THE INFLUENCE OF SELF-REPORTED ETHNIC ORIGIN AND MOOD ON ELICITED EMOTION AND BRAIN REACTIVITY TO HAPPY AND SAD SOCIAL FILMS.

A thesis submitted for the degree of Doctor of Philosophy

by Katherine Macaulay

School of Social Sciences
Brunel University
September 2011

ABSTRACT

In recent years Social Neuroscience has started to investigate how mood and culture influence social and emotional situations. In the present study differences in elicited emotion and neural activation were investigated when participants viewed films depicting social interactions. Film clips are preferred stimuli for elicitation of emotion in laboratory studies, but given the lack of standardised film sets in the literature, two behavioural studies were conducted prior to imaging. The first study (147 females, 30 males; 98.8% 18 to 24 years) identified a set of clips that elicited emotion profiles in which the target emotion (happy, sad) was strongest, as well as neutral clips, and demonstrated an effect of participants' stable mood. The second study (143 females, 19 males; mean age 19.2 years) optimised the stimulus set and demonstrated effects of self-reported ethnic origin, mood and interest on profiles of elicited emotion. In the fMRI investigation 33 female and 8 male participants (mean age 19.2 years) viewed film clips in a block design experiment with *loose* and *tight* t-contrasts and retrospective ratings of elicited emotion. Across all-participants, social interaction depicting sadness activated key emotion-related structures such as left amygdala and insula, and medial frontal cortex that were not significantly activated with social interaction depicting happiness. However, greater activation was observed for Europeans than for non-Europeans in orbitofrontal cortex, anterior and posterior cingulate for happy social interaction and in hippocampus, precuneus and retrosplenial cortex for sad social interaction. Individual differences in trait emotions and stable mood were measured with PANAS-X. For high fatigue participants greater activation was observed in the left amgydala for happy social interaction. For participants with high positive stable mood greater activation was observed in the insula for happy and sad social interaction. The research described here indicates that self-reported ethnic origin and mood are potentially significant influences on elicited emotion and brain reactivity to positive and negative social and emotional situations.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.

I would like to thank my supervisor Professor Michael Wright for giving me: firstly, the opportunity of carrying out this project; and secondly, for his guidance, supervision and much needed advice whilst planning, undertaking and writing up this investigation. Many thanks also to Ari.Lingeswaran at Royal Holloway for his help with running the experiments and Dr Adrian Williams at Brunel for SPM guidance. The project would have been impossible without the cooperation of both Brunel and non-Brunel participants, to whom special thanks are given. Finally, I would like to thank my partner Barry and children Sam, Patrick, Chloe, Karl and Sophie, for their patience and support during the completion of this thesis.

1. INTRODUCTION.

“When dealing with people, remember you are not dealing with creatures of logic, but creatures of emotion.” Dale Carnegie, writer and lecturer (1888 - 1955).

The investigation of emotional processes is closely associated with both social psychology and neuropsychology. Affect neuroscientists investigating emotion (Davidson, 2004; Ekman, 2003; LeDoux, 2000; Rolls, 2005) have reflected on the fundamentally important role of emotion in the functional organisation of the brain and emphasized that a contemporary model of emotion should respect the distinctions that are made by the brain, for empirical and theoretical consistency. Social cognitive analysis has considered the situational influences on the elicitation and experience of emotions and the social factors in the causation and constitution of emotion, together with individual traits and tendencies. These social and emotion questions, although historically the province of different disciplines, are not prominently distinct phenomenon. The interconnectivity of social and affect phenomena is evident in many current psychological investigations (e.g. emotion and appraisal, Ochsner, Ray, Cooper, Robertson, Chopra, Gavrieli and Gross, 2004) and although emotion is experienced in non-social contexts it is difficult to comprehend of any social interaction completely devoid of emotion (Ochsner, 2008). This widespread intertwining may explain why the paradigms used in both affective neuroscience and social cognition are similar, with neuroscience tasks often using social stimuli (e.g. facial images) and social cognitive tasks involving affective processes. Similarly, this connectivity could also explain why lesion and functional imaging investigations of social and affect phenomena consistently implicate a common set of brain systems (Olsson and Ochsner, 2008).

