discern Laughter More laughter and they move the beans into the middle of the desk
23.21		AE mentions the term variable and writes questions on board Gwen - They look like beans and ... AE – How different are the beans? What variables can you see? Poppy – What's a variable? Sheila – Something different Gwen – Colour, size, shape, weight Sheila – Everything comes in shapes and sizes AE – Just like us Gwen – Yeah Sheila – Look even them ones are completely different – shape, heaviness, colours	More laughter
23.33		AE mentions the term variable and writes questions on board Gwen - They look like beans and ... AE – How different are the beans? What variables can you see? Poppy – What's a variable? Sheila – Something different Gwen – Colour, size, shape, weight Sheila – Everything comes in shapes and sizes AE – Just like us Gwen – Yeah Sheila – Look even them ones are completely different – shape, heaviness, colours	
23.40		AE mentions the term variable and writes questions on board Gwen - They look like beans and ... AE – How different are the beans? What variables can you see? Poppy – What's a variable? Sheila – Something different Gwen – Colour, size, shape, weight Sheila – Everything comes in shapes and sizes AE – Just like us Gwen – Yeah Sheila – Look even them ones are completely different – shape, heaviness, colours	
24.00		AE stops	
Time	Code	Transcript	Notes
38.21		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	Sheila talks to AE and writes on board
38.26		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	A boy from another group makes a joke
38.35		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	All laugh at the naked bean Alan and Gwen keep looking at the beans. Real hilarity now!
25.35		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	Gwen makes a tower of beans and they also start flicking beans at each other. Gwen throws bean at Alan
38.52		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	Poppy throws a bean
26.16		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	
26.24		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	
39.09		Gwen – Thickness Sheila – ... Could it be a bullseye! Sheila – Stop flicking beans off me Alan – I had a naked bean .. AE – Which is the most important variable? Gwen camera Sheila – Taste Alan - ..y at the beans Gwen - .. You have been Trevor is heard to say: 'The bigger the bean the bigger the price' Gwen - Who wants big beans?... AE picks up on this ... who agrees with Trevor re size? Sheila - Its wrinkly AE now moves to the next part of the activity – measuring beans. Alan – Bean flicker	Now trying to break skin off the bean

39.20	AE – Is size a problem for the farmer who grows the beans do people want big ones Alan – Yes Sheila – Yes because there would be lots of little ones left Gwen – They will feel really bad if they don't ...	
39.40	AE – 'Problem with size' as he writes on board We need a mixture .. what types of beans go into the packet? Each group given a number for feedback	Stage 3 A typical packet of seeds is shown to the class at this point.
40.08	Do we need to know anything what goes into a packet ... What's the problem here? Talk about that. Inaudible chat	
40.20	Sheila – No they should not just sell the big ones cause there will be loads of ickle, ickle, ickle ... ones left Poppy – How come they have more beans than us? Sheila – More people Poppy – I'm still standing Gwen – Look I stripped a bean and split it in ½ ... looks like a peanut.	Are the dynamics different because Mike off and Poppy now part of the group?
40.39	Sheila – Who has the time to strip a bean? Gwen – Me in a bean lesson Sheila – They do not just sell the big ones because loads of ickle ones left that have not been sold like this one (she picks up a bean) ... that's not ickle it's big Poppy – Individuality Sheila – Individuality ... whatever that means Poppy – You are an individual ... it's a good thing Gwen – Have a naked bean Sheila – I've just been individualized Poppy – I said she was an individual an individual is one person	Laughing again
41.12	AE – you are group 5 Sheila – I got individualized .. I don't want to be an individual Poppy – Its good to be .. if you are not an individual then you are the same as everyone else Gwen – ½ a naked bean AE to Gwen – You dropped your phone Gwen – Have I, ahh, thank you	Gwen laughs and Sheila looks worried
41.28	Alan copies this Sheila – Dropped out of your bag that you don't have Alan shows bean to Poppy Poppy – Where does he get the beans from? Gwen – Put the naked bean into the bean house	
41.48	Sheila tips up the cup to trap the beans, Alan pulls away and they spill Sheila – Alan!	

42.34	AE stops and mentions the link between this and the roll out of the covid vaccination AE – problem because we cannot juts sell big beans Feedback begins with group 5 Gwen – Just the little ones left AE – Mixture	
43.35 44.03	AE now focuses upon how we know what big is via link to fairground rides and height restrictions Measure beans and decide what is big/small	Alan and Sheila put the beans back into the cup
44.13	Sheila – I have a ruler Gwen – Sir Michael has Inaudible Sheila – I have a ruler	
44.23	AE – measure them all Gwen – inaudible unrelated chat Sheila – We only need 1 ruler .. fine (sings as she looks in her bag) Sheila – Poppy, where are you going To girl from another science lesson We are in a science lesson Sheila to Alan – Find a bean, pick a bean I said a bean (they spill beans on desk) Poppy - The dinosaur tooth thing (looking for previous bean)	
45.05	Sheila – Someone turn it around we put it on here Gwen – I told you Inaudible Sheila – 1 ½ cm 1 ½ cm Gwen – That little Sheila in a strange voice - amaizing bean I have a bean ... Gwen and Sheila – inaudible chat about beans Sheila – I need a bean pick a random bean, a big bean	She marks out a grid on paper
45.51	Alan – I made bean pants Look Gwen – Alan’s invention bean pants Alan – I press hard, then I take off ... look Sheila – 2.5 bean Poppy – There you are there is a bean Gwen – Green bean	They are fascinated with the beans He has removed ½ the shell Lots of laughter
46.20	Sheila – Who wants a green bean? baked bean bean stalk green bean Gwen – There is a smooth bean Sheila – Can someone else do some measuring? Gwen – No, Alan is too busy inventing bean pants Sheila – 1.5 Gwen – How many are we supposed to measure? AE – As many as you can	Said in quiet response to Gwen Lots of inaudible bean chat

46.57	Alan – 2.5 Sheila – 2, no you have to put it to zero on the line Kyle Gwen – Put it on the line Alan – 2.5 Sheila – Put the bean in .. Poppy – Thank you Alan Gwen – Did it go in? Alan – OMG, make it taller	Gwen laughs and picks up several beans and laughs and she throws them into the cup
47.23	Sheila – Have we measured enough beans yet? Sheila – That’s not normal Alan – We have lost a bean Poppy – Get off my beans Sheila – Its time to measure beans Gwen – I can’t, I don’t think feels wrong. Poppy – I stole a bean Sheila – 2.5	Alan and Gwen now throw beans to see if they can get them into the cup
47.46	Gwen sings in a high pitched voice Poppy – Here is a stolen bean Gwen – Who did you steal it from? Poppy – Them Alan – I want a baked bean ... a big bean a big bean Sheila – 1.5	Still trying to get beans into cup held by Poppy More laughter
48.08	Gwen – Hit the rim, hit the rim, hit the rim	
48.15	Alan – I’m going to make a bean tower Sheila – I don’t have to be precise Alan – No	
48.26	Alan – Ahhh, I’m making a bean tower ... making a bean tower	Sheila keeps measuring and takes bean from Alan’s pile Sheila throwing beans now
48.47	AE begins feedback calling out groups and they give sizes Sheila is still measuring	
49.27	Gwen asks question re size Sheila – I don’t know, that’s what Alan measured Alan – I didn’t, I measured that one Sheila – Gwen look at this one its 1.5 ... oww Poppy! Gwen – I did not even try to get that in This is just 1 ... it is what it is ... Who touched my foot?	Gwen and Poppy laugh
49.44	Alan – I made a bean triangle, I mead a bean tree Poppy – All the beans out	He spreads the beans in front of him She spreads out the beans

		Sheila – Ahh, they smell ... ugg Sheila - Ugg	More inaudible chat She puts the cup to girl 2's nose

Clip 3/5

Time	Code	Transcript	Notes
01.54		Sheila – Alan ... don't ... ask Gwen – Someone smell it , I'll give you a fiver (referring to the cup) Sheila – Where is the £5? Alan – Where is my £5? Sheila smells the cup and pulls face	Said to Alan – she laughs Alan smells and pulls face as Gwen laughs again
2.17		Poppy – Sniff the cup Sheila – Sniff the cup	To another group All laugh
2.26		AE stops – I will call out a number ... where draw the line between the small and big .. 2 from each size etc Gwen – This one stinks Sheila – 1 and 1.5, 2 and 2.5 (replies to AE) Alan – Big bean big bean	Still laughing
3.30		Gwen – Put your nose right inside and sniff up ... you are fogging it up Alan – I think I should have my £5	Random chat to other groups which is hard to discern Another group are now smelling the cup
3.45		AE calls to attention and collates data Sheila – There you go	
4.55			Gwen plays with cup tapping a rhythm, Alan takes and copies, Sheila joins in – playing a game now
5.30		Feedback	
6.10		AE – Can we decide? Where is the cut off point between small and large?	
6.18			Poppy shakes the cup over the beans and Alan joins in
6.25		Alan – What are we doing again, what doing again? Gwen holds the beans Poppy – Going to make a bean camera	She puts beans on the camera Gwen shows a bean to the camera Sheila sits quietly before sharing
6.51		Sheila – I have mixed emotions (repeats) Gwen – You have what? Sheila – About things	

7.08	Alan – Why? Gwen – You have messy emotions Gwen – I know what things Alan – Just kill people Gwen – I heard she Inaudible Sheila – That was a lot of my problems Gwen – So most of them though ... Alan – Oh no, he is eating the beans Sheila – What do you think? Alan – You made him uneat the bean ... get in	He places cup over the beans
7.21	AE stops Gwen – The guy over there? Sheila smiles Gwen - Sheila nods in agreement	Very hard to hear now
7.23	Alan – Get away	
7.46	AE – Where put the cut off point?	Alan catches the beans in an upside down cup
9.10	Feedback	
9.58	The group suggests that the sample (size) effects it	
	AE uses Eve’s idea about exam marks	
10.22	AE – If you get 1 mark below an 8 should you be given an 8? Sheila – No Gwen – No Alan – Yes Poppy – Did not deserve it AE – Talk about it Sheila – No because you did not deserve it Alan – Only 1 mark Poppy – I don’t care, you did not earn it Sheila – You did not get it so why should you be given it? Poppy – Exactly Alan – It would be the same if it were Sheila - ... no you did not deserve it, say you got one mark above Gwen – You did not get high enough to get it so don’t deserve it.	They all talk at once
10.45	Poppy moves the cup Alan – Stop I want my bean tower bean cup	Sheila laughing

11.11		Poppy – Alan has a bean cup	
11.22		AE stops with a new example – What variable are they using to decide who gets vaccinated? Gwen and Sheila – Most vulnerable, vulnerability Poppy – A 90 year old woman got it this morning Shakespear Gwen – The Queen should get it, then give it to me ... I have met the queen before ... wrinkly woman	
11.38		Poppy – Here are more beans Kyle Alan – Wrinkly woman (laughing) Sheila – You are not allowed to get it yet Gwen – I am Sheila – Not giving it to people under 16 Gwen – No, no, no, no Poppy – Stupiditis Sheila – I was on the not giving it to anyone under 16 even if have asthma and stuff and not giving to pregnant people Gwen – I have respiratory problems Alan – People with respiratory problems get it first Gwen – Yeah we will all die and she will get it Alan – Die quicker if don't get it Gwen – If you get the vaccine do you never Sheila – Yeah but you need two Alan - every year just like	
12.24		Sheila – So you have to get a needle then ... another needle Gwen – So Alan – Have you had like the flu shot every few years Gwen – I don't Sheila – Neither do I, don't get	
12.39		AE stops and shares reasons	
Time	Code	Transcript	Notes
25.28		- exams and problem in Summer ie 40% error - have to make a decision as to who gets the vaccination Poppy to Alan – What are you going to speak about? Invites groups to share + gives preparation time – I'm pick something to share	They switch between conversations quickly
		Alan – My water tastes funny Ebony Sheila – You know Polly was saying she She wasn't Gwen – inaudible Sheila – Maybe Sheila - vaccine they give it to old people before they give it to young Sheila – That's what I said to my mum .. she said you have a point really Gwen – Exactly You have a life Sheila – They have already lived theirs ... that's the point Poppy – What are we going to talk about?	Some of this is inaudible

26.01	Alan – Why are they giving it to old people when most are going to die in two years Sheila – That’s what my mam was saying Gwen – That’s what we were saying ... this woman who was 90 Alan - Why are they giving it to old people when most are going to die in two years Gwen – They have already lived their lives we have not Poppy – Give Tamsin it Gwen – I need to (inaudible) Sheila - I don’t want it Gwen – I don’t know if I want it Sheila – I’ll sacrifice my ... Gwen – I’ll sacrifice Kyle	
26.33	Alan – You will sacrifice me to the coronavirus gods Gwen – Apparently the side effects can be ... Sheila agrees	
26.47	AE stops Sheila – I am just not getting it till everyone else has had it and then I might get it	
26.55	Heard from another group – Young people deserve it not old people Gwen and Sheila – That is what we have been saying Alan – That is what we said	
27.14	AE stops – all relates to science ... there is a range and we have to make a decision Feedback	
28.40	AE – where is the cut off point for the beans? Gwen and Sheila chat quietly Gwen – around 2 ... around there Alan – What size is this for? ... I don’t know what’s going on	
29.09	AE – Is there a correct answer? They now put the beans away.	Sheila takes the cup to tidy the beans They now laugh as they insert the beans into the upturned cup through cracks in its side They are very collaborative in this task They all start singing the same song started by Gwen They now start trying to turn the cup over by inserting paper under it.
29.30	Alan – Get off my cup Sheila – Insert the bean Alan – Careful ... going to break it	
29.46	Poppy – Put it on paper Sheila – Hold it Alan – Still things to put in I want this box ... still things to be put in	
30.13	Sheila is singing the same song on own Gwen – Just empty it out Gwen – I want to keep a bean Alan – What beans do you want	

30.50	Alan – Let Tamsin have shark tooth Where is the dinosaur tooth? Gwen – I don't have it Alan – Where is the dinosaur tooth? Sheila – Here Alan – Poppy, Poppy Gwen – That's not Dinosaur tooth, that's a different one Sheila – Where is the white one? Gwen – Your ruler is on the floor Sheila – I don't need it anyway Gwen – My bean went ... Alan – I want a bean	Holds it up and Gwen is very interested
31.02	AE stops to move to last part of the lesson about fair sampling + story of nephew picking beans.	Laughs because beans fall to floor
31.09	Sheila – I got a bean bag	Sheila uses her split ruler as chopsticks to pick up beans
31.28	Alan – That's a cute bean picker	Laughter because a bean shoots out of the picker
31.44	AE – Fair sample, what do you think this means? Gwen – Average Alan – Even amount of beans	They are given their sample
32.01	AE – This bag is fair for size Alan – That's not fair Sheila – That's what I just said. AE – Similar amounts of large and small beans Alan – Smell a bean	He puts a bean on the floor Sheila uses her bean picker to pick up a seed coat.
32.17	AE describes the process of picking beans to go into each small bag AE – This was fair for size, you will be given a sample	Stage 4
32.43	Lots of quiet chat AE – Is your sample fair for size? If not, why not? Measure to see if its fair. Gwen – You do that then squash the bean	Alan gets something from the floor
33.18	Sheila – No its not fair because they are all big beans	Gwen and Sheila interested in another part of the room.
33.24	Poppy – Alan ... I hope you Alan (from floor) - My bean Poppy had my bean my bean	No task engagement at all at this point
34.34	Gwen grabs the bean bag – I got a bag of beans Sheila – Poppy you measure because I measured them before Poppy – Okay	Sheila – reengages and starts to measure again Alan and Poppy play with the bag like a balloon Laughter
35.04	Sheila – Measure beans Gwen – Let me catch the bag Alan – Put over head I'll do it ...	Alan laughs because Gwen puts bag over her head

35.25		Poppy – How do I measure Sheila – With a ruler Sheila – What are you all laughing at? Gwen – Me, I’m a bag head Alan – You put on head, breath in and you will die	Sheila gets out her hand gel Comment from teacher re behaviour is heard Rubs hands over the beans
35.41		Alan – Gwen She is making a hat Alan – Put beans on bag whilst on head Alan – Gwen come here	
35.51		Sheila – I’m sanitizing the beans Poppy – Sit I don’t know how to measure beans Sheila – Put one bean on at a time and measure from zero Alan – Ahh, that was my bean I gave you Gwen – There is one on the floor	Some of the next bit is inaudible Sheila measures beans
36.12		Poppy – Sir, how measure beans? Sheila – Like we did before Inaudible Sheila – Look Poppy, this is how you measure beans Alan - ... 3cm Poppy - ... I am not measuring beans like that, he is really clever	Inaudible pen chat + girl 1 sings Sheila circles in pen each group of beans, saying 3
36.37		Alan – 3cm Sheila – Poppy do you want a pen?	
Time	Code	Transcript	Notes
49.02		Sheila – Now measure an ickle bean (repeat) Alan – What bean?	Sheila draws on paper
36.50		AE – This sample was fair, yours was a sample, was it fair? Is this like anything else in life? Thoughts? AE stops	Inaudible chat as they wait
49.35		Alan – 2.5 Sheila – No, because all big ones Gwen – Is there any need? Alan – This is	He is silly with the beans – laughter
49.49		Sheila – Yes Alan – I will throw a bean off you AE – Is your sample fair? Sheila – I’m laughing at the size of the beans Alan – No Alan – Abby ... you got beaned	He throws beans
50.27		Sheila - ...or I would have had to(buy it?).... And then I would have £100 in my bank AE stops Sheila – We need to put the beans back in the packet Gwen laughs Sheila – Stop doing stuff ... broken arm! Gwen – Chop, chop, chop beans in bag Sheila – Alan! Alan – I did not do anything Sheila – You did, wacked it off	Sheila talks to another group about phoning someone – hard to hear Much of this episode is off task Because some have gone on the floor

51.33	Alan – No I did not (repeats) Sheila – The bean Poppy – It was the Dino bean .. Alan – I want Dino nuggets I want turkey nuggets ... they are better Sheila agrees Gwen laughs – Turkey pterodactyls Sheila mimes flying Gwen – Turkey chicken Poppy – Turkey chicken Sheila – Turkey chicken Turkey unicorns are the best Alan - Turkey unicorns are the best Gwen – Popcorn chicken Alan – I like popcorn chicken Sheila shares something personal/historical – very hard to hear	Gwen talks about popcorn chicken
52.00	AE begins feedback	
52.30	Alan – I have bean Sheila to Gwen - tell her, tell her AE – they had 32 in their sample Sheila and Alan – We had like 5 in ours AE – they had 10 do you think how big the sample is effects things? AE shows slide of voting – Is this like anything else?	Much of this is inaudible
53.31		
53.48	AE – Is this why D Trump thinks he has won the election? Alan – I know ... he has more votes but the states that voted for Biden have more voters Gwen – More smaller states Poppy – Also why would an orange person win? Alan – There are two different ... votes in total plus per state. Joe B has won the bigger states ... than he has but voters college made up of 72, 0000 since Joe B won Sheila – So precise with those numbers Kyle Poppy – Biden won Alan – Trump got more votes in total ... each state	Stage 5 Very engaged
55.10	AE stops – feedback and as part of this he asks Alan to speak then ends by mentioning exit polls.	

Barry School - Group 1

Lesson 4 – CASE lesson 20 Treatment and effects also known as Does it work?

Lesson overview

This is a lesson about variables and the need to set up control and experimental groups in any trial for effectiveness that involves treatments on living things. The concept of correlation is introduced through the way the four possible outcomes are combined to look for a causal effect i.e. with treatment + effect and without treatment + no effect results must be greater than the other two possibilities. Students struggle to realise the importance of the no treatment and no effect as a proving factor. The two sets of data (called proving or disproving) are compared as a ratio to look at the size or strength of any possible effect. The main stages in this lesson can be summarised as:

Stage 1 – introductory discussion on how we know if a product being advertised works and what evidence would need to be collected. Such a context allows for many different and current examples to be chosen to engage whichever group of pupils makes up the class.

Stage 2 – the main activity is introduced through a discussion of parsnips and the impact of a miracle fertilizer. This serves to highlight the four possible outcomes involved and which prove/disprove effectiveness. In addition to this the reality of the variation in living things is used to highlight that perfect evidence would never be a reality. The negative aspect of this i.e. no treatment and no effect that needs to be considered is a real challenge for many pupils.

Stage 3 – pupils sort cards from a range of everyday scenarios to look at which treatments have evidence of effect etc.

Stage 4 – this aspect involves the application of the thinking into new scenarios.

The stages above are personalised in the following ways:

Stage 1 – an advert for Wellman/woman vitamins and the question ‘Are they lying?’ is used to kick off the lesson.

Teacher comment: the familiar faces involved and showing the actual fish oil tablets that many pupils take serves to make the start enjoyable, real and meaningful.

Stage 2 – real parsnips are used to highlight the variety of sizes among and group of living things.

Teacher comment: exposure to something real and familiar affords an opportunity to both amuse and engage the pupils. As a consequence their talk flows more easily than would have been the case with a more abstract example.

Stage 3 – new coloured picture cards showing more familiar trails are used and the latter part of this stage is built around the effectiveness of fish oil on children’s thinking and the discredited trail from Durham LEA. A box of fish oil tablets is shown to the pupils.

Teacher comment: the cards are simple and concrete and the numbers are manageable and serve to focus the pupils on the four outcomes in any trial that need to be accounted for if we are to decide upon a products effectiveness.

Stage 4 – data from a smoking sessation trial in Scotland is shared as a new and related example of this type of reasoning. This is used because half of the participants were given money to stop smoking and it is an example that really engages pupils of this age.

Teacher comment: an engaging context is used to help the pupils see how the same thinking (i.e. four possible outcomes) can be applied to any situation where the effectiveness of a treatment needs to be assessed.

Lesson context

The fourth CASE lesson with this group of 2 female and male students. Also the timings on this camera do not reflect the start time. An extra new girl, Poppy, joins for this group for the first time. The wearing of masks makes it hard to discern what is being said at times so much worse than normal in terms of working out what is said and by whom. The camera does not stop but the footage split into 4 clips but will treat as continuous footage.

Time	Code	Transcript	Notes
23.20		AE shows starting image 'I have seen' New girl – Who is Jimmy Anderton? All look at the image	Stage 1 
23.34		AE – I have also seen Some people make their children take fish oil tablets because apparently it makes them cleverer. Gwen and Sheila smile and chat	
23.41		AE – When you see adverts like that .. are they lying, do you believe it? Have a chat	
23.47		Mike – I don't think they are lying (repeats)	

23.56	AE now moves Mike because there are 5 pupils in this group Mike – I don't ... Sheila – Put yourself in the right place	Said to Mike as he moves his chair New girl directs Mike Gwen takes Sheila's pen
24.09	New girl – Move chair there	
24.21	Gwen and Sheila laugh Mike – I don't think they are lying .. they are ... you think it is going to happen but it does not ... sometimes it might work, you never know (inaudible) .. I don't think they are lying I think they believe it. Sheila - I'm sorry	
24.37	Mike – I don't think the people in these adverts are lying Sheila – Talking about what? Mike but it might not be the outcome ...	She looks aghast at something When Mike speaks they all attend to him
25.34	AE input re adverts and fish oil tablets etc Mike shares his answer with the class AE – I have great looking hair! What things do you use that you think work? Mentions wife's friend who spends a lot of money on make-up. Have a chat about that.	
26.49	Mike – I have technology Sheila – I have a bed (thinking) Mike to Sheila – You have an expensive bag, does that make you better? Sheila – I don't have an expensive bag Mike – It says River Island on it gold chains on it Sheila – Its just a bag Mike – But its more expensive than one from Asada Gwen – How much? Sheila - £45 Mike - £45 for a bag! You could get a carrier bag and get the same value Gwen laughs Mike – Carrier bags do exactly the same thing and probably carry more	
27.19	AE stops + input + mentions fish oil trial that will come back to	
28.09	AE introduces the problem and shows a bag of parsnips 'What notice?' 'All different' is the response AE input re the same but different in living things. 'How can we easily compare a treatment on me, older adult, with you? Really difficult to do etc Companies bring out treatments for children and charge more.	Stage 2 New girl carries on talking inaudibly Gwen makes Sheila laugh
29.07	Imagine you are a parsnip farmer explains context and shows parsnips.	AE introduces this via a story of parsnip farmers.

29.09	Sheila – Why parsnips? New girl – I don't know	
29.49	AE – what if they said you would get bigger parsnips, what would convince you? Talk about that New girl The company family planning Sheila – What did they say? Mike – If you show me a full bag of massive parsnips I will believe it .. to get that many, that size ..	
30.08	New girl ... dodgy things you can make a parsnip bigger sounds ... Mike – You are being recorded and caught in 4K Gwen and Sheila talk – eyes wide Mike – If you could show me a bag of massive parsnips then that proves consistently you get bigger ,....	Possible innuendo between girls associated with the word size.
30.24	Gwen and Sheila laugh Sheila – Well no because they might just show the biggest of the bunch Mike – Yeah but if you get 100's of big ones it would take 100's of years and he is not going to spend	
31.19	New girl - Here is a big one (she mimes pulling one out of a bag) Mike – You would be able to tell Sheila – What could you tell? AE stops for feedback AE – What would convince you? AE shows slide of the parsnips (treatment and no treatment) - Talk about that	
31.38	Gwen – Yeah, averagely bigger Sheila – Its obviously worked Mike – Might have been a slight increase but a lot more money when selling Alan – Yeah Sheila – But all still not the same size Alan – Its an increase Sheila – Not the same size Mike – I like might not have more big but has less small ones Sheila – Yeah but ... (stops and laughs) Mike – Why are you laughing, its literally just parsnips Alan – So on average its bigger Mike - Look at me I've got my River Island bag and I laugh at parsnips	
32.02	Mike – £45 on a bag (said in strange voice) New girl – Gropar Mike – Gropar is good	Both girls laugh

32.12	Sheila – I don't get it Mike – You don't get it Alan – On video (to Mike) Sheila – Say cheese Mike – Cheese Been caught on 4K, what are they going to do! AE stops Gwen – inaudible chart AE feedback 'Who thinks its worked??' focuses upon the 4 possible outcomes: Treatment + effect, treatment + no effect etc	AE models the actual numbers on the board and draws a grid showing the four different outcomes.
46.20 47.17 47.51 48.08 48.15 48.41 48.53 49.02	Next clip On the whiteboard AE shows the grid and the four options 'Does this help? Talk about that Mike – If the point is to make the parsnips bigger then surely the evidence New girl – Why are we and that group being recorded? Sheila – I don't know Alan – inaudible Mike – What .. Sheila wake up! Sheila laughs Gwen – I'm not a dog Mike – A duck Sheila – Quack, quack Mike – Woof Sheila – It helps because Mike – You can see how many are bigger New girl – They are all similar size .. Mike Sheila – Yeah, what Kyle said Mike – How many got bigger how many got smaller Mike – Hannah how many got bigger? X 3 Gwen replies in kind and Mike laughs AE begins feedback AE – does this help, how help? (refers to grid) AE – think of something to say Mike – Could help, maybe ... the results are too diverse to be put into a linear table .. you have to have multiple sets to get it right AE takes feedback + shows perfect results (treatment + effect = 15 and no treatment and no effect = 15	Said as a rap in funny voice Both girls talk – inaudible + Sheila looks puzzled Gwen looks in Sheila's bag and takes out sunglasses Both girls seem distracted, Sheila drinking juice

53.00	Mike utters a word 3 times Wagam? Mike to Sheila – Stop looking at the lights	There are lots of chat while this takes place, low level, noisy, hard to discern
53.11	Sheila – We read about that in English Mike – Yeah New girl – What Macbeth? Gwen – inaudible reply	
53.23	Mike – Weird, why are they trying to eat a woman? Sheila – Reads from Macbeth poster (or work on wall) for 10 seconds	The new girl is now interested in the camera
54.56	AE uses the numbers from the slide 20 : 10 (prove to disprove) ‘Is this strong enough evidence?’ AE also mentions head and shoulders Sheila – I have dandruff, I don’t use Head and Shoulders Gwen – inaudible reply and Sheila nods in agreement AE – Talk about that now Mike – No Gwen and Sheila – carry on talk about shampoo (price or size of the bottle!) Mike – Test over and over and over again .. on average you would set after set Trial 1, 2, 3, 4 Sheila - A big white bottle	Stage 3 begins about now The five different scenarios are spread around the class and pupils are able to swap with a different group when ready to move on.
55.20	New girl talks to Alan – inaudible because of masks	
55.38	Gwen – Shampoo last ages Mike – What are you two talking about Gwen – Shampoo and conditioner Mike – Does not sound like parsnips Gwen- Charlotte makes potions AE can be heard talking Gwen - makes potions with all shampoo and conditioners	
55.50	Mike – So you are a witch Sheila – You would have stones put on you and thrown into the river Mike – Stones put on you Sheila nods to Mike Gwen – Its break time	
56.03	AE – put hands up if think enough evidence? AE – never get perfect results – what results are enough evidence? Now refers to covid vaccination process	



		After break – clip 3 – camera switched on late as pupils working on fish oil tablet card sort activity	
48.34		Mike – This is a set of results, look at all the frowns Sheila – They all look the same New girl – No they are not Mike – We also have a couple of smiley faces Sheila – Smiley face, smiley face x 5 (she does this as she places down the cards) Sheila – Ahh I am going to separate into smiley faces Mike – so smiley face with and without pill ... so remember that with and without pills are different New girl – Okay so if take drugs you are happy and if you don't take drugs you are not happy	
49.06			
49.13		Mike – Yeah, yeah, yeah, that's how they do it on tiktok Sheila – Smiley face (said as puts cards down) New girl – Ah look Mike – Ah, all these men all taking roids New girl – Its just Mike to Sheila – You need a smiley face pill, smiley face not pill Mike – No I literally just Been putting them in groups Mike – Stop mixing them Gwen – we need to put into groups Sheila and new girl laugh	
49.54		Mike – Smiley face, pill, smiley face without pill are different This one had the pill and still did bad Mike – Give us the cards, you cannot just hold them Sheila – I'm holding the cards Mike – More smiley faces with pill You have to ... Gwen to Sheila – Just fly away ... Mike – Smiley face without pill and smiley face with pill Sheila – I will sort them	Sheila grabs cards Sheila takes cards again
50.16		Mike – Gwen we are 5 miles an hour x 2	Playing with the card bag
50.35		New girl – I think ... Mike – Smiley face with pill, smiley face without pill ... unhappy without pill, happy with .. New girl – Pills make you happy Sheila – Looks like they are nuts Mike – They are not nuts they are fish oil pills happy with pills Alan – Why are they happy with pills New girl - Only ... happy with pills – go for it Mike – The evidence would show that has more effect on men	She smiles as she hides the cards Mike sings or makes a song reference Mike now takes charge of the card sorting
51.01			

51.16	New girl – Drugs help men Mike – Grrrrr (clenches fist) .. happy with pills , happy without pills. So men are dumber but when take pills they are smarter Mike – Men are dumb but when take drugs are smart Alan – Happy women will not take pills	
51.41	Mike – Took pills, no all men who succeeded took pills so females succeeded without help from pills Sheila – Mike is my dad! Mike – Don't take the men with pills Mike – For the rest of the rest of this lesson you have to talk like a ... man	New girl puts bag over camera Mike is excited and animated Sheila – still trying to take the pill cards
51.53	Mike – Just count how many in your pile and what gender they are Gwen to mike – inaudible Mike – No, I refuse Sheila – Not allowed Mike – 9 men succeeded overall and all 9 took pills Sheila to Gwen – That's yours there you go Alan to Gwen – inaudible	All pupils counting now Passing cards
52.20	New girl – I've got 10 women who are upset because they did not take pills Sheila – I have 11 women who are happy to take drugs New girl – They did not take them and failed Mike – She has women who are unhappy they took drugs	
52.33	Mike – Maybe The pill works better on men Gwen – So why is she smiling when New girl – Harvey What did yours look like because we got these? Inaudible chat follows Mike – Men are happy that they took drugs Maybe this suggests that the pill has better effects on men than women New girl – They are the same ones Mike - Might effect women in the reverse New girl pills ..	Talking to boy in another group Quite a bit of inaudible chat
53.02	Alan – Teeny, weeny, teeny, weeny Mike to new girl – inaudible then 'Look at those unhappy men because they did not take drugs LSD before the test Mike – Poppy you are ruining the evidence Girl 2 – Poppy you are ruining everything G – Me and Hannah have taken a lot of time and been careful about everything Girl 1 – inaudible G – Tamsin, all your women took drugs and now they ae upset Girl 2 – Tamsin	Singing a song now New girl flips the cards over and smiles
53.25	Mike – My men took a lot of drugs and they are very happy Okay this is what happens when you do roids Inaudible	

53.45	Mike – This is what happens when you take roids – you get happy Alan - Inaudible Mike – You win the physical fitness test look at all those happy women Gwen – I would not say I normally get drunk Mike – So would the data show that women are unhappy when they take drugs? Alan – I’ve got Mike – Look at all those men, they failed because they did not take drugs al the men that won took drugs New girl – Same as us (to another group)	
54.00	AE stops and asks to swap cards with another group Sheila and Gwen – inaudible chat Gwen – I will just go round Sheila – I don’t James and ... Mike – Remember your numbers for the drugs and the How many ... I’ve got 9 Girl 2 – James texted New girl – G you need them all Mike – Remember your number Tamsin, remember your number Gwen – I did not count them Sheila – You had 11 Gwen – I had 8 mike – So 8 women who were happy they took drugs, this is like when anti-depressants depress you Jade needs to take her photo ... do you know this Sheila Alan – Mike, the bag New girl – What are you doing?	Mike gets up to swap cards with another group
54.33	New girl – He has a new bag Alan – Ahhhh New girl – Ahhh ... I am so sorry Sheila – Poppy Mike – Do steroids make you buff? Mike – I’ll take the men with drugs Sheila – Wait a minute I am doing this Mike – I’ll get the men who took drugs Alan – I want to write something Sheila – Write a number on Mike – You have to be able to tell if they are buff or not New girl – my boy is buff Alan – I want women who took drugs New girl – I want my independence Mike – they are frowning if they are weak virgin men	Sheila is ripping off small squares of paper and folding them Little chat at this point Sheila passes a piece of folded paper to the new girl. The new girl writes on the paper Mike rejoins group and tips out the cards
55.52		Sheila possibly referring to the slip of paper?

56.00	Sheila – Write your number on there Mike – My what Sheila – Your number Alan – Mike, you really Gwen – How many cards do we have? Sheila – Come on Alan 1 to 10 ... 9 men and what I noticed was that ... Mike – The women who took fish oil tablets all failed. The men who took the fish oils succeeded ... only the ones who took the fish oil pills New girl – I’ve got the guts who ... Gemma – Does that prove anything? Mike – You would have to do it about 15 times	Same again
56.38	Alan – Wrong person (?) Mike – Fish oil This has been shown to help with brain so I would not be that surprised if you know its not that far off Look at all these .. so the men who succeeded ... most of them did not no, no, no, thats a fail Sheila grabs cards – I want these Alan – I don’t have any ...	Now talking to his normal teacher
56.56	Mike – I have the weak people who took drugs New girl – I have the strong ones Sheila – Strong ones who took drugs Mike – Strong females who took drugs Sheila – Didn’t Mike – That’s a weak virgin woman ... weak You’re a virgin Kyle (to boy 2) ... ahh wait I forgot you are not Alan – I forgot you were not a virgin Inaudible Mike – Don’t you mean my sister ... Laughter Mike – Why are you looking at my sister Kyle Gwen – Your sister is in my sister’s class in school Mike – Wow New girl – I don’t have a sister Sheila – Sisters class in school Gwen – His sister is in my sister’s class in school	Places down her cards
57.41	Mike – Miss Is it true that the men who took failed? Inaudible Sheila – Ahh the disrespect Mike - repeats Alan – I only had 2 again	Said to Gwen in conversation
57.59	Gwen – I had 22 Gwen – I had 2	

58.13	Mike – So 12 men failed AE stops – This is difficult, like juggling etc New girl – I can juggle AE – Like juggling with things in your mind Control and experimental Gwen – I don't understand why Sheila - Someone Both girls laugh Sheila looks embarrassed – I didn't ...	AE talking from now on but pupils carry on chatting This personal chat is quiet and hard to hear
59.00	Alan – What are you two on about? Both girls laugh again Alan – Yes Gwen – Sheila is not a virgin Sheila – I am a virgin (said v quietly) Sheila smiling – Gwen's not Both girls laugh Sheila – You are not Gwen – I am Sheila – No you are not (They both repeat this to each other) Alan – inaudible	
59.55	Gwen – I got a paper cut Sheila – Really..... Mike – So men who took drugs died but when women took drugs they are happy Sheila – Happiness Mike – Depression New girl – I got Sheila – I mean I probably would Mike to Sheila – Look at that Sheila to Gwen – You folded them Mike – Women who take drugs and now they Clip 4	Said while looking at the cards Gwen puts down her cards
12.06	Gwen – You weasel Mike – No drugs, weak (to girl 1) Sheila – Have you written your number down New girl – Yeah, 22 Sheila – Do you remember what it was?	
12.16	Mike to new girl – Alan could not find me Sheila – Well the other one was New girl – How many had drugs	There is quite a bit of non-work chat now that is hard to discern

		Alan - ... flick you on the nose and you would feel it Mike – 9 men who took fish oil pills won and 12 men who took drugs failed The fish pills ..	Inaudible chat to Gwen
12.33		Mike – I mean fish improves your brain so it would not be far off for pills ... my Grandad always told me that cod fish helped. Sheila – They make you smart She Alan – No-one cares about your Grandad	
12.43		New girl – My grandad died Alan – My dad Mike – OMG	
12.53		Alan – I remember when I was a kid, on the news saying my dad had died saying that I needed friends ... that was really depressing Mental instability Sheila to Gwen – Well she felt They need to tell each other everything AE – Put the cards in the bag Mike – If I put the cards in the bag how can I understand that men New girl – You wrote it down ...	
13.22		Sheila – She said ... ohh shut up Mike – Wait a minute 12 men no drugs. Men are just naturally amaizing at getting buff. 22 men no drugs.... That does not make sense, men who don't take drugs are naturally buff Sheila – Well she said she might ...	
13.40		AE stops class Mike to Gwen – Why are you doing stupid Tictok dances? Sheila laughs Gwen – Cause (raises hands) AE manages feedback but calling out random names AE stresses how talking helps your thinking Feedback takes place	Gwen talks to Sheila who rolls eyes but inaudible Gwen moves camera and Sheila pulls face at the camera Smiling laughing at this time, Gwen moves close to listen. They keep chatting quietly
14.01		Gwen to Sheila – Shut up (she is embarrassed)	Lots of talk now
15.12		Sheila whispers to Gwen – Keep ... you're a virgin	
16.30		AE input on spina bifida and should folic acid be added to bread so all women take it. 'Should it be added without your permission?' Response - Yes, no – if it saves more lives then yes Mike – Whatever saves you, folic acid wont kill you but it saves a child's life Sheila – I don't care why ... Mike – Well you are horrible aren't you	Stage 4 begins about now as AE shifts to explore other related examples.

Lesson 5 – Models 1

This is a CASE-type lesson that works well with older pupils.

Lesson overview

This lesson introduces pupils to the skill of developing models in science and it requires them to create explanatory mental models, based upon observable evidence, to explain phenomena that are unseen or hidden. The main stages in this lesson can be summarised as:

Stage 1 – an introductory discussion of the word model and it's multiple uses in everyday life.

Stage 2 – a fun activity where pupils have to decide what's inside a closed box. The box has string running through it and will fall when held vertically but it will stop mid-fall when the string is pulled taught. They are tasked to draw what they think is inside the box and to share this with the rest of the class.

Stage 3 – pupils discuss historical and current models of the solar system to help them understand the limitations of models.

Stage 4 – pupils apply their ideas to explain the difference in mass between two cubes (Aluminium and Lead) of similar size.

They are required to draw a model to explain the nature of both substances that explain the difference in mass.

Stage 5 – a short period of reflecting upon the nature of models in science in contrast to the examples shared in stage 1.



The above stages are personalised in the following ways:

Stage 1 – AE shares a personal anecdote re modelling to challenge pupils to see the range of meanings in the word model.

As part of the discussion a toy is picked up from within the class and used focus the discussion. Throughout the lesson examples of explanatory models that are now obsolete (many of which concern the natural world) are shared by AE to show that modelling is a skill common to all people.

Teacher comment: a simple start such as this opens up and airs the range of language associated with the term model. This serves to focus pupils upon the use of the word in a science.

Stage 2 – Each pair of pupils has access to a box and AE encourages them to play with the box.

Teacher comment: the mystery box is very engaging activity that fascinates many pupils especially boys and the more tactile students. Its serves to show that modelling is about developing explanatory models based upon something unseen. It acts as a very important link to the particle theory activity which ends the lesson and so its acts as a thread running through the lesson.

Stage 3 – the key slide here is a model of ‘What the ancients used to think the world was like?’ i.e. flat. In this lesson personal examples of what AE’s children used to think about the world are used to bring both humour and to encourage the pupils to share personal thoughts and ideas.

Teacher comment: this stage enables pupils to see that developing explanatory models is a feature common to human cognition but it is also something that can be improved as human knowledge increases.

Stage 4 – all pupils are given the opportunity to hold the two cubes to enable them to realise the difference in mass between Aluminium and Lead.

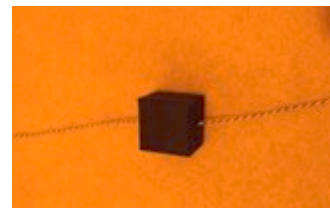
Teacher comment: this stage of the lesson challenges pupils to explain a common phenomena i.e. the very obvious difference in mass between two substances. To do this they use the ‘familiar’ idea that substances are made up of particles and quickly realise that they have been using an everyday word without really having their own model of the problems associated with its use.

Stage 5 – time did not permit this aspect of the lesson to take place.

Lesson context

This is the fifth CASE lesson with this group of 2 female and male students. The timings on this camera do not reflect the start time. The wearing of masks makes it hard to discern what is being said at times so much worse than normal in terms of working out what is said and by whom. Camera does not stop but footage split into 4 clips of which the last was corrupted. This means that much of stage 4 onwards is missing.

Time	Code	Transcript	Notes
0.09		AE – It's all about modelling in science and what it means. Mike – Does it mean when you wear vaccines on your head? Sheila – Is that the way your photo is taken? Mike – Yeah, before and after your photo is taken ... yeah you take the magic pill Sheila – How they got on and the ... AE relates story of wearing a suit instead of shorts and being described as a catalogue model. 'Is that what we mean in science?'	Stage 1 Unable to see what this refers to
1.10		Mike – Could be made out of clay .. Gwen – Ehh Mike – Like modelling something Gwen – Oh yeah Mike – Don't make fun of the way I speak Gwen – Its part of your init?	Girl 1 laughs followed by girl 2 Some kind of cultural ref?
1.24		Mike – Its part of my vocabulary x 2 Gwen – Init Mike – Init	
1.32		AE – What's an atomic model? All – What?	
1.45		Sheila – I don't know what atomic means?	
2.12		AE 'Any other models?' Mike – Clay models	
2.30		AE – What is the difference between atomic models and a cat made out of clay? AE shows an Easter chick 'Is this model the same as the atomic model? Talk about that Sheila – What's an atomic model? Mike – You know when you have 1 ball and the rings going around it (other balls) Gwen – Atoms Mike – Your atoms Girl 2 – Alan, what's an atomic model ... I am so confused Mike – Your atoms ... Alan won't know and I do	AE picks up on a idea shared by a pupil – an atomic model.

3.09	Mike to Gwen – If she had spent more money on tutoring instead of golden wrist bands then she would know. Mike – Buy a pack of loom bands Gwen – I used to do them Gwen – I used to do them Mike – I bought .. Alan – Have you seen the one with the fork that you can wrap ... Mike – I bought a £60 box of them just because popular Gwen - Nearly made my fingers fall off Sheila – I used to put a table in the street and sell them. AE stops – Any thoughts?	
3.24		
3.33	Mike shares in feedback – both the same because its what people think AE – Say that again AE now tells migration stories	Quiet but odd words from Mike and both girls
4.49	AE – Its what people do in their minds to explain something based upon evidence. ... Is the atomic model 100% certain?	Swans are included because they nest near the school and the pupils are familiar with them.
5.00	Mike – No AE – That’s why it’s a model – scientists can agree and change - that’s what we are doing today. You are going to get a box that cannot be opened	
5.15	Alan – Cannot open! Mike – Ill break it open Sheila – You cannot open it, not allowed to open it Gwen – I’m going to open it.	Stage 2
5.51	Mike – This is a trick ... we are going to be tricked, there is going to be knots in the string and like He is going to make us think there is something in them.	
6.15	Mike – You can work with Alan, I’ll work with Sheila, the smart people Sheila – It does not open Mike – Its not meant to open, so before we do anything lets do not pull the string through Sheila – Its got a knot in it, it’s not going to come out. It does not Gwen – Don’t be stupid AE – Watch	AE gives the group their box
6.22	Mike – So it does have weight? Sheila and Alan – Ours is broken Mike – That’s not broken Alan – It is, it does not work Mike – It does work, you are just not playing with it properly	Gwen talks but is inaudible

7.00	Gwen - Then pull it tight Mike – I reckon there is nothing in it, I reckon there is nothing in it at all. Mike – Filled with glue, nothing at all Gwen – You can see where the hot glue gun ... Mike – Yeah its just a box with a hole in, nothing at all I do not see it or feel it Mike – You sound like Goofy, shut up	AE shows how to get the box to stop Through the rest of the lesson the pupils constantly play with the boxes as they talk or when they are bored. Sheila laughs as the box does work and it falls Mike spins the box
7.28	Mike – Because there is tension Sheila – G stop saying ‘Init’ Mike – Its part of my vocabulary, shush man ... Init, Init, Init, Init brother Mike – we have been given paper for a reason Gwen to Mike – Do you ‘Anyone got a cigi?’ Mike – Anyone got a cigi! Mike – Wait a minute ... what I am going to do is put this in here	Mike copies Sheila’s laugh Both girls spin the boxes – lots of enjoyment and laughter
7.55	AE – Year 9	Cultural ref from before plus said to annoy Sheila
8.00	Sheila - How did you get that? When?	
8.10	AE – What humans do We imagine stuff we cannot see – can you imagine what’s inside?	Laughter Mike folds box inside some paper
9.07	AE – Draw what you think is inside the box .. based upon evidence ... do a sketch	
9.15	Sheila – Mike what do you think is inside? Mike – Nothing Sheila – So do I ... I am going to draw a box Mike – That pencil is broken	Gwen has Sheila’s bracelet Alan playing with box
9.34	Sheila – Idiot Mike – Idiot ... are you stupid? ... When British people say stupid there are about 17 s’s ... ‘Are you stupid?’	
9.49	Gwen - ... idiot Mike – A box, it looks more like a corridor Gwen – It looks more like an asylum Mike - your mum Gwen to Mike – What if I told you my mum was dead? Mike – That’s because	Mike and Gwen now talk in phrases + change voice – shift to playful? Gwen laughs

10.06	Sheila – It's a empty box Mike – It's, it's an empty box Sheila – Box Mike – Its an exi oops Sheila – I would have drawn it properly but I cannot draw I will just scribble my lovely box out Gwen – Let me draw a box	
10.12	Mike – Lovely drawing that's self-flattery Sheila – I will self flatter myself Mike – Alan is onto something here AE can be heard 'What's inside the box?'	
10.37	Sheila to Gwen – What are you doing? Suppose to be open and not closed box Sheila – What are you doing? I think the box is empty AE – But why does it do what its doing?	Mike copies Alan by swinging box
10.43	Mike to Gwen – Don't, I'm testing something Shelia – I don't know Gwen – Tension Sheila – Tension	They watch Gwen draw
10.49	AE – Okay ... pulling string back .. something is happening and you are trying to use the words you know ... Sheila – No pressure Mike – But it keeps spinning even when you stop it.	All play with the boxes as pendulums
11.01	AE note – a trigger can ignite innate/natural curiosity Mike – Gwen ... I will make a deadly weapon out of this box Sheila – I can make a deadly weapon out of your pen	Laughter because Gwen knocks the box as Mike was trying something
11.12	Mike – Pen is already a deadly weapon ... have you seen xxxx Slams someone's head down	Mike mimes a scene from a film where someone's head is banged and then models it with Gwen's the pen
11.22	Gwen – I think its empty Mike – I think its empty Sheila – I drew an empty box but they scribbled on it G – No you asked her to scribble on it Gwen – That's an empty box Sheila – inaudible Gemma – So nothing in it at all Mike – I think it's a trick Sheila – There is string Mike – I think the string itself has knots in it right ... they have put knots in to try and trick us Ahh there are no knots in it But there is nothing in it Sheila – Other than string	Mike now explains this to Gemma (teacher) as the girls laugh Sheila stays

12.02	Gemma – inaudible Mike – unless someone cuts it open and proves me wrong ... I don't see nothing in there, I don't see nothing in there Gemma – You have said a double negative, you don't see nothing ... that means you see something Mike – Miss its British slang and I come from the great country of the UK So... Sheila – There must be something in it because it stops Gwen – It's the pressure of the string ... tension Mike – I said those words you are just copying off me Sheila – No you didn't she said them ages ago Mike – I literally just mentioned tension 5 minutes ago	Both girls play with boxes
12.37	Gwen – I said them ages ago, I said them to Alan Mike – Alan, I thought he was bean man ... is that not his name? Gwen – Jack in the beanstalk .. Alan and the beanstalk ... bean stories	
12.49	Mike – I don't even think I was in on that Sheila – Literally AE – Okay what we are trying to do is what people do naturally	All laugh Sheila and Alan are fascinated by the boxes
13.11	AE now retells migration stories	The girls laugh at the mention of the name barnacle
13.50	AE – What's inside the box we have evidence etc ... 1 minute get ready to speak	
14.02	Mike – This is discrimination you know, they have given Trevor a small box and the other members of his team a big box ... discrimination Gwen – Well they gave us two small boxes Gwen – inaudible Mike – they gave us two small boxes Mike – Stop knocking my chair please .. its going to be a problem You are speaking to Mr Boldon himself Gwen – Are you going to get your lawyer ... who was it ... Mike – Yeah Gwen to Sheila– Do you remember when he used to say Mike – Thank you	Gwen swings box Mike bangs desk in mock anger
14.37	Mike – How dare you ... I was about to say that you know caught in 4k Caught in 4 k AE now talking and feedback starts from each group in turn Mike – Like a gotcha moment, there is nothing in the box	Girls laugh Mike moves paper plus some of this is inaudible Mike points to camera and the girls laugh Gwen test out each idea

17.28	AE challenges Mike to speak AE asks class to vote	
18.34	Alan – When you pull tighter the string gets thinner ... it would not stop. AE picks up on this	
18.48	AE – Who is intrigued as to what is inside the box? Think over break ... what do you think? ... what are you thinking more about?	
19.21	Alan – There could be something sticky in it so when you pull it, it stops the box Sheila – Just like a thing that ...	
19.26	Mike – I don't think this box is very high tech Alan – There could be ... Mike – I'm going to see if denting the box changes the way it reacts	
19.40	Sheila – Mike stop trying to sound smart, its not going to work ... Alan - ... does not feel .. Mike – There is nothing inside the box, I refuse to believe otherwise, there is nothing inside the box, this is a trick so Sir can go 'Aha, I got you!' Alan – He said he made them so it could be true	
19.49	AE stops – Right! End of clip	
0.00	Mike - another trick AE input re talking and thinking	
0.53	AE – is that a helpful idea?	Alan talks about a Chinese finger trap
1.11	AE – You are trying to come up with a model to explain what's inside Most science is like this Have a think over break	Stage 3 begins about now.
1.20		
1.59	AE – What evidence were they using?	
2.14		

2.31	AE – No think about it over break, what thinking that made them come up with this model? Were they wrong or stupid? Why did they think this? Have a chat before break. Sheila – Right we need to have a conversation ... being quiet ... get your head off the table (to girl 1) Mike – The way they saw it, heaven was just another earth, around the earth ... like you look at the diagram there is just another earth with its ocean ... something to hold it up around ... Sheila – What? Mike – The reason there were pillars is that they did not believe it was round ... they believed it was a semi-circle Init! Sheila – Stop saying Init Its getting aggravating now Mike – It's my blooming vocabulary Sheila – Not even vocabulary ... do you think you should talk like that ...	New task now – what people used to think the world was like. Image shown on board. AE describes the picture. G puts up hand Silence Girl 1 laughs
2.56	Mike – Ciggi ciggi Mike – Ciggi Cigarette ... Alan – Wow , where's me bacci? Alan – Where's me bacci?	
3.09	Mike – Fag Gwen – You know you would not be allowed to say that word unless you are part of the LGBGT Mike - Its another word for cigarettes Gwen – inaudible Mike – It is if you ask someone for a cigarette AE recaps on thinking task for over break Mike – There is nothing in the box, is all a big ploy.	Mike bangs table This bit is hard to hear Noise in class rises The girls laugh Said in silly voice
3.21		
3.35		
0.00	End of clip AE – What ideas did you used to have to explain things when you were younger?	Sheila waves at the camera
0.11	Mike – Something interesting Sheila – I don't remember Mike – The smaller ones make a click Gwen – If you ate bread your hair went curly Sheila - ... the crusts of the bread	Said as he leaves Not sure when this clip is from but it occurs before the density cube exercise
0.22	AE – Or if you ate apples a tree would grow inside you Gwen – Carrots help you see in the dark Alan – If you ate watermelon seeds a watermelon would grow inside of you Sheila – Your tummy	
0.37	AE to Alan – So you ate lots of crusts then Mike – That man there was a violation I personally would not have it.	Still playing with box

1.00		Gwen inaudible but in same voice as Mike Mike to Gwen– You are coming very close to hitting me in the knee this one	Mike and Gwen play with and spin the boxes
1.10		AE now starts to explain density cube task Mike – Sheila I need to test that but you have broken it I needed to test that. Alan – Gwen broke it Mike – Sheila you have to give that back ... she has broken your box (said to another group) Gwen – She did	Stage 4 All smile and laugh Gwen and Alan laugh about hair Uses funny voice which is picked up by Gwen Sheila takes box from Mike Sheila laughing as she pulls string though the box Mike points to Sheila Sheila laughs and Alan plays with remining box

Barry School – Group 1

Lesson 6 – CASE lesson 21 also known as How many are there?