One reason given for the historical separation between disciplines as regards the study of emotion is, in the main, theorists from different disciplines understandably view cause-effect relations and part-whole associations in terms that are fairly incommensurable (Lewis, 2005). Affect neuroscientists, for example, tend to chart aspects of the emotion mechanism onto specific brain regions. Thus, neural explanations importantly incorporate great complexity, bidirectional causal assumptions and focus, in the main, on interacting elements. In contrast, social investigations verify causal assumptions that are straightforward, linear and emphasise psychological wholes (e.g. “emotion”) but can sometimes overlook how these states derive from collaborative elements. This partition of affective neuroscience and social cognition research is not unexpected given that they are relatively new disciplines. Moreover, as Ochsner (2008) proposes it can take time for disciplines to mature and their core findings to become solidified.

In recent years due to theoretical and methodological advances an approach called *Social Neuroscience* has started to investigate, and emphasize, the importance of understanding how gender, personality, power relations, cultural processes influence the functional organisation of the brain, as well as how the brain and body influence these social relationships (Harmon-Jones and Winkielman, 2007). Investigators in the past mainly described emotion experience and social cognition as divisible processes - for example, the amygdala as key for emotion and the prefrontal cortex as key for social cognition – whereas current social neuroscientific research has found the interconnectivity of these structures are now more apparent. For example, a review by Salzman and Fusi (2010) assessing emotion, cognition, and mental state representation found that emotion and social cognition are inextricably linked and activated in neural networks typically composed of interconnected prefrontal and limbic brain structures. From their viewpoint, as will be further discussed in this chapter, functional interconnectivity between limbic and prefrontal cortex mediates emotional control on processes such as social behaviour regulation as well as decision making. The relationship between emotion elicited by social processes and brain structures is an area of particular relevance and will be the focus of this thesis. Specifically, this investigation wishes to establish, and then operationalise, a robust method that will identify the brain regions activated when social factors are the causation and constitution of positive and negative emotional elicitation, in concert with individual characteristics. In addition, the ultimate aim of this thesis is to contribute to the increasing psychological knowledge on the importance of understanding how individual differences and cultural processes influence the functional organisation of the brain and inversely how brain structures could influence social relationships.

The remainder of this Introduction will firstly concentrate on current empirical findings about emotional neuro-circuitry in predominantly the prefrontal cortex, amygdala and anterior cingulate cortex (key interconnected regions in emotion and social processes) and how divisions found in the brain are incorporated into contemporary models of emotion and social interaction. Current research into sociality - the social components of emotional processing – will then be considered. The later part of the Introduction will briefly focus on individual characteristics – biological sex, gender, stable mood and ethnic origin – that may give rise to differences in the production of emotional experiences.

1. 1. Neural Basis of Emotion.

Currently, emotion is viewed as comprising of many distinct sub-components that are instantiated in a dispersed network of sub cortical and cortical circuits. Within the network of sub-components are processes that involve the perception of emotional information (e.g. facial expressions) and processes that involve the production of emotion (e.g. self-generating emotional feelings). It is important to note that many affect studies use facial expressions of emotion as stimuli, but whether these studies elicit any emotion is uncertain and it is important that these, and similar imaging studies, should be classified as investigating the perception of emotion not emotion *per se* (Davidson and Irwin, 1999). This is particularly relevant to the current investigation as it is proposed that perception of emotional actions characteristically leads to automatic and rapid stereotypical neural responses that are distinct from the pattern of neural responses supporting the experiential effects of emotion that influences long-term behaviour and social interaction (Dolan, 2002).

1. 1(a). Production of Emotion.