Lesson overview

The thinking that underpins this activity concerns the concept of ratio and proportion and how this, via equivalent fractions, underpins the sampling techniques used to estimate wild animal populations. The main stages in the lesson can be summarised as:

Stage 1 – an everyday scenario is used to introduce the problem of estimating animal populations.

Stage 2 – pupils are introduced to the technique of mark/recapture which is used to model real and unknown/hidden animal populations. The example of woodlice is used with beads or beans representing the animals themselves with a handful of beans being equivalent to a sample being taken or animals marked. The first sample is replaced with a different colour or type of bean to highlight that the original population remains the same but now includes a proportion of marked individuals.

Stage 3 – each group carries out the mark recapture procedure which results in three values for them to use in estimating the original population i.e. $A/B = C/D$ with A being the original unknown population, B the first sample, D the second sample and C the number marker in the second sample.

Stage 4 – pupils share their answers/strategies and the focus upon ratio emerges from this.

Stage 5 – the concept of ratio in this context is applied to other scenarios.

The stages above were personalised in this lesson in the following ways:

Stage 1

Three scenarios are used (How many elephants are there? etc) to introduce the key focus for this lesson ‘How many are there?’ as a starting activity to kick off the activity and to promote discussion among the groups. The examples are distributed randomly on paper strips around the class. Regular reference is made to animals and wildlife throughout the lesson.

Teacher comment: making the link to popular wildlife programmes, that many of the pupils in the class may be familiar with, is a good strategy to support discussion and ownership. The mathematics in this lesson (equivalent fractions) is very familiar to the pupils but its application into the context of sampling can seem very baffling for many and it is almost as if the numbers they use in the classroom have no connection at all to everyday life.

Stage 2

A video clip of a well-known wildlife presenter emotionally viewing footage of a tiger caught on a camera trap is used to focus the discussion on the real-life use of ‘mark/recapture reasoning’ and the need to estimate populations of elusive and endangered wild animals. This is accompanied by a cartoon showing examples of a tiger being caught in a camera trap and a whale surfacing at sea. Pupils are given their animal populations (broad beans seeds in large pots) and are given time to handle them as they are unfamiliar with them.

Teacher comment: this stage was included for the widespread use of camera traps and versions of mark recapture are a common experience for many pupils yet often the maths that underpins the techniques is not related to what the pupils may know. This also makes stage 3 and the beans that represent wood lice more meaningful and real for the pupils.

Stage 3/4

The technique of mark/recapture and the three sets of numbers that result is modelled with the class and the numbers generated is shared and written clearly for all to see. These results are left and can be used by the pupils if their own numbers don’t work or are confusing.

Teacher comment: pupils need to be given plenty of time to follow the sampling instructions to generate the correct data and then to use this to try and estimate the unknown starting population. Often, for reasons of silly behaviour, they need to do this activity twice. This stage of the lesson highlights the numerical skills that are often needed in science.

Stage 5

A cartoon showing a new example of estimating whale populations from distinctive features/marks/tags is available for use in the last part of the activity.

Teacher comment: this stage is the one that due to issues of lesson length or timing is often missed or reduced. When used as part of the science curriculum this aspect could be used as a thinking homework and followed up at a later date in a variety of ways. In this particular lesson there is no meaningful stage 5.

Lesson context

This is the final research lesson taught in Barry school. A new girl, Poppy, joins group 1 for the second time. The wearing of masks makes it hard to discern what is being said which means working out what is said and by whom is difficult at times. Camera does not stop but the files are split into 4 clips but it will be treated as continuous footage.

Lesson transcript

Time	Transcript	Notes
0.00 0.07	Alan – Oh my ... I have not even Mike – Each year	Stage 1 Each group is given one of these sets of questions as they sit down. How many are there? We really don't know how many elephants are still left in Africa. Discuss in your group why it is difficult to count such a big animal as an elephant. How many are there? Each year the European Union set limits on the numbers of fish that can be caught to maintain stocks in the sea. How do they know that the numbers are falling? or rising? How many are there? A popular game is to guess the number of sweets in a jar. There are clearly more than 10 and less than a million but how could you improve your chances of guessing the correct number. Discuss.
0.15	Mike – This is tripe ... Alan – I fractured my fingers Gwen – Ahh, have you	
0.20	Sheila (pulling face) – Ahh	
	Mike – Each year	
	Sheila – It moves backwards how?	
	New girl – Mine like that	
	Gwen – Mine don't even go forward, never mind back	
	Sheila – I can do that ...	
	Mike – Guys look, guys look at this finger, fingers on your hands!	

0.35	Sheila – I can bend this one Alan – I fractured these two fingers Sheila – What does it say? Mike – I’m reading it Sheila - I was trying to read it Mike – I was reading it out loud	The pupils are playing with their fingers at the start of this lesson. Mike and Sheila bicker over reading their question which concerns fish quota’s.
0.45	Sheila – I don’t like listening to people read aloud I cannot read out loud, I’m dyslexic	
0.55	Sheila – Each year Mike – I thought you said you were dyslexic Sheila – When people are reading it out I cannot read it New girl – it confuses people Sheila – How many are there? New girl – 7 Sheila – 6 million Mike – This is tripe Are they allowed to decide how many fish we can catch Its disgusting. Sheila – What? New girl – I think its 6 million Mike – I’m glad we left the EU Sheila – 6 million Gwen - what are you talking about? Sheila – Fish	The image below is shown on the board. 
1.30	Mike – Basically ... there is a big evil government in Europe ... that say you are only allowed to catch a certain number of fish New girl – Its says how do they know that the number is rising or falling it does not say you need to like guess a number Sheila – I’ll guess a number Mike – I reckon it’s the birds ... they have cameras in the birds ... because the birds work for the bourgeoisie. New girl – Its rising because of more birds	
1.53	Gwen – The government see ... Mike – The government have camera’s in the birds that’s why zoos never have any birds because they are out doing their job	
2.07		
2.09	Mike – Hey stop messing with the camera New girl – Say cheese then Mike – No	
2.24	AE(teacher) input re modelling with reference to the box activity from last time. Mike – I hate the EU now	

2.44	Gwen to Sheila – I have ear ache now AE begins feedback New girl – Ours is about fish	Feedback begins about now as AE invites groups to share their thoughts concerning the ‘How many are there?’ questions.
3.03	AE – who has the sweets in the jar one	
3.14	New girl – Take a big stick and break it Sheila - you would not be that would be fine.	
3.24	AE input on estimation as a human attribute - Lucky guess? Mike – Wait I figured it out	
4.15	AE mentions Floyd Mayweather boxing at weekend and the £20 million prize money – Did he get exactly that?	
4.26	AE – Who got the fish one? Tell us what the fish one was and what you were talking about. Mike shares AE – Stop there Gwen – Stop there New girl – Are the numbers rising or falling? AE – How know? Sheila – Fish count	This is used to focus upon the fact that many large numbers/amounts used are actually estimates.
5.13	Mike - boats with a camera, sonar, ... rough guess then do again each month Sheila – I think he might be right New girl – He is Sheila – I would like to be one of those people who ...	
5.37	AE input on fish conservation, net size, his own survey work and the 12 th August	
5.46	(grouse shooting after young have grown) Mike – Boom AE – Who had the elephant one? Mike – I’m happy with that	Personal wildlife examples used by AE who worked in conservation prior to teaching.
6.09	Mike – You are Mickey Mouse, shut up AE – There’s one, there’s one how do we know how many? Sheila – How do you know if you counted one several times?	
6.24	Gwen – Draw on them AE mentions wildlife program ... Do you know who Steve Backshall is Deadly 60 guy	Stage 2

6.54	New girl – Ahh, Backshall .. Mike – I know a Pete Bucanon AE – How do we know when they are hard to see?	This begins with AE’s reference to popular TV presenters. The class now watch the video clip of Gordon Bucannon checking a camera trap which reveals a rare tiger.
6.56	AE now plays a clip of Gordon Bucanon from you tube with a camera trap and his quest to find tigers. AE – How can a scientist work out if an animal is endangered or not?	
7.17	AE – Watch clip and tell us what you think. Mike – You know what I was about to say, exactly that how dare you steal my thoughts	
7.58	Mike – He looks like an elephant New girl – Like one of those guards who	
8.28	Mike – It’s a stripey bear though it was a zebra mate ... Sheila – I want a pet baby tiger Gwen – A cub Sheila – Mm hum Mike – He really wants to bed that zebra	
8.42	AE – I did that in my garden the other day guess what I saw? Sheila – A hedgehog Alan - Rat Mike – Rats no AE tells story (something eating food in garden etc ... saw a cat and two rats using camera trap and got rid of them) New girl - Them tigers Mike – My cat brings in rats everyday man AE – I trapped them	AE uses a personal anecdote to engage and mentions his use of a camera trap to check if there are rats in his garden.
9.03	Mike – You have to keep him locked up because if he gets in the kitchen there will be a rat there. Sheila – You have rats in your kitchen! Mike – Yes, he brings them in Sheila – I think your cat has issues.	
9.26	AE can be heard talking Sheila – I thought you stabbed your cat with a fork Mike– No my sister stabbed my cat with a fork its not dead! Alan - And put in a blender Mike – No my cat got its foot in a blender	
9.45	AE – My question to you and what I want you to think about he spotted a tiger So how would he get a sense of how many there are?	

10.07	Mike – He should strap cameras to himself and stand in the same area to see if it comes back. Sheila – He could run after the tiger to see where it goes. Mike – No see if it comes back to the same area New girl – They do that actually Sheila – I’m so smart Gwen – How is your cat not dead Mike – I fork is not going to kill a cat ... my cat is not dead AE – Can I have the questions back please? Sheila – I thought you said your sister stabbed your cat with a fork Mike – It depends how hard you stab it ... my sister was , you know five New girl – Were getting recorded and you I got stabbed in my leg Sheila – You don’t know how funny ...	AE focuses class on the key question for today – how do we know how large a population of rare and elusive animals is?
10.17	Alan – If she stabbed it in the head would it get brain damage? Mike– what? Alan – If she stabbed it in the head would it get brain damage? Mike – This man just hates my cat so much Gwen – Your sister is in the same Sheila – What if you stabbed it in the abdomen? Mike – What if Carl Ferguson bought my cat a lollipop what would happen? Gwen – Well your sister is in my sisters class at school	
10.45	AE – Okay New girl – You had better ... Mike – What?	
11.23	Gwen – Your sister ... AE – You will never, ever, ever Know how many of a species there are a giant otter popped up on my phone after being found in Argentina. hopefully	
11.41	use skills to estimate.	
11.55	Feedback and input invited from pupils New girl to Sheila – Your idea because camera Feedback ongoing AE – Some animals you can never see ... I have tried to see some all of my life but so rare Gwen – Koala bear AE - how did they work out ... Mike – Go to the gym Sheila – I want a per baby tiger	AE relates a story about Otters in South America and how hard it is to accurately say how many there are.
12.10	Mike – Do you want to die? Sheila – I Little tiger ... baby	Class discussion about the tiger problem from the video clip begins.
12.21	Gwen – I want a baby Koala	

12.32	Mike – I want a Shiba ... I have a hunting dog but I want one of those Shiba's ... like the golden ones Gwen to Sheila - pandas Sheila – Red panda Mike – Red not blue Gwen - ...blue Sheila – the ones that have	
12.47	AE – ‘Year 9’, starts feedback	
13.51	AE – You might see the same one again Ike a comedy tiger ... being photographed again and again like in Madagascar.	
14.00	Gwen to Sheila – I though he was going to say	
14.14	AE – Lets keep that thought It could be the same animal.... How do we know its not the same? Rare there's one there's one!	
	New girl – Down	
14.28	Inputs from other groups: use distinguishing features, use paint like they do on sheep AE – You could actually spray an animal talks about homing experiments with snails putting tipex on them ... its possible to mark an animal	
15.19	AE – Which idea that you have heard could help Mike (to the class) – You could microchip them with a gun AE – Like you do with a dog	AE now flags up the idea of marking animals referred to earlier using a recent example involving snails that was in the news recently.
15.25	Mike – Yeah New girl (to group) - ... camera and attach it to them Mike (laughing) – ... and put them in a van till you are done New girl - no you them Sheila – You would have to put it round their necks New girl – inaudible	
15.39	Mike – you are not going to get a baby tiger with that attitude Sheila – I want a baby tiger Gwen – inaudible	
	AE now introduces the task of mark/recapture with a story about woodlice	

15.48	Sheila – Ehh (pulling face at the mention of woodlice) AE – Small animals don't know how many there are. AE shows the seeds and explains the task - ... you are going to be given a tub of Mike – Woodlice New girl - ...it's what Mike – It's the beans (laughing) AE - these are animals	Stage 3 The main activity involving beans starts and this image is shown: 
16.05	Mike – What kidney beans are animals! AE - Look at them and think how many Mike – You could say the is quite wild New girl – 7 Alan – 100 New girl – My	
16.21	Mike – The beans, the beans New girl - Why are we always recorded? Sheila – because New girl – Yes, that's why. Mike – Ahh, the beans are back	
16.35	Mike – Stop it, stop it Why Mike – I want the beans New girl – They are in the jar	
16.48	New girl to Mike – Get the bean and pick it up Gwen – Get the bean then, you bean Mike – Kyle took the bean Alan – What G you took the bean Mike – Can I touch them? Alan to new girl – I did not New girl to Mike – Pick it up Gwen – Give Mike a bean	
17.09	Alan – Put a few on your hand and Like kind of squish them New girl – You should show you should show ... because ... him Mike – Beans! They look like nuts not beans Gwen – So do people eat these? New girl – Yes you like boil them ... Alan – Put them in a Mike – have you heard of jumping beans?..... they have these little insects inside of them ... that make them jump	The beans are now given out at this point. The pots of beans generate significant interest from the pupils. This often manifests itself in the following behaviours, being silly and playing with them, bickering over them, taking ownership of the pot of beans, throwing the beans etc.

17.43 18.02 18.31	Gwen – Jump, jump, jump Sheila – Just so weird Mike – You know what’s so weird though you want a baby tiger. Sheila– Yes I genuinely want a baby tiger Gwen – I want a Koala Mike – Why, why cannot you have a cute dog? Gwen – She has a cute dog Alan – Pick that up now New girl – I don’t know where it is. AE claps hands and talks about populations of animals Mike – You don’t Sheila– Yes I do Mike – My dog is cool AE invites pupils to speak Gillian from group 2 speaks AE explains the task and what to do with the beans New girl – Similar but different Mike – The other beans New girl – Weight distribution Mike to new girl – Do you think we share the other bean bag and they keep the normal ugly beans. New girl – No we get to share the beans Mike – You share the beans with me Mike – Yeah, me and Poppy get the bean New girl – Kind of pop corny Mike – They look like Joes Alan – Kernel Mike – Let me see New girl – Do weight distribution Mike – They are squashy Sheila - my very Beans New girl – What are you doing? Mike – Crunching the beans init! Mike – No way put them back ... New girl – Put them back Mike - Then we will have to Mike – Hannah you are useless you. Sheila – It was Tamsin not me Mike – It was both of you	

	AE – Year 9 this is a model because we are inventing something AE explains the task – how could we use the second set to calculate AE invites boy 1 from group 2 to speak.	
	Clip 2	
0.00	Mike to new girl - Beans, I've got a bean still in my hand New girl – There is the bean she ate them all AE – Year 9 you have a lot of skills that can be applied to solve problems ... understanding the skills you have listen to this A pupil from the class speaks then AE shares about using factions	
0.10	Mike – inaudible chat about crushing the beans into dust AE demonstrates the task and the need to count the beans taken out etc Sheila – G take some beans out of the pot Mike – I have the tiny beans Sheila - not loads	
1.26	Alan – that's loads Poppy put some back Mike – No You are such a you are trying to control the beans	
1.50	Alan – Shut up nobody likes you	
2.11	Sheila – Right, okay These ones in there? AE – Yes Sheila – How many? New girl – 17 AE heard saying – write that number down. Mike – 52 New girl to boy 2 – We are doing 17 Mike – I have 52 New girl to Mike - It's not going to be your thing	
2.42	Mike – I know I've just said New girl to Gwen – You put 17 in there Alan to Mike – G do you want 52 Mike – No I don't want your beans Alan– I don't want your beans either	AE focusing upon the use of knowledge they have to solve this problem.

2.55	New girl – Put the beans in there Sheila – Alan put the 17 beans in there please New girl – What do I do with these beans?	
3.01	Sheila – Mike put the 52 beans back Alan – I don’t want that one, take it out New girl – Alan can you put the thing in here Sheila to Mike – You have put an extra bean in there Mike – I actually took one away Alan – I need another bean Gwen – counts to 17 to check, does this twice Alan – Wow, Poppy look at that! New girl – I got 1 bean Alan 1 bean	
3.21	Mike – I may have a bean up my sleeve New girl - there were 17, I counted it and he knows Mike – wow, you guys have some epic beans I don’t like beans	
3.43	Clip 3 Mike – Would you say you are a big fan of New girl to Alan – Put the cow in front of here Boy 2 – Hello (with the cow)	Break time – the pupils leave the class for 15 minutes
0.00	New girl – Sexy cow Mike – So would you guys say there is a big red combine harvester New girl – No Mike – Basically so do I replace with 17?	
0.14	New girl – No we have already have Mike ... leave the beans alone Mike – I’m just touching the beans I’m allowed to touch the beans	As the class returns Alan shows the rest a toy cow that has eyes that act as a torch. The novelty of the cow dominates much of the talk during the rest of the lesson for this group.
0.20	my beans AE – make sure you have all done the first part, then stop I had 50 Mike – It turns out that my 52 was closer ... New girl to AE – Do you put them back?	
0.48	AE – Yes you put the new ones back New girl to AE - Yeah, okay AE to class – You have replaced them Mike– OMG, I have turned all these beans into 1 bigger one! I have made a big bean	
0.55		

1.28	Sheila – OMG It lights up New girl – Its really blinding Mike – Stop messing about with the camera Gemma (usual class teacher) moves towards the group Mike – I had 52 but they did not want to do that last New girl – We did it with 17 look into it its bloody blinding Gwen – Let me have a turn Ahh Mike – What’s the point of having a baby tiger if you cannot see one	
1.51	Sheila – I can see two dots New girl – Mine are there AE claps hand - Year 9, listen up, shush	
1.55	Sheila – Ooooooh I love it, it makes a sound to Alan – You can have it if you want	
2.14	Sheila – I love it, can I actually have the cow that lights up and makes a noise ... I love it	
2.18	AE – Year 9 ideas AE explains the rest of the task and adds – Has the number changed?	
2.39	All – No AE – So now, as Gillian said, I have 50 marked ones in the population	
3.21	AE shows the numbers on the board (50, 40, 15). Mentions what three words because of the just three numbers and relates a story about calling the coast guard using what three words.	
4.40		
4.49	AE – How can we work out the population at the start using these three numbers? Off you go. Mike to new girl – How many of them beans?	
5.05	Sheila – I love it!	
5.18	Mike – Get a handful now count the number you don’t have to ... she took out a normal handful Alan – Can I take a handful, I want to try GMike– I’m not going to touch those beans	
5.31	New girl – Put some of them back, that’s too many Alan – Leave it not its not New girl – You dropped some of them Gwen – Is your cow a boy or a girl?	

Stage 3 starts around now as the class now have three numbers to use to estimate the original population.

5.54	Mike – Stop being Alan – They are being so ... Sheila – it has boobies Mike – All cows have boobies Sheila – How do you know? Alan – Why are you looking then. Sheila – Stop presuming my cows gender New girl – Can I have your cow for a second Mike – I thought it was heterosexual – I apologise Mike – Hey stop	
6.02	Gwen – Lets hope the people watching don't have New girl - does same Alan – I think we should put more of the other beans in Sheila – My cow is a girl and my cow needs a name Mike - No we should not manufacture a scoop – it was a natural scoop AE – you get what you get that's important Sheila – I want I want cow Mike – Alan stop re-scooping Alan – I want to re-scoop New girl – Re-scoop them Mike – You don't have to re-scoop them	
6.21	New girl – It needs to be more diverse Mike – No it does not New girl – Yes it does Mike – More diverse does not mean better Alan – Well yes Mike – No Gwen -What does diverse mean? New girl – Diversity Mike – Different	
6.32	Sheila – My cow is a girl My cow is called I need a name Alan – Betty Mike – Betty – we both said the same Alan – I don't want Betty now Sheila– Betty Alan – Call it Bartholomew Barth	
6.43	Mike – A truce New girl – What do we do now? Mike – That's a bears name not a cows ... have you never read Bedtime with Bartholomew the book? New girl – What about the beans?	

6.55	Mike – It's a book about a bear in space Gemma – So how many do we have New girl – 5 Mike – Alan keeps re-scooping New girl – Shush, shush, shush Gemma – How many of the new beans do you have in here the original Gwen – 17 New girl – No they are in here Alan – 23 Gemma – Okay 5 in 23 what would the ratio be and how many of the new beans did you exchange? Alan – 5 in 23 it won't divide	
7.34	Sheila – 17 New girl - 17	
7.43	Gemma – 17 ... so how could you use those numbers to work out how many were in the pot? Mike – So what was the original number Sheila – So for every 5 thingy beans so how was there 23 normal beans Mike – Right Alan - That's 5 that's 46	
8.06	Alan – 69 Sheila – 69 Alan – So there will be another 2 so you will have to divide and then	
8.19	Mike – Alrighty I have got the 23 beans Alan – Just add together and divide by 2 Gemma – It might help you to write down what you are thinking....	
8.23	Mike – I've got the 23 additional beans Alan- you divide by 2	
8.35	Mike – Aren't we adding more in progressively New girl – No, no leave it Gemma – I like that kind of thinking Mike – How are we ever going to know how many there are if we don't add in more progressively	
8.48	Alan – I'm confused now ...I don't know how you do ratios New girl – I'm in the second bottom set Sheila – I know how to do it if but there is 15 numbers in each New girl – Leave them	
9.01	Sheila – How do you get it to 17 there is 2 5 and then 2.5 Mike – I just want to ...	

9.17	New girl – Leave them Sheila - 8 ... no 17 11 Mike – These are bad beans, I don't like them they are ugly Mike – Get off them, they are mine Alan – Well you are touching them ... Mike – But they are mine now New girl – They were originally 17 Alan – I don't know what is going on I don't know why I am doing maths in science New girl – I'm not Gemma – because ... Alan – I know but science well I like	
9.39	Mike – Miss is something sciencey to do with What does that mean? Gwen – Sweaty hands Mike – Shut up how dare you ... Sheila – That	
10.01	Gwen – That's the scientific reason Mike – I will turn this into a weapon and beat you with it New girl – What's this for?	
10.10	Sheila – Those beans will never stick to my hands ... so the bean Gemma - ... this is just an extra thing Mike – This definitely hurts quite a bit Gemma to Sheila – Sheila do you want to explain to the group what you are working out to see if that helps? Sheila – Right okay ... so .. Mike – We want to try and figure out how many beans .. New girl – Then let her explain. Alan - Sheila – shut up G there are 5 beans there and 23 Alan – Yes 23	
10.45	New girl – Write it down Sheila – 5 ratio 23 then you put 17 ... so you have to get the ratio with 17 and a number ... Alan – A number on this side You have to work it out but if you times that by 3 you get 15 and 69	
11.12	Alan – If it was 0.5 it would be 0.5 to 2.3 so you could work that down .. Sheila – Right ...	
11.22	Alan – If you times the 0.5 by and then you times that by 2 which is 4.6 and then times that by 17 New girl – Kyle you are a genius	

11.33	Sheila – Kyle you are a genius Sheila– So we times 4.6 by 17	This is preparation for stage 4 now – the class sharing of ideas.
12.00	AE – Stop I’m interested in what you do with the numbers ... the answer is not that important but the skills you are using are	
12.07	Alan – Did I do it right?	
12.22	Sheila – inaudible reply	
12.45	AE – How many whales if they mark them This is how they do it AE now recaps and focuses upon – What did you do with the numbers?	
13.03	Alan – Is this wrong?	
13.11	AE mentions maths skills and models his numbers: Took out 50 then 40 and 15 were marked ... the population never changed. What could we do with the three numbers to work out the population? Get ready to talk in 3 minutes. New girl – Hannah is going to explain	
13.25	Sheila – I need to explain New girl – You are going to explain it to people I don’t get it Sheila – I can explain on the paper Mike – There must be an easier way to figure out how many there are New girl – I do get it I just don’t know how to word it ... Mike - literally yeah, just count them Alan – Well you count them	
13.47	Sheila – Say if we had a different perspective and we were trying to figure out the number of cows Say we were trying to figure out the number of cows in the world you are not going to sit and count them Mike - Probably thousands ask the farmers who own the cows how many they have.	
13.58	New girl – You could not they Sheila – You cannot count all the cows in the world Mike - You could if you were dedicated enough Sheila – You would have to use the ratio method to figure it out	
14.31	Mike – If I had Jeff Bazos’s money I would New girl – No G you would be dead ... you would not be in hundreds of places Sheila – Why	

14.42	Mike - Texas, Texas is a great place probably one of the best states. New girl – The cow works it works	
14.56	Mike – These are some smelly beans Gwen – Both of them Sheila – What’s his name? AE – Year 9 Gwen – Shit, what’s his name?	
15.34	Mike – What’s going on I want to count 1, 2, 3, 4, 5, 6 AE – We did not know who many at the start but do know something over here every group is going to share get ready off you go Gwen to Sheila - that’s who it was but he didn’t	
16.03	Gwen – People keep making new ones. Alan – Gwen would you say Mike – Gwen would you say that its another harvest festival Gwen and Sheila – Its another harvest festival Mike – Mrs Dent was a horrible woman	
16.14	Alan – She believed you Mike – She was a massive sexist New girl – Did you go to the same primary school? Mike – This woman Miss Dent was the biggest sexist I have ever met ... she had one boy in the choir just so she could compete in competitions	
16.35	Sheila – Get beans New girl – We need to talk about maths Gwen to Alan – Are you good at singing? Alan – No New girl – I went to choir to get away from maths because I hated it	
16.51	Sheila – I was in the choir, I quit Gwen – When I went to Hedworthfield I was in the choir Mike – I would have been in the choir if I had not been so scared of Dent	
16.57	AE – Just put them back in the pot Gwen – In the primary we used to go in the entrance of Asda Alan – The school went and we sang in that Asda Mike – You guys got to go down street Alan – We sang in that cathedral thing New girl – We went to the cathedral	

17.21	Mike – Cathedrals are great Alan – I remember when I was in the dance club and we danced to ... Thriller New girl – You had a dance club Sheila – Did you go to the Customs House same Alan New girl – We went to the Customs House	
17.27	Mike – I hate the Customs House, just go to a cinema	
18.05	New girl – What school did you two go to? Alan – Biddick Gwen – Hedworthfield ... went for a while Mike – You lot went to crap schools I did too to be fair Sheila – Who is chucking beans	
18.17	New girl – Its Ebony AE – Year 9	
19.13	Mike – If you corrupt our data I will smack you AE leads feedback re marking populations of animals AE – I will show you an example with whales Mike – The country of the animal! Sheila – Alan do you understand the ratio will you speak? Alan – I'll read it out if you want AE – the maths is quite simple but applying it is a skill	The lesson now progresses and moves, very briefly, into Stage 5

Barry School – Group 2

Lesson 1 – CASE lesson 18 also known as the Pepsi challenge

Lesson overview

This is a lesson on probability and is specifically linked to blind taste tests. The concept is explored through the reality of theoretical v's experimental probabilities and how the latter can differ widely from the actual, experimental, probability as calculated by the pupils. The chance of guessing is modelled with a coin toss (either heads or tails i.e. right or wrong) before a graph of the experimental probability against increasing sample size is plotted. The data and the line they draw slowly approaches the probability of 0.18 for guessing 4 or 5 correctly as all the data is cumulated.

The main stages in this lesson can be summarised as:

Stage 1 – the lesson begins with an introductory discussion exploring pupil understanding of probability, chance, in the context of everyday events.

Stage 2 – a blind taste test is used to contextualise the nature of chance (here 50:50) prior to a volunteer actually carrying out a taste test involving five taste samples. The key question; 'How can we know if they were guessing?' is used to bring focus and to challenge their thinking.

Stage 3 – coins are introduced as a tool to help explore the nature of guessing in this context i.e. you are either right or wrong and to model how we can actually calculate the chance of something occurring.

Stage 4 – pupils carry out a coin tossing activity to model stage 2 and they are required to work out the probability of guessing 4 or 5 right.

Stage 5 – the range of answers is explored and then the class data collated and used to show the cumulative impact of increasing the sample size on the probability. This data is plotted as a graph to show that the experimental probability only approaches the experimental data when the sample size is large enough. On the graph this is shown by the line levelling at around 18% which is the actual probability of guessing 4 or 5 correctly.

The stages above are personalised in this lesson in the following ways:

Stage 1

A cartoon showing the headline '1 in 100 year flood' is used to explore the everyday language of probability and chance.

Teacher comment: The headline was chosen as the phrase has been used within the memory of these pupils to describe flooding. Such a start enables the language used by the pupils to be focused upon the deeper idea of how probability underpins many real life events.

Stage 2

An image showing a blind supermarket taste test is used to focus attention on the main activity to come.

Teacher comment: This is a warm up activity to provide a concrete bridge between probability and the way it will be developed in the blind taste test. The pupils are being set up to use the data derived from the simple tossing of a coin to explore the difference between theoretical and experimental probability – this is new for many pupils and the lesson tries to make that as real as possible for the pupils.

Stage 3

A pepsi/coke challenge is carried out involving a pupil from the class during which they are given a sample of five drinks to taste. The class are asked how many they need to get right before we know they are not guessing. The class choose the order of drinks while the volunteer is out of sight.

Teacher comment: this is a very engaging activity that uses the simple task of tossing a coin as a model to enable a deeper exploration of probability.

Stage 4

Pupils are introduced to the fact that a coin can be used to model stage 3. Five coins are used to replicate a large number of trials during which the pupils have to calculate the chance of guessing 4 or 5 correctly.

Teacher comment: the data collection activity acts as a bridge to move the task away from the concrete towards an abstract discussion of probability. In stage 5 the cumulative data is expressed graphically, showing that it approaches the true probability, which is something that is new for most pupils of this age.

Stage 5

The differences in pupil answers (the probability of guessing 4 or 5 correctly typically ranges from 0 to 40%) and is used to trigger a discussion concerning the need to use the cumulative probability to illustrate what happens as the sample size increases. The cumulative data is plotted as a line graph that levels out. Probability and pet health is used as a new context through which to apply the learning from the lesson.

Teacher comment: the simplicity of this activity and the range of data produced serves to make the pupils think more deeply about the apparently simple idea of a 50% chance. This part of the lesson pushes their thinking will into formal operational

thinking. The link to pet health that is sometimes used at the end serves to both apply the idea of the true meaning of chance to an area of importance and also to illustrate how helpful this thinking is in everyday life.

Lesson context

This is the first CASE lesson (following an initial introductory) lesson with this group but the pupils in this group are familiar with each other. There are 4 pupils in this group; 2 x female and 2 x male.

Clip 1/3

Time	Code	Transcript	Notes
0.00		1 in 100 year flood image Gillian – That is what we are supposed to do Trevor – You could open doors, could be on a road Emma – Really rare, not obvious	Stage 1 All engaged in task.
0.58		Trevor – Dumb because did not open the windows Gillian– if open the windows it will just get in All smile as a group	
2.00		Trevor now mimes the window going down and carries on talking – Dumb, tsunami so lets go for a drive Emma plays with her hands Now they move to discuss the weather forecast Emma– How predict a 1 in 100 year flood because it is pretty rare Ron – How predict, not accurate All involved in this chat	

2.39		Trevor – Stupid, no common sense Gillian – Low probability, does not happen very often Trevor – 1 in 100 chance I will jump out of window	
3.46		AE now shows the taste test Trevor – I know ... the probability you will like it Ron – 1 in 5 Trevor – Some people like swallowing Emma laughs Trevor – Dirty mind All laugh All discuss the taste test again	Stage 2
4.18		Emma - Guys you have to be quiet AE stops to focus on the taste test	
4.38		Gillian to Trevor – both talking ‘That’s what I was trying to say Emma and Trevor laugh	
4.42		Emma – Because those 2 not talking Gillian – Guy’s ... there are two drinks and if close eyes ... 50% chance Emma – He’s putting gloves on Gillian – Someone is going to drink that Trevor – Like a 1 in 10 chance to be ginger All laugh Gillian – Yeah that probability	
5.19		Trevor – My dad was ginger	All engaged and the comment ‘Ginger’ does not really divert them from that task.
5.30		AE now shows the shot glasses – What are we going to do?	Stage 3
5.52		They discuss what they think Gillian – Don’t touch the camera, even though its ... Emma – We have to think about Trevor be quiet Trevor – He is recording us to see what we talk about ... Gillian – We are supposed We did not have enough time.	
6.33		AE stops	
7.15		Trevor – Not sure if you can tell the difference Gillian to Trevor – Put your hand up	
7.31		AE gets the class ready for the test and uses coin to choose who will take it. AE – How many correct so we know they know? Gillian – If you never drank would not know. If ... They talk about how familiar they are with coke/pepsi	Lots of talk between tasks, much inaudible Mike from group 1 does the test

10.13		Trevor – G get out, I'll kick your ass	
10.20		Emma – Power of Jesus – laughing at G Gillian – I don't really care ... put in hand sanitizer	
11.23		Gillian – He will get 3/5	
11.45		Emma – He drinks Iron Bru Ron – I have never drank coke	
		Trevor – He has experience of shots The whole class laughs AE – How many did he get?	
		The class now erupt Gillian – Told you he would get 3 Mike – More than average They now discuss the average here	
12.45		AE – Do we think he knows? How find out the chance? How can we know the chance of guessing?	
13.15		Lots of talk – very engaged in this context Gillian - ... get less than 2.5 AE – what could we do to find out? All involved in designing a test	
14.48		“If not then would be guessing” “3 year old laugh 3 year old's cannot lie” Gillian – They lie all of the time, they lie more than us	
15.09		Trevor – Ginger	
15.25		Emmma laughs	
16.30		Feedback time AE shows coins Lots of side talk all time - I Trevor and Gillian both laugh	
		Ron – Would be funny if always tails Trevor – What if it lands on side – 0.5 Both boys make noises with the cups	
19.15		They all laugh because coin on floor	Stage 4 begins about now

		Emma – What is he writing?	

Clip 2/3

Time	Code	Transcript	Notes
0.00		The group are coin tossing. Trevor – He is too perfect 4H, 1 T Gillian scribes Trevor – 2H, 3T Ron – I’m I’m (happy) ‘2T, 3H’ Last one	Great interest in the coins
0.26			
0.39		Gillian – Okay, lets do some maths ... how often did we get ... Ron – You just have to count the heads Trevor and Gillian play with the coins All laugh Trevor – Money is dangerous Gillian – 1, 2	Clear pleasure/happy sounds and intonation
1.00		Trevor – Don’t blame me, blame it on physics Trevor to girls – Try, throw it Emma puts coins in cup Trevor– You are soft Gillian – counting to self now	Trevor playing with coins and cup and he seems willing to distract the rest of the group but still on task
1.18		AE direct the class to the questions Gillian – $\frac{1}{4}$ 2 out of 10 Trevor makes some comment in rhyme about the cup Trevor – Who made this cup? Angela .. she drew the tree the same size as the bird All laugh Emma comments Trevor to Ron – My cup I’ll Gillian to Emma – This is really hard Emma – What’s the probability? Gillian – 2 out of or $\frac{1}{5}$ Emma – So its $\frac{1}{5}$	No idea what this refers to

2.57	Trevor plays with cup Ron – Matthew stop Trevor carries on and the rest of the group disagree with him Trevor trying to throw the cup and coins, Boy 2 tries to take it off him Trevor offers it to Emma and both laugh	Lots of elements of humor here but they are related to disruption and annoy the other members of the group
3.01	Trevor – You want it back he talks to camera ‘She is stealing the 2p’s’ Trevor to Ron – Put it back Trevor – I am a hobo, put the money back Ron – He is homeless, give him the money Ron puts a coin in the cup Trevor to Ron – Thank you kind man	
3.26	Trevor still throws the cup	
3.32	Gillian – These ones come up 4 times, they were the most common Trevor throws cup ‘I’m just here for entertainment	
3.46	Gillian - 3 out of 5 or 2 out of 5 2 ½ out of 5 one half Trevor – Why did we just not Why did we not do the 2ps like this? He throws cup and coins	
3.54	Gillian removes the cup from Trevor ‘Stop messing about’ Trevor to camera ‘See that, that’s bullying Emma places cup out of reach Trevor now picks up a book ‘I cannot read’ and puts it back Emma laughs	
4.19	Gillian to group – So we know that Trevor – I want my pen Emma – You have that, say 2.5	
4.30	AE focuses upon feedback ‘Pick someone to speak’ Gillian– Can I do it? Trevor – Can I have my cup back?	
4.47	AE – 1 minute count down	
5.09	Trevor still complaining ‘Took my cup’ Gillian – Yes because you were ... Trevor – I want to do flips Ron - Sit down Emma – You can have the cup if ... you go to the front and do a flip	

5.43 5.54		Ron – I would like to see that Trevor picks up camera and points it ‘These people are bullying me ... I am being bullied here .. you are bullying an autistic child They all look puzzled Emma ... inaudible Trevor– I can I’m autistic Trevor to Emma – You are just weird Trevor now bangs hands as he settles.	
6.30 7.15 7.39 8.06 8.34 8.39 9.10 9.30		Class feedback starts Emma and Trevor discuss the probability Emma – 10% Trevor - 10 10 Trevor takes paper and its it with pencil over table edge Both girls discuss the answer Gillian to Trevor – Can I have a pen to do some maths? Trevor - No Both girls and Ron discuss the answer Ron - I have a calculator Trevor and Gillian trade the pen for the cup Gillian – Trevor tell me the numbers Emma helps Trevor – Not sure what to do as so many numbers Girls discuss rounding AE makes point that no-one is wrong Gillian tries to get Trevor to focus Gillian asks Trevor for a coin Gillian – We need to add get an average Trevor to Emma – It might be if you had ..	Trevor does re-engage but also this does not really detract from the task
10.04 10.30 10.49 11.00		AE sums up the strategies Trevor to Gillian – What kind of science is this creepy Both smile Gillian invites Trevor, puts hand on table, fingers spread, and he bangs pen between fingers Trevor – That’s easy Trevor bangs pen faster Both girls discuss possible answer ‘Need to do an average’ Emma stops Trevor, helped by Ron Ron to Trevor – I hit my thumb because of you Trevor - I will shove you in the bin	Stage 5 about now Trevor does move them off task

		Gillian – Calm down Trevor and Gillian discuss some shared memory Gillian – Guys do you think math's is better than English Trevor – Depends Gillian – English is way better All comment	
11.22 12.30 13.30 13.40 14.20 14.30 14.45 14.52 15.05 15.20 16.04 16.41 16.52		AE stops to cumulate data prior to drawing the graph Whispered fun chat between Trevor and Ron 'Sorry little boy' Trevor – 6 groups did it Emma stops him – Its nearly lunch time Trevor and Ron chat Trevor starts to sing to self, Emma and Ron do not respond Trevor gets percentage wrong – 30% instead of 15% Trevor laughs – I was close The rest laugh at him Trevor and Emma discuss the answer AE – Why do the numbers do that? What are the numbers telling us? AE – Talk about that Trevor – I don't have a clue, I don't understand Gillian – The average Ron – The fraction Trevor – Its trying to tell us that the percentage Gillian – Trevor, what! Gillian - Its not all about how big the numbers are .. Emma to Trevor – Go stand over there in the corner Trevor – I can't, I am already in a corner Emma – Go to the naughty corner Trevor and Ron are silly 'Little boy heard' AE stops – No-one is wrong etc AE – Gabrielle is saying Trevor talks to Ron, Emma stops him AE focuses upon sketching the graph – What's happening? What is the chance? Ron and Trevor discuss the graph Trevor thinks Ron says ground instead of graph and so traces the ground with finger Trevor – You talk to quickly All laugh Emma – Graph goes like this because that's the way graphs go Trevor – I'm entertainment, this lesson I have made all of you laugh, mostly at me Gillian – At you, not with you.	Trevor copies AE's voice She touches him at this point Trevor annoys Gillian

17.22		Emma and Trevor talk Trevor – You are annoying me with your teeth thing Trevor and Ron are saying silly words	
18.00		AE now asks 3 questions about the graph: Why do this? What chances? What happen if we carried on?	Ron says results that justify levelling graph
Time	Code	Transcript	Notes
18.30 0.00		Emma moving hand AE taking feedback on the shape of the graph. Gillian and Emma keep going straight AE – stays same but wiggles Ron – If get different results it will go down Trevor – I see, right? Emma moves hand down	Engaged with the graph activity. Pupil answer Does action with hand – talking to self
1.10		Ron – It is basically a straight line AE – If we did it 1 million times it would stay the same Trevor talks about the camera Gillian discusses why straight Ron to Trevor – I'm not putting my hand up for any of them Ron – It means all the others have to be very similar	This creates lots of discussion and thinking out loud
2.15		AE stops class AE – What is the graph telling us Ron and Emma chat in agreement Lots of chat re the 25%	
3.03		Trevor makes comment to Emma AE looks at G results and the meaning of 1 in 4 Class focus upon why the graph levels	
		In discussion Emma moves hand to show answer	
4.54 5.23		AE now moves to the context of probability in health and the treatment for his dog – 70% chance of a cure. ‘What questions would you ask the vet?’	
5.33		Trevor – What tested upon? Ron – 30% Trevor to Ron – 25% you dafty Trevor – He said 75%	
5.53		Gillian – No 70% Gillian – How many times tested? Trevor now makes ‘hmm’ noises to the camera Emma – Side effects ... if tested and worked Gillian – It had on 10 but 3 died	
6.19		Emma – I had a pet die Gillian – I had Trevor – In my life I have had 3 dogs but 1 died	
6.37		Emma – I have had 3 dogs, lives with me now. 1 died and 1 lives with mams friend Trevor – All are dead now Emma shares something about another pupils	

6.57		Ron – Same 5 dogs AE mentions drugs out of license and cost etc Emma wants to speak – Side effects Trevor and Ron argue over answer Trevor – I was right 600, 000 AE – Sample size All group argue over 6 million or 600,000 and laugh Gillian – You need to get your ears checked.	

Barry School – Group 2

Lesson 2 – CAME lesson 27 Exponential growth with corn

Lesson overview

A (CAME) lesson on patterns of mathematical increase that uses the context of pieces of corn to introduce the pupils to the special case of exponential increase. The aim here was to specifically link this to the covid outbreak that was affecting the country at the time of teaching. It was hoped that this would support their understanding of the meaning of the R number and the restrictions arising from this relating to the spread of this disease.

The main stages in this lesson can be summarised as:

Stage 1 – an introductory activity that challenges the pupils to visualise two different kinds of increase graphically. They have to imagine what the graph of a balloon and rocket will look like before seeing the graph of distance and time.

Stage 2 – a story about this wise man and a king who had lots of corn is used to provide the context for exploring a doubling increase.

Stage 3 – here the pupils physically count and place corn onto a chess board to explore the nature of exponential growth. During this stage they shift from corn to actual numbers and then to rounding involving two significant figures as the corn becomes too large for the chess board. The pupils then convert the corn grains to its mass and they find that by square 32 the king has run out of corn.

Stage 4 – the importance of exponential growth is applied to many other biological contexts including the spread of covid and the significance of the r number.

The stages above are personalised in this lesson in the following ways:

Stage 1

The balloon and rocket are introduced via cartoon images and with reference to a local fair. The actual graph of the balloon and rocket is only shown for a very short time as a way to trigger their thinking and to promote discussion.

Teacher comment: This is a powerful thinking activity for pupils of this age as they have never been challenged to think about the real life contexts in which linear and quadratic graphs apply. The context of fairground rides motivates and engages them to consider the real-life meaning of $y = 6x$ and $y = x^2$

Stage 2

A story about a wise man helping a king and asking for corn as a reward is used to engage the pupils. The visual prompts of a real chess board and corn are used to support the concrete nature of this part of the lesson.

Teacher comment: a very simply story and a very concrete context are used to think about the reality of what large the numbers get when simple doubling is involved. This is important preparation if we want pupils to develop in their thinking and also to

realise the role that simple words, such as more, play in abstract thought and how valuable graphs are as a tool to show different patterns of mathematical increase are.

Stage 3

Groups are given a cup full of corn and a chess board drawn on flip chart paper. The large size enables them to both physically place the corn on the 'board' and then also to write down the very large numbers involved here. No work sheet is given as all numbers are written on their chess board as a way to help them articulate the specific nature of this type of mathematical increase. It is important to allow the pupils to physically see how large the numbers actually get by say 32 squares from a starting value of 1 grain of corn.

Teacher comment: Starting with actual corn provides a concrete link to the maths involved later in the lesson when the idea of exponential growth could be shown graphically. Using corn and then writing the numbers on the paper makes the rounding and the use of significant figures a meaningful strategy if we are to get a real sense of the different types of mathematical increase involved.

Stage 4

Various cartoon examples are used to help the pupils see that this type of increase is very common in the natural world. In this particular lesson it was planned to look for the opportunity to bring up the covid outbreak and the fact that when the r number is 2 then the rate of covid infections is growing at the same rate as the corn.

Teacher comment: this stage of the lesson is designed to show how common exponential growth is and that this type of increase underpins many of the practical experiences of growth (or more) that the pupils have experienced. It also seeks to show how applicable the maths skills they are acquiring are to real life scenarios. The use of the r number is a deliberate trigger by the teacher given that lockdown one had recently ended in the UK

Lesson context

The second CASE lesson with this group of 2 female and male students. Also the timings on this camera do not reflect the start time.

Clip 1/3

Time	Code	Transcript	Notes
		Footage from the start including the graph challenge. Very concrete start – aiming to make link with covid spread.	The use of real corn may increase the risk of A behaviour.
0.00		All talk about the camera (if it is just audio recording)	Stage 1
		Gillian – It could see last time	
		AE models thinking @ start, remembering biology from when he was at Barry School	
2.44		Emma – I have no idea what is going on	
		Trevor – Blue is the balloon	
		Emma – Rocket builds up constant speed but air balloon	
		Trevor – Rocket is not at a constant speed, balloon is the constant line.	
3.23		Trevor to Gillian – Move your coat. Don't know where the pen lid is.	
3.33		Trevor – Blue is the rocket	
		Gillian – That line is that the	
3.45		AE Input re graphs ... way to look at the world	
5.40		AE draws new graph showing plant growth	
6.16		AE – What happens after the 16?	
		Emma – denatures	
		Trevor – Dies	
		Trevor – If growth ... curls over or dies	
		AE stops	
7.22		AE – Still growing but by less each day	
8.30		AE starts the corn problem with image and story	All talking Trevor and Gillian want to answer Emma moves the camera, the rest stop her
		Trevor – Chinese	

14.01	Emma – Where is it? (Laughing) Ron – This might take a while Trevor - I take the corn Gillian – I take the corn Inaudible chat started by Trevor because he is unable to get the corn Ron writes the numbers in the grid.	They both ‘fight’ over the corn Gillian puts corn out of reach of Trevor
14.28	AE gives the group a second cup of corn Gillian – We have some but we don’t trust Matthew with it. Emma throws corn Gillian – That’s enough Trevor and Gillian – We have two cups Emma – Okay lets count (places corn on the grid).	
14.46	Trevor to Harvey – I don’t even eat corn normally (he smells it) Gillian – Just numbers we cannot fit Emma – Popcorn is delicious	
15.01	Gillian – We are just going to have to stick with numbers for a while Gillian – Trevor stop eating the corn	Emma counts corn then writes the doubling
15.20	Emma – Trevor, that’s really disgusting actually (repeats again)	
15.28	Gillian – What have you got, 32? Emma – We wont have enough space for 64	Gillian helps to count corn
15.54	General corn chat - inaudible Ron - I’m in the millions Trevor – inaudible Gillian – You are annoying Gillian – At least he is actually doing something Emma – Yeah That’s a lot	
16.09	Trevor – Take my corn you peasant Emma counts corn Trevor and Gillian laugh	
16.33	Trevor – Harvey, Harvey (points to camera) Emma – Its not a camera Trevor - It is	
17.00	Emma – It’s a voice recorder	They argue again about the camera
17.12	Emma – Think its time to stop, yeah Trevor throws corn Emma – You are going to be in so much trouble	

17.18		Gillian to Emma- Remember how I used to wear those earrings	Earring chat Both girls are now upset with Harvey (but not loudly so) and throw corn back at him An episode of corn throwing takes place
17.30		Trevor – Head shot, Harvey I am going to try and get this in your cup AE focuses class Lots of quiet and general chat during this time but inaudible	
19.10		Gillian to Trevor – What doing? He is making a pile of corn	
19.40		AE now gives out the conversion info Emma moves the paper to see the numbers and the corn Emma – Imagine getting a million Ron – Pretty sure I got to a billion! Gillian – I am up to 7 ... Ron - Up to 200 million!	

Clip
2/3

Time	Code	Transcript	Notes
0.06		Ron – He has 200 tons That means 2g 2 million	They are all talking and its hard to attribute the words to one person. They stop because grain is thrown.
		Emma throws grain back, Trevor joins in	
		Emma – Who is going to pick that stuff up	
		Trevor – Stop I am trying to make a corn pile	
		Ron – There is 400 million grains of corn	
		Emma – Now Trevor don't eat any of them	
		They all count corn and talk about the corn on the floor	
		Trevor – I'm making a pile of corn, corn Everest	
		Ron – 500 million	
		Trevor – Kernel Everest	
		Unsure who speaks - Its not a mountain	
		Trevor – Pile	
		Ron – For a party Everest	
		Trevor – But it will be ...	
		Gillian – We got to 64 (laughs)	
1.12		AE stops to focus upon the numbers.	

1.55	Gillian – I got 64 Ron – For some reason I feel this work Trevor – You are being quite corny now ... Emma to Ron – I’m in the millions Gillian – Can you not	More corn is thrown Emma throws corn back
2.30	Gillian – I have just got showered with corn Emma – That was a kind of bad throw Emma – No Gillian he said to put it back	
2.41	AE stops to focus upon the 3 questions	They are now converting the corn grains to give a total mass as the king as 200 tons.
3.33	Trevor – Too much Emma to Ron – How much is 200 tons in grams? Ron – 4 billion grains (amazed look on face) Trevor – How come the radiator ...	
4.01	Ron to Emma – He has 4 billion grains x 2 ... I don’t want to do that equation ... I feel its Emma – But we do need to times by 200, time by 200 Trevor – Harvey	
4.38	Ron and Emma say together – 1000 x 200 Why did I even use a calculator its 200,000 Emma – Its hard	
4.49	Emma – Yes I told you its hard Trevor and Emma chat Ron – So 200,000, it is 1000 X 200 is 200,000	
5.09	Emma – It went in your hand but you did not catch it Emma – Just corn, its going to be dry You don’t have any flavour Ron – Grams to KG’s x 1000 (reflecting out loud) Emma – 200 grains is 100g	Trevor puts corn on the radiator
6.00	Emma – Trevor, how many times does 100 fit into 200,000 Trevor – 200 times Emma to Ron – Divide it Ron – You need to turn it round	Ron has calculator
6.18	Emma – Who even threw corn, was it Harvey? He was turned around Ron – Do 200,000 divided by 100 so 2,000 (he now whispers something and smiles)	
7.44	AE stops to focus, prep to talk instructions etc. Emma – Grams of corn I think its 4000 x Emma – 200 is the same as So if 2000 then Ron – They cannot be	Hard to hear
8.17	Trevor – My head hurts Ron – If that’s rounded, 200 becomes 1 gram ... equals 1.2 gram	
8.36	Trevor – You keep messing with	

8.40		Gillian – I think its coming from Trevor – I will make you eat a chair	More corn is thrown
8.53		Gillian – I said	Gillian talks to Trevor – inaudible
9.19		Gillian – Trevor we need that .. Trevor – I will capture on camera that I am cooking corn AE stops class Emma – Its not on Trevor Trevor – Just keep quiet and let me dream	Related to corn throwing Emma moves camera to the other side of the desk. Trevor looks at the camera.
Time	Code	Transcript	Notes
9.40		Trevor to Gillian - inaudible Emma – At last I have some corn	Lots of A chat between Trevor and Gillian – quiet chat as AE talks etc
0.00		AE feedback – 11 minute to prepare to speak etc	
0.29		Trevor – Actually I have corn in my pocket Trevor – Look corn in hand Emma to Gillian – inaudible Ron - Who is speaking? I am not I spoke earlier.	
12.15		Gillian – I think Trevor to be honest Trevor – ... feeling a bit corny Trevor tries to cut corn with scissors and talks to another group Emma – Does he like corn	Gillian points to the corn on the radiator
12.26		Trevor – Trevor you are talking Emma – It has gotten lighter .9. I'm going to make popcorn – any of you have any salt? Trevor – I am speaking Emma – I don't know what to write Ron – What are we speaking about? Trevor sings Hey Macaroni quietly Emma – inaudible	
13.34		Ron – What are we getting him to say? What are we getting him to say? AE – The king runs out / away Emma – Trevor! Trevor – Harvey Science Trevor – my popcorn	Trevor and Gillian talk to pupils on other tables
14.00		AE stops the king had 400 million grains and it was not enough	Inaudible A chat
14.08		Emma – What am I speaking about?	
14.30		Trevor – But why corn?	
1.40		Emma – I only have two pieces of corn AE – language is a problem, this is a massive number .. I cannot quiet imagine it	
2.28		Feedback from the class	Trevor talks to a pupil on another table – joke.
2.43		AE comments: powers + how much corn to make a loaf of bread	Stage 4 begins about now
3.12		AE – Exponential – what does that make you think about?	Emma and Trevor fight over corn
3.23		Trevor – Corn in bread ... flour	
3.33		Emma – Potential Trevor – making tables Trevor – Big AE – Why? What is like this? Ron – Rise and Gillian – To me its bigger Trevor pretends to throw pen Ron – That's a big word Emma – The wise man most defiantly trusted in his plan Gillian – It has the potential to get more Emma – inaudible	Trevor and Gillian throw corn Emma is very thoughtful and moves hands out to show increasing
3.33		Trevor to Ron – Imagine you as Mr Sheen (he laughs) Gillian to Trevor – Why did you Corn ... Trevor – Imagine him baldy, like Mr Sheen Emma to Gillian – I don't know why but	
3.54		AE input on penny dropping, word on tip of tongue	

Clip
3/3

4.14	AE mentions R number All the group repeat + laugh Trevor – Big number Ron – Big number, small number vague number Number (he laughs)	
4.36	Gillian – I thought radius Trevor – Did Gillian just AE talks about R number Ron – R number Gillian – Infection rate ... where did that come from Trevor and Emma – Harvey Trevor – Imagine baldy like Mr Sheen Trevor throws corn	Deep on thought Corn is thrown
5.03		
5.20		
6.19	AE stops – What did you just say girls? They mention the infection rate AE - How does this help you to understand the virus? Gillian – Shows who it really infects	
7.23	2 questions: How help understand? Where else might this apply? Gillian – Not just about the virus ... any infection really Gillian aghast – He hit me in the throat	
7.39	Trevor – Do you want a thing in your throat? Gillian – He thought, you thought Ron – What are you two talking about? Trevor – Something All laugh know because of innuendo Ron – Its one of the two things I am thinking about Trevor gently throws corn – Death by corn Ron – I don't feel safe here	Both laugh because of innuendo
7.59		
8.02		Odd comments but little conversation
8.25	AE – Anyone think of anything like this etc? Gillian (in feedback) – When you see a number you don't really think of people but seeing the corn really helps AE input on exponential	
9.15	V quiet chat to end	

Barry School – Group 2

Lesson 3 – CASE lesson 13 also known as Sampling beans

Lesson overview

This is a lesson on biological sampling that uses broad beans to illustrate the range of variation that can be found in any population of living things. The pupils meet the idea of stochastic variables i.e. there are a range of values yet a central tendency can be picked to represent the whole. An additional challenge comes as the pupils consider the problem of sample size when trying to pick a representative sample from a large population.

The main stages in this lesson can be summarised as:

Stage 1 – an introductory discussion exploring the meaning of the term ‘sample’ in real life and science.

Stage 2 – broad beans are used to help pupils consider the large number of variables present within any group of living things.

Stage 3 – size is chosen as a key variable and pupils measure a large number of seeds to decide upon what makes a bean small or large. This is discussed and a collective decision is made as to the cut off between large and small beans is made.

Stage 4 – the problem of choosing a representative sample of living things is explored through a range of bean ‘samples’ being given to the pupils where the sample size and proportions have been rigged. The size of the samples they are given ensures that different groups pick different values and that a full range of data is needed to make a correct decision. This stage introduces pupils to the notion of a fair sampling and how other, smaller, samples taken from this may vary.

Stage 5 – the problematic nature of sampling is applied to the issue of sampling involved in political elections.

The stages above are personalised in this lesson in the following ways:

Stage 1

A range of real-life contexts in which sampling is a key part is used to open up the discussion and to draw out their thinking and ideas. In this particular lesson the use of the term sample is applied to the topic of bodily fluids.

Teacher comments: this approach has proved to be very engaging to 14 year old pupils and a good way activate any knowledge the pupils have at the outset. It also airs areas of uncertainty that can be explored during the lesson.

Stage 2

The pupils are given a large sample of broad beans to explore and investigate. Many pupils have no experience of such large seeds and so find them interesting and time was given to allow them to become familiar with them.

Teacher comments: time was given to allow the pupils to explore the beans to try and make a concrete link between the numerical aspect of the task and its relation to real population sizes.

Stage 3

A real packet of broad beans is shown to focus on the fact that each would need to contain a range of beans and not just large ones. Pupils measure a large number of their beans and pick two small and two large measurements to share. These are written on the board to show both the range and the variation and overlap in what some groups consider small/large to be. The pupils are challenged to use their own data to decide where the cut off point should be. During this stage links are made to the age of people involved in the roll out of the covid vaccination process and the allocation of grades in exams.

Teacher comments: many pupils experience of data involves the simple calculation of some form of average and often involves 'tidy' numbers. Here the use of real data (measurements) and the variation that this contains really challenges the pupils to develop their data handling and manipulation skills.

Stage 4

Sample bags containing a 'handful' of beans are given out. These have been 'picked' from a fair sample for size but what they do not know is that each bag has been doctored (different proportion of large to small and different amounts) with only about 1/10 being an equal split of large:small. The size value agreed in stage 3 is used by the pupils to explore the proportion of small to large beans in each sample and to consider why a small sample can differ so widely.

Teacher comments: the bags are doctored as a deliberate trigger to challenge the pupils to think about how sample size can effect the proportions involved and so lead to bias. The way this is done, with the whole class, enables them to see how the variation effects each groups results and that they have based their individual conclusions upon a sample that is not representative.

Stage 5

The recent US election is used as a suitable context to apply the ideas on representative sampling discussed in the lesson.

Teacher comments: a very recent, real, example of the problem involving sampling (the US election results involving Biden and Trump) was chosen as a suitable context to apply the thinking explored in the lesson.

Lesson context

The final lesson before Christmas and all pupils are present

Clip 1/3

Time	Code	Transcript	Notes
0.00		Trevor – Is that a voice recorder? AE – Just sees hands and your voices Gillian – So	All sitting and chatting waiting for the lesson to start.
0.42		Trevor – See that, vandal’s ... what’s on at reg Trevor – No Ron – Don’t touch it Trevor – Only hands, if point at face it won’t see it, just sees hands Ron - Because it’s there Trevor – Only sees hands	They all laugh as Trevor moves hands in front of camera Ron and Emma whisper about the camera Gillian sings Trevor points to radiator Emma puts a bottle in front of the camera Trevor moves camera to film Emma Trevor uses very extravagant hand gestures
1.04		Emma – If point up will see face Okay shut up	
2.00		AE recap on previous lessons. Have you made any thoughts, connections etc? Have a chat about the activities etc	They argue over the field of view.
2.17		All say popcorn and laugh Ron – That’s three that only thought popcorn Gillian - radiator for making popcorn	

2.24	Emma Hmmm Where do you think the center of the world is? Trevor – The center of the world Ron – Where the core is Gillian - between Trevor - ... new Jersey Gillian – I always got told USA.....	
2.39	Gillian - ... Like What should be in the middle of the map? Trevor - center of the earth ... Africa Gillian laughs Emma – Africa is at the bottom ... Ron – Middle Gillian – Like China Trevor – China (in a funny voice) Emma – Middle east Trevor – I don’t know Emma – We are ...	
2.55	AE stops and encourages to talk Trevor - Emma – N Africa Gillian - ...	Quiet chat during feedback
3.04	Trevor – Mexico Emma – America	This is shared in a very tentative manner, moving hands as she thinks and speaks.
3.30	Emma - if you think about big Earth	Puzzled faces.
3.45	AE now mentions taking a stool sample Emma – Stool is poo Trevor – Needle Stick a needle into and take whatever AE – Stool equals poo	Stage 1 begins now All the class laugh at this. Gillian laughs
4.01	Trevor – Like when sitting down Trevor - make your own sample	Trevor mimes taking a sample
4.18	Emma – Trevor you did not answer the question Trevor – What question? Emma - you think the big earth is? Trevor – Nah, I think God was playing golf ball – Interesting theory AE – Take a sample, where have you come across that before? Trevor – Eating food ... free sample .. when they come out and say ‘Do you want some sausage?’ Emma – Covid test Gillian – Dixons (she laughs at this)	All seem very animated and happy

7.53	Emma – Trevor is going to .. Trevor – I did not know what I was doing Ron – These are beans? Emma – Beanstalk Trevor (funny voice) – Beans Emma – They look like the magic bean but anyway ... how did humans behave then? Gillian – God knows I Emma – Ahh yeah .. Trevor – Are these edible? Emma – No I dare you, I dear you yes, yes, eat it	They are fascinated by the beans Their talk at this point is hard to hear Matthew tips out the beans
8.22	Ron – No eating the beans Sheila – Eat the magic bean AE stops class – How many variables? Gillian – What’s a variable? Trevor – Shape, colour, shell ... Gillian – Size	Trevor upset because bean on floor Gillian taps out a rhythm with two beans
8.48	Emma - - Anyway Emily, what happens when we die? Trevor – These are my beans Gillian – That one feels like Emma – What if I could not ... Trevor – Beans Ron – You just die and become beans Emma – Why are we here in the first place if just going to die? Gillian – I said to my mam the other day ... I did not ask to be born	
9.00	Trevor – That is the most perfect bean Sheila – You did not I did not want to celebrate my birthday, I did not want to be born	
9.11	Sheila – This one I want to keep this one for the rest of my life Gillian – In a box	
9.30	AE – feedback on variables Gillian – Guys I can lift it off Alan Gillian – Do you think all teachers write their Z’s like that? Ron – Speed	Inaudible chat Emma still tapping on desk
10.00	Gillian – It’s a ... Trevor – Spinning force Emma – Momentum Gillian – I think that one went smaller Trevor – Beans, beans, my beans Gillian – That’s was so exciting, can I have my bean back please? AE – Which variable is the most important for growing? Gillian – Size	Looking at and playing with beans

10.30	Emma – Trevor, Trevor Trevor – Bigger beans bigger AE – Say that again Trevor – Bigger beans, bigger price Emma – More beans, more ... AE – Who agrees with Matthew? Who thinks that could be important?	Trevor comments and Emma laughs
11.03	Emma – I disagree Trevor – Long beans Emma - not worth it	
11.30	AE – I would want big beans. Is there a problem with this, people wanting big beans? Talk about that. Gillian – What, what are we talking about? Ron - If you want Not sure if he said big beans or baked beans Emma – He said big beans Gillian – I think he means Big not baked Ron -	
11.45	Trevor – I still Emma – You took my perfect bean Trevor - Emma – You don’t get ... Trevor – OMG I have two perfect beans	Trevor makes funny noise and tries to grab beans Inaudible bean chat as they pick the ones they like
12.11	Emma – Anyway, where did humans come from? Ron – They came from monkeys Gillian – But where did monkeys come from? Ron – They came from	
12.19	Trevor – The water Gillian - ... Ron – They did not Trevor – They came from fish Emma – Did they? Ron – Evolution	
12.30	Trevor – You like beans, you like jazz Gillian – No ... weird Trevor – Prefect beans AE – feedback	He shows a bean to the camera
12.45	Girl 2 – the earth is not like a golf ball ... its too complex Trevor – Did I not say ...	
13.00	AE – questions on board – What goes in a packet? What’s the problem here?	Stage 3

13.38	Gillian – Beans Trevor – Big ... Emma – Bouncing bean AE finishes Gillian – They should just not sell the big ones ... have loads of little ones left Emma – Yeah, you want a mix different packets	
13.47	Trevor – He is changing what I said .. I said the bigger they are the better	
13.58	Ron (silly voice) – You out the big beans in this packet and the small beans in this packet	
14.04	Emma – So if energy cannot be created or destroyed Energy .. Ron – Talk about beans here Gillian (laughing) - all the beans in ... Emma – If energy Trevor Trevor, if energy cannot be created or destroyed ... then after we die, if we have energy in our bodies where does it go? Ron – It leaves our bodies but Gillian (inaudible)	Trevor – spills beans so they stop
14.33	Emma – where does it go space? Ron – Space you talk about beans. Emma – I want to energy AE gives each group a number – You are 7 Trevor – No I am 13 Emma (inaudible) Gillian - ... as the witches in the Say energy flows back into the Universe and they take it back out ... Emma – Universe It would still be in your body ..	
15.01	Gillian – We get put in the ground Trevor – I bean Emma – But it can't do that but also Stop AE claps hands to stop for feedback Gillian – We are 7 so that is fine	Emma put hand sanitizer on table and puts beans around it. Trevor comment and keeps beans. She now plays with beans and sanitizer. They all laugh as a bean from Emma falls onto floor near Trevor
15.24		Emma and Trevor interact over beans in upturned cup, Emma grabs beans.
16.07	Gillian – Stop Emma – Trevor, not just for you for everyone Trevor – Putting beans back, this is mine, this is mine Trveor – I've dropped the perfect bean	Emma hits bean with sanitizer causing it to fall onto floor
17.00	AE – What word are we using without understanding, how do we know which is which? Mentions fairground rides and height limits – have you ever been. They all agree	
17.30	AE – Measure beans to decide what makes a large one ... off you go	

17.55		Ron – A big bean is one that Trevor – It's not you Ron – Is bigger than this is bigger than normal Trevor (gets all beans) – Your not tall, you are ... Emma – You think If we die we have to have somewhere ... Ron – Why are we talking about earth, death and energy? Emma – Okay, me and Emily will talk about it AE gives out paper	Joke over Ron's height
Time	Code	Transcript Trevor – Sir is this supposed to be broken? (splitt)	Notes
0.00		Trevor (pointing to beans) – Little, big, big, little etc AE – Yes, it's not very strong	Trevor and Gillian are chatting quietly Gillian and Emma chat quietly
0.28		Gillian – Yes, Trevor, apparently this is the size of them Trevor – Supposed to be broken (shows cup to camera)	Trevor joins in grouping the beans
18.19		Emma – We have the perfect bean Gillian – This one is small	
0.39		Ron – I ain't no perfect bean Gillian – We need to measure the beans (repeats) Trevor – I was sitting in the car with my mum and Stacey turned to me and said 'You ain't no perfect ...' I said 'Ohhh' Gillian – I will get the perfect bean Gillian – bag earlier (!)	
18.34		Emma – Guys do any of you have a ruler? Ron – Actually I need to	
0.45		Gillian – This is twice the size of the other one	
0.50		Emma to Gillian – Are you buying fruit everyday Gillian – Little and big	
19.08		Trevor – I buy fruit everyday because I cannot be bothered to make a packed lunch Trevor – Why are you trying to cut it?	Trevor and Ron are sorting the beans
1.01		Emma – So I can see what's inside Gillian – What is wrong with Trevor – It's just normal Emma – Perfect	
19.11		Ron (picks up bean) – Whats wrong with that? Trevor – Let me see it's a small bean now ... I want it Gillian – We have ... Gillian – It depends upon your standards, your standards Ron – Perfect bean ... Put the perfect bean back Put it back Emma – I dare you Gillian – Trevor I will chop your finger if you dare take my ½ bean	Trevor and Ron squabble over the cut bean He takes bean from Trevor
1.14		Gillian – Standards	
1.21		Trevor – I want to eat it Ron – These are small, these are big beans Ron – Don't Gillian (laughs, to Trevor) – You look like ... Emma – Do it Ron – He is weird, don't look at him Emma – Do it, do it, do it Gillian – I sat next to him for a whole year, he smacked me across the head with a plastic bucket Ron (grabs bean) – ... poison Emma – When was that?	Ron moves the beans onto the paper
19.44		Gillian – Year 8 ... he got Ron – Since we don't have anything to measure with Emma – Ahh Trevor – Use your finger Ron – That's assault because Gillian – Will it work (smiles) Ron – He is abusive, he tried to put On me once Trevor – Okay, little, little, little .. if they are similar to my finger they are little Ron – Missed!	Trevor throws bean at Emma, they both throw beans Emma throws bean
1.58		Ron – Stop	
		Trevor – She is the one chucking stuff Ron – Don't throw the scissors put the scissors down	

2.18	Emma – No I will never AE stops for feedback	Hard to hear now + all seem distracted
2.27	Emma – Its worth going to prison AE – 2 small and 2 large measurements. Gillian – These are the large ones Trevor (funny voice) – Black bean AE – 1 minute to prepare. Ron – I think this seems right ... that seems about right	Ron and Gillian agree categories
3.08	Gillian – Beans do not have a smell cause they are cooked, right! Ron – Big, medium, small ... say they have to end Emma – Put them into extra small Ron – Okay then, extra small ... it depends how small that is compared to that one Will do the finger test on them all. Emma – that sounds very inappropriate	Trevor is inaudible
3.36	Ron - These are so dirty Emma – Okay, this one is extra small Ron – Look	Trevor and Gillian talk quietly while Ron and Emma sort and examine the beans
3.57	Gillian – I have to wait for Trevor to say something so that the camera will turn itself off Ron – This here is like Big, medium, small, extra small	
4.08	Trevor – I A bean Emma – Or small, medium, large, extra large Trevor – This is you perfect bean Gillian – My perfect bean Trevor – Can I keep your perfect bean? ... I want my bean Emma – Smallest of the small Trevor – Give me the bean bean bean	AE is now talking Trevor and Emma are using funny voices Trevor grabs bean from window sill from Gillian
4.53	Emma – Ron, you are supposed to be the organized one Ron – We don't have any numbers on them	
5.04	Ron – They are not really rulers but I might have part of a ruler Emma – Part of it? Ron – Trevor broke this one Trevor – Give me the beans	
5.19	Trevor (to Gillian) – What are you singing? I think you are the kind of person that signs weird songs Gillian – That's the song ever Emma – Josh said to be more	
5.27	Trevor – I don't know what you said	

	Emma – Josh said before that he wanted to Trevor (funny voice) – Beans Gillian – Do you mean that 34/35 song Trevor – Hmmmmm ... no Gillian - 34/35 Trevor – A song	Ron keeps on measuring, Trevor makes a bean pile
6.43	AE asks them for feedback Trevor to Ron – Small man	Trevor now bangs beans
7.04	Trevor (whispers) – Pretty Beans Gillian – Bean stash	Trevor takes a bean off the radiator
7.18	Trevor - wouldn't it be nice if pistachio beans Who is going to Pistachios are not beans (repeats)	Emma tries to get a bean off Trevor and he flicks her hand away, she does the same back.
7.45	Trevor to Ron – Don't do that AE – Do you think you have enough information to draw the line?	He now pesters Ron
7.51	Gillian – Probably need ... AE – Where cut off and why? Gillian – Probably be about 1.9, about 2.0 is when we start saying large	
8.14	Trevor – I am going to I am not sure what is happening Ron – Its around 2 when start but small at 1.9 Gillian – That's why I'm saying the cut off is at 1.9 Ron – 1.9 is small and 2.5 would be large Trevor – I am going to disagree with you guys Emma – Do the maths Trevor – I am not the stupid one just the immature one Gillian – I can tell	Much is inaudible
8.38	Emma – The ignorant one ... name 5 cities in Scotland Trevor – That's not general knowledge Emma – Yes its ... Gillian – Geography Ron – Dundee, Glasgow, Edinburgh ...	
8.58	Trevor – You are dissing my beans that's yours ... you had two Ron – St Johnstone, okay I will just name 5 football teams AE stops – feedback Emma – Trevor what's a general knowledge question then?	
9.30	Gillian puts her hand up to speak during feedback	Emma asks Gillian for a bean Much is inaudible

9.56	AE – where put line? Gillian – I think 1.9	Trevor cuts the beans
10.20	Emma – Matthew .. name a place in London (she repeats) Ron (laughing) – Eh hh, Paris Ron (laughing) – Wales	Trevor gives a puzzled expression in response Emma lists places in London
11.12	AE – you know when you buy clothes and the sizes are weird Girl 1 – Ah, yes, all the time Trevor – I just ...	
11.33	AE – What about this example – exams. 1 mark below an 8 in science, should you be given an 8? Emma – Yes Gillian – No because. You did not reach ... Ron – No, its not an 8 ... its that simple Emma – Maths Emma to Trevor– Name a city in France that is Trevor – This is not general knowledge you know Ron – Leon, Marseilles Emma – Name a footballer who plays for Sheffield United Trevor – I don't care about football Gillian – I had a lad that was in Sheffield Trevor – I am probably the only lad this year who does not like football. Gillian – My Dad gave me a football strip in pink, I was so excited. Emma – Footballer for Sheffield Wednesday Ron – I don't know AE stops class Emma – Does Gary ... play for ... Ron – Yes	Trevor and Gillian examine beans She shows here bean in response Emma does the same
12.38	AE – What variable are they using to decide who gets vaccinated? Gillian – Age, age Ron – Stop stabbing beans Gillian – Give her one Ron – You also have that one to stab, no others Gillian – Trevor you are supposed to get ... Trevor – Stabbing it, I'm killing it Gillian – I'm the kind of person who sits with the weird people My mam ... Ron – name a player from Man United? Trevor – What? Emma – Name me three players who play for Man United	Unsure of exact wording Ron and Emma talk quietly
13.00		
13.22		Emma stabs beans, Trevor equally engrossed Ron gives 1 bean at a time to Trevor

13.43		Trevor – Harry Mc, Anthony M, Marcus R Emma – Very interesting, Liverpool ... Gillian – My strong point is not football Ron – Names 3 players Trevor to Gillian – inaudible Gillian – Yes, in the house, I had 8 used to use them to shave my face Ron – Which ones did you not know?	
14.00		Emma – I don't know anything about ... Trevor to Ron – You are a small person, do you have a small blade? Ron – What do you mean, small blade? Trevor - Small blade	
14.10		Ron - Blade Gillian to Emma – inaudible AE stops	
14.29		Ron – Don't know what you are implying Trevor – I asked if you had a blade AE stops	
14.47		Emma – That's Sheffield W's nickname Trevor – I am so bad Trevor (stabbing beans) – Beans are strong AE – makes comment about how awful the exams were in the summer and predicted grades Have to make a decision about who to give the vaccine to. Invites feedback on exams, beans, vaccination	
15.20		Trevor – Beans Emma – What's the nickname for Sheffield United? Trevor – I prefer the beans ... Ron – Manchester .. which one? Trevor – I'm a magician ... why am I so good at deshellings beans?	
15.43		Trevor – Matthew Mullins is an autistic kid Emma - Autistic kid Trevor – Yeah, M Mullins Gillian – I'm waiting for my results Trevor – No Gillian – I am probably ... Trevor – Does that make you special? Ron – Disability Gillian – I'm the same as Trevor Trevor – Which one?	

16.12	Gillian – Did you ever notice that I get random personality (changes?) act out different personas. Ron – We have maths next Gillian – I like maths Ron – Miss Young ... we have Miss Young and Gillian– We need to do a test on Gillian – Ahh Trevor look at Trevor look at what Trevor did	
16.40	AE stops class	Trevor shows bean to Gillian – inaudible
17.07	AE talks about vaccination + exam mark feedback Gillian – She can have it AE takes feedback on exam marks	Trevor has made a mess Gillian and Emma are inaudible They all chat about the beans Trevor cuts beans with scissors
18.03	Gillian – They should do tests to see if vulnerable Trevor – They do Trevor to Gillian – its falling into your bag Gillian – It better not	
18.28	Gillian – Why is Poppy on that table? Trevor – She has always been on that table Emma – Mike	
18.45	Gillian to Emma – Try that Emma– That smells delicious Gillian – I wear it all the time Trevor – It smells delicious so ... Gillian – Wear it 2 bottles ... Emma – Expensive? Gillian – It’s not Emma - £25 Gillian – No £10 Emma – Ohh ... AE asks to tidy Ron – Put the beans in the cup Trevor – My beans	Girl 1 gets perfume out
19.17		
19.26	Gillian– Why do you think I always have a spray on me .. Trevor – How can a spray smell delicious .. are you going to eat it? Gillian – I threatened to drink it once, my mam Emma – inaudible Trevor – Look at this ... shell .. Gillian – Its Trevor’s head ... Emma – Trevor (inaudible) Ron – Look at me	

		Gillian – Do you mind, I will smell of beans. Trevor – They don’t have a smell ... you said ...	

Clip 3/3

Time	Code	Transcript	Notes
0.03		Emma – I know but smells like beans Emma – inaudible Trevor – How do you cook beans? Are these actual beans? Gillian -(inaudible) ... if you get pooped on by a bird does it at break it was in her hair ... all over her hands she was in the girl’s bathroom. Trevor – I don’t think it is ... Teacher collects beans	Emma throws bean
0.35		Ron – I would not say getting pooped on would bring us luck Trevor sing using a silly voice Ron to Trevor – You keep chucking beans Gillian – Does it bring you good luck if you get pooped on by a bird? It happened at break but not to me I would literally die if that happened to me Emma– Guess what you guys, I have the perfect bean Trevor – Guess what you guys, I have beans and probably a lot of shells	
0.55		Emma – I want to This now Trevor – I am going to eat this when I get home Emma – Is this the end of the lesson Gillian – I am going to count down the minutes	
1.03		Gillian to Trevor– Are you excited for Christmas? Trevor – If I plant this in my garden Gillian– Answer my question. AE talking Gillian– Are you excited for Christmas? Trevor – What? Gillian – Excited for Christmas? Trevor – What about it yeah Gillian – I’m getting (bags) Phones ... Trevor – I basically just get stuff, from these ... Gillian – New shoes new	

1.24	Trevor – I’m getting a laptop AE intros the final part – sampling beans Gillian– inaudible Trevor – I did more than ... I killed them Emma – Not Trevor – You just think it does (he now sings) Gillian – I thought blossom Gillian – Mike Wersowski(?) AE – This bag is fair, what do you think it means?	
2.00	Trevor – I am actually going to plant these when I get home Trevor – Beans Gillian– Ahh	Trevor repeats this phrase several times till 2.50
2.14	Trevor – Beans Gillian – I was thinking more	Much is inaudible Emma holds up a bean
2.45	AE – You are going to be given a sample Gillian to Trevor – Shush! Trevor – Beans Gillian – Elliot is immortal .. I feel like is it normal to feel like you have just downed a bottle of vodka	Stage 4 about now
3.07	Ron– And he gave me terrible ... Trevor – When I get home I am actually going to plan these in my garden	
3.19	Ron – why don’t you ... Trevor – Do you think I will be able to plant these in my back garden? Emma – No Gillian – Do I look hung over Trevor - ... my house looks like ... Emma – No	
3.33	AE – Is this sample fair? Trevor – No Gillian – No, its tiny Emma – Let us see Matthew Gillian – Pass it here Emma (open bag) – Leave the beans Trevor. Ron – The beans ... Emma – How long till the end? Trevor – Are you sure Emily? Gillian – Lift your hand Trevor	Trevor takes the sample bag Trevor takes Ron’s calculator Trevor is hiding the beans under his hand

4.04	Emma – More Trevor Gillian– Looks unfair as they are mostly medium beans. Emma – How long? Gillian – About 10 minutes. Gillian – He ate the beans Emma - Did he actually? Gillian (laughs) – No Trevor – I switched it (picking bean off floor) .. how did I do that?	Trevor lifts hands
4.25	Ron – I cannot find which one is the start Ron – Give me some beans, I need to measure them. Gillian – (inaudible but about size) Trevor - I need to shell the beans	Ron is trying to fix his ruler
4.42	Trevor now singing Gillian – I cannot wait till my 18th birthday	Trevor is silly with Emma because she gives the beans to Ron
4.50	Ron – Are we just measuring it Trevor (singing to Gillian) ... I'm going to .. Gillian– You can try Gillian – I like that song Ron calls out lengths 2 etc Gillian - change the song, I'm going to get wrong	Trevor smiles
5.18	Trevor - ... French now we can annoy Gillian – We all hate French Trevor Trevor – Spanish Gillian – In this school? Trevor – They have	Gillian and Emma talk quietly Trevor – still singing
5.27	Emma – Not in this school Gillian – Just decide if the Ron – This is 1, 2, 1 ½ ... there are still 2 left Bean ... there we go measured.	Emma now sings He drops one on the floor
5.51	Gillian – Oh, I've got PE Ron – Good	
6.05	Gillian – You don't do what we do, you have to lie on your back trumpets .. AE – Fair, if not fair why not? Trevor – What are trumpets? Gillian – They are ... Gillian – What do you do? Trevor – Handball Ron – Football on Monday, handball ... Gillian – Trampolines on Monday Emma – Netball on Monday Tuesday	

6.30	Emma – I love football Gillian – I love trampolining Emma - inaudible Trevor – Is that compared to all the girls in your group or ... Gillian – When I play football I just stand in the goal	
6.40	Ron to Emma – Listen, you don't want to be in my set Gillian – I am so lucky I did not pick games as I got my retainer Ron – You do not want to be in my set, its hard to play football ... Our set is hard to play football against Trevor – I sweat like I'm a beast and I am also obese	
7.04	AE stops Emma – Interesting Trevor – Is that like a weight scale AE recaps the questions etc	Trevor cuts the beans
7.20	Gillian – It's a ... scale ... Trevor – What? Gillian – It's a vocal scale Emma – Here you go Trevor – The bean is not working	Passes bean to Trevor Gillian now sings quietly through the scales, Trevor tries and laughs
7.49	AE – Decide which question you want to answer. Gillian – My eye is hurting Ron comments AE – Is the sample fair? Emma – Not really because two of them .. so many medium Gillian – I love ... Trevor – I am so with this bean ... Emma – This is still rare all about ..	
8.04	Ron – That's all small ... there is a range of sizes 2, 1 ½ 1 Gillian– I actually love netball so much .. Emma – I might play football	Emma carries on talking about bean size from before
8.23	Ron – People wait, what are you laughing at ... Emma – cause I said I might play football Trevor – You just don't seem like an active kind of person Emma – I have played Ron – If you were in my class you would not look good ... Trevor – You would not stand a chance Emma – What's everyone's thoughts on sport? What sports do you like? What do you play the most? Trevor – What mean?	

9.00	Gillian – Trevor Trevor – Football Ron – Handball Gillian – what’s your sport? Emma – Every sport, I like every sport to be honest Trevor – I hate hand ball and softball Gillian – I’m a swimmer Emma – If you don’t move its boring Football	
9.18	Gillian – Swimmer ... I have literally done every sport possible. I was a dancer, a swimmer, trampoline, gymnast ... Emma – I used to do cricket ... netball .. Gillian – I did hockey as well I was quite good till I broke my finger ... I used to play hockey till someone hit me in the face ...with a hockey bat ... that was Ron – I have only ever done football Trevor – A bat Gillian – What’s the word? Trevor – A hockey stick Teacher collects seeds Trevor – Sir, sir I have deshelled a bean Emma – Trevor get ... Gillian – Elisha, Lilly ...	Trevor is upset with Ron as he tries to take a bean
10.00	AE talks Trevor – Beans Emma – Can I cut this paper?	Lots of quiet neutral A chat – “Can you not, ... Brushed bean!”
10.34	AE – How possible? Gillian – When you pull out it won’t always get the same answer Emma – When together fair but its made into smaller groups ...	
10.58	AE asks Emma to repeat Emma – As a whole it was fair but in small groups it was no AE – How is that possible? Trevor – You can see the shells ... the one you deshelled in the bag More feedback	Gillian and Trevor look out of window and laugh
11.46	AE – Do you think how big the sample is effects things All – yes Emma – I hope I have football today Later on Gillian – I have Zumba Emma – Lats time I played I got 4 goals in Gillian – I have Zumba Trevor – Go compare Emma – Trevor! AE now talks about D Trump	He throws bean at the camera Stage 5

12.10	Trevor – Does Trump think he has won the election? Gillian – Because he it would be funny if he won you know. Emma – Football and I got 4 goals last time Ron – I don't score, just defend Emma – I like striking Ron – Whenever I do I am always with a team of people who do not play well Trevor - moving blind Gillian to Trevor – Its okay have makeup on to say we are okay ... you are lucky I don't have makeup on today	
12.35	Emma – Not that good at striking but no one else on the team was Gillian – When I wear makeup I bring it to school and I will your face Gillian – Ow, my foot Emma – I remember last year ... Gillian – I have large feet Ron – I have small feet Gillian – I'm a size 7 Emma – I'm a 4 Trevor – I'm a 10 Emma – Why do we have the same sized feet? Gillian – I might take my shoes off ... look ...	Trevor hits Gillian's foot She goes to lift her foot up Trevor is silly with paper
13.10	AE – Listen to this ... Alan .. Gillian – Ow Emma – Should have seen the injury twisted ankle ... Trevor – I am in his set, top set Some how got	Much is now inaudible
14.39	Trevor – Actually it was proved that Biden was cheating Gillian – Trump was trying to say ... Trevor – It was proven Biden votes Someone who died ... the vote was out in after they died.	

Barry School - Group 2

Lesson 4 – CASE lesson 20 Treatment and effects also known as Does it work?

Lesson overview

This is a lesson about variables and the need to set up control and experimental groups in any trial for effectiveness that involves treatments on living things. The concept of correlation is introduced through the way the four possible outcomes are combined to

look for a causal effect i.e. with treatment + effect and without treatment + no effect results must be greater than the other two possibilities. Students struggle to realise the importance of the no treatment and no effect as a proving factor. The two sets of data (called proving or disproving) are compared as a ratio to look at the size or strength of any possible effect. The main stages in this lesson can be summarised as:

Stage 1 – introductory discussion on how we know if a product being advertised works and what evidence would need to be collected. Such a context allows for many different and current examples to be chosen to engage whichever group of pupils makes up the class.

Stage 2 – the main activity is introduced through a discussion of parsnips and the impact of a miracle fertilizer. This serves to highlight the four possible outcomes involved and which prove/disprove effectiveness. In addition to this the reality of the variation in living things is used to highlight that perfect evidence would never be a reality.

Stage 3 – pupils sort cards from a range of everyday scenarios to look at which treatments have evidence of effect etc.

Stage 4 – this aspect involves the application of the thinking into new scenarios.

The stages above are personalised in the following ways:

Stage 1 – an advert for Wellman/woman vitamins and the question ‘Are they lying?’ is used to kick off the lesson.

Teacher comment: the familiar faces involved and showing the actual fish oil tablets that many pupils take serves to make the start enjoyable, real and meaningful.

Stage 2 – real parsnips are used to highlight the variety of sizes among and group of living things.

Teacher comment: exposure to something real and familiar affords an opportunity to both amuse and engage the pupils. As a consequence their talk flows more easily than would have been the case with a more abstract example.

Stage 3 – new coloured picture cards showing more familiar trails are used and the latter part of this stage is built around the effectiveness of fish oil on children’s thinking and the discredited trail from Durham LEA. A box of fish oil tablets is shown to the pupils.

Teacher comment: the cards are simple and concrete and the numbers are manageable and serve to focus the pupils on the four outcomes in any trail that need to be accounted for if we are to decide upon a products effectiveness.

Stage 4 – data from a smoking cessation trial in Scotland is shared as a new and related example of this type of reasoning. This is used because half of the participants were given money to stop smoking and it is an example that really engages pupils of this age.

Teacher comment: an engaging context is used to help the pupils see how the same thinking (i.e. four possible outcomes) can be applied to any situation where the effectiveness of a treatment needs to be assessed.

Lesson context

This is the fourth CASE lesson with this group of 2 female and male students. Also the timings on this camera do not reflect the start time. The wearing of masks makes it hard to discern what is being said at times so much worse than normal in terms of working out what is said and by whom. Camera does not stop but footage split into 4 clips but will treat as continuous footage.

Clip 1/4

Time	Code	Transcript	Notes
0.00		AE moves girls because of camera position Emma – Just move (to boys) Trevor – Just sit there Emma – Move chair, just move your chair Gillian – Sit there	They now argue about the seating arrangements They move the other table and laugh
0.22		AE shows the starting image, Emma puts her glasses on AE – When you see adverts like this, are the lying? Do they believe it? What do you think? Have a chat	Stage 1
0.50		Emma to Trevor – You look so squished Lots of noise in the class now	Trevor tries to read the image
1.00		Emma – She looks like she is trying so hard to smile Emma - Vitamins ... its vitamins Trevor – Probiotics (said in silly voice) Trevor – What? (laughs) What did I do?	Gillian talks to Trevor

1.50		Gillian – inaudible Emma – You are so annoying Trevor – Its not a noise ... I said the word! Ron and Gillian laugh Trevor – I’m not going to swear Trevor – Vitamins (reading slide) Emma – You know what ... Gillian – I think its fake Trevor – Oranges Gillian – Oranges AE – Year 9 ... bombarded by things like this, what do people want to say? Mentions fish oil tablets	They interact with their fingers Much is inaudible Gillian and Trevor – smiling and joking
2.04		Emma – I can barely read it Trevor – Fish (said in silly voice) AE – Vitamin D increases resistance to covid Trevor – Ohh, D AE – What about this kind of stuff? Reads the adverts Feedback Trevor – Well Woman (said 3 times as he pulls face) AE – What think about these? Trevor – Its making you shine (said to both girls) Laughter	Repeating AE in silly voice
2.29		Trevor – She does not look that healthy Emma – She looks frightened Trevor – Are those tablets making people shine ... but they are chemicals	Trevor pulls face as he hears Mike’s comments from group 1 – looks quizzical
2.57			
3.30	-	AE – I have great looking hair! Emma – Thoughts and dreams AE – What things do you use that you think are good? Tells story of wife’s friend who uses fancy expensive cream’s. Trevor – Fancy! Trevor – Fancy cream just same sort of thing out of a different bottle Emma – Exactly Gillian – The only thing you need to spend a lot of money on in botox Trevor – Ahh Emma – You could get Botox Gillian – Yeah Trevor – Yes Emma – Not Gillian – That improves the way you look Trevor – Botox is just buttocks said in a different way	All the group laugh at this All want to talk - very engaged Hard to hear at times Gillian laughs
4.12			

4.29	Emma – I don't think its like Trevor – Why does she have ½ a smile? ... like its wide then it goes Gillian – It might go Emma – Her eyes might go ... she looks like Trevor – She has a big forehead Emma – True but you have a bigger one	They now discuss the female used in the adverts Trevor mimes shutting mouth They are all laughing now Emma and Trevor chat about this
4.24	AE input re fish oil etc Trevor – I want some Trevor – It refills with sunlight	Stage 2 about now Gillian asks Trevor about his water bottle Lots of laughter
5.00	AE input re effect and no effect and shows parsnips	
5.11	Gillian – Parsnips AE – I got some parsnips All laugh at this Trevor – What if parsnips are trans?	
5.28	AE – What notice? All – They are orange AE – All different	They all laugh at this
5.32	Emma - Are we all different? AE shares about paracetamol not working well in some women Trevor – Ibruprophen! Gillian laughs at this	Trevor very interested in this – quizzical expression
5.50	AE – Hard to compare effect of drug on me and Matthew Trevor – Why does he keep using me as an example? ... is he calling me a parsnip? All laugh Trevor – I don't know how he knows my name, I could not remember his	
6.16	Emma – Matthew can you shut up?	
6.20	Emma – Will you shut up? Trevor – Watch your manners	She hits him with her pencil case
6.30	Trevor – Ian Moffatt ... you know him, there is someone in my family called Ian Moffat. I don't know him, whoever he is, I don't know and have never met him ... just know he is there. Emma – Just like your (laughing) ... ridiculous	
6.58	AE – What would; convince you that it worked? Trevor – Parsnips ... Matthew you were listening, what's he saying? Ron – I don't know Trevor – What's the question? Ron – No parsnip fertilizer Trevor – Cows	Gillian laughs Trevor reads the slide
7.17	Trevor – Isn't a parsnip like a potato? Ron – Would you rather have big or small parsnips?	Both girls make a comment to Trevor
7.23	Gillian – What are you talking about big parsnips? ... We need to find out.	

		Trevor – It refilled! It had nothing in before. Gillian – We need to talk about your long lost Uncle Emma – Long lost ... brother	Trevor takes water bottle from window and shakes it spilling the water – laughter
7.41		Trevor – Like I said, the sun replenished it Emma – The sun!	
7.49		Trevor – That’s exactly what I said to her, I put it there and then she said are you trying to warm it and I said the sunlight replenishes it AE – Okay Trevor – Electric bottle, takes all the juice from home ... Emma – This is not true at all	
7.55		Trevor – Parsnip AE – What would convince you to invest some money in fertilizer? ‘Proof’ - Unsure who says this Trevor – Poop buying poop ... Emma – Low cost Emma – Are you for real Matthew? Trevor – I am not going to pay a tenner for poop Emma - Its not poop Trevor – Yes, fertiliser is poop Emma – No its not Boy 1 – It is Emma – Are you for real?	Said with quizzical look on face
8.28		AE now shows image of the treatment Trevor – Gropar water Gillian – Not at all (laughs) Trevor – Why are they so sharp, like knives Ron - parsnips Trevor – Someone tries to break into a farm so he puts his hand into the ground and pulls up a knife (very animated)	
8.42		All the group laugh Gillian – A parsnip (mimes having a dagger in hand) Emma – Framers have lots of knives Trevor - every parsnip is secretly a knife Emma – Okay, that’s smart hiding a knife inside a parsnip Trevor – You could hide lots of weapons around the farm, you could put a grenade in the ground as a pumpkin Laughter Ron – So someone comes in and you just blow them up	

9.16	Trevor – Yeah ... you start throwing pineapples and you just throw a grenade Emma – You don't have pineapples on farms Trevor – You do, they grow from bushes Emma – No they don't Trevor – Yes they do, pineapples grow from bushes Ron - South America Ron – They grow on islands and South America, they don't grow here Trevor – They grow from bushes Emma – Exactly, exactly, tell him Ron – In South America	
9.25	AE claps hands, boy 1 is inaudible	
9.33	Emma – That's not how it works you actually Gosh Trevor – Put some sun over it Ron – Its too cold AE comments can be heard	
9.42	Emma – Low cost, cannot be expensive	
10.03	AE input – encourages to always ask questions etc + former pupil who has done well at Nissan Emma – True Trevor – A lot of people are more clever than me	Gillian and Trevor laugh, Emma sighs and shakes head.
10.39	Trevor – Ow Trevor – Director? Trevor – I'll keep it Gillian – Fencing! Trevor – I'm keeping this Emma – No you are not Trevor – Yes I am!	Emma – moves pen to touch Trevor's arm Emma laughs Trevor grabs pen
11.00	Trevor – I don't want it, don't like pens Trevor – Pineapples Emma – Grenade Ron – Some with water are big	Trevor mimes pulling something out of his top Gillian laughs
11.19	AE adds the results to the grid	
11.37	Trevor – Ahh, bigger average size biggest AE – You either have something or you don't	
11.44	Trevor - Yeah You don't have a life, you don't have money But I have AE mentions blind trials Trevor – Blind!	Trevor and Gillian talking – inaudible

12.13	AE – What did we say about the size of the parsnip? Big or small Gillian – ‘average size’ heard Trevor – That’s what she said – big! AE fills in the table with the true numbers – Does this help? Trevor – No..... it’s a square	Trevor pulls face and both laugh Trevor mimes putting hand down trousers
12.38	AE – Have a chat about that now. Trevor laughing - ‘Doesn’t ... have different results. Gropar .. that’s a weird name ... has a bigger average but the water has the biggest Ron – Bigger ones Trevor – The girthest	Trevor and Gillian share random words
12.55	Gillian – I banged my head off the radiator Trevor – The shear girth of a parsnip Emma – Girth! (giggles) Trevor – Girth The thing is they are all different sizes but ... all have 4 lines, how does that work? Ron – Because parsnips have to have 4 lines! If they don’t have 4 lines they are a banana Trevor – No because they are white Ron – White bananas Emma – I don’t get white bananas Ron – It completely makes sense Trevor – No it does not Ron – Yes it does Trevor – We are not talking about bananas we are talking about parsnips You are talking about bananas Gillian - ...carrots (inaudible due to mask)	All laugh at this Reference to the style used by the illustrator in the parsnip diagram.
13.28	Trevor – What what if parsnips are just carrots? Ron - inaudible Trevor – Well we are never on topic ... that’s why we are on the special table	All laugh AE giving feedback all this time
13.48	Trevor - Cool we are number 1 Emma – We are better than everyone else. Trevor – You missed Emma – I did not want to Emma – That hurts, oww how strong are your fingers?	Emma now bangs the table near Trevor Emma now goes to Trevor’s hand but he flicks hers instead
14.09	Trevor – Very strong Emma – Russian man Ron - everytime he comes in we are always off topic Trevor – Because I am here Ron - random stuff (hard to hear)	Said in Russian accent – all laugh
14.19	Trevor - that’s rude	Emma slaps Trevor

14.35	Emma. – You are rude Trevor – Whoever is watching this is going to be laughing their heads off ... they are going to be laughing at me saying this What....? Emma – Good because we are so funny It still hurts Trevor AE – Group 2 Emma - ... hurts (holding finger) Trevor – Pain Emma– Pain without the s Trevor – Pizza AE still getting feedback	Said to Emma Gillian and Ron chat – inaudible Emma and Trevor flick fingers, Trevor tries with Gillian
15.18	Trevor – missed Emma – I won’t try again Emma - stop it. Trevor does it, absolutely hurts	Emma still flicking finger towards Trevor Inaudible chat now + Trevor playing with water bottle Emma moves both hands to flick Trevor
16.02	Emma - ... what was that? Trevor – It was continuous and no middle because (shows with hands the moving middle.?) Trevor – Middle Emma – Middle Emma – This thing is hot ... AE – How many would be big if perfect? AE – How many small Emma – 15	Gillian and Emma discuss the feedback Emma now nips Trevor
16.39	Trevor – Trick question AE summarises the data Trevor – Gopro some water Trevor to Gillian – That’s how you confuse Emma – That’s how you ... Trevor – You show then ... Trevor – 5, 5 Emma– inaudible comment Scary ... baldy (aimed at Trevor) Trevor - Beech ... Emma laughs and repeats ‘Beech’ Trevor - son of a beech	She moves the camera Trevor pulls quizzical face Trevor and Gillian make comment about a child who answered Said in funny voice + getting bored Emmapretends to play the piano
17.30	Emma - I am not scared of you, I’m just ... I don’t want to ...	He now hums and dances Emma squares up to the camera Trevor goes to flick Emma He laughs and repeats the word beech
17.46	Trevor – It’s still water Trevor – Don’t flick the camera Emma - Okay, I need to stop	Emma goes to flick the camera Emma and Trevor laugh

18.17	Trevor – Don’t touch .. that’s broke it now AE – add up the numbers Trevor – What numbers? Ron– Just big and small parsnips Gillian - Are the big parsnips the huge ones! Emma – Bigger than Trevor Gillian – 25 small and 5 large according to my brain Ron – Did you just do random numbers without even counting them? Gillian – I just did not count them	Much is inaudible
18.43	Trevor – 7 big Gillian– Looks like 23 small Trevor nods	
18.59	AE talks through the numbers	They are restless now, ready for break Trevor is bouncing, Emma bangs hand on desk
19.39	Emma – Spiderman Trevor – Spiderman did not do that	Emma holds hand palm up Trevor copies and Emma moves hand Trevor mimes web coming out of hand
0.10	Clip 2 – after break Trevor – I’m starving AE shares story of using garlic on his daughters feet	
0.39	Trevor – Clean your dishes with garlic	Trevor is very amused
0.56	Trevor – Genius – you can taste it AE – We thought it worked ... treatment etc. Now introduces the 4 possibilities AE introduces the different treatments on the cards	Stage 3 about now
2.07	AE - Does keratin make your hair straight? Trevor – What the hell is keratin? AE – So my wife tells me Trevor – Of course! AE – Fish oil	
2.42	Trevor pulls face and smiles – What the heck have fish got to do with anything ... its fishy AE – Do lambs get bigger ... Trevor – No its genetics lambing AE talks about daughter lambing	

3.13	AE talking about pills Trevor – Steroids or horse piss Emma– What are steroids? Trevor – People inject horse piss into themselves AE gives out the cards	Emma strokes the camera lens Speaking with a funny voice
3.30	Emma – Can I get an hour, hour Trevor – Hour, hour Gillian – Hour, hour (hard to hear)	Trevor repeats a word (bizz?) 3 times but mostly inaudible Emma talks to the camera Funny voices, expressions here
3.38	Gillian – At least you are next to me Trevor – How am I going to close it when its already closed! Emma – Already closed Emma – Hour, hour	All laugh Trevor opens window which he cannot do Lots is inaudible
4.00	Trevor – Breaktime Now I’m here Breakdown Trevor – What ... what I’m causing people to have breakdowns ... ha,ha ... new level Trevor – Ohh paper!	Trevor makes a silly noise All laugh at this – must be some cultural ref
4.16	AE – Here you go, do pills make your muscles bigger? Trevor – Yes Gillian – Depends Trevor – Give it back ...give me back the bag Ron – Calm down	AE gives cards to this group Emma grabs bag and Trevor pulls, Emma laughs and wont let go
4.41	Emma – Okay lets put them Trevor – Why are there so many pills, pills, pills Ron – Cause there is Emma – Hold on, lets put them in different .. like ... Trevor – Pills, pills, pills They are all pills Emma – It’s got what ... Gillian – I’ve got my bit Emma – It’s got what? Trevor – Lass L, A , S, S Ron – Lass	Emma laughs and tries, in jest, to get the bag back Trevor looking at cards as he says this Ron grabs some cards Lots of overlapping talk at this point
5.05	Gillian – I think it goes in that one Trevor – That’s the straightest hair I have ever seen Emma - Paying attention right now Emma – Apparently no pills works quite well All these are no pills and they Trevor – That is the straightest hair line I have ever seen Emma – Pills Emma – This one has more than her Ron – This one does not work	The girls talk about the cards

5.30	Trevor – Pills, pills, pills these have pills Emma – Hold on no pills and no pills and you have Ron – I’ve got no pills and Trevor – What are we even supposed to be doing? Emma – We are grouping them Trevor – You said there are four groups there are not. Emma – Yeah Emma - What there is ...	Gillian and Ron chant the four groups
5.39	Trevor – Ahh, that’s pills and he is not happy and he has ... Emma – We are trying to work that out 5 minutes ago Matthew ...	
5.46	Trevor – Guess what I didn’t Emma – They are all the same Trevor – No they are not ... good and bad Ron – Give me all the ones that are good Trevor – Bad, bad, bad Ron – Bad I think	All engaged now
5.58	Emma – Which is good Emma – This is ... bad, bad, bad ...	
6.07	Ron – It appears that they don’t work Trevor – It’s lasses Oh its working more in lasses than it does dudes Emma – Oh, yeah that’s true Ron – It does not work with dudes Trevor – But then That’s dudes Emma – Put them in the right place then Trevor – Yeah Ron – That’s what I’m doing I’m putting.. Trevor – That goes here Emma – You are taking a long time Ron – I’m sorting them out ... here. Dudes Trevor – 4 lasses were not happy All the guys ...	Lots of words like this can be heard as they sort the cards.
6.30	Ron – We not happy Emma – Okay the conclusion is ... Trevor – The conclusion is ... whether we can get steroids .. Emma – The conclusion is stop interrupting so much Trevor – Its true, all these women have muscles with steroids Gillian – It does not work for guys Trevor – Depressed Ron – Men don’t if women have steroids they get muscles, if men have steroids don’t Gillian – If men get steroids ... they get ... just look at his face Trevor - Look at him .. I Emma – So they don’t work on guys but they do work on girls	Quite animated now and all speaking over each other All laugh at this joke Points to card He makes as if the man in the card is talking

7.08	Gillian – Yup Trevor to Ron – Do you want to know an easy way to see how muscular your arm is Pull that down and put your hand there Ron laughs as he gets it wrong Trevor – No your arm is not that Ron – I’ll take it off Trevor – Well come on! ... it cannot go up your arm so you are going to take it off! ... This is my life (to camera).	Trevor holds forearm and flex’s muscles + demonstrates to Ron where to hold his arm. He also gets exasperates with Ron for not doing as he says. Ron tries to copy and takes of sweat shirt so he can see his arm. Trevor gets exasperated with Ron They are all laughing
7.28	Trevor – Bag, I want to pop this we need a bag Ron – My shirt might lift up ... I cannot get my arm out right now ... hang on, I’ve got it Trevor – Right so, put your arm there right, lift, squeeze, twist, squeeze as hard as you can.	
7.43	Ron – Which way do I twist? Trevor – Just twist it inwards and you like tense there I think you tense there Gillian - ... your arm Emma - scabs	Ron struggles to get his arm out and eventually gets his left arm out then copies Trevor
8.03	Trevor – Ahh Ron – Yeah that made sense Trevor – Yeah, the sand is very dangerous ... Both boy’s – Yes sand	Trevor is inaudible
8.17	Ron – Chaos I just got a nose bleed from doing nothing in football Dangerous Trevor – Taylor said he was just getting them randomly Emma – Taylor? Trevor – This Taylor Ron – He slapped me and I got a nose bleed so it ... Trevor - he probably just snorted some air .. Gillian – No I’m putting them in their piles Ron – The evidence is	
8.46	Gillian - And he was just sitting in my reg group and he just farted ah Taylor you stink Ron – The other day, think it was Monday Just disgusting for 10 seconds it just did not stop ... he was right next to me as well ... disgusting Gillian – I remember once in Year 8	All laugh Trevor now sings
9.00	Trevor to Ron – I have a video of a guy who xxxx himself on my phone ... you don’t see it but hear it ... Ron – He is just lying down and the xxxxx comes out Trevor – Not that one, not that one	The girls chat but inaudible because of masks
9.09	Ron – What we have got form this is if men take steroids it does not work but if girls do it does. Emma – No these are not steroids these are different things Trevor – Matthew, Matthew this is Ahh no! Ron – These are steroids AE – Now swap with another group	Trevor opens a video on his phone

9.32	Gillian – You have different to us Trevor – Ahh, they have faces ... I thought they had some special things on the back Gillian – Matthew! Ron - ... What like three 7's Trevor – Matthews, mysterious, all muscelly Gillian – They are all like this ... look at the way their hands are they are like this	Ron now looks at phone Both boys laugh Said to another group Trevor has a comedy laugh Trevor looks at and touches Emma's card
9.52	Ron – This is where Max's fart went Trevor – Smells like an old man Gillian – Look at that hand, its like this Emma – Hey pass the bag (to boy 1) AE – Now try the ones with the exam results Gillian to AE – We figured it works on women and not on men Trevor – I want to do that. Ron – Yours works, yours does not Trevor – What I'm taking works if they are happy Gillian – What I'm taking	She bends arm to show bicep and mimes flexing. Hard to hear Trevor playing with bag Ron smells the bag – both girls laugh, Trevor now smells the bag She mimes the pose on the card
10.26	Ron – Say if it works they are happy How can you tell if they took it ... that's how you tell Trevor – Pills, no fish oil tablets Gillian - That is Matthews Ron – He gets the does works ones Trevor – I get the	Boys bicker over cards Said to each group member
10.36	Trevor - You failure Trevor – Yeah but they had the pills Ron – Are you dumb (funny voice) Trevor – Yes Ron – Are you dumb? Trevor – Yes dumb ... are you dumb Are you? Trevor makes noises with mouth Ron – That's what ... so basically	Points to card as he says the last bit Ron deals the cards
10.56 11.00	Trevor - Happy ... Gillian – So there is Mine does work Ron – 5 what I've got what we have got here Trevor – Why is it always two lasses with the pills I don't understand Is it the same 2, I don't understand why is my over there Gillian – We are all	Inaudible chat Talking to person on card Inaudible from Ron
11.12	Ron – What we have here boys need the pills Gillian – Trevor needs the pill Trevor – Hey, there are those lasses here ... shut up	Both using comic voices – some cultural ref He feels under the table
11.28		

11.33	Emma – Why is it always guys ... being disappointing Trevor – What do you mean? On the last one it was all the lasses taking steroids and its working Trevor – They are fish oil tablets Gillian – No Trevor, Trevor, Trevor Gillian – So why does it work? Trevor – Its magic, all the air is rubbing out of it, then its gone Gillian – 5, 5, 5, 5 Emma – Bag, bag, pass me the bag	Both boys protest Trevor blows up the bag and Gillian protests All laugh He rubs the bag Emma tries to take the bag They fight over the bag and keep grabbing it from each other. Inaudible fun chat Now talking to class teacher
12.10	Gillian – Works better without, happy with tablets, happy without tablets Trevor – These are all failures Ron – They need to succeed	
12.22	Gemma – So what does it tell you? Trevor – That everyone has some success Ron – That the men Gillian – We are all the same so not really sure if it has an effect Trevor – The women are smaller than men Ron – Men need them Gillian – They are not ... AE begins to draw to a close	
12.37	Gillian – I don't think we need pills we have got Matthew and he has Trevor – Get out of my way there is something in there and it stinks Emma – I actually agree Trevor – It stinks	All laugh at this He throws the bag Inaudible
12.55	Emma – You stink Ron coughs - ... stinks and I did not even sniff it and it stinks Gillian – I can smell it	
13.08	Trevor – Cause its women that think it Trevor – Stereotypical isn't it Women Gillian – Women are better Trevor – Eh, men Emma – Actually Trevor – Women are more truthful Emma – That's not true at all Trevor – No truthful, we don't need pills	Ron holds bag for her to sniff Girl 2 hits boy 1 on hand in response She holds up a card and takes card from boy 1 Some inaudible chat All laugh, boy 1 uses silly voice
13.30	AE – Right Year 9 Gillian – Get the one on the floor	

13.57	Trevor – Shush Gillian – Are there any on the floor (said to boy 1) Trevor - Dunno AE – Can you think of any kind of thinking like this?	He sings a song quietly Girl 2 puts a bag over the camera which boy 2 removes and girl 1 takes back
14.48	AE gives three questions to focus + repeats All now wave/dance with their hands	Generally the pupils look bored, boy 1 is singing, girl 1 is waving hands
15.10	Emma – Its like this Trevor – Silly Emma – It has to be Trevor – I feel like I’m air bending	Both girls can do the hand dance but boy 1 cannot. He keeps trying and girl 2 explains how to do it.
15.31	Trevor – These are not right (referring to his hands) Emma – Okay Gillian – I can just imagine him and landing flat on his face	They all try the dance Laughter + inaudible chat
15.49	Trevor – Hey ... whose looking Gillian – Do it slowly Both show him – Like that Trevor struggles – That’s still too fast Trevor whispers – Ron Trevor – Give up and try to get taller, migit	More laughter
16.02	Trevor – You said I feel like a walrus	Boy 1 and 2 talk
16.11	Gillian - It looks like	Still trying hand dance but now moving hands like seal flippers – laughter
16.34	Ron – Ow, my hand has just hit the table Gillian – Tiktoc Emma – Yes Gillian – It was me who	Girl 1 does the hand dance Girl 2 and boy 1 clap hands like a sea lion Now they all move hands together quietly, Trevor makes silly noises
17.04	Ron – Now Matthew is obsessed as to whether the earths core is metallic or not Gillian – If you just start ... Ron – Me and Harvey were arguing against Will and Max on Tuesday obviously we were right. Emma – We need more patience Gillian – I think I need practice Ron – Don’t even know what I am going to talk about	Both girls chat quietly Comments to Ron re his hands
17.24	Emma – Killing all (?)	Others move their hands
17.33		

18.16	Feedback – Gemma picking names to speak Trevor – Tiktok Emma – I don’t like that one – shut up Trevor – I don’t want to Emma – You just have to get your wrists .. Trevor – I’ll just pay	Trevor comments on the hand dance – still trying to get it right. Gillian shows him again. Trevor and girls do the hand dance – Trevor and girl take make comments
18.37	AE mentions supplements being added such as fluoride in water Trevor – I thought water cancel them AE – Iron in cereal..... Trevor – What?	Gillian now does the dance quickly Trevor laughs – hands tangled up
	Clip 3	Looks quizzical Girls chat quietly
0.10	Trevor – Head and shoulders Feet and legs AE – Talk about that now	Gillian hand dances, Trevor pokes Ron in back. Trevor fascinated by hand dance.
0.25	Emma – I don’t even know Trevor to Gillian– Do you know how to count with your fingers? You go 1 , 3 Emma – 1, 2, 3, 2, 1 Trevor – Can we just talk about parsnips?	Emma talking Gillian laughs
0.43	Ron laughing – Have we got to talk about parsnips again Emma – Do you think aliens exist Gillian – No Trevor – Yes Emma – I don’t think Gillian – Yes Matthew is sat right ... Trevor – ET go home Ron - ... ET Gillian – At break can I	They all laugh because he misses out a finger
	AE stops ...Natural Trevor – Natural Emma – Natural Emma – Hey is that Oh I don’t Every day Gillian – I just think he is sexy Emma – Yeah	Much is inaudible
1.03	Trevor – Carrots Gillian – Out of Emma – 1, 2, 3, 4, 5, 6, 7, 8	Trevor makes ET noises and points finger Laughter Inaudible Gillian shows Trevor something on her phone, Trevor laughs
1.46		Both girls chat

1.57		AE mentions the covid vaccine trials, lockdown and China	AE shows the carrots again
2.19		Trevor – China	Gillian laughs
		Emma – China	Emma counts carrots
		Trevor - ...carrots great carrots	
		Clip 4	
		AE review on using evidence to make decisions	Trevor makes noises
		Trevor – Steroids	Stage 4
0.10		AE mentions folic acid and spina bifida	Trevor is board and calling out words
		Trevor – So it does not split that would be cool (to girl 1)	
0.23		AE – Folic acid is a good thing – do you think its right to add it to all bread? Is it right to add something to your diet without your permission?	
		Trevor – What about the men?	Emma is lying on her coat
0.50		Trevor – You can have pills instead of bread	
		Trevor – Butter (mimes spreading it)	
		AE – Folic acid	
		Trevor – But what does it do for them though?	
1.17			Gillian – inaudible
1.26		AE – Do you think the evidence is strong enough?	Both girls respond but much is inaudible
		Emma – No	
		Trevor – No who needs them	
		Emma – Has to be taken ...	
		AE now mentions a smoking cessation trial in Glasgow	
		Trevor – Glasgow, why not Lilly or algae(?)	
		Ron – puzzled expression	
2.07		Trevor – Only if they have babies	Both girls – inaudible
		AE - £250 voucher	
		Trevor – Lucky (quizzical expression)	
		AE – Do you think its okay to give them money?	
		Trevor – No they may spend it on worse New kid	
2.31		AE - Do you know how much it costs the NHS ...	
		Emma – Compared to Its not bad	Both girls laugh
		Trevor - Cigarettes But they make you feel good	
		Emma – That is	
		AE – Talk about that	
		Trevor – What are we talking about?	
3.01		Ron – That on the board	Hard to hear all that is said here
		Trevor reads the board out loud	
		Both girls - The others not given ...	

3.18	Ron – They get money for Trevor to Emma – Why the hell are you trying to stop people smoking Gillian - £500 Ron – They will smoke more Trevor – It’s a boomerang .. haa Ron – Is that an actual question?	Ron comments Trevor holds ups a pen Emma – inaudible + girl 1 laughs Much inaudible and they seem bored now
3.36	AE stops Trevor - ... stop, just because does not mean you have to bitch about it ... Trevor – Its ripped	
4.03	Trevor - ... fag ... fag Emma – Fag is not a bad word Trevor - `It is if you get caught smoking a fag then mmmm Trevor to Emma – See I’m moving it Emma – Yes ... it depends on the context Trevor – Could be used for	Trevor talks to Gillian about books on windowsill Gillian laughs, Emma shakes head Gillian laughs
4.15	Gillian - ... cigarette ... Trevor – People get fed up with these days Emma – You can definitely say Trevor - you can get cancer without consent	Trevor is playing with the blind
4.29		
4.35	Trevor - ... I’ve got autism Autism Emma - cancer Trevor – Aspergers Emma – inaudible Trevor – What, ahh cool I think mine is more expensive	Hard to work out what is being said here Both girls talk – inaudible Gillian replies to him
4.55	AE shows the smoking data on the board	
5.05	Trevor (looking at camera) – That has been going for minutes So just 5 minutes more.	The boys smile at something in the classroom

Barry School - Group 2

Lesson 5 – Models 1

This is a CASE-type lesson that works well with older pupils.

Lesson overview

This lesson introduces pupils to the skill of developing models in science and it requires them to create explanatory mental models, based upon observable evidence, to explain phenomena that are unseen or hidden. The main stages in this lesson can be summarised as:

Stage 1 – an introductory discussion of the word model and it's multiple uses in everyday life.

Stage 2 – a fun activity where pupils have to decide what's inside a closed box. The box has string running through it and will fall when held vertically but it will stop mid-fall when the string is pulled taught. They are tasked to draw what they think is inside the box and to share this with the rest of the class.

Stage 3 – pupils discuss historical and current models of the solar system to help them understand the limitations of models.

Stage 4 – pupils apply their ideas to explain the difference in mass between two cubes (Aluminium and Lead) of similar size.

They are required to draw a model to explain the nature of both substances that explain the difference in mass.

Stage 5 – a short period of reflecting upon the nature of models in science in contrast to the examples shared in stage 1.



The above stages are personalised in the following ways:

Stage 1 – AE shares a personal anecdote re modelling to challenge pupils to see the range of meanings in the word model.

As part of the discussion a toy is picked up from within the class and used focus the discussion. Throughout the lesson examples of explanatory models that are now obsolete (many of which concern the natural world) are shared by AE to show that modelling is a skill common to all people.

Teacher comment: a simple start such as this opens up and airs the range of language associated with the term model. This serves to focus pupils upon the use of the word in a science.

Stage 2 – Each pair of pupils has access to a box and AE encourages them to play with the box.

Teacher comment: the mystery box is very engaging activity that fascinates many pupils especially boys and the more tactile students. Its serves to show that modelling is about developing explanatory models based upon something unseen. It acts as a very important link to the particle theory activity which ends the lesson and so its acts as a thread running through the lesson.

Stage 3 – the key slide here is a model of ‘What the ancients used to think the world was like?’ i.e. flat. In this lesson personal examples of what AE’s children used to think about the world are used to bring both humour and to encourage the pupils to share personal thoughts and ideas.

Teacher comment: this stage enables pupils to see that developing explanatory models is a feature common to human cognition but it is also something that can be improved as human knowledge increases.

Stage 4 – all pupils are given the opportunity to hold the two cubes to enable them to realise the difference in mass between Aluminium and Lead.

Teacher comment: this stage of the lesson challenges pupils to explain a common phenomena i.e. the very obvious difference in mass between two substances. To do this they use the ‘familiar’ idea that substances are made up of particles and quickly realise that they have been using an everyday word without really having their own model of the problems associated with its use.

Stage 5 – time did not permit this aspect of the lesson to take place.

Lesson context

This is the fifth CASE lesson with this group of 2 female and male students. The timings on this camera do not reflect the start time. The wearing of masks makes it hard to discern what is being said at times so much worse than normal in terms of working out what is said and by whom. Camera does not stop but footage split into 4 clips. Much of stage 1 is missing as the pupils did not turn the camera on till part-way through the activity.

Time	Code	Transcript	Notes
6.28.00		AE – Are they the same? Both models	Stage 1

	Mike – The same AE – Maybe its about what we think (tells migration story involving swans because they can be seen near the school). Gillian – Ehh AE – Maybe its what we do in our minds to explain something we are not 100% sure of ... Is the atomic model 100% certain ... it's a model	Camera focus is upon both girls who chat quietly Pupils invited to speak and Mike from group 1 can be heard Gillian is thinking (quizzical expression)
6.31.03	AE intros box activity 'Explain what's inside? What are your observations telling us? Draw what you think is inside.	Stage 2
6.31.34	Gillian – Draw it on what? My hand!	
6.31.54	AE gives them the boxes Emma – Small box for a small mind	
6.31.58	Ron – How are you meant to guess what's inside?	
	AE shows how to play with the boxes	
	Gillian – Nothing, its empty	
	Emma – Is there something inside?	
	Emma – Small box for a small	
6.32.23	AE encourages to explore and play	Inaudible chat now
	Emma – I think there is nothing in it	
6.32.36	Ron – I think there is string inside	
	Emma – If you shake it	
6.32.46	Ron – It reminds me of one of those things children use	
	Gillian – Its getting	They play with the boxes with little chat at this point.
	Emma – If you do it that way ...	
	Gillian – Only goes one way	
	Ron – Its because Just let go if you don't	
6.33.35	Gillian – You have to pull it tight	
	Ron – No I think its because if you do it tight ...	
6.33.47	AE – Year 9 but what's inside that causes it to stop ..	Shaking and playing with the box
6.34.26	Gillian – Air (whispered)	
	AE – Can you imagine draw what you think is inside the box	
6.34.54	Gillian – Just draw a box]	
	Ron – Just draw anything nothing	
	Emma – Its kind of hollow	

6.39.08	Emma – See that sounds different its just like a glue AE begins feedback + mentions migration stories as examples of how people tried to explain observations. ‘Say what you think and why?’	This clips ends with inaudible chat + clip 2 does not star immediately following clip 1.
7.01.17	Clip 2	
7.01.29	Gillian – I don’t get why I am in this class, I don’t know what’s going on? AE – Well nobody does – use your brain Gillian – I know but everyone else is coming up with ... AE – You are worthy to be here Gillian - debatable Emma – Non-debatable Gillian – The only thing I am good at is maths. Its my favourite Emma – I don’t like maths. Ron – I like maths, its better than English Gillian – I like having a problem with a definite answer So if there is a way to get to the answer, there is no other answer.	
7.01.51	AE – Stop ... the more you talk, you exercise your brain and mentions open book exams	
7.02.28		
7.02.44	AE invites a boy to share – he talks about a finger puzzle involving friction ‘Say that again, etc’	
7.03.28	AE to class – Is that helpful	
7.03.49	AE mentions next task to think about over break – how the ancients viewed the world and describes the picture.	
7.04.17	AE – What evidence were they using and why? AE – Were they wrong or stupid? Was it based upon evidence? Why think this?	
7.04.32	Emma - So tired	
7.04.44	Gillian – We actually ... talk about this Ron – What are you thinking about? Emma – Nothing Gillian – I said oxygen Ron – Oxygen	Much is inaudible Not wearing glasses.
7.04.56	Gillian – I don’t get what that’s going to do but I know I’m right Gemma now talks to the pupils – So why	

7.05.11	Emma – I cannot even see that Gillian – Because they had this idea that heaven and hell existed Gemma – Where did the ideas come from? Emma – Religion Gemma repeats her question Gillian – What someone else has told them Gemma - Religious ideas? Gillian – It really was just someone who has decided something and everyone said yes, lets go with that.	Often inaudible
7.05.28	Emma – String every religion .. Gillian – Someone has to start things someone else’s ideas Emma – Not necessarily Break time starts	
7.53.25	Clip 3 This clip does not start as soon as the pupil come in from break. There is no equivalent footage from group 1	Hand movements from pupils to show planetary motion. Image shown to pupils is of the earth and moon orbiting the sun
7.53.53	AE heard in background – What’s wrong with that model? Ron – How they in circles? Gillian – I thought we ... spun going round Emma – I (does not finish) Ron – Do you think it like sits there in one position and we have to sit there while it spins? Gillian – Wow See why I don’t belong in this class Emma – Exactly ... does not necessarily go around the earth ... Ron – It goes around the earth ... as we go round the sun Emma – that’s why Does not have an orbit	Gillian moves her hands and body to try and show this
7.54.34		Emma comments upon Gillian’s drink – inaudible All quite now
7.55.02	Gillian to Emma – Are you still trying to feed that string back through the box ... instead of taking the knot out. Ron - it’s kind of If Trevor was here he definitely would have just taken the knot out Gillian – Trevor would have ... its Trevor you know.	Gillian tries to undo the knot
	AE – Right ... who wants to share their thoughts	

7.57.57	AE invites a girl to speak 'The earth is like a treadmill' AE – What's wrong with this model etc General feedback with groups being invited to speak	
7.58.01	AE – What ideas did you used to have like where babies came from Gillian – Do you think we could cut out the string?	Emma commenting on Gillian's efforts to open the box
7.58.06	AE – What ideas did you used to have to explain the world? Emma – Put your eye to the hole	She now shakes the box, wraps it with string and shakes again
7.58.54	Emma – Shall I cut the string? ... if I wrap this round like this Ron - how Emma – Nothing is in the box because when you no	Ron now taps the box Gillian carries box and walks to see another group with the box
7.59.04	Ron – The noise does not change though ... if you it does not really change if you had scissors you could just stab the scissors into the top of the box	
7.59.12	AE – Here we go Here is your last task Gillian to Ron – Is it open, the box?	Stage 4 Fascinated by the box, undoing knots etc
8.00.02	AE shows the two density cubes - Exactly the same size, going to weigh them. Gillian – This side ... you could ... if there was Gillian – I need scissors ... it would be the one thing ... AE can be heard sharing the weight of the cubes.	Inaudible chat from girl 2 Girl 1 smiles as she undoes the knots Boy 2 whispers
8.00.49	AE can be heard explaining the drawing task	
8.01.03	Gillian – I cannot because of the knots ... I think its done Ron – Why Emma – Then what will you do? Gillian – Then I can pull the string out and I can put my eye on the little hole Ron – You wont be able to see Emma – How will you get it back inside? Ron – You will see nothing inside the the hole is too small Gillian – Can I pull that through I did it ... I need something to stab through Emma – Hold on	Girl 1 dismisses him and laughs Girl 1 pulls the string out and tries to take off the lid
8.01.45	Ron – Like I said you cannot see inside Emma – Wait pass Ron something on the inside	Girl 2 gets her phone and switches the torch on Girl 1 now gets a compass to poke in the hole + inaudible chat now.
8.02.06	Gillian – Well he can I'm trying to open this ohh the glue ...	Girl 2 is on her phone now, girl 1 is trying to pull open the box

8.02.13	Gillian – I have almost got the box open I got the string out Ron – Why Emma – Because its really pissing me off. Ron – Inside of it AE – What do you imagine is inside of these that makes them so different? Feel these Ron – Mass AE – No that’s a word, what do you imagine that’s inside that makes them so different Emma – Material AE – Don’t do that (then repeats the above) Gillian – I was going to say atoms. AE – Well what do they look like – why are the atoms different?	Girl 1 looks @ AE who has brought the density cubes for them to look at. Girl 1 is still working on the box.
8.02.48	Emma – Different particles inside the atoms Ron to Gillian So there are more atoms inside	Said to Gillian who is still trying to open the box. Gillian tries to put the string back inside the box. All quite, they are not engaged with the drawing task
8.03.28	Ron – How would you know Gillian – I have given up 15 minutes left Emma – My brain does not work What’s this? Gillian – It’s a thing from maths	
8.04.03	Ron – A diagram about the inside of that Then Gillian – I just don’t know I just don’t know ...	
8.04.15	Emma – Ginger AE – Year 9 ... they are solid, same size, aluminium and steel ... whats inside that makes one so much heavier ... imagine what’s its like inside to make them so different ... if use a word to explain can you imagine Explain to the class in 5 minutes.	Emma draws on sheet to show arrangement of particles.
8.16.57	Clip 4 Gillian – To me everything looks the same Ron – But what about the one that is more dense, how would we describe it.	She collects the boxes in
8.17.30	Ron – More dense, more atoms, got more atoms or particles. Gillian – I will put them back in the bag	Emma is inaudible to her
8.17.36	Gillian – What?	Ron comments on the damaged box
8.18.29	Gillian – Its just one piece of string Ron stabbed Gillian – I did not manage to get through they were sitting with pens, trying to chop a hole in	Shakes head She mimes stabbing the box

8.18.46	Gillian - He is putting his coat on no its his jacket, makes more sense we have like minutes we have 10 minutes left 10's not too bad	
8.19.59	AE – 2 minutes, practice what you are going to say etc ... what imagining ... no-one has seen but we have accepted models and theories what is your idea?	
8.20.35	AE mentions applying the same idea of modelling to peoples lives to see how influences effect them	Very tentative – almost thinking aloud
8.21.09	Ron – Dense atoms Dense atoms Gillian smiles – I think little particles ... and a little bit more spaced out but not to do with density ... it's the mass .. further apart but in solids they are closer together than in liquids surely ... Ron – No because liquids are still close together but not as close as in because one has more which is why it weighs more ... Gillian – Has slightly more than other	
8.21.50	Ron – A lot more Gillian – Yeah	Both girls are inaudible now
8.25.50 8.26.40	AE stops for feedback AE – What is modelling? AE now mentions the cell membrane idea as a model	Stage 5 – simply touched upon here

Barry School – Group 2

Lesson 6 – CASE lesson 21 also known as How many are there?

Lesson overview

The thinking that underpins this activity concerns the concept of ratio and proportion and how this, via equivalent fractions, underpins the sampling techniques used to estimate wild animal populations. The main stages in the lesson can be summarised as:

Stage 1 – an everyday scenario is used to introduce the problem of estimating animal populations.

Stage 2 – pupils are introduced to the technique of mark/recapture which is used to model real and unknown/hidden animal populations. The example of woodlice is used with beads or beans representing the animals themselves with a handful of beans being equivalent to a sample being taken or animals marked. The first sample is replaced with a different colour or type of bean to highlight that the original population remains the same but now includes a proportion of marked individuals.

Stage 3 – each group carries out the mark recapture procedure which results in three values for them to use in estimating the original population i.e. $A/B = C/D$ with A being the original unknown population, B the first sample, D the second sample and C the number marker in the second sample.

Stage 4 – pupils share their answers/strategies and the focus upon ratio emerges from this.

Stage 5 – the concept of ratio in this context is applied to other scenarios.

The stages above were personalised in this lesson in the following ways:

Stage 1

Three scenarios are used (How many elephants are there? etc) to introduce the key focus for this lesson ‘How many are there?’ as a starting activity to kick off the activity and to promote discussion among the groups. The examples are distributed randomly on paper strips around the class. Regular reference is made to animals and wildlife throughout the lesson.

Teacher comment: making the link to popular wildlife programmes, that many of the pupils in the class may be familiar with, is a good strategy to support discussion and ownership. The mathematics in this lesson (equivalent fractions) is very familiar to the pupils but its application into the context of sampling can seem very baffling for many and it is almost as if the numbers they use in the classroom have no connection at all to everyday life.

Stage 2

A video clip of a well-known wildlife presenter emotionally viewing footage of a tiger caught on a camera trap is used to focus the discussion on the real-life use of ‘mark/recapture reasoning’ and the need to estimate populations of elusive and endangered wild animals. This is accompanied by a cartoon showing examples of a tiger being caught in a camera trap and a whale surfacing at sea. Pupils are given their animal populations (broad beans seeds in large pots) and are given time to handle them as they are unfamiliar with them.

Teacher comment: this stage was included for the widespread use of camera traps and versions of mark recapture are a common experience for many pupils yet often the maths that underpins the techniques is not related to what the pupils may know. This also makes stage 3 and the beans that represent wood lice more meaningful and real for the pupils.

Stage 3/4

The technique of mark/recapture and the three sets of numbers that result is modelled with the class and the numbers generated is shared and written clearly for all to see. These results are left and can be used by the pupils if their own numbers don't work or are confusing.

Teacher comment: pupils need to be given plenty of time to follow the sampling instructions to generate the correct data and then to use this to try and estimate the unknown starting population. Often, for reasons of silly behaviour, they need to do this activity twice. This stage of the lesson highlights the numerical skills that are often needed in science.

Stage 5

A cartoon showing a new example of estimating whale populations from distinctive features/marks/tags is available for use in the last part of the activity.

Teacher comment: this stage is the one that due to issues of lesson length or timing is often missed or reduced. When used as part of the science curriculum this aspect could be used as a thinking homework and followed up at a later date in a variety of ways. In this particular lesson there is no meaningful stage 5.

Lesson context

This is the final research lesson taught in Barry school. All pupils are present for the lesson but the wearing of masks makes it hard to discern what is being said which means working out what is said and by whom is difficult at times. Camera does not stop but the files are split into 4 clips but it will be treated as continuous footage.

Time	Code	Transcript	Notes
6.29.26		AE – Here is yours okay. Trevor - (grabs it) – What is this?	Stage 1 Clip begins with the pupils being given a paper slip prior to this they are chatting quietly. Ron reads the sheet Emma talks to Gillian about the crisp she has just eaten – inaudible Trevor pulls face
6.29.42		Ron – How many are there elephants Emma - because you won't know where they all are because Gillian – What Matthew – Ace question	

		Ron – You don't know where all of them are Simple.	
6.30.01		Ron – Why have you got a book? Trevor – inaudible Ron – Why have you got a book? Trevor – They are all the same book Gillian – They are not Ron – They are	Gillian eats crisps and thinks, Trevor takes a book from the windowsill – during the early part of the lesson Trevor is quite distracted and unsettles the rest of the group.
6.30.10		Gillian – They are not all that book Emma – I have not seen an elephant before Gillian - I have only ever seen one once Trevor – I went to a zoo	Trevor drops the book
6.30.14		Gillian and Emma – inaudible Ron – I saw a video of one Trevor – I smell quavers have you been eating quavers? Ron – Well I saw a video of two doing	
		Emma – inaudible Trevor – How many are there? Gillian – One elephant lots	To Gillian – laughter
6.30.28		Emma – Hundreds, there are a couple of hundred ... did you just ... elephant Trevor – they are probably owned by some (slave) company	Said in funny voice
		Gillian – inaudible Ron – No it's a slave company Emma – Are we going to watch Gordon Ramsey?	Gillian eats more quavers
6.30.47			Trevor reads the sheet again
		Gillian – Its something else Trevor – Uganda	Gillian looks at screen as AE prepares the video clips. They now all look at the board,
6.30.53		Gillian – I sit in the weirdest Trevor – Gordon Buchanan (struggles to pronounce) Gillian – I sit in the most awkward positions ever	Trevor hums out loud + is annoyed by something on the wall. They are distracted by AE's preparations for stage 2.
6.31.10		Trevor – I thought Gordon Ramsey because he could not cook an elephant	
		AE now begins the feedback – mentions the sweets in the jar problem Trevor – How put ...sweet there will just be one (confused)	
6.32.00		Gillian – Different amounts Trevor - Ahh ... he said every month he will put 1 in It would not be that good ...	Trevor hums which annoys boy 2
6.32.13		Gillian and Trevor – inaudible chat Trevor – Elephants, elephants Gillian – Estimated	Odd comments between the pupils at this point

6.32.30	Trevor – Guestimate AE now mentions the earnings from a boxing match Trevor – Logan Paul ... (laughter) ... obviously does not know who he is Big man Alan does not I actually watched the fight ... I did not watch the end but watched it ...	AE invites groups to share/feedback
6.32.50	Gillian – I didn't ... I was out Trevor – Who won? Trevor to Ron – Do you know who won the fight?	
6.33.16	AE – Who got the fish one? Trevor – Fish Le poisson (laughs) Gillian – Why are you speaking French? Trevor – Fish is boring AE mentions fish quotas Emma – That's ridiculous..... Trevor – Who can estimate this? Do people sit and count	Gillian shrugs shoulders
6.33.51	Trevor – There were more fish so people catch more fish Trevor laughs at Mike (group 1) and AE comments on Google boats	At this point group 1 give feedback, via Mike, on their response to the fish problem
6.33.59	Trevor – What a submarine? Gillian laughs Emma – Submarines go under water	
6.34.07	Trevor – Just use a submarine Gillian – Just don't count fish Trevor – Just put some however many ... Emma – You're a fish (to Trevor) Trevor – You're an elephant	
6.34.34	AE now mentions grouse shooting and time limits to conserve populations Trevor – Shoot ... shoot ...	
6.34.57	AE – Who had the elephant one? Trevor – Elephant we are elephants ... if we are elephants why are they answering our questions?	Trevor and Gillian chat about this but hard to hear
	AE now gets ready to show video clips – explains the TV program and mentions other presenters such as Steve Backshall Trevor – Ahh Bucanan Oh I've seen that	Gillian and Ron shakes heads as in some dance
6.35.40	AE – What has this got to do with how many animals there are when you cannot see them? Gillian – You sit for like an hour and if an animal does not come past (shrugs shoulders) Trevor – You take people to an area and if they get killed there are animals	Stage 2

6.35.55	Trevor – If they kill each other then its just too bad	
6.36.03	Class watch the video clip of Gordon Bucannon (GB) watching footage of tiger caught on a trail camera	
6.36.30	Gillian – Completely I’ve got a really bad could not move Trevor – What was that about?	Gillian and Emma chat Gillian laughs
6.36.56	Gillian – My was broken ... Gillian – Wow Trevor - ... like 10, 10 ... is that because he saw a tiger? Gillian – They are going extinct Emma – Is he crying? Trevor – He has asthma and takes really deep breaths	Gillian and Emma chat out of shot In response to GB on the video Trevor mocks GB in video, making similar noises
6.37.30	AE – I did that (camera trap in garden), guess what I saw Trevor – Tiger Emma – Frog	
6.37.39	Trevor – Worried there AE talks to the class and answers questions re the rats in his garden	Trevor and Emma laugh at AE’s story of what is in his garden
6.37.57	Trevor – Trap to kill them Trevor – Catches them, starves them and they run out of food Gillian – That’s disgusting Trevor – You know how people are	
6.38.02	Gillian – Trevor look .. AE – He spotted one tiger Gillian – And cries AE – How could he use this evidence to get a sense of how many there are – talk about that ...	Gillian jokes about catching some thing
6.38.32	Gillian – How does he not count the same tiger many times? Emma – They could follow it Ron – It’s night time Trevor– How is he going to follow it?	
	Trevor – If the tiger went of camera how would he follow it? Emma– The tigers live Gillian – I’m just concerned what if he counts them and counts the same one again Yeah I saw that one yesterday and I counted it again! Trevor – What if one comes up behind him, what happens then?	All talking at same time so some of what is said is missed
6.38.53	Trevor – what is going on? ... I liked that piece of paper	Gemma (teacher) removes the sheet

6.39.07	Trevor to Ron – Do your arms ever get sweaty wearing that? Ron - (inaudible) Gillian– It does look breathable Ron - ... I am used to it Trevor - ... Ron – I’ve worn them since Trevor – What’s breathable?	The boys discuss Ron’s PE kit Gillian and Ron chat about the camera – hard to make out what is said
6.39.30	AE input – never, ever know how many Mentions Galapagos tortoise that had been in the news Trevor to Gillian – inaudible	Both laugh at this
6.40.20	Feedback AE talking – mentions ‘a wish’ Trevor – a wish (smiling) Trevor – People can took some video ... AE – there are some animals I have never seen but would love to Trevor – Search up a picture AE – You can find their footprints Trevor – He follows their footprints AE – How could you actually work out ... Gillian– You could follow them ... but how do you know you are not counting the same one multiple times?	Trevor has quizzical expression in response
6.40.45	Trevor – You could capture them and mark them with something Gillian – Ahh yeah sheep Trevor – Yeah but they could do the same thing they do with dogs – put a chip in it Emma – Yeah but what happens if it’s like a lion and you touch it ... Emma - ... Trevor – Shoot it with a tranquilizer first Gillian– That’s animal abuse Emma – It is Trevor – Its not	Trevor and Gillian – inaudible chat
6.41.05	Gillian - see them (mimes shooting) AE asks for comment Gillian (pauses before responding) How know you are not counting the same one multiple times?	Gillian smiles at this
6.52.58	Clip 2	Whole class discussion at this point.

6.53.14	Gillian (to the class) – What happened if you see one, put cameras up and see another ... how do you know its not the same one? AE speaks Gillian to another pupil and pointing to Trevor – He said use some tranquilizer on it!	Gillian pulls face in response
6.53.24	AE – It might be like a comedy tiger Trevor – Comedy tiger Hah Gillian – It might be like me, it might just like photos	
6.53.46	AE – Let's keep that thought – it could be the same animal Gillian – Trevor ... you might ... Trevor – What's with the tranquilizer AE - ... there's one, there's one Some pupil – Look at the detail AE - maybe it has a piece bitten out of its ear Gillian– Like my guinea pig Trevor - normal?	
6.54.02	Same pupil – You know what they do with sheep Trevor – I actually think that is what they do ... they put chips in to track them ... Gillian – Spray paint is probably better Trevor – No spray paint damages fur AE now tells the snail story about a guy marking snails to see if they would return. Trevor – They spray painted a snail! AE – Animal migration is fascinating Trevor – Is it!	
6.54.22		
6.54.39	Trevor - Snails are magnetic! AE – You have homing snails Trevor – Homing snails ... can they follow stuff? AE – You know how to get home, maybe snails do Gillian – Not really I get lost Trevor – I just walk I happily follow my nose	
6.55.00	Mike (from group 1) shares – You could microchip them Trevor – Ahh, see Gillian – But that can ... Emma – That's inhumane Trevor – Its not inhumane ... it does not hurt them Gillian and Emma – inaudible response Gillian- Yeah you are shooting them Trevor – You do it with dogs	

6.55.11	Gillian – My dog ... Gillian – You cut open its skin and ... Trevor – Dogs get chipped Gillian – that's because its illegal not to Trevor – You don't have to its not a legal ... Ron – It's a safety thing Gillian -	Stage 3
6.55.20	Trevor – It's a safety thing in case it gets lost Gillian – But it's a wild animal ... ahh yeah just going to shoot it! Trevor – So .. Gillian - Trevor – Shut up	
6.55.41	AE introduces the main task by telling woodlice story	
6.55.50	Trevor – Trying to eat woodlice! AE explains talks with beans to represent woodlice	Trevor and Gillian chat – banter
6.56.18	Trevor – You are going to give us bugs! AE shows tubs of beans Trevor – Beans again Gillian – It says do not .. Trevor – Ahh, they are raspberries Ron – Did you see? Trevor – It says raspberries on the tub Ron – I think he said ... Trevor – Raspberry flavour .. Gillian to Trevor – Trevor would you like to eat one of them now Trevor – Yeah ... I will do it ... I will .. miss are they raspberry flavoured?	They now get distracted by the cow noise from group 1
6.56.59	Gillian– Often ... Trevor – Ahh yeah Emma – Eat one Ron – Are we ... count them ... Trevor count them Gillian – I say 100 Ron – I'm saying 62 Emma – Look he is putting them into a bag Trevor (counting the beans in the pot) 30, 35 or like 40 round there	Beans are in a yogurt tub
6.57.17	Ron – Well I said 62 so .. Trevor – Beans! No, no, no, no they are my beans	Gemma gives the group their tub - Trevor holds the tub
6.57.30	Trevor – What is that going to do(he laughs) I can count as well Beans Ron – 15, 42	The class is now quite noisy so its hard to hear everything
6.57.42		

6.58.03	Gillian - its you with the tranquilizer Pass it here Gillian – Heinz, means beans Gillian – Just take it off him Trevor to Ron – I am bigger than you get off Trevor– Just waiting for you to drop it AE now explains the sampling process + Gemma gives them paper Trevor – Oh paper (grabbing it) ... okay you can have it .. (passes it to Emma) AE to Gillian -What was your name Gillian – Gillian (smiles) Trevor – Gillian (she smiles again) AE explains how to take the samples Trevor – What’s with where does he get all these? AE – How can we use this to help?	Gillian asks to have the beans and extends hand Gillian holds up 3 fingers and smiles Ron now grabs the tub Trevor takes back the beans and gives to Gillian – she looks at the tub and holds up the beans
6.58.28	Gillian – Count them ones and see howe many you think are in ... yeah Trevor – Cause since the bag can move you can split it off Gillian – Or you could count them ones and look there is about 4 times more in there guestimate ... I’m smart ... I should ...	
6.58.38	Ron – Why don’t Gemma gives then the second bag of replacement beans Trevor – Beans Ron – Why do you get all the beans? Trevor – Because I’m the bean boy 1, 2, 3 Gillian – Matthew is the bean man	
6.58.55	Emma – Now (she takes the tub of beans) AE – How can they (second lot) help us? Trevor – I pulled them out ... in 2 ... Ron – Don’t push the beans You cannot touch the beans (to Emma) Trevor – 2, 3, 4, 5, 6, 8, 12, 14 Gillian – Which one ... Matthew eat one Emma – Dissect (opens pencil case) Trevor – 80 ... too many to count Gillian – tries to get beans ‘I’m good at maths Trevor – maths by counting beans, beans	Emma takes a bean He bangs desk playing some tapping game
6.59.05		
7.00.13	AE - Model explains the task AE – We can use these to imaginer we have marked them AE – Trevor what did you think? Trevor – What? ... Don’t know AE – How might this help us	Trevor smells the beans, Gillian tries to stab a bean with her pen Trevor hums, Emma plays with bean tub, Gillian counts beans in bag

7.00.42	Emma – Creamy beans	Girl's chatting but inaudible
7.01.00	Emma – You said it yourself you cannot say how many of this are in this (points to both types of beans in turn) Gillian – You have to count these ones to know Trevor – Its like 2 beans for 1 of these Emma – Okay we think that (trails off) AE – You have a lot of skills you can apply Trevor – Do I!	
7.01.39	Feedback from class Trevor – This one (holding up bean) Gillian – there are 150 beans in there Trevor – half that ... 75 Pupils speaks during feedback, AE – That's a ratio 5:! Trevor to Gillian – tapping bean tub – 75 beans in there	Gillian is still counting
7.02.21	More feedback + AE	
7.02.29	Gillian – I'm starving ... 2 minutes .. you have to basically count all of those beans AE – Take out a small handful Trevor – Beans AE – Do that now Gillian – Okay Small handful Ron – Can I do it because I have small hands Trevor – Take a small handful out – he said small hand Gillian – Use Ron, Ron's hand is smaller Trevor – What! Gillian – Put more in the bean pile Ron – He did say small Gillian – But not like 7! Ron – What is a small handful? Emma – Look at this!	Trevor taps the bean pot and tries to count all the original beans – not much talk here Trevor puts the beans back
7.03.29	Emma – What number do we have? Gillian looking at AE – Are we putting AE confirms. Ron – This is funny Trevor – Put the beans in what are you doing? Ron – We need them What are you doing? We need them	Both girls laugh Trevor takes out more beans All laugh at this. Gillian is counting and Trevor takes out the replacement handful Gillian twirls her pen Gillian and Trevor discuss beans but inaudibly
7.03.51	Trevor – Put them back in Ron – Put them back in	Ron counts beans Gillian records the numbers
7.04.03	Gillian – Write the number down	Said to Emma who has the bean pot

		Gillian – Can we go now? Trevor – There we go Ron – There is not any need Trevor – There is beans	Her reply is inaudible
7.50.40		Clip 3	Break time – Trevor mixes the beans
7.50.57		Ron – I’m next to Max next lesson I’m next to Max AE – While we are waiting Trevor to Gillian – You are a racist you are racist AE recaps Gillian – 23 Ron – What did we do again? Gillian – Wait ... Trevor – I don’t like beans ... I don’t like beans Ron – By the way there are 24 as I picked one off the floor	Trevor is looking at his phone and chats to Gillian about this He points at her but is not serious
7.51.53		Ron – I don’t trust you, I don’t trust you AE – Did you do it, how many did you take out ALL – 23 Ron – 24 Gillian – Shush Gillian – If you hit me I swear I will smack you Gillian – Ow, you	Gillian laughs as she puts the bean back Emma comes in a sits down and chats to Gillian . Noise level in room rises Trevor is swinging the bean bag round and hits the desk with it
7.52.16		Ron – I was scared for my life ... I was scared for my life He could have killed me. Trevor – I am the bean master Gillian – Does it actually hurt? Ron – I’m doing basket ball AE – Okay Year 9 Gillian – You know when you play basketball, is it not really difficult? Aren’t you really bad at it because you are small?	Trevor hits Ron with the bean bag Trevor hits Gillian on arm Trevor does martial arts with the bean bag
7.52 – 7.53.16			Inaudible
7.53.24		AE recaps on the process and numbers and moves to board to model the numbers on the board. Gillian – Look Gillian - ... while I count them ... 2 of them Put the beans back (to boy 1) ... do not mix them Trevor do not test me he just the other two Ron – What (smiling) Trevor – One of those	Moving in to stage 4 Trevor and Gillian play with beans Gillian takes out the second handful Trevor plays with bag

7.54.07	Emma - ... what Ron – Put it back	
7.54.54	AE - ... what three words ... just three numbers and tells story about what three words and the coastguard from the weekend	Emma examines beans
7.55.15	Trevor - Stop moving it AE explains the three numbers	
	Gillian – So there was 90 so he has taken Ron – 50 Emma - ... take another handful out Gillian – I have already done it Trevor don't mix the beans Ron – Put that back (to Emma) Trevor– Literally Gillian – 6, 8 (counting beans) Emma - ... I dare you to eat a bean	Trevor talks to a pupil from another group – inaudible. Emma moves the bean tub
7.55.40	Ron - Ohh, no Matthew Emma – Eat one, eat one Ron – He will die if he eats those beans Emma – No he wont Gillian – There are 24 normal and two ... Ron – So basically we get the exact same amount plus two more Trevor– Another two brown Emma – 26	Clearly thinking – starts to speak slowly
7.55.52	Ron – We got the exact same amount but two of them are marked Emma – 26 altogether Gillian – Miss we got the same amount Gemma – Okay Gillian – Because my skills are just so Gemma – So how can you use that? Gillian – So there are 24 there and there is them Gemma – So how can you work out how many there were?	They both goad Trevor into eating a bean
7.56.12	Emma – Its just ... Gillian – Keep doing that Gemma – How many of the new beans are in? All – 24 22 left	
7.56.26	Gillian – Just count them! (laughs) Gemma – For every 2 beans how many of the other beans? All – 24	

7.56.42	Ron – 22 left Gemma – How can you work it out? Gillian – 24 x 22 Emma – 24 x 22 Gillian – Where is my calculator? Gemma – That sounds like a very large number Gillian – Do you think there is 2 for every Emma – Times by 11 Ron – 264 Emma – I did it in my head Trevor – I cannot do maths	
7.55.07	Ron – Calculator Gillian – I had my calculator open Gillian – You know the science homework – when is it in Ron – Science homework – 14 Gillian – You know last night I ... rushed around Trevor – You got science homework .. Ron – Yeah we do Trevor – When?	
7.57.15	Ron – We had a lesson Emma – I'm going .. Gillian – I don't really ... this one Trevor – The yellow booklet Gillian – Matthew was of because he pulled the roof down Ron – Ah yeah Trevor – What, was that on Monday? Emma – You were the one who did that Ron – Ahh ... there is always Trevor – What date did we get that? Ron – That must have been the Monday Tuesday Trevor – I was in the base unit on Monday	Gillian and Emma chat
7.57.39	Ron – You were, we watched you get taken out of the lesson Emma – You were the one who pulled the roof down! Ron – What happened was, he pulled the roof down then exactly 1 week later Rees flooded the bathroom Trevor – I helped him and the roof looks clean	Gillian shows her science booklet
7.57.51	Gillian laughs – Who	
7.58.04	Ron – So basically they gave him the last two weeks of half term Trevor – We the hand driver Emma or Gillian – We had one	

7.58.37	Ron – We are waiting to find out what happens this Friday Gillian – I picked up the wrong one ... Ron – I’m waiting to find out what happens this Friday Gillian– I am supposed to give myself eye drops Emma – Ahh Ron – It’s the hay fever, you don’t die of hay fever Trevor – You can have severe cases of hay fever Gillian – My eyes swell up its supposed to be a spray No you are not going any where near my eyes Trevor – Let Ron do it Ron – He would probably poke you Emma– Let the ginger do it Trevor – He wont be able to put enough pressure on to get even a single drop Gillian – I’ll attempt it later Ron – I hate him I already got bullied Gillian - ... test ...	She takes a spray from her bag Much of this is hard to hear Said to boy 1
7.58.53	Ron – I got bullied first lesson for being small ... Jake kept saying I was not five foot .. I am five foot and half an inch Gillian– I’m 5’8 and that’s like normal Emma – Well Gillian – I am going to cry, I’m on the verge of tears My life is going downhill Because of those drops and not the spray Ron – Why because ahh Trevor – Just do the drops ... Ask Miss Gillian – Because I ...	
7.59. 12	Ron – What did you do Gillian– At primary ... you just get your medicine	Inaudible eye drop chat
7.59.34	Ron – They gave me some ... Gillian - ... they are not allowed Ron - They basically did They just threw it at me (laughing) in my mouth Ron – What? Trevor – People throwing stuff and you catching it in your mouth .. Ron – It does not make me like a Chihuahua ... most dogs do that Gillian – I cannot do it when people are looking Ron – Well don’t .. just do it in the bathroom Trevor – Turn around Ron – Between lessons Gillian – But if I die ...	Much of this is inaudible

7.59.48	Trevor – Turn around Ron – Do it in the bathroom between lessons Trevor – Get Emma to do it Ron – Do it at dinner AE comes over – How many did you take out? Gillian – We took out the same amount ... Ron - because there was one on the floor AE – 26 ... we don't know how many we started with what's the difference? Ron – 2 AE – How could you use those three numbers Ron – 2 of them for every 12 of them Emma – Get another handful and another handful Trevor – 26 Ron – There are two for every 24 of them Trevor – 26 Gillian– And the is 24 of them in there Ron – 22 left of them And do 164 Trevor to Emma – Quit breaking them Ron – Quit breaking them Emma – It was already broken Trevor and Ron – No Trevor - eat beans cannot afford to eat beans	
8.00.26		
8.00.38	Ron – That's assault ... no for that Trevor – Where do you get a lawyer How do you get a lawyer Ron – You just go ... you have got 2 witnesses ... she threw a bean off your head, she threw a bean off your head she tried to kill you!	Emma and Trevor fight over the beans Trevor flicks the bean pieces back at Emma
8.01.28	Ron – Don't Trevor Gillian – You can put them back Emma and Gillian - ... work in French that you would Gillian – Sometimes .. Trevor – Quit chucking them Ron – I just kept stealing Trevor's ideas before he could use them ... Trevor kept saying something .. AE – Year 9 Trevor – Snort a line AE - Gillian – Multiply them ...	Trevor tips the beans onto the desk Emma laughs – 20 seconds of inaudible chat He sniffs the beans

8.02.11	AE - ... Gillian – Put them all in AE – What could we do ... if you want to use my numbers you can	Girl 2 spills the beans Boy 1 puts his beans back in the bag
8.14.12	Clip 4 AE - ... what maths skills + recaps the three numbers they have	Stage 4 – preparation to talk
8.14.32	Gillian– When you get them ... AE – The population did not change ... have a think Why the different colours? That’s what I want a discussion of in 3 minutes.	
8.15.10		
8.15.34	Gemma – Figured out what it is? Gillian – Multiply it Ron – Two for every 24, there is 24 of one thing, there are 11 pairs so you times them to get 264 Gemma – You had better get ready to explain Gillian – Or you could just do what I do Gemma – You have to work it out Gillian – I My brain cells do Ron – I forgot what I said Gillian - Times by 11, 11 pairs, that’s 11 x 24 Trevor – There are 11 pairs so you times it by the amount that’s there	Playing with beans now + laughter Ron lines up the beans Emma pours out the beans
8.15.59		
8.16.42	Ron – Where did the bean go? Emma – This is not working	
8.16.55	Emma – Ha, ha, ha, ha – look at this AE – Year 9 often the answer is something you already know. In 3 minutes you will share	Background chat as they wait patiently + playing with beans
	Gillian - I did it, I did it Emma – I’m just ... Ron – You have never done it Ron – Heart Trevor – Yes, heart Ron – I would never, ever Trevor – Beans!	Eye drops
8.17.45		Reference to shape made out of beans

8.18.11	Emma – Look at this, look at this Trevor – And them, if I’m fats enough, if I’m fast enough Emma – Try it, try it Ron – They will go everywhere Emma – Try it, try it Ron – Okay they did not go everywhere – that’s a surprise Gillian – My eye Ron – What Gillian – My eyes and I did not cry AE – Put the beans back in the pot Emma – Ahh Put everything in the pot Ron – We need to split the beans Emma – We need to split the beans Ron – So they can go back in the bag in the pot ..because we were told to do ... what we could Emma – Well I was not paying attention Trevor – Little bean ... little bean .. Emma – Little bean is so protective over the beans	Emma moves bean tub around Trevor has beans in the lid and is going to flip them Trevor now flips them without spilling them
8.18.46	Ron – Why Nan Emma – Did you just say ... your Nan Ron – Nan Trevor – Yeah, because who does not have a Nan Emma – I don’t have a Nan Gillian – I don’t have a Nan Trevor – I cannot afford a nun then Gillian laughing – Nun Gillian – All I know is that my Nana is 93 Emma – My great Grandad Gillian – That’s nice 93 is still alive ... I hope I don’t get to that age Ron – It would just be boring Gillian – I hope I ... 23 .. I wonder if I’ll die from alcohol poisoning ... I lived the good life	
8.19.18	Trevor - My pen (to girl 2) Ron – I have literally Ron – I had eyedrops 2 years ago Trevor – Yes it is, give it back then	

8.19.35	Ron – How have you ... Trevor – Under your seat Emma – I'm proud of you for putting your eye drops in Emma – My eyes are always swollen ... I just deal with it	
8.19.42	AE – Year 9 – recaps on what they have done Feedback Emma to Trevor – Do you mind?	
8.20.46	Emma – You are getting me confused Emma – Ow Trevor – Dust everywhere Emma – I don't know what the question is The rest of the lesson has no significant talk from the pupils – they play with the beans as the feedback progresses slowly. Lesson ends with a discussion of how to census whale populations	Trevor reads from book on windowsill then uses the hard covers from the book to rub them together and to annoy the others Trevor flicks Emma's hand Trevor crushed the beans between the book covers. Gillian lies with her head on her bag Trevor flicks beans

Appendix 2 – Details on the Piagetian content of the CASE lessons

The Piagetian Reasoning Patterns: the thinking focus and the ‘content’ of CASE lessons

Control and exclusion of variables

Establishing the evidence for an adequate proof of a relationship involves being sure which one of a number of potential variables causes an effect on another variable. To gain this quality of evidence there must be certainty that the other variables (which may potentially cause the same effect) are controlled at known values, thus excluding them, whilst the one which is of interest is the only one that has its value changed. To do this, pupils must be able to identify potentially relevant variables and then identify the possible combinations of causes and effects, inputs and outputs. The relationship between variables which results in their values changing relative to each other can be illustrated through line and scatter graphs. If constructed and interpreted accurately such tools help students to understand the relationships between two or more interacting variables.

Examples of later lessons within the variable strand:

In Interaction (16) the pupils come to realise that the impact of two variables together is greater than the impact of the sum of each acting individually. Scientists use the term synergy to define this concept.

In Beans (13 & 14) pupils are challenged to think about fair testing in the context of populations with significant variation. Probability is also required to understand the idea that when sampling, if the sample is large enough, then we can be certain of including all of the variation. It also requires them to consider the question of whether their sample contains the same proportion of different characteristics as does the whole population. They also face the concept of stochastic variables where there is a central tendency and also a measure of spread that needs to be taken into account.

Classification

In this strand pupils are challenged to appreciate that classification systems are an artificial construct depending upon the criteria used for sorting at that particular time. This type of thinking requires the appreciation that classification systems often use several criteria at a time to group items into many categories. This is clear to see when children are asked to reclassify common groups of objects for different purposes using different criteria each time. To do this they may need to both include and exclude as part of a hierarchy. This regularly occurs in science when newly identified species cause the restructuring or discarding of a system of classification.

Ratio and proportion

A ratio is a constant value by which one set of data can be multiplied to derive a second set. Ratio describes a constant multiplicative link between two variables such as where the number of legs relates to the number of cows. Proportion concerns how two ratios compare, i.e. considering how it is that different mixtures of red to white paint can give the same

colour and shade of pink. Proportional thinking requires the mental manipulation of four independent variables such as would be required to see if two different orange squash drinks are the same concentration. Further to this scaling requires the handling of similar ratios to decide, for example, how much bigger or smaller something in comparison to the original. This is clear when they try to produce drawings that require a mouse and elephant to be drawn to scale on a sheet of A4 paper.

Inverse proportion

If pupils are familiar with ratio (e.g. the number of cow legs in a field = four multiplied by number of cows. Or $y = mx$, where m is 4 and the ratio of legs to cows is 4:1) then they can be challenged to come to terms with proportion. In mathematics, two variables are **proportional** if a change in one is always accompanied by a change in the other, and if the changes are always related by use of a constant. Thus for $yx = m$ (e.g. time for treacle to drop through a funnel multiplied by temperature of treacle) y and x must go up and down in a constant proportion for m to be constant and stay the same. Initially students will approach this type of relationship qualitatively but to use this type of thinking requires formal operational thinking. To summarise this thinking we can use the words of Michael Shayer (1981): *“This is a multiplicative relation between numbers, as distinguished from the more familiar additive relation e.g. 5 is 2 more than 3. Quite a lot of it is unconscious. It can be grown into by familiarity by being recognized as a relation of quantities, so $5/3$ is a sort of scaling-up process. However proportion is distinctly more difficult than Ratio, because it is a ratio relation between two ratios. Think of the relation between different weights in balance with different distances from the fulcrum in a balance beam. How is it that the numbers are as they are?”*

Probability and correlation

In science, probability is underpinned by both chance and causality. So to understand sampling, pupils need to grasp that when the sample is large enough then all the reasonable variations are represented so that the average value can now be used when looking for differences not caused by chance. Correlation describes the strength of association between independent and dependent variables. Taken together these two types of thinking are integral to assessing the impact of cause and effect in everyday life. We all face such thinking challenges every day: the impact of mobile phone masts upon health, the debate over nuclear power and the testing of GM crops are just three of the issues that require an understanding of probability and correlation to effectively assess the risks involved.

Compound variables

A compound variable is a combination of two other variables, something very common to the study of science: pressure = force/area, density = mass/volume and Momentum = mass $\times$ velocity. To use a compound variable fluently one must be able to handle the ratio or product as one variable, at the same time as seeing it as being made up of two variables, each of which can change independently. This type of thinking requires formal operations and eventually, over time and with relevant examples students are able to see the idea of compound variables in new contexts.

Formal models

A formal model has parts, but these are abstract and imagined entities. The thinker is able to build a mental ‘micro-world’ where they can speculate and predict the outcomes are actions,

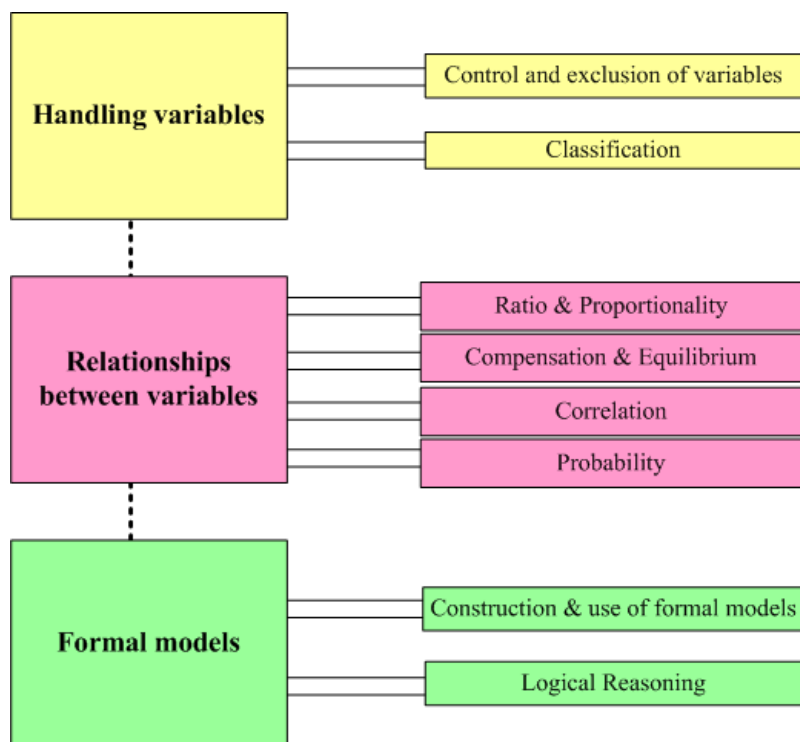
or causes of effects. Metaphors and analogies are linguistic models that attempt to make the abstract more concrete.

- Family trees are models of relationships.
- Designers are practiced in visual modelling, juggling the conflicting demands of form and function.
- Engineers use mathematical models to test out ideas.
- Scientists have models to explain solid, liquid and gas states, energy transfers and photosynthesis.

Equilibrium

This reasoning pattern involves thinking about four variables and requires students to think about two sets of compound variables at the same time. Each of the variables can be altered independently, and if the system was in equilibria and one is changed then equilibrium can be restored by altering any one of the other three. This system can be summed up with the equation: $ab = cd$. Equilibrium requires the use of two comparative inverse relationships at the same time. Students may approach this qualitatively by realising that a heavy weight needs to be closer to the fulcrum if it is balanced by a lighter one further away. There are many examples of equilibrium models within science that will be out of the thinking reach of pupils that are not able to reason in this way; diffusion gradients and chemical equilibrium are just two that students will face in higher levels of science study.

Each CASE lesson has one of these reasoning patterns as its core underlying focus and is designed in a way that facilitates bridging i.e. the application of the same thinking in a different or new context. This is a specific aspect of CASE and one that is designed to support pupils to break away from the initial context encountered. The ability to apply the idea free from the initial context in which the idea is first met is a key feature of formal operational thinking. The authors of the CASE lessons, Adey (1987) adapted by McCormack (2009), used the following template to provide a realistic and manageable way to support this aim during the first two years of secondary education:



Shayer (1998) has shown that the curriculum most students face beyond the age of 14 requires the use formal operational thinking. This level of thinking requires students to: manipulate formula; design rigorous scientific experiments and determining the relation between the experimental data and abstract scientific theory. In practical terms this means that the study of science for students who have not reached this level of thinking is likely to be challenging and unproductive.

A summary of the 30 CASE lessons showing how they expose students to the range of schemata is shown below:

Lesson	Title	Reasoning focus
1	What varies?	Variables and relationships
2	Two variables	Variables and relationships
3	What sort of relationship?	Variables, relationships and graphs
4	The fair test	Variables and relationships
5	Roller ball	Variables and relationships
6	Making groups	Classification

7	More classifying	Classification
8	Gears and rations	Ratio and proportion
9	The wheelbarrow	Ratio and proportion
10	Trunks and twigs	Inverse proportion
11	Keeping balanced	Inverse proportion
12	Current, length and thickness	Inverse proportion
13	Sampling beans	Probability
14	Bean growth	Probability
15	Combinations	Variables
16	Interaction	Variables
17	Spinning coins	Probability
18	Tea tasting	Probability
19	The behaviour of woodlice	Correlation
20	Treatment and effects	Correlation
21	Sampling – fish in a pond	Probability
22	Throwing dice	Probability
23	Explaining states of matter	Formal models
24	Explaining solutions	Formal models
25	Explaining chemical reactions	Formal models

26	Pressure	Variables – compound variables
27	Floating and sinking	Variables – compound variables
28	Uphill and downdale	Equilibrium
29	Divers	Variables – compound variables
30	Re-balancing	Equilibrium

One final point needs to be made, in that the Thinking Science lessons were designed to expose students to the levels of thinking required by GCSE, but at a time in their schooling when mastery is not required, rather than to specifically teach ‘controlling variables’ or ‘proportionality.’ McCormack (2009) also adds that *‘the model on which the activities is based does not predict, for example, that after three lessons on probability that the schema will be mastered.’* It was always envisaged that CASE would complement the standard curricular instruction received by the pupils in a way that raises the cognitive ceiling as thinking is aimed at the ripening functions, those that may not be required for two or more years, Shayer (personal comment).

Appendix 3 – Permission letters

Pupil consent letter



Talking in groups in Science Project Information and Consent Form

Your class are involved in a study is to find out how important your ideas are and how you talk about them in science. The results of this research will be used to help teachers understand how important the ideas of their students are.

In this study you will:

1. Be taught normal science lessons and be observed about six times this year.
2. Possibly be videoed so your conversations can be carefully recorded.
3. Be asked to answer a few questions at the end of the lesson.
4. Be interviewed about your views if this is felt to be helpful.

There are no risks to you being involved in this research and the information will only be seen by me and my supervisors at Brunel University.

This study is anonymous which means that I will not be collecting any personal information about you. No one will know who you are or where you go to school. The records of this study will be kept strictly confidential and all information will be coded and stored securely with password protection. I will not include any information in any report that will make it possible to identify you. The decision to take part in this research is up to you and you can refuse to take part in this study at any time without affecting your relationship with the school or teacher. You have the right not to answer any questions, as well as to withdraw from any interview at any point; additionally, you have the right to request that I do not use any of your material I might collect.

You have the right to ask me questions about this research and to have those questions answered by me. If you have any questions about this study then feel free to talk to Mrs S Graham and Mr S Welsh.

As a visitor to Boldon School I have agreed to abide by your schools safeguarding procedures. This means that if I hear anything that should be passed on to Mrs Pippin then I will do so. All of your teachers have agreed to the same safeguarding conditions.

If you agree to be interviewed I will ensure that this is as unobtrusive as possible so I will fit around times within the school day that suit you best.

Thank you for taking the time to read about this project and agreeing to take part. I would be grateful if you would read and sign the consent form below. Finally, agreeing to take part now still allows you to change your mind at any time without consequence.

If you require any further information, please do not hesitate to get in touch with me through Mr Walsh and Mrs Graham.

Many thanks,

Alan Edmiston

Yes

No

1. Have you read and understood the information above?	☐	☐
2. Have you had the opportunity to ask questions and discuss the study?	☐	☐
3. Have you received satisfactory answers to all your questions?	☐	☐
4. Do you understand that you will not be referred to by name in any report about this study?	☐	☐
5. Do you understand that you are free to withdraw from the study at any time and without having to give a reason for withdrawing?	☐	☐
6. I agree to my interview being videoed.	☐	☐
7. I agree to the use of non-attributable direct quotes when the study is written up or published.	☐	☐

Name (please print) _____

Signature _____

Date _____

Parental consent letter (included with the pupil letter)

KS 3 science research study parental consent form

Alan Edmiston, Brunel University

Your signature below indicates that you have agreed to allow your child to volunteer as a research participant in this study, and that you have read and understood the information provided.

The science department will keep a signed, dated copy of this letter along with copies of any other materials deemed necessary by them. They will be stored in a locked cupboard in the school.

Name:

Signature:

Date:

Researchers signature:

Date:

Appendix 4 – Colour coded transcripts

4a – group 1

4a – group 2

Group 1 –Lesson 1 Pepsi challenge

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Clip 1/4

Time	Code	Transcript	Notes
5.30	I	Mike and Gwen argue about the force of the rain in the image Gwen – Heavy rain Mike – English rain, we don't have strong rain like Russia All laugh	The pupils discuss the starting image on the screen - 1 in 100 year flood newspaper headline.
6.30	A - neutral	Mike – Its like telling someone without a house to get a job	I – because of context of rain + simple joke. They are engaged in the task and elements of it. The image is a good trigger because promotes such talk.
7.30		AE stops the class because he heard someone in the room use the word probability Feedback from the groups Girls in group chat	
9.09		AE – wonders out loud what they think and if have heard such a phrase before	
9.13		AE – What's the picture got to do with probability?	
9.30		Lots of I talk follows - associated with probability	
10.00	I	Taste test image on board now AE shows bottles Sheila – You could see if Mike – Blindfold – force them to guess ----- probably	I – engaged in the task
10.38		Mike – we are on a roll, we are getting the coke Sheila – definitely yes Mike – I am acting up for the camera but we are def on a roll	Neutral A - slight deviation.

10.45	Neutral A I	Mike and Sheila – Look at the gloves! AE now shows the 5 shot glasses – What think? Sheila– I want to speak Mike – Did you say peoples Lots of I talk Group feedback on how to do this test.	
13.39 14.28 15.00 15.17	A	AE - How many right? Alan – I don't like Lets do rock paper scissors bring in the bacon , ah, haa More I talk Mike is chosen for the taste test. Mike – Happy, it's the power of Jesus – I am a man of God Mike does the actual test.	Neutral A as the decide who will do the test. Neutral A

38.15	A	Mike – I am proud to have got that ... Jesus is reigning down	Is G like this because engaged in the task? All of his A comments do not seem disruptive just part of who he is.
38.22		AE input to guide and support talk ... What is the probability? Followed by all I talk	
40.10 40.30	A	Mike – Look at me, I have a special purple pen Gwen – Its mine Mike – So why are you not using it ... she is taking advantage of you Sheila – Yes Gwen Mike - Excuse me I will have you know that I'm a Back to I as they read and answer questions.	Neutral A here – slight deviation from the task but I resumes quickly.

Clip 3/4

Time	Code	Transcript	Notes

52.36	A	Mike – We have got this in the bag	Neutral A – showing general task completion talk – still on task
52.52		Mike – Tranquilize the cat and we will put it in the bag	
		Mike – We do not need to continue, finish first, we are the best.	
53.05		Mike – Why doing random religious symbols?	
		Mike – Do you want to summon the Lord Jesus?	Task focused with minimal other chat
		Mike – I don't think that Ian over there cares if its pretty ... pity, its not going to get me the coke man.	
		Gwen – just have fun	
		Mike – Because I am a logical person	
53.31	I	AE gives time warning to focus ready for class feedback	Key trigger question
		Sheila - You can explain it to me	
		Mike – If I use really long words it sounds as if I know what I am talking about	
55.00			
55.00	I	Feedback AE – No-one wrong ..how work out the answer	Hard to know who is speaking at this point.
55.25		All I as they discuss the fact the answers are all different for the probability for 4/5 right	
56.50		AE - If no-one is wrong why are the results so different? What is the probability? Why can we not get an answer?	
59.14		Mike plus Sheila – lots of I If want all then ½, ½, ½, ½, ½ Its impossible because it changes all the time?	
59.30		AE now shows cumulative probability	
		AE – What are the numbers telling us? Why do they do that?	
60.00		I again - Mike – Just random chance!	
63.30			

Clip 4/4

Time	Code	Transcript	Notes

1.16	A	AE – Is there a pattern? What happens if I keep going? Class told to sketch graph of this data - What's happening?	
	I	Mike examines the coke bottle – he thinks they are going to win and is excited Gwen– So Mike – Not getting Dominoes Sheila – I love cookie dough Mike – We are going off in a tangent Mike – What are we all thinking? The group discuss the graph	They all laugh - mix of neutral A and I
1.18		Mike – I need to pay my taxes this week Alan and Sheila discuss drinks	
1.18.26		AE – reviews + revisits graph and gives 3 questions: 1 – What are the numbers telling us? 2 – What is the chance? 3 – What will happen with more coins?	
1.19.30	+ve A	Mike – He is examining his prizes again They all laugh and one of the girls talks to the teacher “Examining those calories Sir!” Mike – He wants to know which one is healthy Mike – Its red, back the red my man republican Mike – That attitude is not a coke winning identity	He refers to the class teacher (supply)
1.20	-ve A	They argue about a pen and one of the girls swears. They all laugh because she was caught on camera.	I would code this as +ve A as they have moved away from the task and talking about more general but triggered by the task. -ve A because of element of disruption
1.20.45		Feedback – sharing views on graph All very engaged - I	
1.22		AE asks to vote on which option for the graph they think is correct	
1.24		Mike tries to explain	AE draws the 3 possible for the path of the graph
1.25		AE introduces the idea of the theoretical probability AE moves to a time for questions re probability when applied to health (pet) 70% chance of full cure with the new treatment	
1.26	I	Mike – How apply the treatment? Gwen – Could it get worse?	

1.26.52	-ve A	Mike – Side effects or another ailment – mercury poisoning They now talk to another group ‘You are such a bong bong’ - the next bit is unheard	Off task and talking to another group +ve A because related to the task but tangential in nature
	+ve A	Mike – Keanue Reeves ... What is someone invented a gun you could plant an entire field! Sheila – I would not do it Mike – 70% is fine but not to take AE input re ideas + discusses out of license drugs Mike – I am excited, want to know who wins!	

Group 1 – Lesson 2 Exponential growth

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)

- Teacher interjection.

Clip 1/3

Time	Code	Transcript	Notes
		This clip starts with the corn on the table – they switched the camera on when the group began to work. The use of real corn increases the risk of A behaviour.	
6.17.20	I	Gwen – 16 so 40 Mike – Yes, yes Gwen – they don't stay in place ... I need glue Mike growls Gwen – How many will be next 32 Sheila – You will never get 32 in there – you are mad Mike – Excuse me, don't call me that Gwen - 8 9 Sheila – 32 Gwen – Well I got 9 in so shut it	I – very practical and concrete start – appropriate trigger to engage at the start.
6.17.37		Mike – Count these Sheila – You are not going to	
6.17.47		Gwen - ... Try some participation 10, 11, 12, 13	
6.17.57		Sheila – I have 28 laughs Mike – Take away 3 from that and I can just Sheila – You have 28	
	A	Gwen – I have a whole cup of corn Sheila laughs because the corn won't fit into the square. Gwen (upset) What are you doing Incapable	
6.18.12		Mike – Ahh ... Gwen ... You are the one who is having romantic times with Gwen and you have done the least	
6.18.24	I	Sheila – I have done the second least ... you have 28 bits of corn.	
6.18.42		Mike – Don't take my autism pen ... that's not how you write with it. Sheila – Why have you written upside down ... Gwen look	
	A	Mike – No wonder I am not the last, I have a 6 th head so I must have a 6 th brain	
	I	Gwen – 32 64 Sheila – I'll put it back in the cup Mike – We had a disaster with the kernels so back to the numbers	
	A	Gwen – incapable	Neutral A – comment relating to the use of corn and does not detract from the task. This section is all neutral A because on task chat and does not detract from level of engagement.

6.19.28	I A	Mike – I am not Sheila to Gwen – inaudible Mike to Sheila - just sat there critising everyone. Mike – You are bringing negative vibes to this group Sheila – You sound like a parrot Mike – Me sound like a parrot Gwen – Keeps doubling Mike – I’m not a fan of good vibes ... but you are being really negative even though most of the negativity should be towards you. Sheila – inaudible Mike – Gwen I have for you Sheila asks Gwen to smell the corn Sheila – Let me smell	
6.19.51		Mike – Why don’t you round it up to 41,000 so then we can make 82, 000 – if we round it. Gwen – What will we round it to? Mike – 82,000	
6.19.51	P	Mike now sings ‘I got a gift, I got a gift, I got a kernel of popcorn	
6.20.20	I	Gwen - 16,000 20, 000 Mike takes the cup of corn to get kernel from Sheila Gwen – Is it 20,000? Sheila grabs corn	P – singing + being creative within the context (or +ve A)?
6.20.27	A	Mike – No, what have you done ... kernel on floor Get off my finger Gwen Gwen talks to Alan about the numbers and keeps counting AE stops class to focus	
6.20.32		Mike to Sheila – You are such a cob Sheila laughs Mike to Sheila – No what have you done, there is corn all over the floor Sheila – let go of my finger AE stops to focus again	
6.21.41		Mike – He is such a cob Sheila laughs and then drops corn slowly on the floor AE shares an anecdote about his children.	
6.21.58		Sheila is being silly with corn. Mike – Shut up you cob AE now gives out info re converting grains to weight.	
6.22.05		Sheila plays with the cup of corn, tipping it onto her hand Sheila throws corn	
			Negative A – disruption creeps in and they begin to move off task. Lasts for 3 minutes till 6.23.

6.22.55		Both girls now tip the cup of corn onto paper Mike – Someone has committed a crime called the cobbles Gwen and Sheila spread out the corn and laugh Mike – Sheila no	
6.22.39		Gwen Inaudible Mike – It was you, Gwen would never do anything like that Mike – Sheila you are a bad influence on her you are a bad influence.	
6.22.50		Gwen uses A3 sheet to put the corn back Mike – Great idea	
6.23.01			
6.23.19	I	Gwen laughs as she pours the corn into the cup. Alan spills some corn and all three put it back.	
6.23.39		Mike – So he has 400,000,000 grains of corn He wont be able to pay the wise man ... the wise man has more than he requires. The wise man will have food for the rest of his life, he is going to have infinite corn. Gwen now reads the questions Mike – He has 400 million, I have already calculated it Sheila – 400 million Mike – Yes, 200 tons Sheila – Has anyone ever Mike – 200 So its 400, 000,000	They now re-engage with the task as the numbers get larger
6.24.09		Sheila plays with corn Mike – It means that this king in rolling in corn he has a bath of corn Sheila – I can juggle with corn	
6.24.19	P	Gwen – We did not have that much corn ... I did not have 400 million Mike – We did not do every single one ... this is what the kings has, this is what the wise man wants. Gwen – I want that many Mike – You did not help to win a war Gwen – Ehh? Mike – The war against Sheila’s silliness Gwen – Yes exactly, I won that war	P because the humour has arisen from the context of the lesson
6.24.37			
6.24. 53		Mike - If someone commits a crime (corn pun by the way) you call the cobbles Gwen – laughs – Where has all the corn gone? Sheila – I have 3 corns Mike – What do you call a Jewish alcoholic? He brew Both girls laugh	

6.25.02	A	Mike – Silly joke – am I right?	Neutral A - not detracting from the task
6.25.16	E	Inaudible chat Mike – This study is into how children naturally speak so I am going to speak the way I normally speak shush, you cat like a 5 year old, my little sister is more mature than you.	Sharing personal information
	I	AE stops Sheila – I walked behind your sister on the way to school brother Mike – My brother is Gwen – Mike - 400 million that's the end – he forfeits his kingdom to the wise man.	
6.26.30	R	AE stops to focus on the 3 feedback questions	R - Says something, child-like, about numbers in a singing voice. They also realise something about the size of the numbers.
6.26.53	A	Sheila - I don't like big numbers Mike – Put all of the corn. ... this man is going to have so much corn he will feed Sheila – Corn he is going to feed the whole world Mike – Corn ... you need a microwave don't you They had those back in the medieval times. Gwen – It will fire and go poooof! Sheila – Put it in Gwen – They did not have them then	Positive A because they are talking within the lesson agenda but are being creative with the context of corn and relating it to popcorn. By 6.27 negative A features.
6.27.07		Mike – You two stop it Gwen – You stop it Gwen – disrespectful	
6.27.22		Sheila – I did not want them to look at me Mike – You have been disrespectful and now your face is on police report. Mike – Hey you Gwen – Stop being a disrespectful specimen Gwen and Sheila now play on the fact that they cannot say disrespectful specimen Sheila – You chicken nugget	
6.27.57	A	AE walks past Mike – Sir, this man is going to have a lot of corn All the corn in the city Gwen and Sheila both talk and laugh - inaudible	Largely negative A now.
6.28.01		Mike – Why are you laughing, what say? Tell me what you said.	
6.28.04		Sheila – Stop kicking me ... not sure who He is not She now laughs Mike – You do not realise that I still have motion in my legs, can pause and start again, I am not a machine	

		Mike – Alan Sheila laughs Mike – Tell me what you said Sheila – He said he is not an oiled machine Mike – Tell me what you said to Gwen You are basically the same person Give me the corn. Mike – You are actively starving the homeless people by	

Clip 2/3

Clips split because of memory storage on card but continuous footage

Time	Code	Transcript	Notes
6.40.30	P	Mike – Its socialism – everyone deserves a little piece of corn Sheila and Gwen – Inaudible Gwen – I want corn – thank you Sheila – Do you reckon this actually is Mike - Gwen do you see this ...	Playing within the context of the lesson – showing creativity.
6.40.45	I	Gwen – 2, 263 million AE stops class Gwen carries on – 763,000,000 Trillion Mike – Billion Gwen - million ... laughs AE begins feedback – prep to talk	Mix of talk for the rest of this clip: I + neutral A and negative A because of length of time – but keep coming back to the task. Also fighting over pen moves it into negative A

6.41.39		Mike – He was wise	
		AE - 3 minutes to decide which question to share	
6.42.28	A	Sheila plays with Gwen's hair	
	I	Mike in American accent Look at those corns over there!	
		Alan – Lets work out the	
		Gwen – What am I working out?	
6.42.38		Alan – Give me my corn	
		Mike – Its my corn now	
		Mike with accent – Give me my pen It cost like £15	
		Alan – my corn back	
		Mike– Your corn does not cost	
6.42.49		Sheila – Technically if that doubles that's x 2 x 2 that doubles	
		Gwen to Alan– Man, cannot even keep to his own promises	
		Mike – You are just a bit laboured	
6.43.13		Sheila to Mike – Can I just try your pen?	
		Mike – No you cannot	
6.43.17		Gwen – How come apparently	
		Mike to Sheila – I want to write like this but parents want me to write like this.	
		Sheila – I have one is it	
6.43.34		Mike – Yeah (laughs)	
		Mike – Sheila, threw my corn	
		Alan to Gwen – 13120	
6.43.45		Mike – I am Captain Corn	
		Gwen – What am I writing?	
		Mike – What's my maiden name?	
		AE begins feedback	
		Sheila to Gwen – I'll just write it (whispered)	
6.44.01		Mike gets pen back from Sheila	
		AE input – Need a word to help retrieve a memory	
6.45.25		Gwen to Alan – I know what I will say	
		Gwen to Sheila – We are ...	

6.46.38		Mike to Sheila – I am going to show you a magic trick AE gives 1 minute countdown Gwen – I'll speak Mike – I will I did most of the Last time we had Alan, I think I should do the talking Sheila has not really given any input.	Negative A dominates because they have now moved off task and are playing with the corn. H
6.46.46		Gwen – Alan did all of this with his brain Mike – A calculator Sheila – There is no Around it	
6.46.56		Mike – You mean the bright pink thing ... you can see clearly Mike (back to trick) – I'll prove I cannot do it Mike – I'm disabled	
6.47.06		Sheila – He did this before with me ... fell on the floor Mike – One's attracted to me (ref to corn) + also whispers about the trick.	
6.47.33		AE – When does he run out of corn? Sheila – You have a corn magnet inside of you Mike – Mmmm ... Ben's Corn Alan to Gwen – He runs out .. Mike – When he does	
6.47.55		AE – He has 200 tons that's loads of corn When does he run out? Alan – He runs out Counting now Mike – Lots of corn	
6.48.25		AE - The King runs out ½ way through the chess board Sheila comments on something else Alan to responding to Sheila – It would just sink Mike – Lots of corn	
6.49.45	R	AE – Our language can be a problem ie A lot of corn. This is a massive number on a chess board. 400 million grains on the board is quite a bit – its hard to picture, some people can Gwen – It's too much numbers Sheila to Gwen– inaudible Mike – Gwen cup (she laughs) Still feedback - AE – I am not sure if there is enough corn to fill the chess board	R because considering size

6.50.13		Mike – Gwen, it’s the goblet of corn Mike to Sheila – Give me my corn now	
6.51.07		AE – There is a pattern and writes 2 x 2 x 2 on board + shares how much it takes to make a loaf f bread. Sheila and Gwen chat Alan writes	

Clip 3/3

Time	Code	Transcript	Notes
7.04.07		AE – Key Q’s: Why done this? Anything else like this? Any words help?	
7.04.59	I P	Sheila – I just think lockdown Mike – Guys its Harry Potter and the goblet of corn Harry Harry you touched the goblet of corn Gwen – You are talking absolute potatoes Mike – No its corn not potatoes Gwen – Can you imagine corn that pops and makes a potato? Mike – You mean like popcorn Gwen – Lobster and potato x 2 Sheila – Is that a thing? Gwen – A Pink potato Sheila – A blue carrot Mike – Hey guys its me, Mobster 1, 2, 3	Is this P because being creative in a fun way?
7.06.07		AE conducts feedback using register to pick names. Can you decide who is talking etc, What is going on here etc. 1 minute to agree	
7.06.29	I	Mike – So this man is obviously very wise and I don’t know why he picked corn, he could have picked wheat to get a bunch of bread but ...	
7.06.45	A E	Sheila – You can get popcorn, sweet corn, corn on cob Mike – You could get bored with corn everyday but wheat Could make different types of bread	Positive A because related to the topic of corn

7.06.57		Gwen – What if he was gluten free like Emily Mike – Lactose intolerant Sheila – Yeah, that one Gwen – Wheat, gluten, lactose, dairy Gwen – Wheat and gluten free	E – sharing personal information.
7.07.20			
7.09.02		Feedback	
7.09.16	I	AE now writes ‘exponential’ on board – What comes into your mind? What make you think more about? Gwen – Exponential Mike – I think Alan can do the speaking for us Gwen – Experience Mike to Sheila – Since you are such a genius at everything Sheila – I never said	
7.09.46	A	Sheila to girl trying to say exponential and both laugh Mike – Give me my corn back Gwen, I dare you Alan – inaudible Mike – Classics kernels AE now write r number on the board Gwen – What’s the r number Mike – The thing you put in front of movies	Neutral A
7.10.07			
7.10.25			
7.10.51			
7.11.17	A	AE input on r number – The government want to get it below 1 Mike – Money AE – Covid – if the r number is 2 what does that mean? Talk about that Mike – Higher Gwen I can see your corn ... I like to see your kernels have you got none Gwen pulls face	
7.11.36		Mike – Oh my Alan, did you actually write all of the numbers. AE stops	
7.12.13		Mike – Shhh	
7.13.13		AE points to news and gives examples AE – Why might this help someone understand how dangerous the virus is? AE – Anything else like this?	
7.13.28	A	Gwen – Talk ... about the virus Mike – Talk Mike – Gwen how many cobs do you have? Sheila – Thank you so much Mike – You like my cobs?	Low level negative A chat begins to dominate – the is largely negative A.

7.14.13		Alan makes some comment Mike – Alan Best to try Sheila – No-one can beat me Mike – Determination is the key Gwen and Sheila chat Mike – Is Gwen secretly bugged? Sheila – No she has a hard kick Mike to Sheila – Why are you so Gwen – It really hurts when you kick people apparently AE now mentions politicians and D Trump in this context	Much is inaudible but -ve A because no real reference to task or engagement.
7.14.36			

Group 1 – Lesson 3 Sampling beans

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Clip 1/5

Time	Code	Transcript	Notes
8.14.49		Register taken + chat with class teacher.	
8.16.00 8.16.43 8.16.58		AE intro + recap on previous lessons + ratio intro lesson at the start etc AE – Have you had any thoughts/made connection after the lessons? Have a chat about the two last activities, have they made you think?	
8.17.04 8.17.48 8.18.03	I	Sheila – Hi guys So what AE – Stop Important thing is that you think and talk AE – Anyone had any thoughts important to think and speck when things are hard to understand.	They chat about a new boy in the class, much is inaudible + chat to the class teacher
8.17.37		AE starts lesson – I had to take a stool sample from someone who was ill. What am I talking about?	
8.18.44	I	Alan – That’s minging AE – Faecal sample sometimes	AE makes joke about the size of the sample and the size of the bottle
18.49	I	Alan – Poo	

19.03 19.11		General laughter AE – Common occurrence to take sample, where else have you heard or come across this? 2 mins to chat	
19.26	I	Sheila – inaudible Sheila – Sample of fruit Sheila ... chocolate ... ice cream sausages ... that was so random Gwen – inaudible	
19.50	I	AE mentions the pictures on screen Gwen – Food make up Sheila - I ... on my face colour match Poppy talks about sample from space Mike – Blood sample	
20.47 21 .30 21.54	Neutral A	AE mentions anthrax and Scottish Island etc AE now shows beans Mike – I want a bean Can I eat the bean? Gwen – I don't think you can eat the beans. Mike – I want to eat the beans. Poppy – You cannot eat the beans Gwen – That's a lot of beans	All chatting – hard to hear, discern
22.07	Neutral A	All laugh Gwen mentions Mike Gwen – They are green Sheila – Green beans ... split cup bean Gwen – If I put in soil will it grow into a bean stalk? Gwen grabs cup from Sheila and beans spill onto desk Alan – We did not knock it over	Laughter Are they becoming playful because of the element of fun creeping in? More laughter and they move the beans into the middle of the desk
22.49	P	Alan – Silly beans Gwen – Silly bean Sheila - It's a white bean (laughs) Gwen – Looks like a tooth Sheila – A black bean Gwen - Looks like a dinosaur its does look .. Sheila – Don't you dare put it in your mouth	Now P because of tone and starting to use own ideas?
23.21		AE – makes mention of variables and questions on board Gwen - They look like beans and ... AE – How different are the beans? What variables can you see?	More laughter

23.33 23.40	I	Poppy – Whats a variable? Sheila – Something different Sheila – Colour, size, shape, weight Gwen – Everything comes in shapes and sizes AE – Just like us Gwen – Yeah Sheila – Look even them ones are completely different – shape, heaviness, colours	Sheila talks to AE as he writes on board
24.00		AE stops	A boy from another group makes a joke
24.38	Negative A	Gwen – Purple! Gwen – Thickness ... bullseye! Sheila – Stop flicking beans off me AE – Which is the most important variable? Sheila – Taste Alan - at the beans	Alan and Gwen keep looking at the beans. Gwen makes a tower of beans and they also start flicking beans at each other.
25.25 25.35	I	Trevor is heard to say ‘The bigger the bean the bigger the price’ AE picks up on this ... who agrees with Trevor re size? AE now moves to the next part of the activity – measuring beans.	
26.16		Alan - get measuring the beans	
26.24	Negative A	AE – People want big beans. Is there a problem if people want big beans? Look at your sample. Alan – Big beans, big beans, Sheila – I don’t know what that means Gwen - big beans I stripped it	Negative A because of disruptive element She shows her bean to the group. Are they moving towards -ve A or P due to the change in tone and general air of silliness?

Clip 2/5

Time	Code	Transcript	Notes

38.21	Negative A with elements of P	Sheila - ... could it be	Negative A because simply playing with beans – but is this due to a lack of experience and to be expected?
38.26		Alan - ... I had a naked bean ..	
		Gwen camera	
38.32		Gwen – You have been Gwen – Who wants big beans Sheila – Its wrinkly Alan – Bean flicker	
38.52		Gwen – I thought that was on there Alan – Ha, ha ... wrinkle bean (to Poppy) Sheila – That's what I said Gwen - bean Sheila – When Kyle says it, its funny Gwen - ... because you just said it	
39.09	I	Gwen – I'm trying to Sheila – It's a dinosaur Gwen – Did you hear that crack?	All laugh at the naked bean Real hilarity now! Gwen throws bean at Alan Poppy throws a bean Now trying to break skin off the bean
39.20		AE – Is size a problem for the farmer who grows the beans do people want big ones Alan – Yes Sheila – Yes because there would be lots of little ones left Gwen – They will feel really bad if they don't ...	
39.40		AE – 'Problem with size' as he writes on board We need a mixture .. what types of beans go into the packet? Each group are given a number for feedback	
40.08		Do we need to know anything what goes into a packet ... Whats the problem here? Talk about that. Inaudible chat	
40.20		Sheila – No they should not just sell the big ones cause there will be loads of ickle, ickle, ickle ... ones left Poppy – How come they have more beans than us? Girl 2 – More people Poppy – I'm still standing	
40.39	Neutral A	Gwen – Look I stripped a bean and split it in ½ ... looks like a peanut. Sheila – Who has the time to strip a bean? Gwen – Me in a bean lesson Sheila – They do not just sell the big ones because loads of ickle ones left that have not been sold like this one (she picks up a bean) ... that's not ickle its big	Are the dynamics different because Mike off and Poopy now part of the group? Neutral because not disruptive – simply discussing beans Laughing again

41.12	Positive A	Poppy – Individuality Sheila – Individuality ... whatever that means Poppy – You are an individual ... it's a good thing Gwen – Have a naked bean Sheila – I've just been individualized Poppy – I said she was an individual an individual is one person AE – you are group 5 Sheila – I got individualized .. I don't want to be an individual Poppy – Its good to be .. if you are not an individual then you are the same as everyone else	+ ve A because they are exploring the idea prompted by variables
41.28	Positive A	Gwen – ½ a naked bean AE to Gwen – You dropped your phone Gwen – Have I, ahh, thank you Alan copies this	Gwen laughs and Sheila looks worried
41.48	Moves to negative A	Sheila – Dropped out of your bag that you don't have Alan shows bean to Poppy Poppy – Where does he get the beans from? Gwen – Put the naked bean into the bean house Sheila tips up the cup to trap the beans, boy 2 pulls away and they spill Sheila – Alan!	
42.34		AE stops and mentions the link between this and the roll out of the covid vaccination AE – problem because we cannot just sell big beans Feedback begins with group 5 Gwen – Just the little ones left AE – Mixture	
43.35		AE now focuses upon how we know what big is via link to fairground rides and height restrictions	
44.03		Measure beans and decide what is big/small	
44.13	Neutral A	Sheila – I have a ruler Gwen – Sir Michael has Inaudible Sheila – I have a ruler	Alan and Sheila put the beans back into the cup
44.23	Negative A with	AE – measure them all Gwen – inaudible unrelated chat Sheila – We only need 1 ruler .. fine (sings as she looks in her bag) Sheila – Poppy, where are you going To girl from another science lesson We are in a science lesson Sheila to Alan – Find a bean, pick a bean I said a bean (they spill beans on desk) Poppy - The dinosaur tooth thing (looking for previous bean)	Negative A because playing with beans

45.05	elements of P	Sheila – Someone turn it around we put it on here Gwen – I told you Inaudible Sheila – 1 ½ cm 1 ½ cm Gwen – That little	
45.51	I	Sheila in a strange voice - amazing bean I have a bean ... Gwen and Sheila – inaudible chat about beans Sheila – I need a bean pick a random bean, a big bean Alan – I made bean pants Look Gwen – Kyle’s invention bean pants Alan – I press hard, then I take off ... look	She marks out a grid on paper
46.20	I	Sheila – 2.5 bean Poppy – There you are there is a bean Gwen – Green bean Sheila – Who wants a green bean? baked bean bean stalk green bean	They are fascinated with the beans He has removed ½ the shell Lots of laughter
46.57	I	Gwen – There is a smooth bean Sheila – Can someone lese do some measuring? Gwen – No, Alan is too busy inventing bean pants Sheila – 1.5 Gwen – How many are we supposed to measure? AE – As many as you can Alan – 2.5 Sheila – 2, no you have to put it to zero on the line Kyle Gwen – Put it on the line Alan – 2.5 Sheila – Put the bean in .. Poppy – Thank you Kyle Gwen – Did it go in? Alan – OMG, make it taller	Said in quiet response to Gwen Lots of inaudible bean chat
47.23	Mostly negative A	Sheila – Have we measured enough beans yet? Sheila – That’s not normal Alan – We have lost a bean Poppy – Get off my beans Sheila – Its time to measure beans Gwen – I can’t, I don’t think feels wrong. Poppy – I stole a bean Sheila – 2.5 Gwen sings in a high pitched voice	Gwen laughs and picks up several beans and laughs and she throws them into the cup Alan and Gwen now throw beans to see if they can get them into the cup

47.46		Poppy – Here is a stolen bean Gwen – Who did you steal it from? Poppy – Them Alan – I want a baked bean ... a big bean a big bean Sheila – 1.5	
48.08		Gwen – Hit the rim, hit the rim, hit the rim	
48.15		Alan – I’m going to make a bean tower Sheila – I don’t have to be precise Alan – No	Still trying to get beans into cup held by Poppy
48.26		Alan – Ahhh, I’m making a bean tower ... making a bean tower	More laughter
48.47		AE begins feedback calling out groups and they give sizes Sheila – still measuring	Sheila keeps measuring and takes bean from Alan’s pile
49.27	I	Gwen asks question re size Sheila – I don’t know, that’s what Alan measured Alan – I didn’t, I measured that one Sheila – Gwen look at this one its 1.5 ... oww Poppy! Gwen – I did not even try to get that in ...this is just 1 ... it is what it is ... Who touched my foot?	Sheila throwing beans now
49.44		Alan – I made a bean triangle, I mead a bean tree Poppy – All the beans out Sheila – Ahh, they smell ... ugg Sheila - Ugg	Gwen and Poppy laugh He spreads the beans in front of him She spreads out the beans More inaudible chat She puts the cup to Sheila’s nose

Group 1 – Lesson 4 Does it work?

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Time	Code	Transcript	Notes
23.20	I	AE shows starting slide (Wellman and Wellwoman) 'I have seen' New girl – Who is Jimmy Anderton? All look at the image	The starting image of sports people advertising products triggers real engagement.
23.34			

23.41 23.47 23.56	Clearly I	AE – I have also seen Some people make their children take fish oil tablets because apparently it makes them cleverer. Gwen and Sheila smile and chat AE – When you see adverts like that .. are they lying, do you believe it Have a chat Mike – I don't think they are lying x 2 AE now moves Mike because there are 5 pupils in this group Mike – I don't ...	
24.09 24.21		Sheila – Put yourself in the right place New girl – Move chair there Gwen and Sheila laugh Mike – I don't think they are lying .. they are ... you think it is going to happen but it does not ... sometimes it might work, you never know (inaudible) .. I don't think they are lying I think they believe it	
24.37		Sheila - I'm sorry Mike – I don't think the people in these adverts are lying Sheila – Talking about what? Mike - but it might not be the outcome ...	
25.34		AE input re adverts and fish oil tablets etc Mike shares his answer with the class AE – I have great looking hair! What things do you use that you think work? Mentions wife's friend who spends a lot of money on make up. Have a chat about that.	
26.49	A	Mike – I have technology Sheila – I have a bed (thinking) Mike to Sheila – You have an expensive bag, does that make you better? Sheila – I don't have an expensive bag Mike – It says River Island on it gold chains on it Sheila – Its just a bag Mike – But its more expensive than one from Asada Gwen – How much? Sheila - £45 Mike - £45 for a bag! You could get a carrier bag and get the same value Gwen laughs Mike – Carrier bags do exactly the same thing and probably carry more	Negative A – the input form AE triggers a discussion
27.19			

28.09	I with A	AE stops + input + mentions fish oil trial that will come back to AE introduces the problem and shows a bag of carrots ‘What notice?’ “All different”, is the response AE input re the same but different in living things. ‘How can we easily compare a treatment on me, older adult, with you? Really difficult to do etc Companies bring out treatments for children and charge more. Imagine you are a parsnip farmer (shows image of parsnip fertilizer etc) – explains context Sheila – Why parsnips? New girl – I don’t know	This next section is what I would call normal – a mix of I and A with I dominating. Later @ 31.38 it turns to making fun of each other in a light hearted way. This is still A – neutral A because it does not cause them to stray off task. The use of real parsnips is a key trigger.
29.07			
29.09			
29.49		AE – what if they said you would get bigger parsnips, what would convince you? Talk about that New girl The company family planning Sheila – What did they say?	
30.08		Mike – If you show me a full bag of massive parsnips I will believe it .. to get that many, that size.. New girl ... dodgy things you can make a parsnip bigger sounds ... Mike – You are being recorded and caught in 4K Gwen and Sheila talk – eyes wide	
30.24		Mike – If you could show me a bag of massive parsnips Then that proves consistently you get bigger Gwen and Sheila laugh Sheila – Well no because they might just show the biggest of the bunch Mike – Yeah but if you get 100’s of big ones it would take 100’s of years and he is not going to spend New girl - Here is a big one (she mimes pulling one out of a bag) Mike – You would be able to tell Sheila – What could you tell?	
31.19		AE stops for feedback AE – What would convince you? AE shows slide of the parsnips (treatment and no treatment) - Talk about that Gwen – Yeah, averagely bigger Sheila – Its obviously worked Mike – Might have been a slight increase but a lot more money when selling Alan – Yeah Sheila – But all still not the same size	

31.38		Alan – Its an increase Sheila – Not the same size Mike – I like might not have more big but has less small ones Sheila – Yeah but ... stops and laughs Mike – Why are you laughing, its literally just parsnips Alan – So on average its bigger Mike - Look at me I've got my River Island bag and I laugh at parsnips Gwen and Sheila laugh Mike – £45 on a bag (said in strange voice)	
32.02		New girl – Gropar Mike – Gropar is good Sheila – I don't get it Mike – You don't get it	
32.12		Alan – On video (to G) Sheila – Say cheese Mike – Cheese Been caught on 4K, what are they going to do! AE stops Gwen – inaudible chart AE feedback 'Who thinks its worked??' focuses upon the 4 possible outcomes: Treatment + effect, treatment + no effect etc	
46.20		Next clip AE shows the grid and the four options 'Does this help? Talk about that	
47.17	I	Mike – If the point is to make the parsnips bigger then surely the evidence New girl – Why are we and that group being recorded? Sheila – I don't know Alan – inaudible	
	A	Mike – What .. Sheila wake up Sheila laughs Gwen – I'm not a dog Mike – A duck Sheila – Quack, quack Mike – Woof	
47.51		Sheila – It helps because Mike – You can see how many are bigger New girl – They are all similar size .. Mike -	As above – I with mix of A – usually negative, silly talk triggered by G

48.08	A	Sheila – Yeah, what Kyle said Mike – How many got bigger how many got smaller Mike – Hannah how many got bigger? X 3 Gen replies in kind and Mike laughs	
48.15		AE feedback	
48.41		AE – does this help, how help? (refers to grid) AE – think of something to say	
48.53		Mike – Could help, maybe ... the results are too diverse to be put into a linear table .. you have to have multiple sets to get it right	
49.02		AE feedback + shows perfect results (treatment + effect = 15 and no treatment and no effect = 15)	
		Mike utters a word 3 times Wagam? Mike to Sheila – Stop looking at the lights	
53.00			
53.11		Sheila – We read about that in English Mike – Yeah New girl – What Macbeth? Gwen – inaudible reply Mike – Weird, why are they trying to eat a woman? Sheila – Read form Macbeth poster (or work on wall) for 10 seconds	
53.23		AE uses the numbers from the slide 20 : 10 (prove to disprove) ‘Is this strong enough evidence?’ AE also mentions head and shoulders Sheila – I have dandruff, I don’t use Head and Shoulders Gwen – inaudible reply Sheila nods in agreement	
54.56		AE – Talk about that now Mike – No Gwen and Sheila – carry on talk about shampoo (price or size of the bottle!) Mike – Test over and over and over again .. on average you would set after set Trial 1, 2, 3, 4 Sheila - A big white bottle	
55.20		New girl talks to Alan – inaudible because of masks Gwen – Shampoo last ages	There are lots of A chat while this takes place, low level, noisy, hard to discern Shampoo trigger engages but then results in positive A as related to the effects of shampoo

55.38	I	Mike – What are you two talking about Gwen – Shampoo and conditioner Mike – Does not sound like parsnips Gwen- Charlotte makes potions AE can be heard talking Gwen - makes potions with all shampoo and conditioners Mike – So you are a witch Sheila – You would have stones put on you and thrown into the river	Fish cards trigger real engagement and interest – some elements of A emerge but this is part of the normal pattern of talk. A significant period of mainly I talk which includes task orientation and organsiation.
55.50		Mike – Stones put on you Sheila nods to Mike Gwen – Its break time	
56.03		AE – put hands up if think enough evidence? AE – never get perfect results – what results are enough evidence? Now refers to covid vaccination process	
		After break – clip 3 – camera switched on late as pupils working on fish oil tablet card sort activity	
48.34		Mike – This is a set of results, look at all the frowns Sheila – They all look the same New girl – No they are not Mike – We also have a couple of smiley faces Sheila – Smiley face, smiley face x 5 (she does this as she places down the cards) Sheila – Ahh I am going to separate into smiley faces	
49.06		Mike – so smiley face with and without pill ... so remember that with and without pills are different New girl – Okay so if take drugs you are happy and if you don't take drugs you are not happy	
49.13		Mike – Yeah, yeah, yeah, that's how they do it on tiktok Sheila – Smiley face (said as puts cards down) New girl – Ah look Mike – Ah, all these men all taking roids New girl – Its just Mike to Sheila– You need a smiley face pill, smiley face not pill Mike – No I literally just Been putting them in groups Mike – Stop mixing them Hannah – we need to put into groups Sheila and new girl laugh	

49.54		Mike – Smiley face, pill, smiley face without pill are different This one had the pill and still did bad Mike – Give us the cards, you cannot just hold them Sheila – I’m holding the cards Mike – More smiley faces with pill You have to ... Gwen and Sheila– Just fly away ... Mike – Smiley face without pill and smiley face with pill Sheila – I will sort them	
50.16		Mike – Gwen we are 5 miles an hour x 2	
50.35		New girl – I think ... Mike – Smiley face with pill, smiley face without pill ... unhappy without pill, happy with .. New girl – Pills make you happy Sheila – Looks like they are nuts Mike – They are not nuts they are fish oil pills happy with pills	
51.01		Alan – Why are they happy with pills New girl Only ... happy with pills – go for it	
51.16		Mike – The evidence would show that has more effect on men New girl – Drugs help men Mike – Grrrrr (clenches fist) .. happy with pills, happy without pills. So men are dumber but when take pills they are smarter Mike – Men are dumb but when take drugs are smart	
51.41		Alan – Happy women will not take pills Mike – Took pills, no all men who succeeded took pills so females succeeded without help from pills Sheila – Mike is my dad! Mike – Don’t take the men with pills	
51.53		Mike – For the rest of the rest of this lesson you have to talk like a ... man Mike – Just count how many in your pile and what gender they are Gwen to Mike – inaudible Mike – No, I refuse Sheila – Not allowed Mike – 9 men succeeded overall and all 9 took pills Sheila to Gwen – That’s yours there you go Alan to Gwen – inaudible	
52.20		New girl – I’ve got 10 women who are upset because they did not take pills Sheila – I have 11 women who are happy to take drugs New girl – They did not take them and failed Mike – She has women who are unhappy they took drugs	

52.33		Mike – Maybe The pill works better on men Gwen – So why is she smiling when New girl – Harvey What did yours look like because we got these? Inaudible chat follows Mike – men are happy that they took drugs Maybe this suggests that the pill has better effects on men than women New girl – They are the same ones Mike - Might effect women in the reverse New girl pills ..	
53.02		Alan – Teeny, weeny, teeny, weeny Mike to new girl – inaudible then ‘Look at those unhappy men because they did not take drugs LSD before the test Mike – Poppy you are ruining the evidence Sheila – Poppy you are ruining everything Mike – Me and Gwen have taken a lot of time and been careful about everything Gwen – inaudible Mike – Sheila, all your women took drugs and now they are upset Sheila – Gwen	
53.25		Mike – My men took a lot of drugs and they are very happy Okay this is what happens when you do roids Inaudible Mike – This is what happens when you take roids – you get happy Alan - Inaudible	
53.45		Mike – You win the physical fitness test look at all those happy women Gwen – I would not say I normally get drunk Mike – So would the data show that women are unhappy when they take drugs? Alan – I’ve got Mike – Look at all those men, they failed because they did not take drugs al the men that won took drugs New girl – Same as us (to another group)	
54.00		AE stops and asks to swap cards with another group Sheila and Gwen – inaudible chat Gwen – I will just go round Sheila – I don’t James and ...	
54.20		Mike – Remember your numbers for the drugs and the How many ... I’ve got 9 Sheila – James texted New girl – Mike you need them all Mike – Remember your number Gwen, remember your number Gwen – I did not count them	

54.33	A	Sheila – You had 11 Gwen – I had 8 Mike – So 8 women who were happy they took drugs, this is like when anti-depressants depress you Jade needs to take her photo ... do you know this Tamsin Alan – Mike, the bag New girl – What are you doing?	Positive A – they are discussing personal preferences and thinking triggered by the context but are not on task. Later this moves to negative A (56.56) because the focus is upon personal stuff and sexual references (not rude but happens twice) and siblings. Most of this is a mix of positive and negative A – moving freely between the two.
55.17		New girl – He has a new bag Alan – Ahhhh New girl – Ahhh ... I am so sorry Sheila – Poppy Mike – Do steroids make you buff? Mike – I'll take the men with drugs Sheila – Wait a minute I am doing this Mike – I'll get the men who took drugs Alan – I want to write something Sheila – Write a number on	
55.52		Mike – You have to be able to tell if they are buff or not New girl – my boy is buff Alan – I want women who took drugs New girl – I want my independence	
56.00		Mike – they are frowning if they are weak virgin men Sheila – Write your number on there Mike – My what Sheila – Your number Alan – Mike, you really Gwen – How many cards do we have? Sheila – Come on Kyle 1 to 10 ... 9 men and what I noticed was that ... Mike – The women who took fish oil tablets all failed. The men who took the fish oils succeeded ... only the ones who took the fish oil pills New girl – I've got the guts who ...	
56.38		Gemma – Does that prove anything? Mike – You would have to do it about 15 times Alan – Wrong person (?)	

56.56		Mike – Fish oil This has been shown to help with brain so I would not be that surprised if you know its not that far off Look at all these .. so the men who succeeded ... most of them did not no, no, no, thats a fail Sheila grabs cards – I want these Alan – I don’t have any ... Mike – I have the weak people who took drugs New girl – I have the strong ones Sheila – Strong ones who took drugs Mike – Strong females who took drugs Sheila – Didn’t Mike – That’s a weak virgin woman ... weak You’re a virgin Kyle Alan ... ahh wait I forgot you are not Alan – I forgot you were not a virgin Inaudible Mike – Don’t you mean my sister ... Laughter	
57.41		Mike – Why are you looking at my sister Alan? Gwen – Your sister is in my sisters class in school Mike – Wow New girl – I don’t have a sister Sheila – Sisters class in school Gwen – His sister is in my sisters class in school Mike – Miss Is it true that the men who took failed?	
57.59		Inaudible Sheila – Ahh the disrespect Mike - repeats	
58.13		Alan – I only had 2 again Gwen – I had 22 Gwen – I had 2 Mike – So 12 men failed AE stops – This is difficult, like juggling etc New girl – I can juggle	
59.00		AE – Like juggling with things in your mind Control and experimental Gwen – I don’t understand why Sheila - Someone Both girls laugh Sheila looks embarrassed – I didn’t ... Alan – What are you two on about? Both girls laugh again	

59.55		Alan – Yes Gwen – Sheila is not a virgin Sheila – I am a virgin (said v quietly) Sheila smiling – Gwen’s not Both girls laugh Sheila – You are not Gwen – I am Sheila – No you are not (They both repeat this to each other) Alan – inaudible	
12.06		Gwen – I got a paper cut Sheila – Really..... Mike – So men who took drugs died but when women took drugs they are happy Sheila – Happiness Mike – Depression New girl – I got Sheila – I mean I probably would Mike to Sheila – Look at that Sheila to Gwen– You folded them Mike – Women who take drugs and now they	They re-engage here!
12.16	I	Clip 4 Gwen – You weasel Mike – No drugs, weak (to girl 1) Sheila – Have you written your number down New girl – Yeah, 22 Sheila – Do you remember what it was? Mike to new girl – Kyle could not find me Sheila – Well the other one was New girl – How many had drugs Alan - ... flick you on the nose and you would feel it Mike – 9 men who took fish oil pills won and 12 men who took drugs failed The fish pills ..	
12.33		Mike – I mean fish improves your brain so it would not be far off for pills ... my Grandad always told me that cod fish helped.	Personal sharing triggered by AE showing fish oil tablets.
12.43	E	Sheila – They make you smart She	
12.53		Alan – No-one cares about your Grandad	

13.22	A	New girl – My grandad died Alan – My dad Mike – OMG Alan – I remember when I was a kid, on the news saying my dad had died saying that I needed friends ... that was really depressing Mental instability Sheila to Gwen – Well she felt They need to tell each other everything AE – Put the cards in the bag Mike – If I put the cards in the bag how can I understand that men	Positive A - they are talking about the task but their interpretation of it.
13.40		New girl – You wrote it down ... Sheila – She said ... ohh shut up Mike – Wait a minute 12 men no drugs. Men are just naturally amazing at getting buff. 22 men no drugs.... That does not make sense, men who don't take drugs are naturally buff Sheila – Well she said she might ... AE stops class Mike to Gwen – Why are you doing stupid Tictok dances? Sheila laughs Gwen – Cause (raises hands)	
14.01			
15.12		AE manages feedback but calling out random names AE stresses how talking helps your thinking Feedback takes place	
16.30		Gwen to Sheila – Shut up (she is embarrassed) Sheila whispers to Gwen – Keep ... you're a virgin	
18.15		AE input on spina bifida and should folic acid be added to bread so all women take it. 'Should it be added without your permission?' Response - Yes, no – if it saves more lives then yes Mike – Whatever saves you, folic acid wont kill you but it saves a child's life Sheila – I don't care why ... Mike – Well you are horrible aren't you	I – this trigger engages the pupils for a couple of minutes.
18.40		AE now input into a smoking cessation trial in Glasgow Sheila – Quarter to Mike to Sheila – Imagine wanting to Sheila - Like polar ice caps AE – Do you think you should give money to help stop people smoking?	

19.07	A	Sheila talks about her pen New girl – I would take the money Mike – No Alan – I would take it ... AE input re cost of smoking to NHS ‘What do you want to know about this test?’ Mike – I would want to know what they spent the money on ... I would want to know if they spent the money responsibility Alan replies to Gwen – inaudible Gwen – After school I went Sheila – I did not show her Alan – And she ... we all literally Waiting there to do her	Moves to negative A because talk about a fight.
19.47		Sheila – Ehh, what, when We were ... she asked Gwen – We were all; getting let out of school she went Sheila – Monday, when we were getting out	
20.00		Gwen – Yeah Sheila – I just looked the other way and did not go Alan – We got out of lessons late so she thought we were waiting for detention Why don’t you ..	
	A	AE writes on board Gwen – Imagine smoking The smell makes me ill Alan - smell as well Gwen – Imagine smoking Sheila – I don’t smoke (girl 1 laughs) Alan – Should be hung Sheila – I don’t Gwen – Yes she does Sheila – I don’t and would refuse to do so Gwen – Promise me you have never smoked in your life Gwen – I promise I have Laughter	Positive A because discussing their views on smoking with elements of E because of personal nature of the talk.

Group 1 – Lesson 5 Models

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Time	Code	Transcript	Notes
0.09	I	AE – Its all about modelling in science and what it means. Mike – Does it mean when you wear vaccines on your head? Sheila – Is that the way your photo is taken? Mike – Yeah, before and after your photo is taken ... yeah you take the magic pill Sheila – How they got on and the ...	I - the term model elicits an interesting line of discussion – useful trigger as it draws upon their understanding of atomic models – see 2.30, 7.28

1.10	A	AE relates story of wearing a suit instead of shorts and being described as a catalogue model. Is that what we mean in science? Mike – Could be made out of clay .. Gwen – Ehh Mike – Like modelling something Gwen – Oh yeah Mike – Don't make fun of the way I speak Gwen – Its part of your init?	Negative A – the term 'Init' is used by G throughout this lesson
1.24		Mike – Its part of my vocabulary x 2 Gwen – Init Mike – Init	
1.32		AE – What's an atomic model? All – What?	
1.45		Sheila – I don't know what atomic means?	
2.12		AE - 'Any other models?' Mike – Clay models	
2.30	E	AE – What is the difference between atomic models and a cat made out of clay? AE shows a Easter chick 'Is this model the same as the atomic model? Talk about that	Trigger by Mike re wrist bands elicits personal sharing about 'loom bands'.
3.09		Sheila – What's an atomic model? Mike – You know when you have 1 ball and the rings going around it (other balls) Gwen – Atoms Mike – Your atoms Sheila – Alan, what's an atomic model ... I am so confused Mike – Your atoms ... Alan won't know and I do Mike to Gwen – If she had spent more money on tutoring instead of golden wrist bands then she would know. Mike – Buy a pack of loom bands Gwen – I used to do them Sheila – I used to do them Mike – I bought .. Alan – Have you seen the one with the fork that you can wrap ... Mike – I bought a £60 box of them just because popular Gwen - Nearly made my fingers fall off Sheila – I used to put a table in the street and sell them.	
3.24		AE stops – Any thoughts? Quiet but odd words from Mike, Gwen and Sheila	

3.33		Mike shares in feedback – Both the same because its what people think AE – Say that again AE now tells migration stories + includes swans because they nest near the school	
4.49		AE – Its what people do in their minds to explain something based upon evidence. ... Is the atomic model 100% certain?	
5.00		Mike – No AE – That’s why it’s a model – scientists can agree and change - that’s what we are doing today. You are going to get a box that cannot be opened	
5.15	I	Alan – Cannot open! Mike – Ill break it open Sheila – You cannot open it, not allowed to open it Gwen – I’m going to open it. G – This is a trick ... we are going to be tricked, there is going to be knots in the string and like	The box really engages them.
5.51		 He is going to make us think there is something in them. Mike – You can work with Kyle, I’ll work with Tamsin, the smart people Sheila – It does not open Mike – Its not meant to open, so before we do anything lets do not pull the string through Sheila – Its got a knot in it, it’s not going to come out. It does not Gwen – Don’t be stupid AE – Watch	
6.15			
6.22		Mike – So it does have weight? Sheila and Alan – Ours is broken Mike – That’s not broken Alan – It is, it does not work Mike – It does work, you are just not playing with it properly	
7.00		Gwen - Then pull it tight Mike – I reckon there is nothing in it, I reckon there is nothing in it at all. Mike – Filled with glue, nothing at all Gwen – You can see where the hot glue gun ... Mike – Yeah its just a box with a hole in, nothing at all I do not see it or feel it Mike – You sound like Goofy, shut up	

7.28	A	Mike – Because there is tension Sheila – Mike stop saying ‘Init’ Mike – Its part of my vocabulary, shush man ... Init, Init, Init, Init brother Mike – we have been given paper for a reason Gwen to Mike – Do you ‘Anyone got a cigi?’ Mike – Anyone got a cigi! Mike – Wait a minute ... what I am going to do is put this in here	Negative A – back to ‘init’ – stems from G plus now includes other ‘funny’ words such as cigi.
7.55			
8.00		AE – Year 9 Sheila - How did you get that? When?	
8.10		AE – What humans do We imagine stuff we cannot see – can you imagine what’s inside?	
9.07		AE – Draw what you think is inside the box .. based upon evidence ... do a sketch	
9.15	A	Sheila – Mike what do you think is inside? Mike – Nothing Sheila – So do I ... I am going to draw a box Mike – That pencil is broken	Negative A – this seems based around the sound of words and how they are pronounced. At 9.49 its based around girl 1’2 drawing of the box.
9.34		Sheila – Idiot Mike – Idiot ... are you stupid? ... When British people say stupid there are about 17 s’s ... ‘Are you stupid?’	
9.49	I	Gwen - ... idiot Mike – A box, it looks more like a corridor Gwen – It looks more like an asylum Mike - your mum Gwen to Mike – What if I told you my mum was dead? Mike – That’s because Sheila – It’s a empty box Mike – It’s, it’s an empty box Sheila – Box Mike – Its an exi oops	They re-engage with the box
10.06		Sheila – I would have drawn it properly but I cannot draw I will just scribble my lovely box out Gwen – Let me draw a box	
10.12		Mike – Lovely drawing that’s self-flattery	

10.37	A	Sheila – I will self flatter myself Mike – Alan is onto something here AE can be heard ‘What’s inside the box?’ Sheila to Gwen – What are you doing? Suppose to be open and not closed box Sheila – What are you doing? I think the box is empty AE – But why does it do what its doing?	Negative A emerges between periods of engagement with the box. A is not related to Init now but includes AE and his use of beans.	
10.43		Mike to Gwen – Don’t, I’m testing something Sheila – I don’t know Gwen – Tension Sheila – Tension		
10.49		AE – Okay ... pulling string back .. something is happening and you are trying to use the words you know ... Sheila – No pressure Mike – But it keeps spinning even when you stop it.		
11.01		Mike – Sheila ... I will make a deadly weapon out of this box Sheila – I can make a deadly weapon out of your pen		
11.12		Mike – Pen is already a deadly weapon ... have you seen xxxx Slams someone’s head down Gwen – I think its empty Mike – I think its empty		
11.22		Sheila – I drew an empty box but they scribbled on it Mike – No you asked her to scribble on it Gwen – That’s an empty box Sheila – inaudible		
12.02		I		Gemma – So nothing in it at all Mike – I think it’s a trick Sheila – There is string Mike – I think the string itself has knots in it right ... they have put knots in to try and trick us Ahh there are no knots in it But there is nothing in it Sheila – Other than string Gemma – inaudible Mike – unless someone cuts it open and proves me wrong ... I don’t see nothing in there, I don’t see nothing in there Gemma – You have said a double negative, you don’t see nothing ... that means you see something Mike – Miss its British slang and I come from the great country of the UK So... Sheila – There must be something in it because it stops Gwen – It’s the pressure of the string ... tension

12.37	A	Mike – I said those words you are just copying off me Sheila – No you didn't she said them ages ago Mike – I literally just mentioned tension 5 minutes ago Gwen – I said them ages ago, I said them to Alan Mike – Alan, I thought he was bean man ... is that not his name? Gwen – Jack in the beanstalk .. Alan and the beanstalk ... bean stories Mike – I don't even think I was in on that Sheila – Literally	Negative A, off task talk with wide ranging focal points.
12.49		AE – Okay what we are trying to do is what people do naturally AE tells migration stories	
13.11		AE – What's inside the box we have evidence etc ... 1 minute get ready to speak	
13.50		Mike – This is discrimination you know, they have given Matthew a small box and the other members of his team a big box ... discrimination	
14.02		Gwen – Well they gave us two small boxes Gwen – inaudible Mike – they gave us two small boxes Mike – Stop knocking my chair please .. its going to be a problem You are speaking to Mr Boldon himself Gwen – Are you going to get your lawyer ... who was it ... Mike – Yeah Gwen to Sheila – Do you remember when he used to say Mike – Thank you	
14.37	I	Mike – How dare you ... I was about to say that you know caught in 4k Caught in 4 k AE now talking and feedback starts from each group in turn Mike – Like a gotcha moment, there is nothing in the box AE challenges Mike to speak	They re-engage with the box till the end of this video clip.
17.28		AE asks class to vote	
		Alan – When you pull tighter the string gets thinner ... it would not stop.	

18.34		AE picks up on this	
18.48		AE – Who is intrigued as to what is inside the box? Think over break ... what do you think? ... what are you thinking more about?	
19.21		Alan – There could be something sticky in it so when you pull it, it stops the box Sheila – Just like a thing that ... Mike – I don't think this box is very high tech Alan – There could be ...	
19.26		Mike – I'm going to see if denting the box changes the way it reacts	
19.40		Sheila – Mike stop trying to sound smart, its not going to work ... Alan - ... does not feel .. Mike – There is nothing inside the box, I refuse to believe otherwise, there is nothing inside the box, this is a trick so Sir can go 'Aha, I got you!' Alan – He said he made them so it could be true AE stops – Right!	
19.49		End of clip Mike - another trick	
0.00		AE input re talking and thinking AE – is that a helpful idea?	
0.53		AE – You are trying to come up with a model to explain whats inside Most science is like this Have a think over break	
1.11			
1.20		AE – What evidence were they using? AE – No think about it over break, what thinking that made them come up with this model? Were they wrong or stupid? Why did they think this? Have a chat before break.	
1.59	I		
2.14		Sheila – Right we need to have a conversation ... being quiet ... get your head off the table (to girl 1)	
2.31			The engage with the next trigger – the image of what people used to think the world was like.

2.56	A	Mike – The way they saw it, heaven was just another earth, around the earth ... like you look at the diagram there is just another earth with its ocean ... something to hold it up around ... Sheila – What? Mike – The reason there were pillars is that they did not believe it was round ... they believed it was a semi-circle Init! Sheila – Stop saying Init Its getting aggravating now Mike – It's my blooming vocabulary Sheila – Not even vocabulary ... do you think you should talk like that ... Gwen ciggi Mike – Ciggi Cigarette ... Alan – Wow , where's me bacci? Alan – Where's me bacci? Mike – Fag Gwen – You know you would not be allowed to say that word unless you are part of the LGBGT Mike - Its another word for cigarettes Gwen – inaudible Mike – It is if you ask someone for a cigarette AE recaps on thinking task for over break Mike – There is nothing in the box, is all a big ploy.	Negative A – based upon the word 'Init' and now others in relation to smoking.
3.09		Mike – Fag Gwen – You know you would not be allowed to say that word unless you are part of the LGBGT Mike - Its another word for cigarettes Gwen – inaudible Mike – It is if you ask someone for a cigarette AE recaps on thinking task for over break Mike – There is nothing in the box, is all a big ploy.	
3.21		Mike – Fag Gwen – You know you would not be allowed to say that word unless you are part of the LGBGT Mike - Its another word for cigarettes Gwen – inaudible Mike – It is if you ask someone for a cigarette AE recaps on thinking task for over break Mike – There is nothing in the box, is all a big ploy.	
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0.00	I	End of clip AE – What ideas did you used to have to explain things when you were younger?	Engage with trigger provided by AE – what things did you used to think that were wrong?
0.11		Mike – Something interesting Sheila – I don't remember Mike – The smaller ones make a click Gwen– If you ate bread your hair went curly Sheila - ... the crusts of the bread AE – Or if you ate apples a tree would grow inside you Gwen – Carrots help you see in the dark Alan – If you ate watermelon seeds a watermelon would grow inside of you Sheila – Your tummy	
0.22	A	AE to Alan – So you ate lots of crusts then	Neutral A related to task completion
0.37		Mike – That man there was a violation I personally would not have it. Gwen inaudible but in same voice as Mike Mike to Gwen – You are coming very close to hitting me in the knee this one	

1.00		AE now starts to explain density cube task	
1.10		Mike – Gwen I need to test that but you have broken it I needed to test that. Alan – Gwen broke it Mike – Gwen you have to give that back ... she has broken your box (said to another group) Gwen – She did	

The footage for the rest of the lesson was corrupted.

Group 1 – Lesson 6 How many are there?

- I - intellectual engagement,

- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Key question – is it worth highlighting the trigger in some way to show it’s impact on the subsequent talk?

Time	Code	Transcript	Notes
0.00 0.07	A I	Alan – Oh my ... I have not even Mike – Each year	AE puts the camera and their question on the desk
0.15		Mike – This is tripe ... Alan – I fractured my fingers Gwen – Ahh, have you Sheila pulling face – Ahh	Mike is engaged and trying to talk to the rest of the group.
0.20		Mike – Each year Sheila – It moves backwards how? New girl – Mine like that Gwen – Mine don’t even go forward, never mind back Sheila – I can do that ... Mike – Guys look, guys look at this finger, fingers on your hands! Sheila – I can bend this one Alan – I fractured these two fingers	Neutral A – shared conversation about fingers prior to task engagement
0.35	A	Sheila – What does it say? Mike – I’m reading it Sheila - I was trying to read it Mike – I was reading it out loud	Still neutral A – arguing over reading the question sheet
0.45 0.55	E	Sheila – I don’t like listening to people read aloud I cannot read out loud, I’m dyslexic Sheila – Each year Mike – I thought you said you were dyslexic Sheila – When people are reading it out I cannot read it New girl – it confuses people	E – sharing of personal information

1.30	I	Sheila – How many are there? New girl – 7 Sheila – 6 million Mike – This is tripe Are they allowed to decide how many fish we can catch Its disgusting. Sheila – What? New girl – I think its 6 million Mike – I’m glad we left the EU Sheila – 6 million Gwen - what are you talking about? Sheila – Fish Mike – Basically ... there is a big evil government in Europe ... that say you are only allowed to catch a certain number of fish New girl – Its says how do they know that the number is rising or falling it does not say you need to like guess a number Sheila – I’ll guess a number Mike – I reckon it’s the birds ... they have cameras in the birds ... because the birds work for the bourgeoisie. New girl – Its rising because of more birds Gwen – The government see ...	All engaged in discussing the questions.
1.53	A	Mike – The government have camera’s in the birds that’s why zoos never have any birds because they are out doing their job	Positive A because they move into the surreal i.e. the government putting cameras in birds – does this verge upon P because its imaginary? Is it just an odd comment so limited to positive A?
2.07		Mike – Hey stop messing with the camera	
2.09		New girl – Say cheese then	
		Mike – No	
2.24		AE input re modelling with reference to the box activity from last time.	
		Mike – I hate the EU now	
		Gwen to Sheila – I have ear ache now	
		AE begins feedback	
2.44		New girl – Ours is about fish	
3.03		AE – who has the sweets in the jar one	
		New girl – Take a big stick and break it	
3.14		Sheila - you would not be that would be fine.	
3.24		AE input on estimation as a human attribute - Lucky guess?	

4.15		Mike – Wait I figured it out AE mentions Floyd Mayweather boxing at weekend and £20 million prize money – Did he get exactly that?	No real conversation here – just snippets between teacher talk – mix of A and I
4.26		AE – Who got the fish one? Tell us what the fish one was and what you were talking about. Mike shares with the class AE – Stop there Gwen – Stop there New girl – Are the numbers rising or falling? AE – How know? Gwen – Fish count	
5.13		Mike - boats with a camera, sonar, ... rough guess then do again each month Sheila – I think he might be right New girl – He is Sheila – I would like to be one of those people who ...	
5.37		AE input on fish conservation, net size, his own survey work and the 12 th August (grouse shooting after young have grown) Mike – Boom	
5.46		AE – Who had the elephant one? Mike – I'm happy with that Mike – You are Mickey Mouse, shut up	Positive A – pupils share their own idea about pets triggered by use of video clip. This further develops around 8.42 as the example of cats in the garden is used to further push this related conversation.
6.09		AE – There's one, there's one how do we know how many? Sheila – How do you know if you counted one several times? Gwen – Draw on them	
6.24		AE mentions wildlife program ... Do you know who Steve Backshall is Deadly 60 guy New girl – Ahh, Backshall .. Mike – I know a Pete Buccannon	
6.54		AE – How do we know when they are hard to see? AE now plays a clip of Gordon Buccannon from you tube with a camera trap and his quest to find tigers.	
6.56	A	AE – How can a scientist work out if an animal is endangered or not? AE – Watch clip and tell us what you think. Mike – You know what I was about to say, exactly that how dare you steal my thoughts Mike – He looks like an elephant	
7.17		New girl – Like one of those guards who	

7.58		Mike – It’s a stripey bear though it was a zebra mate ... Sheila – I want a pet baby tiger Gwen – A cub Sheila – Mm hum Mike – He really wants to bed that zebra	This resurfaces again at 11.41.
8.28		AE – I did that in my garden the other day guess what I saw? Sheila – A hedgehog Alan - Rat Mike – Rats no AE tells story (something eating food in garden etc ... saw a cat and two rats and got rid of them)	
8.42		New girl - Them tigers Mike – My cat brings in rats everyday man AE – I trapped them Mike - You have to keep him locked up because if he gets in the kitchen there will be a rat there. Sheila – You have rats in your kitchen! Mike – Yes, he brings them in Sheila – I think your cat has issues. AE can be heard talking	
9.03		Sheila – I thought you stabbed your cat with a fork Mike – No my sister stabbed my cat with a fork its not dead! Alan - And put in a blender Mike – No my cat got its foot in a blender	Trigger question moves them into I
9.26	I	AE – My question to you and what I want you to think about he spotted a tiger So how would he get a sense of how many there are? Mike – He should strap cameras to himself and stand in the same area to see if it comes back. Sheila – He could run after the tiger to see where it goes. Mike – No see if it comes back to the same area	
9.45	A	New girl – They do that actually Sheila – I’m so smart Gwen – How is your cat not dead Mike – I fork is not going to kill a cat ... my cat is not dead AE – Can I have the questions back please? Sheila – I thought you said your sister stabbed your cat with a fork Mike – It depends how hard you stab it ... my sister was , you know five New girl – Were getting recorded and you I got stabbed in my leg Sheila – You don’t know how funny ...	Positive A – they quickly revisit the cat conversation from above.

10.07	A	Alan – If she stabbed it in the head would it get brain damage? Mike – what? Alan – If she stabbed it in the head would it get brain damage? Mike – This man just hates my cat so much Gwen – Your sister is in the same Sheila – What if you stabbed it in the abdomen?	
10.17		Mike – What if Carl Ferguson bought my cat a lollipop what would happen? Gwen – Well your sister is in my sisters class at school AE – Okay New girl – You had better ... Mike – What? Gwen – Your sister ... AE – You will never, ever, ever Know how many of a species there are a giant otter popped up on my phone after being found in Argentina. hopefully use skills to estimate	
10.45		Feedback and input invited from pupils New girl to Sheila – Your idea because camera Feedback ongoing	
11.23		AE – Some animals you can never see ... I have tried to see some all of my life but so rare Gwen – Koala bear	
11.41		AE - how did they work out ... Mike – Go to the gym Sheila – I want a per baby tiger Mike – Do you want to die?	
11.55		Sheila – I Little tiger ... baby Gwen – I want a baby Koala Mike – I want a Shiba ... I have a hunting dog but I want one of those Shiba's ... like the golden ones Gwen to Sheila - pandas Sheila – Red panda Mike – Red not blue Gwen - ...blue	
12.10		Mike – the ones that have	
12.21		AE – ‘Year 9’, starts feedback	
12.32	I	AE – You might see the same one again Ike a comedy tiger ... being photographed again and again like in Madagascar.	

12.47		Gwen to Sheila – I though he was going to say AE – Lets keep that thought It could be the same animal.... How do we know its not the same? Rare there's one there's one! New girl – Down Inputs from other groups: use distinguishing features, use paint like they do on sheep AE – You could actually spray an animal talks about homing experiments with snails putting tipex on them ... its possible to mark an animal	
13.51			
14.00			
14.14			
	A	AE – Which idea that you have heard could help Mike (to the class) – You could microchip them with a gun AE – Like you do with a dog GMike– Yeah New girl (to group) - ... camera and attach it to them Mike (laughing) – ... and put them in a van till you are done New girl - no you them Sheila– You would have to put it round their necks New girl – inaudible Mike – you are not going to get a baby tiger with that attitude Sheila – I want a baby tiger Gwen – inaudible	
14.28			
15.19		AE now introduces the task of mark/recapture with a story about woodlice Sheila – Ehh (pulling face at the mention of woodlice) AE – Small animals don't know how many there are. AE shows the seeds and explains the task - ... you are going to be given a tub of Mike – Woodlice New girl - it's what Mike – It's the beans (laughing) AE - these are animals Mike – What kidney beans are animals! AE - Look at them and think how many Mike – You could say the is quite wild	
15.25			
15.39			
15.48	A	New girl – 7 Alan – 100	

16.05	New girl – My Mike – The beans, the beans New girl - Why are we always recorded? Sheila – because New girl – Yes, that’s why. Mike – Ahh, the beans are back Mike – Stop it, stop it Why	Positive A – the use of beans really engages and interests them. They naturally want to explore them being unfamiliar with them – this captures their attention.
16.21	Mike – I want the beans New girl – They are in the jar New girl to Mike – Get the bean and pick it up Gwen – Get the bean then, you bean Mike – Kyle took the bean Alan – What G you took the bean Mike – Can I touch them? Alan to new girl – I did not	
16.35	New girl to Mike – Pick it up Gwen – Give Mike a bean	
16.48	Alan – Put a few on your hand and Like kind of squish them New girl – You should show you should show ... because ... him Mike – Beans! They look like nuts not beans	
17.09	Gwen – So do people eat these? New girl – Yes you like boil them ... Alan – Put them in a Mike – have you heard of jumping beans?..... they have these little insects inside of them ... that make them jump Gwen – Jump, jump, jump Sheila – Just so weird Mike – You know what’s so weird though you want a baby tiger. Sheila – Yes I genuinely want a baby tiger Gwen – I want a Koala Mike – Why, why cannot you have a cute dog? Gwen – She has a cute dog Alan – Pick that up now New girl – I don’t know where it is. AE claps hands and talks about populations of animals	This becomes negative A as they move further away from the task.

17.43		Mike – You don't Sheila – Yes I do Mike – My dog is cool AE invites pupils to speak Gillian from group 2 speaks AE explains the task and what to do with the beans New girl – Similar but different Mike – The other beans New girl – Weight distribution Mike to new girl – Do you think we share the other bean bag and they keep the normal ugly beans.	
18.02		New girl – No we get to share the beans Mike – You share the beans with me Mike – Yeah, me and Poppy get the bean New girl – Kind of pop corny Mike – They look like Joes Alan – Kernel Mike – Let me see New girl – Do weight distribution Mike – They are squashy Sheila - my very Beans New girl – What are you doing? Mike – Crunching the beans init!	
18.31		Mike – No way put them back ... New girl – Put them back Mike - Then we will have to Mike – Sheila you are useless you. Sheila – It was Gwen not me Mike – It was both of you AE – Year 9 this is a model because we are inventing something AE explains the task – how could we use the second set to calculate AE invites boy 1 from group 2 to speak.	
0.00			

0.10		Clip 2 Mike to new girl - Beans, I've got a bean still in my hand New girl – There is the bean she ate them all AE – Year 9 you have a lot of skills that can be applied to solve problems ... understanding the skills you have listen to this A pupil from the class speaks then AE shares about using factions	
1.26			
1.50		Mike – inaudible chat about crushing the beans into dust AE demonstrates the task and the need to count the beans taken out etc Sheila – Mike take some beans out of the pot Mike – I have the tiny beans Sheila - not loads Alan – that's loads ... put some back Mike – No You are such a you are trying to control the beans Alan – Shut up nobody likes you	
2.11	I		
2.42		Sheila – Right, okay These ones in there? AE – Yes Sheila – How many? New girl – 17 AE heard saying – write that number down. Mike – 52 New girl to Alan – We are doing 17 Mike – I have 52 New girl to Mike - It's not going to be your thing Mike – I know I've just said New girl to Gwen– You put 17 in there Alan to Mike – G do you want 52 Mike - No I don't want your beans Alan – I don't want your beans either	
2.55			
3.01		New girl – Put the beans in there Sheila – Kyle put the 17 beans in there please New girl – What do I do with these beans? Sheila – Mike put the 52 beans back	
3.21			Once they refocus they move back into 1 as the engage in the correct way with the beans.

3.43	A	Alan – I don't want that one, take it out New girl – Alan, can you put the thing in here Sheila to Mike – You have put an extra bean in there Mike – I actually took one away Alan – I need another bean Gwen – counts to 17 to check, does this twice Alan – Wow, look at that! New girl – I got 1 bean Alan 1 bean Mike – I may have a bean up my sleeve New girl - there were 17, I counted it and he knows	
0.00		Mike – wow, you guys have some epic beans I don't like beans End of lesson - break	
		Clip 3	
0.14		Mike – Would you say you are a big fan of	
0.20		New girl to Alan– Put the cow in front of here Alan – Hello (with the cow) New girl – Sexy cow Mike – So would you guys say there is a big red combine harvester	
0.48		New girl – No Mike - Basically so do I replace with 17? New girl – No we have already have Mike ... leave the beans alone Mike – I'm just touching the beans I'm allowed to touch the beans my beans AE – make sure you have all done the first part, then stop I had 50	
0.55		Mike – It turns out that my 52 was closer ... New girl to AE – Do you put them back? AE – Yes you put the new ones back New girl to AE - Yeah, okay	
1.28		AE to class – You have replaced them Mike – OMG, I have turned all these beans into 1 bigger one! I have made a big beans	
1.51		Sheila – OMG It lights up New girl – Its really blinding Mike– Stop messing about with the camera Gemma moves towards the group	
			Neutral A – pupil talk while waiting for rest of class to return from break. Boy 2 introduces a toy cow which shifts it into negative A – it becomes a significant distraction. A negative trigger from pupils themselves. Resurfaces at 5.31 as they discuss its gender and again at 6.30.

1.55		Mike – I had 52 but they did not want to do that last New girl – We did it with 17 look into it its bloody blinding Gwen – Let me have a turn Ahh Mike – What’s the point of having a baby tiger if you cannot see one Sheila – I can see two dots	
2.14		New girl – Mine are there AE claps hand - Year 9, listen up, shush	
2.18		Sheila – Ooooooh I love it, it makes a sound to Alan – You can have it if you want	
2.39		Sheila – I love it, can I actually have the cow that lights up and makes a noise ... I love it	
3.21		AE – Year 9 ideas AE explains the rest of the task and adds – Has the number changed? All – No AE – So now, as Gillian said, I have 50 marked ones in the population	
4.40			
4.49	I	AE shows the numbers on the board (50, 40, 15). Mentions what three words because of the just three numbers and relates a story about calling the coast guard using what three words.	I - the number aspect of the task re-engages the pupils – started at 1.28. Resurfaces again at 6.43.
5.05		AE – How can we work out the population at the start using these three numbers? Off you go. Mike to new girl – How many of them beans Sheila – I love it!	
5.18		Mike – Get a handful now count the number you don’t have to ... she took out a normal handful	
5.31	A	Alan – Can I take a handful, I want to try Mike – I’m not going to touch those beans New girl – Put some of them back, that’s too many Alan – Leave it not its not New girl – You dropped some of them Gwen – Is your cow a boy or a girl? Mike – Stop being Alan – They are being so ... Sheila – it has boobies Mike – All cows have boobies Sheila – How do you know? Alan – Why are you looking then.	Negative A – focused upon the cow!
5.54			

6.02	I	Sheila – Stop presuming my cows gender New girl – Can I have your cow for a second Mike – I thought it was heterosexual – I apologise Mike – Hey stop Gwen – Lets hope the people watching don't have New girl - does same Alan – I think we should put more of the other beans in Sheila – My cow is a girl and my cow needs a name Mike - No we should not manufacture a scoop – it was a natural scoop AE – you get what you get That's important Girl 2 – I want I want cow Mike – Alan stop re-scooping Alan – I want to re-scoop New girl – Re-scoop them Mike – You don't have to re-scoop them New girl – It needs to be more diverse Mike – No it does not New girl – Yes it does Mike – More diverse does not mean better Alan – Well yes Mike – No Gwen -What does diverse mean? New girl – Diversity Mike – Different Sheila – My cow is a girl My cow is called I need a name Alan – Betty Mike – Betty – we both said the same Alan – I don't want Betty now Sheila – Betty Alan – Call it Bartholomew Barth Mike – A truce New girl – What do we do now? Mike – That's a bears name not a cows ... have you never read Bedtime with Bartholomew the book? New girl – What about the beans? Mike – It's a book about a bear in space Gemma – So how many do we have New girl – 5 Mike – Alan keeps re-scooping	I re-emerges as they debate their sampling technique. Negative A – cow talk again Significant talk based upon the sampling problem. Small amounts of A.
6.21	A		
6.32			
6.43	I		
6.55			

7.34		New girl – Shush, shush, shush Gemma – How many of the new beans do you have in here the original Gwen – 17 New girl – No they are in here Alan – 23 Gemma – Okay 5 in 23 what would the ratio be and how many of the new beans did you exchange? Alan – 5 in 23 it won't divide	
7.43		Sheila – 17 New girl 17 Gemma – 17 ... so how could you use those numbers to work out how many were in the pot? Mike – So what was the original number Alan – So for every 5 thingy beans so how was there 23 normal beans	
8.06		Mike – Right Alan - That's 5 that's 46 Alan – 69 Sheila – 69	
8.19		Alan – So there will be another 2 so you will have to divide and then Mike – Alrighty I have got the 23 beans Alan – Just add together and divide by 2	
8.23		Gemma – It might help you to write down what you are thinking....	
8.35		Mike – I've got the 23 additional beans Alan - you divide by 2 Mike – Aren't we adding more in progressively New girl – No, no leave it Gemma – I like that kind of thinking Mike – How are we ever going to know how many there are if we don't add in more progressively	
8.48		Alan – I'm confused now ...I don't know how you do ratios New girl – I'm in the second bottom set Sheila – I know how to do it if but there is 15 numbers in each New girl – Leave them	
9.01	A	Sheila – How do you get it to 17 there is 2 5 and then 2.5 Mike – I just want to ... New girl – Leave them Sheila - 8 ... no 17 11 Mike – These are bad beans, I don't like them they are ugly Mike – Get off them, they are mine	Neutral A

9.17	A	Alan – Well you are touching them ... Mike – But they are mine now New girl – They were originally 17 Alan – I don't know what is going on I don't know why I am doing maths in science New girl – I'm not Gemma – inaudible because ... Alan – I know but science well I like Mike – Miss of there is something sciencey to do with What does that mean?	G is playing with the beans by sticking them to the palm of his hand. Neutral or negative A?
9.39		Gwen – Sweaty hands Mike – Shut up how dare you ... Sheila – That Gwen – That's the scientific reason	
10.01		Mike – I will turn this into a weapon and beat you with it New girl – What's this for? Sheila – Those beans will never stick to my hands ... so the bean	
10.10		Gemma - ... this is just an extra thing Mike – This definitely hurts quite a bit Gemma to girl 2 – Hannah do you want to explain to the group what you are working out to see if that helps? Sheila – Right okay ... so .. Mike – We want to try and figure out how many beans .. New girl – Then let her explain. Alan - Sheila – shut up G there are 5 beans there and 23 Alan – Yes 23 New girl – Write it down	
10.45		Sheila – 5 ratio 23 then you put 17 ... so you have to get the ratio with 17 and a number ... Alan – A number on this side You have to work it out but if you times that by 3 you get 15 and 69	
11.12	I	Alan – If it was 0.5 it would be 0.5 to 2.3 so you could work that down .. Sheila – Right ... Alan – If you times the 0.5 by and then you times that by 2 which is 4.6 and then times that by 17	
11.22		New girl – Alan you are a genius Sheila – Alan you are a genius Sheila – So we times 4.6 by 17	
11.33			

12.00		AE – Stop I’m interested in what you do with the numbers ... the answer is not that important but the skills you are using are	
12.07		Alan – Did I do it right? Sheila – inaudible reply	
12.22		AE – How many whales if they mark them This is how they do it AE now recaps and focuses upon – What did you do with the numbers?	
12.45		Alan – Is this wrong?	
13.03	I	AE mentions maths skills and models his numbers: Took out 50 then 40 and 15 were marked ... the population never changed. What could we do with the three numbers to work out the population? Get ready to talk in 3 minutes. New girl – Sheila is going to explain	
13.11		Sheila – I need to explain New girl – You are going to explain it to people I don’t get it Sheila – I can explain on the paper Mike – There must be an easier way to figure out how many there are New girl – I do get it I just don’t know how to word it ... Mike - literally yeah, just count them Alan – Well you count them	
13.25	R	Sheila – Say if we had a different perspective and we were trying to figure out the number of cows Say we were trying to figure out the number of cows in the world you are not going to sit and count them Mike - Probably thousands ask the farmers who own the cows how many they have. New girl – You could not they Sheila – You cannot count all the cows in the world Mike - You could if you were dedicated enough Sheila – You would have to use the ratio method to figure it out Mike – If I had Jeff Bazos’s money I would New girl – No G you would be dead ... you would not be in hundreds of places Sheila – Why	R because applying the problem into a new context but then moves into A.
13.47			
13.58	A		Neutral A – general off task talk.
14.31		Mike - Texas, Texas is a great place probably one of the best states.	

14.42	A	New girl – The cow works it works Mike – These are some smelly beans Gwen – Both of them Sheila – What’s his name? AE – Year 9	Negative A – off task and in new direction moving into E because of personal sharing.
14.56		Gwen – Sxxx, what’s his name?	
15.34		Mike – What’s going on I want to count 1, 2, 3, 4, 5, 6 AE – We did not know who many at the start but do know something over here every group is going to share get ready off you go	
		Gwen to Sheila - that’s who it was but he didn’t	
		Gwen – People keep making new ones.	
		Alan – Gwen would you say	
		Mike – Gwen would you say that its another harvest festival	
		Gwen and Sheila– Its another harvest festival	
16.03		Mike – Mrs Dent was a horrible woman	
		Alan – She believed you	
	E	Mike – She was a massive sexist	Period of E as they share personal information re their primary schools and their memories of singing.
		New girl – Did you go to the same primary school?	
16.14		Mike – This woman Miss Dent was the biggest sexist I have ever met ... she had one boy in the choir just so she could compete in competitions	
		Sheila – Get beans	
		New girl – We need to talk about maths	
		Gwen to Alan – Are you good at singing?	
		Alan – No	
16.35		New girl – I went to choir to get away from maths because I hated it	
		Sheila – I was in the choir, I quit	
		Gwen – When I went to Hedworthfield I was in the choir	
	16.51	Mike – I would have been in the choir if I had not been so scared of Dent	
		AE – Just put them back in the pot	
		Gwen – In the primary we used to go in the entrance of Asda	
		Alan – The school went and we sang in that Asda	
	16.57	Mike – You guys got to go down street	
		Alan – We sang in that cathedral thing	
		New girl – We went to the cathedral	

17.21	Mike – Cathedrals are great Alan – I remember when I was in the dance club and we danced to ... Thriller New girl – You had a dance club Sheila – Did you go to the Customs House same Kyle New girl – We went to the Customs House Mike – I hate the Customs House, just go to a cinema	
17.27	New girl – What school did you two go to? Alan – Biddick Gwen – Hedworthfield ... went for a while Mike – You lot went to crap schools I did too to be fair Sheila – Who is chucking beans New girl – Its Ebony	
18.05	AE – Year 9 Mike – If you corrupt our data I will smack you	
18.17	AE leads feedback re marking populations of animals AE – I will show you an example with whales Mike – The country or the animal!	
19.13	Sheila – Alan do you understand the ratio will you speak? Alan – I'll read it out if you want AE – the maths is quite simple but applying it is a skill	

Barry School

Group 2 – Lesson 1 Pepsi challenge

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Clip 1/3

Time	Code	Transcript	Notes
0.00	I	1 in 100 year flood image Gillian – That is what we are supposed to do	

0.58		Trevor – You could open doors, could be on a road Emma – Really rare, not obvious Trevor – Dumb because did not open the windows Gillian – if open the windows it will just get in All smile as a group	I - all engaged in task but Trevor starting to inject elements of A into it because of the scenario used.
2.00	+ve A	Trevor now mimes the window going down and carries on talking – Dumb, tsunami so lets go for a drive Emma plays with her hands Now they move to discuss the weather forecast Emma – How predict a 1 in 100 year flood because it is pretty rare Ron – How predict, not accurate All involved in this chat	They are on task discussing the question but the talk is triggered by their interpretation of the image used but quickly moves back to engagement.
2.39	I	Trevor – Stupid, no common sense Gillian – Low probability, does not happen very often Trevor – 1 in 100 chance I will jump out of window	
3.46		AE now shows the taste test Trevor – I know ... the probability you will like it Ron – 1 in 5 Trevor – Some people like swallowing Emma laughs Trevor – Dirty mind All laugh	-ve A because of inuendo
4.18	-ve A	All discuss the taste test again Gillian - Guys you have to be quiet	
4.38	I	AE stops to focus on the taste test Gillian and Ron both talking ‘That’s what I was trying to say Emma and Trevor both laugh	
4.42	+ve A	Emma – Because those 2 not talking Gillian – Guy’s ... there are two drinks and if close eyes ... 50% chance Emma – He’s putting gloves on Gillian – Someone is going to drink that Trevor – Like a 1 in 10 chance to be ginger All laugh	+ve A because girl trying to keep on track
5.19	I	Gillian – Yeah that probability Trevor – My dad was ginger	I because all engaged and the comment ‘Ginger’ does not really divert them from that task.

5.30 5.52 6.33 7.15	A I	AE now shows the shot glasses – What are we going to do? They discuss what they think Gillian – Don't touch the camera, even though its ... Emma – We have to think about Trevor be quiet Trevor – He is recording us to see what we talk about ... Gillian – We are supposed We did not have enough time. AE stops Trevor – Not sure if you can tell the difference Gillian to Trevor – Put your hand up	Early stages of group identity Mainly positive A due to their focus upon the camera but they stay on task
7.31	I	AE gets the class ready for the test and uses coin to choose who will take it. AE – How many correct so we know they know? Gillian – If you never drank would not know. If ... They talk about how familiar they are with coke/pepsi	Mike from group 1 does the test
10.13 10.20 11.23 11.45 12.45	Neutral A I P I	Trevor – Mike get out, I'll kick your ass Sheila (laughing at Mike) - Power of Jesus Gillian – I don't really care ... put in hand sanitizer Gillian – He will get 3/5 Sheila – He drinks Iron Bru Ron – I have never drank coke Trevor – He has experience of shots The whole class laughs AE – How many did he get? The class now erupt because he only got 3 correct Gillian – Told you he would get 3 Mike – More than average They now discuss the average here AE – Do we think he knows? How find out the chance? How can we know the chance of guessing?	Neutral A because they are talking as a class and Mike, very loud boy, does the test so some banter was always going to be involved P because of knowledge and context triggered by shot glasses – it's a humorous comment and not disruptive.
13.15	I	Lots of talk – very engaged in this context Gillian - ... get less than 2.5 AE – what could we do to find out? All involved in designing a test	

14.48	+ve A	“If not then would be guessing” “3 year old laugh 3 year old’s cannot lie” Gillian – They lie all of the time, they lie more than us	+ve A because of the tangent nature of this comment and the fact this conversation is moving in a new yet related direction. -ve A because becoming more disruptive
15.09	-ve A	Trevor – Ginger Emma laughs	
15.25		Feedback time	
16.30	I	AE shows coins Lots of side talk all time - I Trevor and Gillian – both laugh Ron – Would be funny if always tails Trevor – What if it lands on side – 0.5 Trevor and Ron make noises with the cups	
19.15		They all laugh because coin on floor Gillian – What is he writing?	

Clip 2/3

Time	Code	Transcript	Notes
0.00	I	The group are coin tossing. Trevor – He is too perfect 4H, 1 T Gillian scribes Trevor – 2H, 3T Ron – I’m I’m (happy) 2T, 3H	Great interest in the coins Clear pleasure/happy sounds and intonation
0.26		Last one Gillian – Okay, lets do some maths ... how often did we get ...	
0.39		Ron – You just have to count the heads Trevor and Gillian play with the coins All laugh	

1.00	Neutral A	Trevor – Money is dangerous Gillian – 1, 2 Trevor – Don't blame me, blame it on physics Trevor to girls – Try, throw it Emma puts coins in cup Trevor – You are soft Gillian – counting to self now	Boy 1 playing with coins and cup and he seems willing to distract the rest of the group but still on task so neutral A
1.18	Neutral A	AE directs the class to answer the questions	
	Neutral A	Gillian – $\frac{1}{4}$ 2 out of 10 Trevor makes some comment in rhyme about the cup Trevor – Who made this cup? Angela .. she drew the tree the same size as the bird All laugh Emma comments Trevor to Ron – My cup I'll Gillian to Emma – This is really hard Emma – What's the probability? Gillian – 2 out of 10 or $\frac{1}{5}$ Emma – So its $\frac{1}{5}$	
	I		
2.57	A both negative and neutral	Trevor plays with cup Ron – Trevor stop Trevor carries on and the rest of the group disagree with him Trevor trying to throw the cup and coins, Boy 2 tries to take it off him Trevor offers it to Emma and both laugh	A because the pupils try to stop Trevor (-ve A) from disrupting the activity
3.01		Trevor – You want it back he talks to camera 'She is stealing the 2p's' Trevor to Ron – Put it back Trevor – I am a hobo, put the money back Ron – He is homeless, give him the money Ron puts a coin in the cup Trevor to Ron – Thank you kind man Trevor still throws the cup	Lots of elements of humor here but they are related to disruption and annoy the other members of the group
3.26			
3.32		Gillian – These ones come up 4 times, they were the most common Trevor throws cup 'I'm just here for entertainment Gillian - 3 out of 5 or 2 out of 5 $2\frac{1}{2}$ out of 5 one half Trevor – Why did we just not Why did we not do the 2ps like this?	

3.46	I	He throws cup and coins	
3.54	All A – mainly negative	Gillian removes the cup from Trevor ‘Stop messing about’ Trevor to camera ‘See that, that’s bullying Emma places cup out of reach Trevor now picks up a book ‘I cannot read’ and puts it back Emma laughs	As above – the group are now off task because of Trevor
4.19		Gillian to group – So we know that Trevor – I want my pen Emma – You have that, say 2.5	
4.30		AE focuses upon feedback ‘Pick someone to speak’ Gillian – Can I do it? Trevor – Can I have my cup back? AE gives a 1 minute count down	
4.47			
5.09		Trevor still complaining ‘Took my cup’ Gillian – Yes because you were ... Trevor – I want to do flips Ron - Sit down Emma – You can have the cup if ... you go to the front and do a flip Ron – I would like to see that	
5.43		Trevor picks up camera and points it ‘These people are bullying me ... I am being bullied here .. you are bullying an autistic child They all look puzzled	
5.54		Emma ... inaudible Trevor – I can I’m autistic Trevor to Emma – You are just weird Trevor now bangs hands as he settles.	
6.30	I	Class feedback starts	
7.15	Neutral A	Emma and Trevor discuss the probability Emma – 10% Trevor - 10 10	Trevor does re-engage so this is neutral A as it does not really detract from the task
7.39		Trevor takes paper and its it with pencil over table edge Both girls discuss the answer	
8.06		Gillian to Trevor – Can I have a pen to do some maths? Trevor - No	

8.34 8.39 9.10 9.30	I I I	Both girls and Ron discuss the answer Ron - I have a calculator Trevor and Gillian trade the pen for the cup Emma to Trevor – Trevor tell me the numbers Emma helps Trevor – Not sure what to do as so many numbers Girls discuss rounding AE makes point that no-one is wrong Gillian tries to get Trevor to focus Gillian asks Trevor for a coin Gillian – We need to add get an average Trevor to Emma – It might be if you had ..	
10.04 10.30 10.49 11.00	-ve A	AE sums up the strategies Trevor to Emma – What kind of science is this creepy Both smile Gillian interacts with Trevor, puts hand on table, fingers spread, and he bangs pen between fingers Trevor – That’s easy Trevor bangs pen faster Both girls discuss possible answer ‘Need to do an average’ Emma stops Trevor, helped by Ron Ron to Trevor – I hit my thumb because of you Trevor - I will shove you in the bin Gillian – Calm down Trevor and Emma discuss some shared memory Gillian – Guys do you think maths is better than English Trevor – Depends Gillian – English is way better All comment	Trevor does move them off task – so -ve A
11.22 12.30 13.30 13.40	Neutral A	AE stops to cumulate data prior to drawing the graph Whispered fun chat between Trevor and Ron ‘Sorry little boy’ Trevor – 6 groups did it Emma stops him – Its nearly lunch time Trevor and Ron chat Trevor starts to sing to self, Emma and Ron do not respond Trevor gets percentage wrong – 30% instead of 15% Trevor laughs – I was close	Trevor copies AE’s voice

14.20	I	The rest laugh at him Trevor and Emma discuss the answer	
14.30		AE – Why do the numbers do that? What are the numbers telling us? AE – Talk about that	
14.45	I	Trevor – I don't have a clue, I don't understand Gillian – The average Ron – The fraction Trevor – Its trying to tell us that the percentage	She touches him at this point
14.52		Gillian – Trevor, what! Gillian - Its not all about how big the numbers are .. Emma to Trevor – Go stand over there in the corner Trevor – I can't, I am already in a corner Emma – Go to the naughty corner Trevor and Emma are silly 'Little boy heard'	Trevor annoys Emma Neutral A because they do not stray far from the task
15.05	Neutral A	AE stops – No-one is wrong etc	
15.20		AE – Gabrielle is saying Trevor talks to Ron, Emma stops him	
16.04		AE focuses upon sketching the graph – What's happening? What is the chance? Ron and Trevor discuss the graph Trevor thinks Ron says ground instead of graph and so traces the ground with finger Trevor – You talk to quickly All laugh	There are elements of humor here that may cause this to move into P. Trevor's comments are included as part of the peer talk. More likely it would move to neutral A
16.41	I	Emma – Graph goes like this because that's the way graphs go	
16.52		Trevor – I'm entertainment, this lesson I have made all of you laugh, mostly at me Gillian – At you, not with you.	
17.22	Neutral A	Emma and Trevor talking Trevor – You are annoying me with your teeth thing Trevor and Ron are saying silly words	
18.00		AE now asks 3 questions about the graph: Why do this? What chances? What happen if we carried on?	
18.30		Emma moving hand Gillian and Emma – Keep going straight Ron – If get different results it will go down Emma moves hand down Ron – It is basically a straight line Trevor talks about the camera	Ron says results that justify levelling graph answer Engaged with the graph activity.

		Gillian discusses why straight Ron – It means all the others have to be very similar AE stops class Ron and Emma chat in agreement Trevor makes comment to Emma	

Clip 3/3

Time	Code	Transcript	Notes
0.00	Neutral A R	AE taking feedback on the shape of the graph. AE – stays same but wiggles Trevor – ‘Wiggle!’	Pupil answer Does action with hand – talking to self This creates lots of discussion and thinking out loud Reflection/surprise because they are surprised at the shape of the graph that levels off
1.10		AE – If we did it 1 million times it would stay the same Trevor – I think anything could happen wont wont Diff outcomes Ron to Trevor – I’m not putting my hand up for any of them	
2.15		AE – What is the graph telling us Lots of chat re the 25%	
3.03		AE looks at G results and the meaning of 1 in 4 Class focus upon why the graph levels In discussion Emma moves hand to show answer	
4.54	I	AE now moves to the context of probability in health and the treatment for his dog – 70% chance of a cure. ‘What questions would you ask the vet?’	
5.23			
5.33		Trevor – What tested upon? Ron – 30% Trevor to Ron – 25% you dafty Trevor – He said 75% Gillian – No 70%	
5.53		Gillian – How many times tested?	

6.19	E	Trevor now makes ‘hmm’ noises to the camera Emma – Side effects ... if tested and worked Gillian – It had on 10 but 3 died Emma – I had a pet die Gillian – I had Trevor – In my life I have had 3 dogs but 1 died Emma – I have had 3 dogs, lives with me now. 1 died and 1 lives with mams friend Trevor – All are dead now Emma shares something about another pupils Ron – Same 5 dogs	E – trigger by teacher talking about his pet results in pupils sharing their own pet histories.
6.37			
6.57	I	AE mentions drugs out of license and cost etc Gillian wants to speak – Side effects Trevor and Ron argue over answer Trevor – I was right 600, 000 AE – Sample size All group argue over 6 million or 600,000 and laugh Gillian – You need to get your ears checked.	

Group 2 – Lesson 2 Exponential growth

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Time	Code	Transcript	Notes
		Footage from the start including the graph challenge. Very concrete start – aiming to make link with covid spread. The use of real corn increases the risk of A behaviour.	
0.00	A	All talk about the camera (if it is just audio recording) Emma – It could see last time AE models thinking @ start, remembering biology from when he was at Barry School	Neutral A
2.44	I	Emma – I have no idea what is going on Trevor – Blue is the balloon Emma – Rocket builds up constant speed but air balloon Trevor – Rocket is not at a constant speed, balloon is the constant line.	I – they are very engaged with the graph activity. Both graph scenarios prove to eb strong triggers.
3.23		Trevor to Gillian – Move your coat. Don't know where the pen lid is.	
3.33		Trevor – Blue is the rocket Gillian – That line is that the	
3.45		AE Input re graphs ... way to look at the world	
5.40		AE draws new graph showing plant growth	
6.16		AE – What happens after the 16? Emma – Denatures Trevor – Dies Trevor – If growth ... curls over or dies AE stops AE – Still growing but by less each day	
7.22			
8.30		AE starts the corn problem with image and story	
8.33	I	Trevor – Chinese Emma – That's not really Chinese Trevor – Do you even need a bull ... Emma – Everywhere Trevor – Just smacks old women Emma – Bulls are everywhere Emma – Is that a chess board?	Engaged in the task but discussing image so a range of ideas and related thoughts emerge
8.52	P	AE input re the clever man to intro the story + gives out the corn Gillian – I'm a wise man ... all I want is some corn Trevor - Plays checkers Emma – They are going to play for corn	Now P because of the fun element of corn

10.04		Trevor – This kid cannot count Ron inaudible	Interesting mix of talk here triggered by the use of a chess board and corn.
10.46	A	AE explains task + ‘Allowed to use brain’ Emma – Guys, shush, this is important Gillian – Can I eat this corn?	
12.26	A	Task starts Trevor – Not much of a chess board Gillian – Are we doing the whole chess board? Trevor – most racist chess board – when were they only white? Gillian mimes corn	
13.00	I	Emma and Trevor argue over the board Trevor – Just write, he said we could just write if could not fit the corn on the board. Gillian - you can put the corn on after Alan agrees Gillian to Emma – That’s not how it works Gillian – Just doubles each time.	
13.18		Gillian and Alan help Emma – 2, 4, 8, 16, 32 Ron – Don’t know whats next Gillian – Give it a second Ron – 128 Emma - 256	Negative A creeps in here as the behaviour moves off task and the use of real corn triggers this disruption.
13.29	A	Emma – You have a calculator don’t you Ron – Yes I forgot about that Machine Emma times by 2 Emma - Trevor that’s really disgusting ... I suggest you throw some at Harvey	
13.50		Trevor – Harvey ... you try it Emma throws corn Trevor – Why throwing corn, don’t waste it Emma – Where is it?(Laughing) Ron – This might take a while	
14.01		Trevor - I take the corn Gillian – I take the corn	
14.28		Ron writes the numbers in the grid. AE gives the group a second cup of corn Gillian – We have some but we don’t trust Matthew with it.	Inaudible A chat started by Trevor because he is unable to get the corn

14.46	A	Emma throws corn Gillian – That’s enough Trevor and Gillian – We have two cups Emma – Okay lets count (places corn on the grid). Trevor to Harvey – I don’t even eat corn normally (he smells it) Gillian – Just numbers we cannot fit Emma – Popcorn is delicious	The chat here is mainly about the camera and their views – neutral A. Happened as a consequence of the context.
15.01		Gillian – We are just going to have to stick with numbers for a while Gillian - Trevor stop eating the corn	
15.20		Emma – Trevor, that’s really disgusting actually (repeats again)	
15.28		Gillian – What have you got, 32? Emma – We wont have enough space for 64	
15.54		General corn chat - inaudible Ron - I’m in the millions Trevor – inaudible Gillian – You are annoying Gillian – At least he is actually doing something Emma – Yeah That’s a lot	
16.09	A	Trevor – Take my corn you peasant Emma counts corn Trevor and Gillian laugh	
16.33		Trevor – Harvey, Harvey (points to camera) Emma – Its not a camera Trevor - It is	
17.00		Emma – It’s a voice recorder	
17.12		Emma – Think its time to stop, yeah Trevor throws corn Emma – You are going to be in so much trouble	
17.18	A	Gillian to Emma - Remember how I used to wear those earrings	
17.30		Trevor – Head shot, Harvey I am going to try and get this in your cup	
		AE focuses class Lots of quiet and general (neutral A) chat during this time but inaudible	

19.10		Gillian to Trevor – What doing? He is making a pile of corn	
19.40	R	AE now gives out the conversion info Emma moves the paper to see the numbers and the corn Emma– Imagine getting a million Ron – Pretty sure I got to a billion! Gillian – I am up to 7 ... Ron - Up to 200 million!	Real surprise at the size of the numbers involved triggers this.

Clip 2/3

Clips split because of memory storage on card but continuous footage

Time	Code	Transcript	Notes
0.06	I	Ron – He has 200 tons That means 2g 2 million	Natural mix of I and neutral plus negative A – distraption is triggered by Boy 1 and corn being thrown from another group. Also expected behaviours such as piling corn up which is not negative engage the pupils.
	A	Emma throws grain back, Trevor joins in Emma – Who is going to pick that stuff up Trevor – Stop I am trying to make a corn pile Ron – There is 400 million grains of corn Emma – Now Trevor don’t eat any of them They all count corn and talk about the corn on the floor Trevor – I’m making a pile of corn, corn Everest Ron – 500 million Trevor – Kernel Everest Unsure who speaks - Its not a mountain Trevor – Pile Ron – For a party Everest Trevor – But it will be ... Gillian – We got to 64 (laughs)	
1.12			
1.55		AE stops to focus upon the numbers. Gillian – I got 64 Ron – For some reason I feel this work	

2.30		Trevor – You are being quite corny now ... Emma to Ron – I'm in the millions Gillian – Can you not Gillian – I have just got showered with corn Emma – That was a kind of bad throw Emma – No Gillian he said to put it back	
2.41		AE stops to focus upon the 3 questions	
3.33	R	Trevor – Too much Emma to Ron – How much is 200 tons in grams? Ron – 4 billion grains (amazed look on face)	R because of the real amazement at the size of the numbers of corn.
4.01	A I	Trevor – How come the radiator ... Ron to Emma – He has 4 billion grains x 2 ... I don't want to do that equation ... I feel its Emma – But we do need to times by 200, time by 200 Trevor – Harvey Ron and Emma say together – 1000 x 200 Why did I even use a calculator its 200,000 Emma – Its hard Emma – Yes I told you its hard Trevor and Emma chat Ron – So 200,000, it is 1000 X 200 is 200,000 Emma – It went in your hand but you did not catch it Emma – Just corn, its going to be dry You don't have any flavour Ron – Grams to KG's x 1000 (reflecting out loud) Emma – 200 grains is 100g Emma – Trevor, how many times does 100 fit into 200,000 Trevor – 200 times Emma to Trevor – Divide it Ron – You need to turn it round Emma – Who even threw corn, was it Harvey? He was turned around Ron – Do 200,000 divided by 100 so 2,000 (he now whispers something and smiles)	Negative A linked to Trevors's disruptive behaviour
5.09		AE stops to focus, prep to talk instructions etc. Emma – Grams of corn I think its 4000 x Emma – 200 is the same as So if 2000 then Ron – They cannot be Trevor – My head hurts Ron – If that's rounded, 200 becomes 1 gram ... equals ½ gram	The level of engagement continues till 8.17
6.00			
6.18			
7.44			
8.17			
8.36	A	Trevor – You keep messing with	Neutral A because the group is trying to control Trevor

8.40		Gillian – I think its coming from Trevor – I will make you eat a chair	
8.53		Gillian – I said	
9.19		Gillian – Trevor we need that .. Trevor – I will capture on camera that I am cooking corn AE stops class Emma – Its not on Trevor Trevor – Just keep quiet and let me dream Trevor to Gillian inaudible	Lots of A chat between Trevor and Gillian – quiet chat as AE talks etc Positive A because off task and related to cooking popcorn
9.40		Emma – At last I have some corn Trevor – Actually I have corn in my pocket Emma to Gillian – inaudible	
12.15	A	Trevor feeling a bit corny Gillian – Does that look	
12.26		Trevor – It has gotten lighter ... I’m going to make popcorn – any of you have any salt? Emma – I don’t know what to write Trevor sings ‘Hey Macaroni’ quietly	
13.34	A	AE – The king runs out ½ way Emma - Matthew! Trevor – my popcorn	Much is inaudible here
4.18		AE – the king had 400 million grains and it was not enough	
14.30		Trevor – But why corn? AE – language is a problem, this is a massive number .. I cannot quiet imagine it Feedback from the class	
17.03		AE comments: powers + how much corn to make a loaf of bread Trevor – Corn in bread ... flour	
18.05		Trevor – making tables AE – Why?, What is like this? Ron – No idea Trevor pretends to throw pen Emma - The wise man most defiantly trusted in his plan	

Clip 3/3

Time	Code	Transcript	Notes
0.00 0.29	A	AE feedback – 1 minute to prepare to speak etc Trevor – Look, corn in hand Ron - Who is speaking? I am not I spoke earlier. Gillian – I think Trevor to be honest Trevor tries to cut corn with scissors and talks to another group Emma – Trevor you are talking Trevor – I am speaking Ron – What are we speaking about? Emma – inaudible Ron – What are we getting him to say? Ron – What are we getting him to say? Trevor – Harvey Science	This is neutral A because its associated with the task but more about their response collectively
1.09		AE stops class Emma – What am I speaking about?	
1.40		Emma – I only have two pieces of corn	
2.39 3.12 3.13	I	AE – Exponential – what does that make you think about? Emma – Potential Trevor – Big Ron – Big word Gillian – To me its bigger Ron – That’s a big word Gillian – It has the potential to get more Emma – inaudible	The meaning of the term exponential engages. They stay on task for the rest of this clip.
3.33	A	Trevor to Ron – Imagine you as Mr Sheen (he laughs) Gillian to Trevor – Why did you Corn ... Trevor – Imagine him baldy, like Mr Sheen Emma to Gillian – I don’t know why but	
3.54		AE input on penny dropping, word on tip of tongue	

4.14	I	AE mentions R number All the group repeat + laugh Trevor – Big number Ron – Big number, small number vague number Number (he laughs)	
4.36		Gillian – I thought radius Trevor – Did Gillian just AE talks about R number Ron – R number Gillian – Infection rate ... where did that come from	
5.03	A	Trevor and Gillian – Harvey Trevor – Imagine baldy like Mr Sheen	
5.20		Trevor throws corn	
6.19	R	AE stops – What did you just say girls? They mention the infection rate AE - How does this help you to understand the virus? Gillian – Shows who it really infects	Reflective at this point – R
7.23		AE - 2 questions: How help understand? Where else might this apply? Gillian – Not just about the virus ... any infection really	
7.39	A	Gillian aghast – He hit me in the throat Trevor – Do you want a thing in your throat? Gillian – He thought, you thought Ron – What are you two talking about? Trevor – Something All laugh now because of innuendo Ron – Its one of the two things I am thinking about Trevor gently throwing corn – Death by corn Ron – I don't feel safe here	Negative A – off task talk by three of the group triggered by corn being thrown.
7.59			
8.02			
8.25		AE – Anyone think of anything like this etc? Gillian (in feedback) – When you see a number you don't really think of people but seeing the corn really helps AE input on exponential	Real surprise and reflection as connection made.
9.15		V quiet chat to end	

Group 2 – Lesson 3 Sampling beans

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Clip 1/3

Time	Code	Transcript	Notes
0.00	A	Trevor – Is that a voice recorder? AE – Just sees hands and your voices Gillian – So	Neutral A chat prior to lesson starting
		Trevor – See that, vandal's ... whats on at reg	
0.42		Trevor – No Ron – Don't touch it Trevor – Only hands, if point at face it won't see it, just sees hands Ron - Because it's there Trevor – Only sees hands	
1.04		Emma – If point up will see face Okay shut up	
2.00		AE recap on previous lessons. Have you made any thoughts, connections etc? Have a chat about the activities etc	
	I	All say popcorn and laugh Ron – That's three that only thought popcorn Gillian - radiator for making popcorn	Positive A because of high level of interest and talk + no disruption. This theme runs through this lesson for this group. The talk is a mixture of I and positive A.
2.17	A	Emma Hmmm Where do you think the center of the world is?	
2.24		Trevor – The center of the world Ron – Where the core is	

2.39		Gillian - between Trevor - ... new Jersey Gillian – I always got told USA..... Emma - ... Like What should be in the middle of the map? Trevor - center of the earth ... Africa Gillian laughs Emma – Africa is at the bottom ... Ron – Middle Gillian – Like China Trevor – China (in a funny voice) Emma – Middle east Trevor – I don’t know Emma – We are ...	
2.55	A	AE stops and encourages to talk Trevor - Emma – N Africa Gillian - ...	
3.04		Trevor – Mexico Emma – America	
3.30		Emma - if you think about big Earth	
3.45	I	AE now mentions taking a stool sample Emma – Stool is poo Trevor – Needle Stick a needle into and take whatever AE – Stool equals poo	
4.01		Trevor – Like when sitting down Trevor - make your own sample	
4.18	A	Emma – Trevor you did not answer the question Trevor – What question? Emma - you think the big earth is? Trevor – Nah, I think God was playing golf ball Emma – Interesting theory	
	I	AE – Take a sample, where have you come across that before? Trevor – Eating food ... free sample .. when they come out and say ‘Do you want some sausage?’ Emma – Covid test Gillian – Dixons (she laughs at this) Ron to Emma - ... into a shop .. on the table ... free sample	The very nature of the trigger engages the pupils. Emma now begins to ask Trevor her meaning of life questions. Negative A as off task but not disruptive. Is the trigger not strong enough to focus and engage? This carries on for about 6 minutes. Re-emerges at 14.04

5.06	A	Emma – Soap as well, moisturizer, when they put it on your hand AE shows images of ‘sampling’ and gets feedback Emma – Trevor, are you being serious when you say that God was Trevor – inaudible Emma – Not really Trevor – Its all to do with balls This world is a ball, humans come out of balls Emma – No they come out of the uterus Gillian and Emma – inaudible Trevor – Ovary, egg ball Gillian - no not a ball Trevor – Sperm comes out of the balls ... the balls Emma – Would someone like to explain this to him. Emma – inaudible Gillian – laughs Emma – Personally would not work Gillian – It does actually Emma – Guys, turn around AE – Music All – Yes Trevor mimes being a DJ Emma – Finish your sentence Trevor – She does not Trevor – inaudible Emma – It’s a ball not a golf ball Gillian – I don’t think it was the big bang ... just so cold that everything was stuck together (Emma replies inaudible) Gillian – Yeah but what if God I love how God can talk about popcorn. Trevor – Beans, beans Emma – Say you are right ... layers come together what do you Trevor to Ron – Who do you think created the earth Trevor – The earth was created by beans Emma – Everything living on the planet has to be ... so if you are right ... it would be empty. Trevor – Sir, I want the beans Ron – You are not having the beans, you will Trevor – I will not Gillian – Unless God made a mistake ... Emma – Don’t give it to him Gillian – Dog food?	
6.04			
6.22			
6.42			
7.05			
7.24			

7.37		Emma – Can we have another one? Emma – Trevor is going to .. Trevor – I did not know what I was doing Ron – These are beans? Emma – Beanstalk	
7.53	A	Trevor (funny voice) – Beans Emma – They look like the magic bean but anyway ... how did humans behave then? Gillian – God knows I Gillian – Ahh yeah .. Trevor – Are these edible? Emma – No I dare you, I dare you yes, yes, eat it	Positive now as they engaged with the beans
8.22	I	Ron – No eating the beans Emma – Eat the magic bean AE stops class – How many variables? Gillian – What’s a variable? Trevor – Shape, colour, shell ... Gillian – Size	
8.48	A	Emma - Anyway Gillian, what happens when we die? Trevor – These are my beans Gillian – That one feels like Emma – What if I could not ... Trevor – Beans Ron – You just die and become beans Emma – Why are we here in the first place if just going to die? Gillian – I said to my mam the other day ... I did not ask to be born	Mix of neutral and positive A Also some E based upon the personal sharing of Gillian
9.00		Trevor – That is the most perfect bean Emma – You did not I did not want to celebrate my birthday, I did not want to be born	
9.11		Emma – This one I want to keep this one for the rest of my life Gillian – In a box	
9.30	A	AE – feedback on variables Emma – Guys I can lift it off Trevor Gillian – Do you think all teachers write their Z’s like that? Trevor – Speed	Negative A – now off task and the conversation is vary varied and includes many topics.
10.00		Gillian – It’s a ... Trevor – Spinning force Emma – Momentum Gillian – I think that one went smaller Trevor – Beans, beans, my beans	

10.30	I	Gillian – That’s was so exciting, can I have my bean back please? AE – Which variable is the most important for growing? Gillian – Size Emma – Trevor, Trevor Trevor – Bigger beans bigger AE – Say that again Trevor – Bigger beans, bigger price Emma – More beans, more ...	
11.03		AE – Who agrees with Trevor? Who thinks that could be important? Emma – I disagree Trevor – Long beans Emma - not worth it	
11.30		AE – I would want big beans. Is there a problem with this, people wanting big beans? Talk about that.	
11.45	A	Gillian – What, what are we talking about? Ron - If you want Not sure if he said big beans or baked beans Emma – He said big beans Gillian – I think he means Big not baked Ron - Trevor – I still Emma – You took my perfect bean Trevor - Emma – You don’t get ... Trevor – OMG I have two perfect beans	Positive A because everything here is triggered by the beans
12.11		Emma – Anyway, where did humans come from? Ron – They came from monkeys Gillian – But where did monkeys come from? Ron – They came from Trevor – The water	
12.19		Gillian - ... Ron – They did not Trevor – They came from fish Emma – Did they? Ron – Evolution	
12.30		Trevor – You like beans, you like jazz Gillian – No ... weird Trevor – Prefect beans AE – feedback	Negative A resulting from Emma’s meaning of life-type questions.

12.45		Emma – the earth is not like a golf ball ... its too complex Trevor – Did I not say ...	
13.00		AE – questions on board – What goes in a packet? What’s the problem here? Gillian – Beans Trevor – Big ... Emma – Bouncing bean	
13.38	I	AE finishes Gillian – They should just not sell the big ones ... have loads of little ones left Emma – Yeah, you want a mix different packets Trevor – He is changing what I said .. I said the bigger they are the better Ron (silly voice) – You out the big beans in this packet and the small beans in this packet Emma – So if energy cannot be created or destroyed Energy .. Ron – Talk about beans here Gillian (laughing) - all the beans in ...	AE’s question triggers their interest.
13.47		Emma – If energy Trevor Trevor, if energy cannot be created or destroyed ... then after we die, if we have energy in our bodies where does it go? Ron – It leaves our bodies but Gillian (inaudible)	
13.58	A		Negative A – girl 2’s questions dominate
14.04			
14.33		Emma – where does it go space? Ron – Space you talk about beans. Emma – I want to energy AE gives each group a number – You are 7 Trevor – No I am 13 Emma (inaudible) Gillian - ... as the witches in the Say energy flows back into the Universe and they take it back out ... Emma – Universe It would still be in your body .. Gillian – We get put in the ground Trevor – I bean Emma – But it can’t do that but also Stop AE claps hands to stop for feedback Gillian – We are 7 so that is fine	
15.01			
15.24			
16.07	Neutral A	Gillian – Stop Emma – Trevor, not just for you for everyone	

17.00		Trevor – Putting beans back, this is mine, this is mine Trevor – I’ve dropped the perfect bean AE – What word are we using without understanding, how do we know which is which? Mentions fairground rides and height limits – have you ever been. They all agree	
17.30	I	AE – Measure beans to decide what makes a large one ... off you go Ron – A big bean is one that Trevor – It’s not you Ron – Is bigger than this is bigger than normal Trevor (gets all beans) – Your not tall, you are ... Emma – You think If we die we have to have somewhere ...	
17.55	A	Ron – Why are we talking about earth, death and energy? Emma – Okay, me and Gillian will talk about it AE gives out paper Trevor – Sir is this supposed to be broken? (the cup is split) AE – Yes its not very strong Trevor – Supposed to be broken (shows cup to camera)	Negative A – see above re Emma’s questions
18.19	I	Gillian – This one is small Ron – We need to measure the beans (repeats) Trevor – I will get the perfect bean Gillian - bag earlier (!)	
18.34		Emma – Guys do any of you have a ruler? Gillian – This is twice the size of the other one Gillian – Little and big	
19.08	A	Trevor – Why are you trying to cut it? Gillian – So I can see what’s inside Trevor – Its just normal Ron – A bean	Positive A – they are fascinated by the physical beans
19.11		Trevor – Let me see it’s a small bean now ... I want it Gillian – It depends upon your standards your standards Emma – I dare you Gillian – Standards Trevor – I want to eat it Ron – Don’t Emma – Do it Emma – Do it, do it, do it	

19.44	I	Ron (grabs bean) - ... poison Ron – Since we don't have anything to measure with Trevor – Use your finger Gillian – Will it work (smiles) Ron – Okay, little, little, little .. if they are similar to my finger they are little	

Clip 2/3

Time	Code	Transcript	Notes
0.00	I	Ron (pointing to beans) – Little, big, big, little etc	Begin with neutral A with some aspects of E but by 1.21 moves to negative A as they discuss other pupils they know.
0.28		Gillian – Trevor, apparently this is the size of them	
0.39		Emma – We have the perfect bean Gillian – I aint no perfect bean Gillian – I was sitting in the car with my mum and Stacey turned to me and said 'You ain't no perfect ...' I said Ohhh	
0.45		Ron – Actually I need to	
0.50		Emma to Gillian – Are you buying fruit everyday Gillian - I buy fruit everyday because I cannot be bothered to make a packed lunch	
1.01		Gillian - What is wrong with Emma – Perfect Gillian (picks up bean) – Whats wrong with that? Ron – We have Ron – Prefect bean Put the perfect bean back Put it back	
1.14		Emma –Trevor I will chop your finger if you dare take my ½ bean	
1.21		Ron – These are small, these are big beans Gillian (laughs, to boy 1) – You look like ... Ron – He is weird, don't look at him Gillian – I sat next to him for a whole year, he smacked me across the head with a plastic bucket	

1.58	I	Emma – When was that? Gillian - Year 8 ... he got Emma – Ahh Ron – That’s assault because Gillian – He is abusive, he tried to put On me once Trevor – Missed! Ron – Stop Trevor – She is the one chucking stuff Ron – Don’t throw the scissors put the scissors down Emma – No I will never	
2.18		AE stops for feedback Emma – Its worth going to prison	
2.27	I	AE – 2 small and 2 large measurements. Gillian – These are the large ones Trevor (funny voice) – Black bean AE – 1 minute to prepare. Ron – I think this seems right ... that seems about right	
3.08		Gillian – Beans do not have a smell cause they are cooked, right! Ron – Big, medium, small ... say they have to end Emma – Put them into extra small Ron – Okay then, extra small ... it depends how small that is compared to that one Will do the finger test on them all. Emma – that sounds very inappropriate	
3.36		Ron - These are so dirty Emma – Okay, this one is extra small	
3.57		Ron – Look Gillian – I have to wait for Trevor to say something so that the camera will turn itself off Ron – This here is like Big, medium, small, extra small	
4.08	A	Trevor – I A bean Emma – Or small, medium, large, extra large Trevor – This is you perfect bean Gillian – My perfect bean Trevor – Can I keep your perfect bean? ... I want my bean Emma – Smallest of the small Trevor – Give me the bean bean bean	They now re-engage with the bean task – positive A also features due to their interest in the beans. By 4.08 they are discussing the perfect bean.

4.53		Emma – Ron, you are supposed to be the organized one	
5.04		Ron – We don't have any numbers on them	
		Ron – They are not really rulers but I might have part of a ruler	
		Emma – Part of it?	
		Ron – Trevor broke this one	
5.19		Trevor – Give me the beans	
		Trevor (to Gillian) – What are you singing? I think you are the kind of person that signs weird songs	
		Gillian – That's the song ever	
5.27		Emma – Josh said to be more	
		Trevor – I don't know what you said	
		Emma – Josh said before that he wanted to	
		Trevor (funny voice) – Beans	
		Gillian – Do you mean that 34/35 song	
		Trevor – Hmmmmm ... no	
		Gillian - 34/35	
		Trevor – A song	
6.43		AE asks them for feedback	
		Trevor to Ron – Small man	
7.04		Trevor (whispers) – Pretty Beans	
		Gillian – Bean stash	
7.18		Trevor - wouldn't it be nice if pistachio beans	
		Emma - Who is going to Pistachios are not beans (repeats)	
7.45	I	Trevor to Ron – Don't do that	
		AE – Do you think you have enough information to draw the line?	
7.51		Gillian – Probably need ...	
		AE – Where cut off and why?	
		Gillian – Probably be about 1.9, about 2.0 is when we start saying large	
		Trevor – I am going to I am not sure what is happening	
8.14		Ron – Its around 2 when start but small at 1.9	
		Gillian – That's why I'm saying the cut off is at 1.9	
		Ron – 1.9 is small and 2.5 would be large	
	A	Trevor – I am going to disagree with you guys	
		Emma – Do the maths	

Sharing personal information re autism

8.38	A	Trevor – I am not the stupid one juts the immature one Gillian – I can tell Emma – The ignorant one ... name 5 cities in Scotland Trevor – That's not general knowledge Emma – Yes its ... Gillian – Geography	Negative A triggered by Emma's questions once again. These steer the conversation well away from the beans.
8.58		Ron – Dundee, Glasgow, Edinburgh ... Trevor – You are dissing my beans that's yours ... you had two Ron – St Johnstone, okay I will just name 5 football teams AE stops the class for feedback Gillian – Matthew what's a general knowledge question then?	
9.30			
9.56		Gillian puts her hand up to speak during feedback AE – where put line?	
10.20		Gillian – I think 1.9	
11.12		Emma – Trevor .. name a place in London (she repeats) Trevor (laughing) – Ehhh, Paris Trevor (laughing) – Wales	
11.33		AE – you know when you buy clothes and the sizes are weird Gillian – Ah, yes, all the time Trevor – I just ...	
		AE – What about this example – exams. 1 mark below an 8 in science, should you be given an 8? Emma – Yes Gillian – No because. You did not reach ... Ron – No, its not an 8 ... its that simple Emma – Maths Emma to Trevor – Name a city in France that is Trevor – This is not general knowledge you know Ron – Leon, Marseilles Emma – Name a footballer who plays for Sheffield United Trevor – I don't care about football Gillian – I had a lad that was in Sheffield Trevor – I am probably the only lad this year who does not like football. Gillian – My Dad gave me a football strip in pink, I was so excited. Emma – Footballer for Sheffield Wednesday	
12.38			
			Negative A

13.00	A	Ron – I don't know AE stops class Emma – Does Gary ... play for ... Ron – Yes	Negative A
13.22		AE – What variable are they using to decide who gets vaccinated? Gillian – Age, age Ron – Stop stabbing beans Gillian – Give her one Ron – You also have that one to stab, no others Gillian – Matthew you are supposed to get ... Trevor – Stabbing it, I'm killing it Gillian – I'm the kind of person who sits with the weird people My mam ... Emma – name a player from Man United? Ron – What?	
13.43		Emma – Name me three players who play for Man United Trevor – Harry Mc, Anthony M, Marcus R Emma – Very interesting, Liverpool ... Gillian – My strong point is not football Ron names 3 players Trevor to Ron – inaudible	
14.00		Gillian – Yes, in the house, I had 8 used to use them to shave my face Ron – Which ones did you not know? Emma – I don't know anything about ... Trevor – You are a small person, do you have a small blade?	
14.10		Ron – What do you mean, small blade? Trevor - Small blade Ron - Blade Gillian to Emma – inaudible AE stops	
14.29		Ron – Don't know what you are implying Trevor – I asked if you had a blade AE stops	
14.47		Emma – That's Sheffield W's nickname Trevor – I am so bad	
		Trevor (stabbing beans) – Beans are strong AE – makes comment about how awful the exams were in the summer and predicted grades	

19.17		Emma – That smells delicious Gillian – I wear it all the time Trevor – It smells delicious so ... Gillian – Wear it 2 bottles ... Emma – Expensive? Gillian – It's not Emma - £25 Gillian – No £10 Emma – Ohh ... AE asks to tidy Ron – Put the beans in the cup Trevor – My beans	
19.26		Gillian – Why do you think I always have a spray on me .. Trevor – How can a spray smell delicious .. are you going to eat it? Gillian – I threatened to drink it once, my mam Emma – inaudible Trevor – Look at this ... shell .. Gillian – Its Trevor's head ... Emma - Trevor (inaudible) Ron – Look at me Gillian – Do you mind, I will smell of beans. Trevor – They don't have a smell ... you said ...	

Clip 3/3

Time	Code	Transcript	Notes
0.03	A	Emma – I know but smells like beans Emma – inaudible	All A but with elements of E because of personal nature.

0.35	E	Trevor – How do you cook beans? Are these actual beans? Gillian -(inaudible) ... if you get pooped on by a bird does it at break it was in her hair ... all over her hands she was in the girls bathroom. Trevor – I don't think it is ... Teacher collects beans Ron – I would not say getting pooped on would bring us luck Trevor (silly voice) – sings Ron to Trevor – You keep chucking beans Gillian – Does it bring you good luck if you get pooped on by a bird? It happened at break but not to me I would literally die if that happened to me Emma – Guess what you guys, I have the perfect bean Trevor – Guess what you guys, I have beans and probably a lot of shells	Mostly negative but with some positive due to the level of engagement with the beans. It moves back to negative as Trevor becomes more involved in triggering their talk.
0.55		Emma – I want to This now Trevor – I am going to eat this when I get home Emma – Is this the end of the lesson Gillian – I am going to count down the minutes	
1.03		Gillian to Trevor – Are you excited for Christmas? Trevor – If I plant this in my garden Gillian – Answer my question. AE talking Gillian – Are you excited for Christmas? Trevor – What? Gillian – Excited for Christmas? Trevor – What about it ...yeah Gillian – I'm getting (bags) Phones ... Trevor – I basically just get stuff, from these ... Gillian – New shoes new Trevor – I'm getting a laptop	
1.24		AE intros the final part – sampling beans Gillian – inaudible Trevor – I did more than ... I killed them Emma – Not Trevor – You just think it does (he now sings) Gillian – I thought blossom Gillian – Mike Wersowski(?)	
2.00		AE – This bag is fair, what do you think it means? Trevor – I am actually going to plant these when I get home Trevor – Beans	

2.14		Gillian – Ahh Trevor – Beans Gillian – I was thinking more	
2.45		AE – You are going to be given a sample Gillian to Trevor– Shush! Trevor – Beans Gillian – Elliot is immortal .. I feel like is it normal to feel like you have just downed a bottle of vodka	
3.07		Ron – And he gave me terrible ... Trevor – When I get home I am actually going to plan these in my garden	
3.19		Trevor – Ron why don't you ... Trevor – Do you think I will be able to plant these in my back garden? Emma – No Gillian – Do I look hung over Trevor - ... my house looks like ... Emma – No	
3.33	I	AE – Is this sample fair? Trevor – No Gillian – No, its tiny Emma – Let us see Trevor Gillian – Pass it here Emma (open bag) – Leave the beans Trevor. Ron – The beans ...	Re-engage because of teacher intervention
	A	Emma – How long till the end? Trevor – Are you sure Emma? Gillian – Lift your hand Trevor Emma – More Trevor	Negative A till the end of the lesson.
4.04		Gillian – Looks unfair as they are mostly medium beans. Emma – How long? Gillian – About 10 minutes. Gillian – He ate the beans Emma - Did he actually? Gillian (laughs) – No Trevor – I switched it (picking bean off floor) .. how did I do that?	
4.25		Ron – I cannot find which one is the start	

4.42	Ron – Give me some beans, I need to measure them. Gillian – (inaudible but about size) Trevor - I need to shell the beans Trevor – singing	
4.50	Gillian – I cannot wait till my 18 th birthday Ron – Are we just measuring it Trevor (singing to Gillian) ... I'm going to .. Gillian – You can try Gillian – I like that song Ron calls out lengths 2 etc	
5.18	Gillian - change the song, I'm going to get wrong Trevor - ... French now we can annoy Gillian – We all hate French Trevor Trevor – Spanish Gillian – In this school? Trevor – They have Emma – Not in this school	
5.27	Gillian – Just decide if the Ron – This is 1, 2, 1 ½ ... there are still 2 left Bean ... there we go measured.	
5.51	Gillian – Oh, I've got PE Ron – Good	
6.05	Gillian – You don't do what we do, you have to lie on your back trumpets .. AE – Fair, if not fair why not? Trevor – What are trumpets? Gillian – They are ... Gillian – What do you do? Trevor – Handball Ron – Football on Monday, handball ... Gillian – Trampolines on Monday Emma – Netball on Monday Tuesday Emma – I love football Gillian – I love trampolining	
6.30	Emma - inaudible Trevor – Is that compared to all the girls in your group or ...	
6.40	Gillian – When I play football I just stand in the goal Ron to Gillian – Listen, you don't want to be in my set Gillian – I am so lucky I did not pick games as I got my retainer	

7.04		Ron – You do not want to be in my set, its hard to play football ... Our set is hard to play football against Ron – I sweat like I'm a beast and I am also obese AE stops Emma – Interesting	
7.20		Trevor – Is that like a weight scale AE recaps the questions etc Gillian – It's a ... scale ... Trevor – What? Gillian – It's a vocal scale Emma – Here you go Trevor – The bean is not working	Gillian is singing
7.49	I	AE – Decide which question you want to answer. Gillian – My eye is hurting Ron comments AE – Is the sample fair? Emma – Not really because two of them .. so many medium Gillian – I love ... Trevor – I am so with this bean ...	
8.04	A	Emma – This is still rare all about .. Ron – That's all small ... there is a range of sizes 2, 1 ½ 1 Gillian – I actually love netball so much .. Emma – I might play football	
8.23		Ron – People wait, what are you laughing at ... Emma – cause I said I might play football Trevor – You just don't seem like an active kind of person Emma – I have played Ron – If you were in my class you would not look good ... Trevor – You would not stand a chance Emma – What's everyone's thoughts on sport? What sports do you like? What do you play the most? Trevor – What mean? Gillian - Trevor Trevor – Football Ron – Handball Gillian – what's your sport? Emma – Every sport, I like every sport to be honest	Teacher intervention causes re-engagement, same again at 10.34
9.00			

9.18		Trevor – I hate hand ball and softball Gillian – I’m a swimmer Emma – If you don’t move its boring Football Gillian – Swimmer ... I have literally done every sport possible. I was a dancer, a swimmer, trampoline, gymnast ... Emma – I used to do cricket ... netball .. Gillian – I did hockey as well I was quite good till I broke my finger ... I used to play hockey till someone hit me in the face ...with a hockey bat ... that was Ron – I have only ever done football Trevor – A bat! Gillian – What’s the word? Trevor – A hockey stick Teacher collects seeds Trevor – Sir, sir I have deshelled a bean Emma – Trevor get ... Gillian – Elisha, Lilly ...	
10.00		AE talks Trevor – Beans Emma – Can I cut this paper? AE – How possible? Gillian – When you pull out it wont always get the same answer Emma – When together fair but its made into smaller groups ... AE asks girl 2 to repeat Emma – As a whole it was fair but in small groups it was no AE – How is that possible? Trevor – You can see the shells ... the one you deshelled in the bag More feedback AE – Do you think how big the sample is effects things? All – yes Emma – I hope I have football today Later on Gillian – I have Zumba Emma – Last time I played I got 4 goals in Gillian – I have Zumba Trevor – Go compare Emma – Trevor!	
10.34	I		
10.58			
11.46			
12.10	I	AE now talks about D Trump Trevor – Does Trump think he has won the election? Gillian – Because he it would be funny if he won you know. Emma – Football and I got 4 goals last time	Even talk about D Trump does not re-engage for long – strength of trigger is not great enough to refocus.

12.35		Ron – I don't score, just defend Emma – I like striking Ron – Whenever I do I am always with a team of people who do not play well Trevor - moving blind Gillian to Trevor– Its okay have makeup on to say we are okay ... you are lucky I don't have makeup on today Emma – Not that good at striking but no one else on the team was Gillian – When I wear makeup I bring it to school and I will your face Gillian – Ow, my foot Emma – I remember last year ... Gillian – I have large feet Ron – I have small feet Gillian – I'm a size 7 Emma – I'm a 4 Trevor – I'm a 10 Emma – Why do we have the same sized feet? Gillian – I might take my shoes off ... look ...	
13.10		AE – Listen to this ... Alan Gillian – Ow Emma – Should have seen the injury twisted ankle ...	
14.39		Trevor – I am in his set, top set Some how got Trevor – Actually it was proved that Biden was cheating Gillian – Trump was trying to say ... Trevor – It was proven Biden votes Someone who died ... the vote was out in after they died.	Ends with I

Group 2 – Lesson 4 Does it work?

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Clip 1/4

Time	Code	Transcript	Notes
0.00	A	AE moves girls because of camera position Emma – Just move (to boys) Trevor – Just sit there	Neutral A – they discuss seating positions

0.22	I A	Emma – Move chair, just move your chair Gillian – Sit there	Normal mix of I and neutral A. The conversation is generally I because of the fact that task engagement that dominates. As part of this boy 1 repeats what is said by AE in silly voice
0.50		AE shows the starting image, girl 2 puts her glasses on AE – When you see adverts like this, are the lying? Do they believe it? What do you think? Have a chat	
1.00		Emma to Trevor – You look so squished Lots of noise in the class now Emma – She looks like she is trying so hard to smile Emma - Vitamins ... its vitamins Trevor – Probiotics (said in silly voice) Trevor – What? (laughs) What did I do? Gillian – inaudible Emma – You are so annoying Trevor – Its not a noise ... I said the word! Ron and Gillian laugh Trevor – I'm not going to swear Trevor - Vitamins (reading slide) Emma – You know what ... Gillian – I think its fake Trevor – Oranges Gillian – Oranges	
1.50		AE – Year 9 ... bombarded by things like this, what do people want to say? Mentions fish oil tablets	
2.04		Emma – I can barely read it Trevor – Fish (said in silly voice) AE – Vitamin D increases resistance to covid Trevor – Ohh, D	
2.29		AE – What about this kind of stuff? Reads the adverts Feedback Trveor – Well Woman (said 3 times as he pulls face) AE – What think about these? Trevor – Its making you shine (said to both girls) Laughter	
2.57		Trevor – She does not look that healthy Gillian – She looks frightened Trevor – Are those tablets making people shine ... but they are chemicals	
3.30		AE – I have great looking hair!	

4.12	A	Emma – Thoughts and dreams AE – What things do you use that you think are good? Tells story of wife's friend who uses fancy expensive cream's. Trevor – Fancy! Trevor – Fancy cream just same sort of thing out of a different bottle Emma – Exactly Gillian – The only thing you need to spend a lot of money on in botox Trevor – Ahh Emma – You could get Botox Gillian – Yeah Trevor – Yes Emma – Not Gillian – That improves the way you look Trevor – Botox is just buttocks said in a different way Emma – I don't think its like Trevor – Why does she have ½ a smile? ... like its wide then it goes Gillian – It might go Emma – Her eyes might go ... she looks like Trevor – She has a big forehead Emma – True but you have a bigger one	Hi level of engagement at this point but A emerges via boy 1 how responds to almost everything AE says. Boy 1 very interested in this – quizzical expression Positive A – all responding to the advertising image trigger – not on task but responding
4.29		AE input re fish oil etc Trevor – I want some Trevor – It refills with sunlight	
4.24		AE input re effect and no effect and shows carrots	
5.00		Gillian – Carrots	
5.11		AE – I got some carrots All laugh at this Trevor – What if carrots are trans?	
5.28		AE – What notice? All – They are orange AE – All different	
5.32		Emma - Are we all different? AE shares about paracetamol not working well in some women Trevor – Ibuprophen! Girl 1 laughs at this	
5.50		AE – Hard to compare effect of drug on me and Matthew Trevor – Why does he keep using me as an example? ... is he calling me a carrot? All laugh	You can see when they go off task into -ve A led by boy 1 and his response to AE and the triggers used.

6.16	A	Trevor – I don't know how he knows my name, I could not remember his	This is +ve A because I mentioned someone who is actually a relative of boy 1
6.20		Emma – Trevor can you shut up?	
		Emma – Will you shut up?	
		Trevor – Watch your manners	
6.30		Trevor – Ian Moffatt ... you know him, there is someone in my family called Ian Moffat. I don't know him, whoever he is, I don't know and have never met him ... just know he is there.	Negative A – not responding to the task at all – boy 1's behaviour distracts the group
		Emma – Just like your (laughing) ... ridiculous	
6.58		AE – What would; convince you that it worked?	
		Trevor – Parsnips ... Ron you were listening, what's he saying?	
	I	Ron – I don't know	
		Trevor – What's the question?	
		Ron – No parsnip fertilizer	
		Trevor – Cows	
7.17		Trevor – Isn't a parsnip like a potato?	
		Ron – Would you rather have big or small carrots?	
7.23		Gillian – What are you talking about big parsnips? ... We need to find out.	
		Trevor – It refilled! It had nothing in before.	Negative A – not responding to the task at all – boy 1's behaviour distracts the group
		Gillian – We need to talk about your long lost Uncle	
		Emma – Long lost ... brother	
	A		
7.41		Trevor – Like I said, the sun replenished it	
		Emma – The sun!	
		Trevor – That's exactly what I said to her, I put it there and then she said are you trying to warm it and I said the sunlight replenishes it	
7.49		AE – Okay	
		Trevor – Electric bottle, takes all the juice from home ...	
		Emma – This is not true at all	
7.55		Trevor – Parsnip	They re-engage at the mention of fertilizer and discuss if it is the same as horse manure.
		AE – What would convince you to invest some money in fertilizer?	
		'Proof' - Unsure who says this	
		Trevor – Poop buying poop ...	
		Emma – Low cost	
		Emma – Are you for real Trevor?	
		Trevor – I am not going to pay a tenner for poop	
		Emma - Its not poop	
	I	Trevor – Yes, fertiliser is poop	
		Emma – No its not	

8.28	P	Trevor – It is Emma – Are you for real? AE now shows image of the treatment Trevor – Gropar water Emma – Not at all (laughs) Trevor – Why are they so sharp, like knives Ron - parsnips Trevor – Someone tries to break into a farm so he puts his hand into the ground and pulls up a knife (very animated) All the group laugh Gillian – A parsnip (mimes having a dagger in hand) Emma – Framers have lots of knives Trevor - every parsnip is secretly a knife Emma – Okay, that’s smart hiding a knife inside a parsnip Trevor – You could hide lots of weapons around the farm, you could put a grenade in the ground as a pumpkin Laughter Ron – So someone comes in and you just blow them up Trevor – Yeah ... you start throwing pineapples and you just throw a grenade Emma – You don’t have pineapples on farms Trevor – You do, they grow from bushes Emma – No they don’t	The image of parsnips used triggers a genuine, and funny, epsiode of P talk. It’s a flight a fancy triggered by the drawing
8.42		Trevor – Yes they do, pineapples grow from bushes Ron - South America Ron – They grow on islands and South America, they don’t grow here Trevor – They grow from bushes Emma – Exactly, exactly, tell him Ron – In South America AE claps hands, boy 1 is inaudible	
9.16		Emma – That’s not how it works you actually Gosh Trevor – Put some sun over it Ron – Its too cold AE comments can be heard Emma – Low cost, cannot be expensive	
9.25		AE input – encourages to always ask questions etc + former pupil who has done well at Nissan Emma – True Trevor – A lot of people are more clever than me	
9.33			
9.42			
10.03			
		Positive A as the discuss where pineapples grow.	
		Elements of I creep into the A at times. But negative A dominates led by boy 1 including his physical squabbles with girl 2	

10.39	I	Trevor – Ow Trevor – Director? Trevor – I’ll keep it Gillian – Fencing! Trevor – I’m keeping this Emma – No you are not Trevor – Yes I am!	
11.00		Trevor – I don’t want it, don’t like pens Trevor – Pineapples Emma – Grenade Ron – Some with water are big	
11.19		AE adds the results to the grid	
11.37		Trevor – Ahh, bigger average size biggest AE – You either have something or you don’t	
11.44		Trevor - Yeah You don’t have a life, you don’t have money But I have AE mentions blind trials Trevor – Blind!	
12.13		AE – What did we say about the size of the parsnip? Big or small Gillian – ‘average size’ heard Trevor – That’s what she said – big!	
	-	AE fills in the table with the true numbers – Does this help? Trevor – No..... it’s a square AE – Have a chat about that now. Trevor laughing - ‘Doesn’t ... have different results. Gropar .. that’s a weird name ... has a bigger average but the water has the biggest Ron – Bigger ones Trevor – The girthest	
12.38		Gillian – I banged my head off the radiator Trevor – The shear girth of a parsnip Emma – Girth! (giggles) Trevor – Girth The thing is they are all different sizes but ... all have 4 lines, how does that work? Ron – Because parsnips have to have 4 lines! If they don’t have 4 lines they are a banana Trevor – No because they are white Ron – White bananas	
12.55			

13.28	+	Emma – I don't get white bananas Ron – It completely makes sense Trevor – No it does not Ron – Yes it does Trevor – We are not talking about bananas we are talking about parsnips You are talking about bananas Gillian - ...carrots (inaudible due to mask) Trevor – What what if parsnips are just carrots? Ron - inaudible Trevor – Well we are never on topic ... that's why we are on the special table	Positive A now – triggered by the image used. Elements of P? here as they discuss the images used and the difference between parsnips and bananas
13.48		Trevor - Cool we are number 1 Emma – We are better than everyone else. Trevor – You missed Emma – I did not want to	Negative A returns as the squabbles resurface plus ignoring the task and focusing upon their own agenda
14.09		Emma – That hurts, oww how strong are your fingers? Trevor – Very strong Emma – Russian man Ron - everytime he comes in we are always off topic Trevor – Because I am here Ron random stuff (hard to hear)	
14.19		Trevor - that's rude Emma – You are rude Trevor – Whoever is watching this is going to be laughing their heads off ... they are going to be laughing at me saying this What....?	
14.35		Emma – Good because we are so funny It still hurts Matthew AE – Group 2	
15.18		Emma - ... hurts (holding finger) Trevor – Pain Emma – Pain without the s Trevor – Pizza AE still getting feedback Trevor – missed Emma – I won't try again Emma - stop it. Matthew does it, absolutely hurts	

16.02	-	Emma - ... what was that? Trevor – It was continuous and no middle because (shows with hands the moving middle.?) Trevor – Middle Emma – Middle Emma – This thing is hot ... AE – How many would be big if perfect? AE – How many small	As the task is clear they now re-engage but with regular negative A resulting from Trevor.
16.39	I	Emma – 15 Trevor – Trick question AE summarises the data Trevor – Gopro some water Trevor to Gillian – That’s how you confuse Emma – That’s how you ... Trevor – You show then ... Trevor – 5, 5 Emma – inaudible comment Scary ... baldy (aimed at Ron) Trevor - Beech ... Emma laughs and repeats ‘Beech’ Trevor - son of a beech	
17.30		Emma - I am not scared of you, I’m just ... I don’t want to ...	
17.46	A	Trevor – It’s still water Trevor – Don’t flick the camera Emma – Okay, I need to stop Trevor – Don’t touch .. that’s broke it now	
18.17		AE – add up the numbers Trevor – What numbers? Ron – Just big and small parsnips Gillian - Are the big parsnips the huge ones! Emma – Bigger than Ron Gillian – 25 small and 5 large according to my brain Ron – Did you just do random numbers without even counting them? Gillian – I just did not count them	
18.43		Trevor – 7 big Gillian – Looks like 23 small Trevor nods	
18.59	I	AE talks through the numbers	

19.39		Emma – Spiderman Trevor – Spiderman did not do that	
0.10		Clip 2 – after break Trevor – I'm starving AE shares story of using garlic on his daughters feet	Trevor responds to the trigger used by AE everything – often positive A but regularly I
0.39		Trevor – Clean your dishes with garlic	
0.56		Trevor – Genius – you can taste it AE – We thought it worked ... treatment etc. Now introduces the 4 possibilities AE introduces the different treatments on the cards	
2.07	A	AE - Does keratin make your hair straight? Trevor – What the hell is keratin? AE – So my wife tells me Trevor – Of course! AE – Fish oil	
2.42		Trevor pulls face and smiles – What the heck have fish got to do with anything ... its fishy AE – Do lambs get bigger ... Trevor – No its genetics lambing AE talks about daughter lambing AE talking about pills	
3.13	I	Trevor – Steroids or horse piss Emma – What are steroids? Trevor – People inject horse piss into themselves AE gives out the cards	
3.30		Emma – Can I get a hour, hour Trevor – Hour, hour Gillian – Hour, hour (hard to hear)	Negative A
3.38		Gillian – At least you are next to me Trevor – How am I going to close it when its already closed! Emma – Already closed Emma – Hour, hour	

4.00		Gillian – Breaktime Now I'm here Breakdown Trevor – What ... what I'm causing people to have breakdowns ... ha,ha ... new level Trevor – Ohh paper!	
4.16	A	AE – Here you go, do pills make your muscles bigger? Trevor – Yes Gillian – Depends Trevor – Give it back ...give me back the bag Ron – Calm down	I dominates with short episodes of A Really engage with the cards used and the context for treatment and effect – clear response to this trigger
4.41		Emma – Okay lets put them Trevor – Why are there so many pills, pills, pills Ron – Cause there is Emma – Hold on, lets put them in different .. like ... Trevor – Pills, pills, pills They are all pills Emma – It's got what ... Gillian – I've got my bit Emma – It's got what? Trevor – Lass L, A , S, S Ron – Lass	
5.05	I	Gillian – I think it goes in that one Trevor – That's the straightest hair I have ever seen Emma - Paying attention right now Emma – Apparently no pills works quite well All these are no pills and they Trevor – That is the straightest hair line I have ever seen	
		Gillian – Pills Emma – This one has more than her Ron – This one does not work Trevor – Pills, pills, pills these have pills Emma – Hold on no pills and no pills and you have Ron – I've got no pills and Trevor – What are we even supposed to be doing? Emma – We are grouping them	
5.30		Trevor – You said there are four groups there are not. Emma – Yeah Ron - What there is ...	
5.39		Trevor – Ahh, that's pills and he is not happy and he has ... Emma – We are trying to work that out 5 minutes ago Matthew ...	
5.46		Trevor – Guess what I didn't	

5.58		Gillian – They are all the same Trevor – No they are not ... good and bad Ron – Give me all the ones that are good Trevor – Bad, bad, bad Ron – Bad I think Emma – Which is good Emma – This is ... bad, bad, bad ...	
6.07		Ron – It appears that they don't work Trevor – It's lasses Oh its working more in lasses than it does dudes Emma – Oh, yeah that's true Ron – It does not work with dudes Trevor – But then That's dudes Emma – Put them in the right place then Trevor – Yeah Ron – That's what I'm doing I'm putting.. Trevor – That goes here Emma – You are taking a long time Ron – I'm sorting them out ... here. Dudes Trevor – 4 lasses were not happy All the guys ... Ron – We not happy Emma – Okay the conclusion is ... Trevor – The conclusion is ... whether we can get steroids .. Emma – The conclusion is stop interrupting so much Trevor – Its true, all these women have muscles with steroids Gillian – It does not work for guys Trevor – Depressed Ron – Men don't if women have steroids they get muscles, if men have steroids don't Gillian – If men get steroids ... they get ... just look at his face Trevor - Look at him .. I Emma – So they don't work on guys but they do work on girls Gillian – Yup	
7.08		Trevor (to Ron) – Do you want to know an easy way to see how muscular your arm is Pull that down and put your hand there Ron laughs as he gets it wrong Trevor – No your arm is not that Ron – I'll take it off Trevor1 – Well come on! ... it cannot go up your arm so you are going to take it off! ... This is my life (to camera).	+ve A emerges as triggered by muscle image plus level of engagement within group By 8.03 it moves into negative A as the conversation moves away from the context of muscles to include other pupils etc.
7.28		Trevor – Bag, I want to pop this we need a bag	

7.43	A	Ron – My shirt might lift up ... I cannot get my arm out right now ... hang on, I've got it Trevor – Right so, put your arm there right, lift, squeeze, twist, squeeze as hard as you can. Ron – Which way do I twist? Trevor – Just twist it inwards and you like tense there I think you tense there	
8.03		Gillian - ... your arm Emma - scabs Trevor – Ahh Ron – Yeah that made sense Trevor – Yeah, the sand is very dangerous ... Trevor and Ron – Yes sand	
8.17		Ron – Chaos I just got a nose bleed from doing nothing in football Dangerous Trevor – Taylor said he was just getting them randomly Emma – Taylor? Trevor – This Taylor Ron – He slapped me and I got a nose bleed so it ... Trevor - he probably just snorted some air .. Gillian – No I'm putting them in their piles Ron – The evidence is	
8.46		Gillian - And he was just sitting in my reg group and he just farted ah Taylor you stink Ron – The other day, think it was Monday Just disgusting for 10 seconds it just did not stop ... he was right next to me as well ... disgusting Emma – I remember once in Year 8	
9.00		Trevor to Ron – I have a video of a guy who xxxx himself on my phone ... you don't see it but hear it ... Ron – He is just lying down and the xxxxx comes out Trevor – Not that one, not that one	
9.09		Ron – What we have got form this is if men take steroids it does not work but if girls do it does. Emma – No these are not steroids these are different things Trevor – Ron, Ron this is Ahh no! Ron – These are steroids AE – Now swap with another group	Short period of I re-emerges
9.32		Gillian – You have different to us Trevor – Ahh, they have faces ... I thought they had some special things on the back Gillian – Matthew! Ron - ... What like three 7's Trevor – Ron, mysterious, all muscelly Gillian – They are all like this ... look at the way their hands are they are like this	Positive A – they discuss the different cards each group has.

9.52	I	Ron – This is where Max’s fart went Trevor – Smells like an old man Gillian – Look at that hand, its like this Emma – Hey pass the bag (to boy 1) AE – Now try the ones with the exam results Gillian to AE – We figured it works on women and not on men Trevor – I want to do that.	Here they refocus upon the task and examine the cards.
10.26	A	Ron – Yours works, yours does not Trevor – What I’m taking works if they are happy Gillian – What I’m taking Ron – Say if it works they are happy How can you tell if they took it ... that’s how you tell	
10.36		Trevor – Pills, no fish oil tablets Gillian - That is Matthews Ron – He gets the does works ones	P – because the element of fun which is triggered by the cards – the pupils are talking to the people represente din the cards.
10.56		Trevor – I get the Trevor - You failure	
11.00		Trevor – Yeah but they had the pills Ron – Are you dumb (funny voice) Trevor – Yes Ron – Are you dumb?	They discuss and sort the cards in the four groups Brief episodes of A triggered by boy 1
11.12	I	Trevor – Yes dumb ... are you dumb Are you? Trevor makes noises with mouth Ron – That’s what ... so basically Trevor - Happy ... Gillian – So there is Mine does work Ron – 5 what I’ve got what we have got here Trevor – Why is it always two lasses with the pills I don’t understand Is it the same 2, I don’t understand why is my over there Gillian – We are all	
11.28	P	Ron – What we have here boys need the pills Gillian – Trevor needs the pill Trevor – Hey, there are those lasses here ... shut up	
11.33		Emma – Why is it always guys ... being disappointing Trevor – What do you mean? On the last one it was all the lasses taking steroids and its working Trevor – They are fish oil tablets Gillian – No Trevor, Trevor, Trevor Gillian – So why does it work?	

12.10	I	Trevor – Its magic, all the air is rubbing out of it, then its gone Gillian – 5, 5, 5, 5 Emma – Bag, bag, pass me the bag	
12.22		Gillian – Works better without, happy with tablets, happy without tablets Trevor – These are all failures Ron – They need to succeed Gemma – So what does it tell you? Trevor – That everyone has some success Ron – That the men Gillian – We are all the same so not really sure if it has an effect Trevor – The women are smaller than men Ron – Men need them Gillian – They are not ... AE begins to draw to a close	
12.37		Gillian – I don't think we need pills we have got Matthew and he has Trevor – Get out of my way there is something in there and it stinks Emma – I actually agree	
12.55		Trevor – It stinks Emma – You stink Ron coughs - ... stinks and I did not even sniff it and it stinks Gillian – I can smell it	A – much is negative and involves the pupils being silly with the bag and its smell + later they go off task. This type of talk dominates for most of the rest of the lesson – for the rest of this clip and at the start of clip 3.
13.08		Trevor – Cause its women that think it Trevor – Stereotypical isn't it Women Gillian – Women are better Trevor – Eh, men Emma – Actually Trevor – Women are more truthful Gillian – That's not true at all Trevor – No truthful, we don't need pills	Positive A – triggered by the cards and the images of females
13.30	A	AE – Right Year 9 Gillian – Get the one on the floor Trevor – Shush Gillian – Are there any on the floor (said to boy 1)	
13.57		Trevor - Dunno	

		AE – Can you think of any kind of thinking like this? AE gives three questions to focus + repeats All now wave/dance with their hands Emma – Its like this Trevor – Silly Emma – It has to be Trevor – I feel like I’m air bending Trevor – These are not right (referring to his hands) Emma – Okay Elizabeth – I can just imagine him and landing flat on his face Trevor – Hey ... whose looking Gillian – Do it slowly Gillian and Emma show him – Like that Trevor struggles – That’s still too fast Trevor whispers – Ron Trevor – Give up and try to get taller, midgit Trevor – You said I feel like a walrus Gillian - It looks like Ron – Ow, my hand has just hit the table Gillian – Tiktoc Emma – Yes Gillian – It was me who Ron – Now Trevor is obsessed as to whether the earths core is metallic or not Gillian – If you just start ... Ron – Me and Harvey were arguing against Will and Max on Tuesday obviously we were right. Emma – We need more patience Gillian – I think I need practice Ron – Don’t even know what I am going to talk about Emma – Killing all (?) Feedback – Gemma picking names to speak	Negative A – they now become involved in a hand dance and the two girls try to teach it to Trevor
14.48			
15.10			
15.31			
15.49			
16.02			
16.11			
16.34			
17.04			
17.24			
17.33			

18.16		Trevor – Tiktok Emma – I don't like that one – shut up Trevor – I don't want to Emma – You just have to get your wrists .. Trevor – I'll just pay	
18.37		AE mentions supplements being added such as fluoride in water Trevor – I thought water cancel them AE – Iron in cereal etc Trevor – What?	
		Clip 3	
0.10		Trevor – Head and shoulders Feet and legs AE – Talk about that now	
0.25		Emma – I don't even know Trevor to Gillian – Do you know how to count with your fingers? You go 1 , 3 Emma – 1, 2, 3, 2, 1 Trevor – Can we just talk about parsnips?	
0.43		Ron laughing – Have we got to talk about parsnips again Emma – Do you think aliens exist Gillian – No Trevor – Yes Emma – I don't think Gillian – Yes Trevor is sat right ... Trevor – ET go home -ET Gillian – At break can I	
1.03		AE stops ...Natural Trevor – Natural – Natural Emma – Hey is that Oh I don't Every day Gillian – I just think he is sexy Emma – Yeah	
	A	Trevor – Carrots Gillian – Out of	
1.46		Emma – 1, 2, 3, 4, 5, 6, 7, 8	

Negative A – all off task and unrelated.

1.57		AE mentions the covid vaccine trials, lockdown and China	
2.19		Trevor – China Emma – China Trevor - ...carrots great carrots	
		Clip 4	
		AE review on using evidence to make decisions	
		Trevor – Steroids	
		AE mentions folic acid and spina bifida	
0.10		Trevor – So it does not split that would be cool (to girl 1)	Mix of I and positive A triggered by the examples used by AE. I dominates now.
0.23		AE – Folic acid is a good thing – do you think its right to add it to all bread? Is it right to add something to your diet without your permission?	
		Trevor – What about the men?	
		Trevor – You can have pills instead of bread	Adding folic acid to bread
0.50		Trevor – Butter (mimes spreading it)	Giving cash incentives in smoking cessation trails.
		AE – Folic acid	
		Trevor – But what does it do for them though?	
1.17		AE – Do you think the evidence is strong enough?	
		Emma – No	
1.26		Gillian – No who needs them	
		GEmma – Has to be taken ...	
		AE now mentions a smoking cessation trial in Glasgow	
		Trevor – Glasgow, why not Lilly or algae(?)	
		Ron – puzzled expression	
		Trevor – Only if they have babies	
2.07		AE - £250 voucher	
		Trevor – Lucky (quizzical expression)	
		AE – Do you think its okay to give them money?	
		Trevor – No they may spend it on worse New kid	
		AE Do you know how much it costs the NHS ...	
2.31	I	Emma – Compared to Its not bad	
		Trevor - Cigarettes But they make you feel good	
		Emma – That is	
		AE – Talk about that	
		Trevor – What are we talking about?	
	A	Ron – That on the board	

3.01		Trevor reads the board out loud Emma and Gillian- The others not given ... Ron – They get money for Trevor to Emma – Why the hell are you trying to stop people smoking	
3.18		Gillian - £500 Ron – They will smoke more Trevor – It’s a boomerang .. haa Ron – Is that an actual question?	
3.36		AE stops Trevor - ... stop, just because does not mean you have to bitch about it ... Trevor – Its ripped	
4.03		Trevor - ... fag ... fag Emma – Fag is not a bad word Trevor - `It is if you get caught smoking a fag then mmmm Trevor to Emma – See I’m moving it Emma – Yes ... it depends on the context Trevor – Could be used for Gillian - ... cigarette ...	Negative A talk triggered by the use of the word fag because the smoking context.
4.15		Trevor – People get fed up with these days Emma – You can definitely say Trevor - you can get cancer without consent	
4.29		Trevor - ... I’ve got autism Autism	
4.35		Emma - cancer Trevor – Aspergers Emma – inaudible Trevor – What, ahh cool I think mine is more expensive	Brief episode of personal sharing.
4.55		AE shows the smoking data on the board Trevor (looking at camera) – That has been going for minutes So just 5 minutes more.	
5.05			

	E		

Group 2 – Lesson 5 Models

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection.

Time	Code	Transcript	Notes
6.28.00		AE – Are they the same? Both models Mike – The same AE – Maybe its about what we think (tells migration story involving swans because they can be seen near the school). Gillian – Ehh AE – Maybe its what we do in our minds to explain something we are not 100% sure of ... Is the atomic model 100% certain ... it's a model	Gillian is thinking (quizzical expression)
6.31.03		AE introduces box activity 'Explain what's inside? What are your observations telling us? Draw what you think is inside.	
6.31.34	A	Gillian – Draw it on what? My hand!	Negative A – potential for disruption
6.31.54	A	AE gives them the boxes	Negative A – as above
6.31.58	I	Emma – Small box for a small mind Ron – How are you meant to guess what's inside? AE shows how to play with the boxes Gillian – Nothing, its empty Emma – Is there something inside? Amma – Small box for a small AE encourages to explore and play	I – real engagement with the box activity
6.32.23		Emma – I think there is nothing in it	
6.32.36		Ron – I think there is string inside Emma – If you shake it	
6.32.46		Ron – It reminds me of one of those things children use Gillian – Its getting Emma – If you do it that way ... Gillian – Only goes one way Ron – Its because Just let go if you don't Gillian – You have to pull it tight Ron – No I think its because if you do it tight ...	
6.33.35			

6.33.47		AE – Year 9 but what’s inside that causes it to stop ..	
6.34.26		Gillian – Air (whispered)	
		AE – Can you imagine draw what you think is inside the box	
6.34.54		Gillian – Just draw a box	
		Ron – Just draw anything nothing	
		Gillian – Its kind of hollow	
6.35.12		Ron – Nothing inside	
		Gillian – Could put like a little thing of glue in and so they say ‘See there is something in there!’ Oxygen, that’s in there.	
		Ron – Air	
		Gillian – Atoms, like all that shizzle	
6.35.32		Ron – There has to be something inside ... it would not be able to stop	
		Gillian – A scrap of paper ... the whole point is you don’t actually know	
		Emma – You could say anything but we would not know if he is lying ...	
6.35.42		Gillian – You had better open one	
6.36. 07	A	Gillian – I am only now realizing how Trevor is so ...	
		Ron – Trevor is always talking about potatoes	
		Gillian – He brings up such random stuff and makes it funny Otherwise you are just sat here	
6.36.17		...	
		Ron – All he does is talk	
		Gillian – At least I don’t think like Trevor ... and it still manages to work out better	
6.36.39	R	Ron – Its because he talks	
		Ron – He probably would have ripped it open.	
		Gillian – Do you think if we say oxygen she will Let us have it?	
		Ron – Are you just going to put	
		Emma – Well there is oxygen everywhere	
		Gillian – Exactly, so she cannot say it’s not in the box	
		Emma – True	
		Gillian – Brain cells	
6.37.00		Gillian – Like a zip line	
		AE can be heard saying ‘The evidence	
6.37.36	A	Gillian – We have 13 more minutes of this	
		Ron – You end up half	
		Gillian – Yeah I know but there is a break in the middle ...	
6.38.06	I		

Emma is inaudible the rest are quiet but
Gillian sings a song to herself

Negative A – discussion of Trevor who is
missing today

Quiet and thoughtful
Is this R because of the ‘thinking out loud’
nature of this type of chat

Very engaged at this point

Neutral A – discussing time.

6.38.24	E	Gillian – Wait there cannot be anything in the box the string would not be able to get through Emma – Not if it was glued to the bottom Ron - Perfect size Gillian – Then you would hear it Emma – How if	Is this I verging on reflection as they ponder alternative solutions?
6.38.37		Gillian – Hit the top and the bottom sounds the same If there would be a difference	
6.39.08		Gillian – See that sounds different its just like a glue	
		AE begins feedback + mentions migration stories as examples of how people tried to explain observations. ‘Say what you think and why?’	
7.01.17		Clip 2	
7.01.29		Gillian – I don’t get why I am in this class, I don’t know what’s going on? AE – Well nobody does – use your brain Gillian – I know but everyone else is coming up with ... AE – You are worthy to be here	
		Gillian - debatable Emma – Non-debatable Gillian – The only thing I am good at is maths. Its my favourite Emma – I don’t like maths. Gillian – I like maths, its better than English Gillian – I like having a problem with a definite answer So if there is a way to get to the answer, there is no other answer.	
7.01.51			
7.02.28		AE – Stop ... the more you talk, you exercise your brain and mentions open book exams	
7.02.44			
7.03.28		AE invites a boy to share – he talks about a finger puzzle involving friction ‘Say that again ..., etc’ AE to class – Is that helpful	
7.03.49		AE mentions next task to think about over break – how the ancients viewed the world and describes the picture.	
			E because sharing personal feelings

7.04.17	I	AE – What evidence were they using and why? AE – Were they wrong or stupid? Was it based upon evidence? Why think this?	
7.04.32		Emma - So tired	
7.04.44		Gillian – We actually ... talk about this Ron – What are you thinking about? Emma – Nothing Gillian– I said oxygen	
7.04.56		Ron – Oxygen Gillian – I don’t get what that’s going to do but I know I’m right Gemma now talks to the pupils – So why Emma – I cannot even see that Gillian – Because they had this idea that heaven and hell existed Gemma – Where did the ideas come from? Emma – Religion Gemma repeats her question Gillian – What someone else has told them Gemma - Religious ideas?	
7.05.11	R	Gillian – It really was just someone who has decided something and everyone said yes, lets go with that.	Short period of reflection upon the start of religions.
7.05.28		Emma – String every religion .. Gillian – Someone has to start things someone else’s ideas Emma – Not necessarily	
		Break time starts	
7.53.25	I	Clip 3 This clip does not start as soon as the pupil come in from break. There is no equivalent footage from group 1 AE heard in background – What’s wrong with that model? Ron – How they in circles? Gillian – I thought we ... spun going round	Pupils engage with the solar system trigger Hand movements from pupils to show planetary motion. Image shown to pupils is of the earth and moon orbiting the sun

7.53.53	A	Sheila – I (does not finish) Ron – Do you think it like sits there in one position and we have to sit there while it spins? Gillian – Wow See why I don't belong in this class Emma – Exactly ... does not necessarily go around the earth ...	She moves her hands and body to try and show this
7.54.34		Ron – It goes around the earth ... as we go round the sun Emma – that's why Does not have an orbit	
7.55.02		Gillian to Emma – Are you still trying to feed that string back through the box ... instead of taking the knot out. Ron - it's kind of If Trevor was here he definitely would have just taken the knot out Gillian – Trevor would have ... its Trevor you know.	
7.57.57		AE – Right ... who wants to share their thoughts AE invites a girl to speak 'The earth is like a treadmill'	
7.58.01	I	AE – What's wrong with this model etc General feedback with groups being invited to speak	They re-engage with the box problem
7.58.06		AE – What ideas did you used to have like where babies came from Gillian – Do you think we could cut out the string?	
7.58.54		AE – What ideas did you used to have to explain the world? Emma – Put your eye to the hole Emma – Shall I cut the string? ... if I wrap this round like this Ron - how	
7.59.04		Emma – Nothing is in the box because when you no	
7.59.12	A	Ron – The noise does not change though ... if you it does not really change if you had scissors you could just stab the scissors into the top of the box	Positive A now as they decide to cut open the box to solve the problem.
8.00.02		AE – Here we go Here is your last task Gillian to Ron – Is it open, the box?	
		AE shows the two density cubes - Exactly the same size, going to weigh them. Gillian – This side ... you could ... if there was	
8.00.49		Gillian – I need scissors ... it would be the one thing ... AE can be heard sharing the weight of the cubes.	

8.01.03		AE can be heard explaining the drawing task Gillian – I cannot because of the knots ... I think its done Ron – Why Emma – Then what will you do? Gillian – Then I can pull the string out and I can put my eye on the little hole Ron – You won't be able to see Emma – How will you get it back inside?	
8.01.45		Ron – You will see nothing inside the the hole is too small Gillian – Can I pull that through I did it ... I need something to stab through Emma – Hold on Ron – Like I said you cannot see inside	
8.02.06		Sheila – Wait pass Ron something on the inside	
8.02.13		Gillian – Well he can I'm trying to open this ohh the glue ...	
	I	Gillian – I have almost got the box open I got the string out Ron – Why Gillian – Because its really pissing me off. Ron – Inside of it AE – What do you imagine is inside of these that makes them so different? Feel these Ron – Mass AE – No that's a word, what do you imagine that's inside that makes them so different Emma – Material	They briefly engage with the density cubes but quickly their attention moves back to getting the box open.
8.02.48		AE – Don't do that (then repeats the above) Gillian – I was going to say atoms. AE – Well what do they look like – why are the atoms different?	
8.03.28	A	Emma – Different particles inside the atoms Ron to Gillian So there are more atoms inside	Negative A
8.04.03		Ron – How would you know Gillian – I have given up 15 minutes left Emma – My brain does not work What's this? Gillian – It's a thing from maths	
8.04.15		Ron – A diagram about the inside of that Then Gillian – I just don't know I just don't know ...	

8.16.57	I	Emma – Ginger AE – Year 9 ... they are solid, same size, aluminium and steel ... whats inside that makes one so much heavier ... imagine what's its like inside to make them so different ... if use a word to explain can you imagine Explain to the class in 5 minutes.	
8.17.30	A	Clip 4 Gillian – To me everything looks the same Ron – But what about the one that is more dense, how would we describe it. Ron – More dense, more atoms, got more atoms or particles. Gillian – I will put them back in the bag	Negative A – off task focusing upon hiding the evidence of the fact they have destroyed the box
8.17.36		Gillian – What?	
8.18.29		Gillian – Its just one piece of string Ron stabbed Gillian – I did not manage to get through they were sitting with pens, trying to chop a hole in	
8.18.46		Gillian - He is putting his coat on no its his jacket, makes more sense we have like	
8.19.59		minutes we have 10 minutes left 10's not too bad	
8.20.35	R	AE – 2 minutes, practice what you are going to say etc ... what imagining ... no-one has seen but we have accepted models and theories what is your idea? AE mentions applying the same idea of modelling to peoples lives to see how influences effect them	They reflect upon the nature of matter and particle theory.
8.21.09		Ron – Dense atoms Dense atoms Gillian smiles – I think little particles ... and a little bit more spaced out but not to do with density ... it's the mass .. further apart but in solids they are closer together than in liquids surely ... Ron – No because liquids are still close together but not as close as in because one has more which is why it weighs more ...	
8.21.50		Gillian – Has slightly more than other Ron – A lot more	

8.25.50 8.26.40		Gillian – Yeah AE stops for feedback AE – What is modelling? AE now mentions the cell membrane idea as a model	

Group 2 – Lesson 6 How many are there?

Talk codes:

- I - intellectual engagement,
- E – empathy or personal sharing,
- R - surprise or reflection,
- P - playful and,
- A - pupil agenda (now +ve, neutral or -ve)
- Teacher interjection

Time	Code	Transcript	Notes
6.29.26	I	AE – Here is yours okay. Trevor (grabs it) – What is this? Ron – How many are there elephants	Clip begins with the pupils being given a paper slip prior to this they are chatting quietly I – initial engagement/interest with the trigger
6.29.42		Emma - because you wont know where they all are because Gillian – What Trevor – Ace question Ron – You don't know where all of them are Simple.	
6.30.01	A	Ron – Why have you got a book? Trevor – inaudible Ron – Why have you got a book?	A – Negative as Trevor is off task and talking about the books on the windowsill

6.30.10	I	Trevor – They are all the same book Gillian – They are not Ron – They are Gillian – They are not all that book Emma– I have not seen an elephant before Gillian - I have only ever seen one once Trevor – I went to a zoo Gillian and Emma – inaudible	I – engaged with the task and questions
6.30.14		Ron – I saw a video of one Trevor – I smell quavers have you been eating quavers? Ron – Well I saw a video of two doing	To Gillian – laughter
6.30.28		Emma – inaudible Trevor – How many are there? Gillian – One elephant Gillian – Lots Emma – Hundreds, there are a couple of hundred ... did you just ... elephant	Said in funny voice Gillian – eats more quavers
6.30.47	A	Trevor – they are probably owned by some (slave) company Gillian – inaudible Ron – No it's a slave company Emma – Are we going to watch Gordon Ramsey?	Positive A as triggered by their interest in the video they are about to watch.
6.30.53		Gillian – Its something else Trevor – Uganda Gillian – I sit in the weirdest Trevor – Gordon Buchanan (struggles to pronounce) Gillian– I sit in the most awkward positions ever	Trevor hums which annoys Ron
6.31.10		Trevor – I thought Gordon Ramsey because he could not cook an elephant	Odd comments between the pupils at this point – neutral A
6.32.00	I	AE now begins the feedback – mentions sweets in the jar problem Trevor – How put ...sweet There will just be one (confused) Gillian – Different amounts Trevor - Ahh ... he said every month he will put 1 in It would not be that good ...	I led by Trevor in response to teacher questions
6.32.13		Gillian and Trevor – inaudible chat Trevor – Elephants, elephants Emma – Estimated trevor – Guestimate	
6.32.30		AE now mentions the earnings from a boxing match at the weekend	

6.32.50	A	Trevor – Logan Paul ... (laughter) ... obviously does not know who he is Big man Alan does not I actually watched the fight ... I did not watch the end but watched it ... Gillian – I didn't ... I was out Trevor – Who won? Trevor to Ron – Do you know who won the fight?	Positive A – they talk about the example used by the teacher
6.33.16	A	AE – Who got the fish one? Trevor – Fish Le poisson (laughs) Ron – Why are you speaking French Trevor – Fish is boring	This is very rich as a tapestry of talk and the impact of triggers from AE. Each utterance from AE is eliciting a response from Trevor which impacts the group. Very fluid talk, ideas bouncing around, being revisited, laughter
	I	AE mentions fish quotas Emma – That's ridiculous..... Trevor – Who can estimate this? Do people sit and count Group 1 give feedback, via Mike, on their response to the fish problem	
6.33.51		Trevor – There were more fish so people catch more fish Trevor laughs at Mike and AE comments on Google boats	
6.33.59		Trevor – What a submarine? Girl 1 laughs Emma – Submarines go under water	
6.34.07		Trevor – Just use a submarine Gillian – Just don't count fish Trevor – Just put some however many ... Emma – You're a fish (to boy 1) Trevor – You're an elephant	
6.34.34		AE now mentions grouse shooting and time limits to conserve populations Trevor – Shoot ... shoot ...	Trevor and Gillian chat about this but hard to hear
6.34.57		AE – Who had the elephant one? Trevor – Elephant we are elephants ... if we are elephants why are they answering our questions? AE now gets ready to show video clips – explains the TV program and mentions other presenters such as Steve Backshall Trevor – Ahh Bucanan Oh I've seen that	Gillian and Ron shakes heads as in some dance
6.35.40		AE – What has this got to do with how many animals there are when you cannot see them? Gillian – You sit for like an hour and if an animal does not come past (shrugs shoulders)	Gillian ands Emma chat Gillian laughs
6.35.55		Trevor – You take people to an area and if they get killed there are animals	

3.36.03		Trevor – If they kill each other then its just too bad	Gillian and Emma chat out of shot
3.36.30		Class watch the video clip of GB watching footage of tiger caught on a trail camera Gillian – Completely I’ve got a really bad could not move Trevor – What was that about?	Mix of I and A – pupils are on task so natural amounts of A. This lasts for the rest of this clip and the next. Interplay with teacher and the use of trigger questions and prompts. Periods of engagement interspersed with natural amounts of A? (from pupils of this age + friendship group)
3.36.56		Gillian – My was broken ... Gillian – Wow Trevor - ... like 10, 10 ... is that because he saw a tiger? Gillian – They are going extinct Emma – Is he crying? Trevor – He has asthma and takes really deep breaths	Is this a natural pattern of talk if engaged?
6.37.30		AE – I did that (camera trap in garden), guess what I saw Trevor – Tiger Gillian – Frog	Trevor and Emma laugh at AE’s story of what is in his garden
6.37.39		Trevor – Worried there AE talks to the class and answers questions re the rats in his garden	
6.37.57		Trevor – Trap to kill them Trevor – Catches them, starves them and they run out of food Gillian – That’s disgusting Trevor – You know how people are	Gillian jokes about catching some thing
6.38.02		Gillian – Matthew look .. AE – He spotted one tiger Gillian – And cries	
6.38.32		AE – How could he use this evidence to get a sense of how many there are – talk about that ... Gillian – How does he not count the same tiger many times? Emma – They could follow it Ron – It’s night time Trevor – How is he going to follow it?	All talking at same time so some of what is said is missed
		Trevor – If the tiger went of camera how would he follow it? Emma – The tigers live Gillian – I’m just concerned what if he counts them and counts the same one again Yeah I saw that one yesterday and I counted it again! Trevor – What if one comes up behind him, what happens then?	Gemma (teacher) removes the sheet

6.38.53		Trevor – what is going on? ... I liked that piece of paper	Gillian and Trevor chat about the camera – hard to make out what is said
6.39.07		Trevor to Ron – Do your arms ever get sweaty wearing that? Ron - (inaudible) Gillian – It does look breathable Ron - ... I am used to it Trevor - ... Ron – I’ve worn them since Ron – What breathable	Both laugh at this
6.39.30		AE input – never, ever know how many Mentions Galapagos tortoise that had been in the news	Trevor has quizzical expression in response
		Feedback AE talking – mentions ‘a wish’ Trevor – a wish (smiling) Trevor – People can took some video ...	Trevor and Gillian – inaudible chat
6.40.20		AE – there are some animals I have never seen but would love to Trevor – Search up a picture AE – You can find their footprints Trevor – He follows their footprints AE – How could you actually work out ... Gillian – You could follow them ... but how do you know you are not counting the same one multiple times?	Gillian smiles at this
6.40.45		Trevor – You could capture them and mark them with something Gillian – Ahh yeah sheep Trevor – Yeah but they could do the same thing they do with dogs – put a chip in it Gillian– Yeah but what happens if it’s like a lion and you touch it ... Emma - ... Trevor – Shoot it with a tranquilizer first Gillian – That’s animal abuse Emma – It is Trevor – Its not Gillian - see them (mimes shooting)	
6.41.05		AE asks for comment Gillian pauses before responding How know you are not counting the same one multiple times?	

6.52.58 6.53.14 6.53.24 6.53.46 6.54.02 6.54.22 6.54.39 6.55.00	I A I I	Clip 2 Gillian (to the class) – What happened if you see one, put cameras up and see another ... how do you know its not the same one? AE speaks Gillian to another pupil and pointing to boy 1 – He said use some tranquilizer on it! AE – It might be like a comedy tiger Trevor – Comedy tiger Hah Gillian – It might be like me, it might just like photos AE – Let’s keep that thought – it could be the same animal Gillian – trevor ... you might ... Trevor – What’s with the tranquilizer AE - ... there’s one, there’s one Pupil – Look at the detail AE - maybe it has a piece bitten out of its ear Gillian – Like my guinea pig Trevor - normal? Same pupil – You know what they do with sheep Trevor – I actually think that is what they do ... they put chips in to track them ... Gillian– Spray paint is probably better Trevor – No spray paint damages fur AE now tells the snail story about a guy marking snails to see if they would return. Trevor – They spray painted a snail! AE – Animal migration is fascinating Trevor – Is it! Trevor - Snails are magnetic! AE – You have homing snails Trevor – Homing snails - ... can they follow stuff? AE – You know how to get home, maybe snails do Gillian – Not really I get lost Trevor – I just walk I happily follow my nose Mike (from group 1) shares – You could microchip them Trevor – Ahh, see Gillian – But that can ...	Positive A because related to/triggered by teacher prompt Gillian pulls face in response

6.55.11	A	Emma – That’s inhumane Trevor – Its not inhumane ... it does not hurt them Gillian and Emma – inaudible response Gillian- Yeah you are shooting them Trevor – You do it with dogs Gillian – My dog ... Emma – You cut open its skin and ... Trevor – Dogs get chipped Gillian – that’s because its illegal not to Trevor – You don’t have to its not a legal ... Ron – It’s a safety thing Gillian -	
6.55.20		Trevor – It’s a safety thing in case it gets lost Gillian – But it’s a wild animal ... ahh yeah just going to shoot it! Trevor – So .. Gillian - Trevor – Shut up	
6.55.41			
6.55.50		AE introduces the main task by telling woodlice story Trevor – Trying to eat woodlice!	
6.56.18		AE explains talks with beans to represent woodlice Trevor – You are going to give us bugs! AE shows tubs of beans Trevor – Beans again Gillian – It says do not .. Trevor – Ahh, they are raspberries Ron – Did you see? Trevor – It says raspberries on the tub Ron – I think he said ... Trevor – Raspberry flavour .. Gillian to Trevor – Trevor would you like to eat one of them now Trevor – Yeah ... I will do it ... I will .. miss are they raspberry flavoured?	
6.56.59			
6.57.17	I	Gillian – Often ... Trevor – Ahh yeah Emma – Eat one Ron – Are we ... count them ... Trevor count them Gillian – I say 100 Ron – I’m saying 62	Positive A – their off-task talk is related to the excitement caused by the use of real beans. They now get distracted by the cow noise from group 1 Beans are in a yogurt tub I – they reengage with the problem – appropriate trigger activity to engage them. Carries on at 6.58 and for much of this clip

6.57.30	A	Emma – Look he is putting them into a bag Trevor (counting the beans in the pot) 30, 35 or like 40 round there Ron – Well I said 62 so .. Trevor – Beans! No, no, no, no Trevor – They are my beans Trevor – What is that going to do(he laughs) I can count as well Beans	The class is now quite noisy so its hard to hear everything
6.57.42		Ron – 15, 42 Gillian - its you with the tranquilizer Gillian – Pass it here Trevor – Heinz, means beans Gillian – Just take it off him Trevor to Ron – I am bigger than you get off Trevor – Just waiting for you to drop it	Positive A - they are enjoying the beans!
6.58.03		AE now explains the sampling process + Gemma gives them paper Trevor – Oh paper (grabbing it) ... okay you can have it .. (passes it to girl 2) AE to Gillian - What was your name? Gillian - Gillian (smiles) Trevor – Emma (she smiles again)	Ron now grabs the tub Trevor takes back the beans and gives to Gillian who looks at the tub and holds up the beans
6.58.28		AE explains how to take the samples Trevor - What's with where does he get all these? AE – How can we use this to help?	
6.58.38		Gillian – Count them ones and see how many you think are in ... yeah Trevor – Cause since the bag can move you can split it off Gillian – Or you could count them ones and look there is about 4 times more in there guestimate ... I'm smart ... I should ... Ron – Why don't Gemma gives then the second bag of replacement beans	Girl 2 takes a bean
6.58.55		Trevor – Beans Ron – Why do you get all the beans? Trevor – Because I'm the bean boy 1, 2, 3 Gillian – Matthew is the bean man	He bangs desk playing some tapping game
6.59.05		Emma – Now (she takes the tub of beans) AE – How can they (second lot) help us? Trevor – I pulled them out ... in 2 ... Ron – Don't push the beans You cannot touch the beans (to girl2) Trevor – 2, 3, 4, 5, 6, 8, 12, 14 Gillian – Which one ... Matthew eat one Emma – Dissect (opens pencil case) Trevor – 80 ... too many to count	

7.00.13	Gillian tries to get the beans 'I'm good at maths Trevor – maths by counting beans, beans AE - Model explains the task AE – We can use these to imager we have marked them AE – Trevor what did you think? Trevor – What? ... Don't know AE – How might this help us Emma – Creamy beans	Trevor smells the beans, Emma tries to stab bean with her pen Trevor hums, Emma plays with bean tub, Gillian counts beans in bag Girl's chatting but inaudible
7.00.42	Emma – You said it yourself you cannot say how many of this are in this (points to both types of beans in turn) Gillian – You have to count these ones to know Trevor – Its like 2 beans for 1 of these Gillian– Okay we think that (trails off) AE – You have a lot of skills you can apply Trevor – Do I!	
7.01.00	Feedback from class Trevor – This one (holding up bean) Gillian – there are 150 beans in there Trevor – half that ... 75	
7.01.39	Pupils speaks during feedback, AE – That's a ratio of 5:! Trevor to Gillian tapping bean tub – 75 beans in there More feedback with AE	
7.02.21	Gillian – I'm starving ... 2 minutes .. you have to basically count all of those beans	
7.02.29	AE – Take out a small handful Trevor – Beans AE – Do that now Gillian – Okay Small handful Ron – Can I do it because I have small hands Trevor – Take a small handful out – he said small hand Gillian – Use Matthew, Matthew's hand is smaller Trevor – What! Gillian – Put more in the bean pile Ron – He did say small Gillian – But not like 7! Trevor – What is a small handful? Gillian – Look at this!	Gillian is still counting Trevor taps the bean pot and tries to count all the original beans – not much talk here Trevor puts the beans back Both girls laugh
7.02.43		

7.03.29	A	Emma – What number do we have? Gillian looking at AE – Are we putting AE confirms. Ron – This is funny Trevor – Put the beans in what are you doing? Ron – We need them What are you doing? We need them Trevor – Put them back in Ron – Put them back in Gillian – Write the number down	Trevor takes out more beans All laugh at this. Gillian is counting and Trevor takes out the replacement handful She twirls her pen Gillian and Trevor discuss beans but inaudibly Ron counts beans Emma records the numbers
7.03.51			
7.04.03		Gillian – Can we go now? Trevor – There we go Ron – There is not any need Trevor – There is beans	Said to Emma who has the bean pot Her reply is inaudible
7.50.40		Clip 3	Break time – Trevor mixes the beans
7.50.57		Ron – I’m next to Max next lesson I’m next to Max AE – While we are waiting Trevor to Gillian – You are a racist you are racist AE recaps Gillian – 23 Ron – What did we do again? Gillian – Wait ... Trevor – I don’t like beans ... I don’t like beans Ron – By the way there are 24 as I picked one off the floor	Negative A – unrelated talk.
7.51.53		Ron – I don’t trust you, I don’t trust you AE – Did you do it, how many did you take out ALL – 23 Ron – 24 Gillian – Shush Gillian – If you hit me I swear I will smack you Gillian – Ow, you Ron – I was scared for my life ... I was scared for my life He could have killed me.	Trevor is looking at his phone and chats to Gillian about this He points at her but is not serious
7.52.16		Trevor – I am the bean master Gillian – Does it actually hurt? Ron – I’m doing basket ball	Gillian laughs as she puts the bean back Emma comes in a sits down and chats to Gillian. Noise level in room rises Trevor is swinging the bean bag round and hits the desk with it Trevor hits Ron with the bean bag Trevor hits Gillian on arm

7.52 – 7.53.16		AE – Okay Year 9 Gillian – You know when you play basketball, is it not really difficult? Aren't you really bad at it because you are small?	Trevor does martial arts with the bean bag Inaudible
7.53.24	I	AE recaps on the process and numbers and moves to board to model the numbers on the board. Gillian – Look Gillian - ... while I count them ... 2 of them Put the beans back (to boy 1) ... do not mix them Trevor do not test me he just the other two	Trevor and Gillian play with beans
7.54.07		Ron – What (smiling) Trevor – One of those Emma - ... what Ron – Put it back	Gillian takes out the second handful Trevor plays with bag
7.54.54		AE - ... what three words ... just three numbers and tells story about what three words and the coastguard from the weekend	Emma examines beans
7.55.15		Trevor - Stop moving it AE explains the three numbers	
		Gillian – So there was 90 so he has taken Ron – 50 Emma - ... take another handful out Gillian – I have already done it Trevor don't mix the beans Ron – Put that back (to girl 2) Trevor – Literally Gillian – 6, 8 (counting beans) Emma - ... I dare you to eat a bean	Trevor talks to a pupil from another group – inaudible. Gillian moves the bean tub
7.55.40	I	Ron - Ohh, no Trevor Emma – Eat one, eat one Ron – He will die if he eats those beans Emma – No he wont Gillian – There are 24 normal and two ... Ron – So basically we get the exact same amount plus two more Trevor – Another two brown Emma – 26	Clearly thinking – starts to speak slowly I dominates as their class teacher Gemma joins them.

7.55.52	A	Ron – We got the exact same amount but two of them are marked Emma – 26 altogether Gillian – Miss we got the same amount Gemma – Okay Gillian – Because my skills are just so Gemma – So how can you use that? Gillian – So there are 24 there and there is them Gemma – So how can you work out how many there were?	Significant period of negative A as they discuss the behaviour of Trevor. Lasts till 7.59
7.56.12		Emma – Its just ... Gillian – Keep doing that Gemma – How many of the new beans are in?	
7.56.26		All – 24 22 left Gillian – Just count them! (laughs) Gemma – For every 2 beans how many of the other beans?	
7.56.42		All – 24 Ron – 22 left Gemma – How can you work it out?	
		Gillian – 24 x 22 Gillian – 24 x 22 Gillian – Where is my calculator? Gemma – That sounds like a very large number	
		Gillian – Do you think there is 2 for every Emma – Times by 11 Ron – 264 Emma – I did it in my head	
		Trevor – I cannot do maths	
7.55.07		Ron – Calculator Gillian – I had my calculator open Gillian - You know the science homework – when is it in Ron – Science homework – 14 Gillian – You know last night I ... rushed around Trevor – You got science homework .. Ron - Yeah we do Trevor – When?	
7.57.15		Ron – We had a lesson Emma – I’m going .. Gillian – I don’t really ... this one Trevor – The yellow booklet Gillian – Matthew was of because he pulled the roof down	

7.57.39	Ron – Ah yeah Trevor – What, was that on Monday? Emma – You were the one who did that Ron – Ahh ... there is always Trevor – What date did we get that? Ron – That must have been the Monday Tuesday Trevor – I was in the base unit on Monday Ron – You were, we watched you get taken out of the lesson Emma – You were the one who pulled the roof down! Ron – What happened was, he pulled the roof down then exactly 1 week later Rees flooded the bathroom Trevor – I helped him and the roof looks clean	Gillian and Emma chat Gillian shows science booklet
7.57.51	Emma laughs Gillian – Who ... Ron – So basically they gave him the last two weeks of half term Trevor – We the hand driver	
7.58.04	Gillian or Emma – We had one Ron – We are waiting to find out what happens this Friday Gillian – I picked up the wrong one ... Ron – I’m waiting to find out what happens this Friday Gillian – I am supposed to give myself eye drops Emma – Ahh Ron – It’s the hay fever, you don’t die of hay fever Trevor – You can have severe cases of hay fever Gillian – My eyes swell up its supposed to be a spray No you are not going any where near my eyes Trevor – Let Ron do it Ron – He would probably poke you Emma – Let the ginger do it Trevor – He wont be able to put enough pressure on to get even a single drop Gillian – I’ll attempt it later Ron – I hate him I already got bullied Gillian - ... test ... Ron – I got bullied first lesson for being small ... Jake kept saying I was not five foot .. I am five foot and half an inch Gillian – I’m 5’8 and that’s like normal Emma – Well Gillian – I am going to cry, I’m on the verge of tears My life is going downhill Because of those drops and not the spray	Gillian takes a spray from her bag Much of this is hard to hear Said to Trevor
7.58.37		
7.58.53		

7.59. 12		Ron – Why because ahh Trevor – Just do the drops ... Ask Miss Gillian – Because I ... Ron – What did you do Gillian – At primary ... you just get your medicine Ron – They gave me some ... Gillian - ... they are not allowed Ron - They basically did They just threw it at me (laughing) in my mouth	
7.59.34		Ron – What Trevor – People throwing stuff and you catching it in your mouth .. Ron – It does not make me like a Chihuahua ... most dogs do that Gillian – I cannot do it when people are looking Ron – Well don't .. just do it in the bathroom Trevor – Turn around Ron – Between lessons Gillian – But if I die ... Trevor – Turn around Ron – Do it in the bathroom between lessons Trevor – Get Emma to do it Ron – Do it at dinner	Inaudible eye drop chat Much of this is inaudible
7.59.48	I	AE comes over – How many did you take out? Gillian – We took out the same amount ... Ron - because there was one on the floor AE – 26 ... we don't know how many we started with what's the difference? Ron – 2 AE – How could you use those three numbers? Ron – 2 of them for every 12 of them Emma – Get another handful and another handful Trevor – 26 Ron – There are two for every 24 of them Trevor – 26	I – they reengage in response to teacher prompting.
8.00.26	A	Gillian – And the is 24 of them in there Ron – 22 left of them And do 164 Trevor to Emma – Quit breaking them Ron – Quit breaking them Emma – It was already broken	Negative A – disruption caused by the beans.

8.00.38		Trevor and Ron – No Trevor - eat beans cannot afford to eat beans Ron – That’s assault ... no for that Trevor – Where do you get a lawyer How do you get a lawyer Ron – You just go ... you have got 2 witnesses ... she threw a bean off your head, she threw a bean off your head she tried to kill you! Ron – Don’t Trevor Gillian – You can put them back Emma to Gillian - ... work in French that you would Gillian – Sometimes ..	He flicks the bean pieces back at her
8.01.28		Trevor – Quit chucking them Ron – I just kept stealing Trevors ideas before he could use them ... Trevor kept saying something .. AE – Year 9	Trevor tips the beans onto the desk
8.02.11		Trevor – Snort a line AE - Gillian – Multiply them ... AE - ... Gillian – Put them all in AE – What could we do ... if you want to use my numbers you can	Emma laughs – 20 seconds of inaudible chat
8.14.12		Clip 4 AE - ... what maths skills + recaps the three numbers they have	He sniffs the beans
8.14.32		Gillian– When you get them ... AE – The population did not change ... have a think Why the different colours? That’s what I want a discussion of in 3 minutes.	Emma spills the beans Trevor puts his beans back in the bag
8.15.10			
8.15.34	I	Gemma – Figured out what it is? Gillian – Multiply it	I – they focus with prompting from class teacher.

8.15.59	A	Ron – Two for every 24, there is 24 of one thing, there are 11 pairs so you times them to get 264 Gemma – You had better get ready to explain Gillian – Or you could just do what I do Gemma – You have to work it out Gillian – I My brain cells do Ron – I forgot what I said Gillian - Times by 11, 11 pairs, that's 11 x 24 Trevor – There are 11 pairs so you times it by the amount that's there	Playing with beans now + laughter
8.16.42		Ron – Where did the bean go? Emma – This is not working Emma – Ha, ha, ha, ha – look at this AE – Year 9 often the answer is something you already know. In 3 minutes you will share	Negative A dominates as the pupils play with the beans and revisit previous conversations etc. This results from a lack of focus from the teacher so they remain off task. 8.14 – 3 minute warning given – this is repeated @ 8.16.
8.16.55		Gillian - I did it, I did it Gillian – I'm just ... Ron – You have never done it Ron – Heart Trevor – Yes, heart Gillian – I would never, ever Trevor – Beans!	
8.17.45		Emma – Look at this, look at this Trevor – And them, if I'm fast enough, if I'm fast enough Emma – Try it, try it Ron – They will go everywhere Emma – Try it, try it Ron – Okay they did not go everywhere – that's a surprise	Background chat as they wait patiently + playing with beans
8.18.11		Gillian – My eye Ron – What Gillian – My eyes and I did not cry AE – Put the beans back in the pot Emma – Ahh Put everything in the pot Ron – We need to split the beans Emma – We need to split the beans Ron – So they can go back in the bag in the pot ..because we were told to do ... what we could	Eye drops Reference to shape made out of beans Moves bean tub around He has beans in the lid and is going to flip them

8.18.46	Emma – Well I was not paying attention Trevor – Little bean ... little bean .. Emma – Little bean is so protective over the beans Ron – Why Nan Emma – Did you just say ... your Nan Ron – Nan Trevor – Yeah, because who does not have a Nan Emma – I don't have a Nan Gillian – I don't have a Nan Trevor – I cannot afford a nun then Emma laughing – Nun Gillian – All I know is that my Nana is 93 Emma – My great Grandad Gillian – That's nice 93 is still alive ... I hope I don't get to that age Ron – It would just be boring Gillian – I hope I ... 23 .. I wonder if I'll die from alcohol poisoning ... I lived the good life	He flips them without mess
8.19.18	Ron - My pen (to Emma) Gillian – I have literally Ron – I had eyedrops 2 years ago Trevor – Yes it is, give it back then Ron – How have you ... Trevor – Under your seat	
8.19.35	Emma – I'm proud of you for putting your eye drops in Emma – My eyes are always swollen ... I just deal with it	Trevor reads from book on windowsill then uses the hard covers from the book to rub them together and to annoy the others
8.19.42	AE – Year 9 – recaps on what they have done Feedback Emma to Trevor - Do you mind?	Trevor flicks Emma's hand
8.20.46	Emma – You are getting me confused Emma – Ow Trevor – Dust everywhere Emma – I don't know what the question is	Trevor crushed the beans between the book covers. Gillian lies with her head on her bag Trevor flicks beans

		The rest of the lesson has no significant talk from the pupils – they play with the beans as the feedback progresses slowly. Lesson ends with a discussion of how to census whale populations	