The proposed investigation will focus on the brain processes involved in the production of emotions rather than perception of emotion. Moreover, as previously stated the study will exclusively focus on the production of emotions associated with social interaction - defined for the purpose of this investigation as emotion shaped by the presence and interaction of human forms. The reason for clearly specifying the aspect of emotion under investigation is two-fold. Firstly, Davidson and Irwin's

(1999) review encourages affect studies to clarify the aspect of emotion under investigation. Secondly, although the brain structures that mediate emotions are becoming clearer within certain key regions (e.g. amygdala) there seems to be a changeable contribution depending on whether the aspect of emotion is perceptual, mnemonic, behavioural or experiential (Dolan, 2002). For example, Anderson and Phelps (2001) investigation of individuals with unilateral and bilateral amygdala lesions found these individuals experienced no deficit in their experiential knowledge of emotion despite the documented importance of the amygdala to emotional perception. These and other findings (Dolan, 2002) seem to indicate that there is some segregation within certain emotion processing regions between mediating perceptual and mediating experiential effects.

Problematical for every investigation exploring any aspect of emotion and social processes is the expectation that the elicitation procedure will activate multiple neural processes. For example, it is expected that in response to an emotion eliciting film clip appraisal and attention processes will be generated as well as processes involved in the somatic and visceral features of emotion, and processes involved in the regulation of emotion. Thus, elicitation of specific emotions in the multifaceted brain of human individuals means many additional processes are engaged and activate diverse subcomponents in overlapping and interconnected circuitries. Davidson (2003) emphasizes that a general difficulty facing any neuroimaging study of affect is that the neural circuits activated even for a specific and relatively unambiguous emotion (e.g. sad) can vary as a function of many different processes, including the nature of the procedure employed, the context in which the emotion is elicited and individual differences.

Despite the aforementioned difficulties, a number of investigations (Davidson, 2003; Rolls, 2005; Vytal and Hamann, 2010; Wood and Grafman, 2003) view a common set of brain regions as involved in emotional experience and social processes, with this experience being partly grounded in emotion-specific neural patterns in the prefrontal cortex, anterior cingulate cortex and amygdala. Other structures, such as the hypothalamus, hippocampus, nucleus accumbens, cerebellum and insula have also been recognized as directly related to emotional experience and sociality. To date research has yet to demonstrate rigorously what precise aspects of emotion are associated with these individual regions but current investigations appear to confirm that each region does perform a particular purpose. Specific paradigms to isolate the more elementary stages of the emotion process have started to be developed, in order to generate analyses in terms of the underlying neural systems (Rolls, 2005). As in most areas of emotion research, however, future theoretical and investigative work is essential in order to fully understand how mental states associated with emotional and social experience form and change: particularly given the importance of this adaptive feature for stable mental and emotional behaviour (Salzman and Fusi, 2010).

Given the proposal that the prefrontal cortex, amygdala and anterior cingulate cortex are key interconnected regions of the brain for emotional experience and social processes, the significance of these connected regions to this process will now be considered in some detail.

1.1(b).The Prefrontal Cortex and Emotion.

The significance, interconnectivity and function of the prefrontal cortex - considered one of the most important brain regions as regards the current investigation - will be briefly presented, however a more detailed review of the connections and structure of this area is provided by Carmichael and Price (1995) or Kringelbach and Rolls (2004).

The prefrontal cortex is located in the anterior part of the frontal lobes, positioned in front of the motor and premotor areas, and has been differentiated on the basis of both functional and cytoarchitectonic considerations. The three divisions of primate prefrontal cortex that are consistently distinguished are the orbitofrontal, dorsolateral and ventromedial regions. In addition, there seems to be significant functional differences between the right and left sides within each region (Davidson, 2001). These regions of the prefrontal cortex have many interconnections with both cortical and subcortical regions. One important activity of this brain region is considered to be the maintenance and orchestration of internal emotional states and discernment of external emotional stimuli across systems: thus enabling individuals to engage in behaviour congruent with the achievement of long term goals (Wood and Grafman, 2003). One structural explanation for the prefrontal cortex’s ability to coordinate and maintain internally and externally perceived emotional representations is that the neurons of the prefrontal cortex are able to fire over extended periods of time and across events, due to the ability of their cell structure to handle more excitatory inputs (Wood and Grafman, 2003).

As of yet, functional differences between the orbitofrontal and ventromedial areas of the pre-frontal cortex are not definitively established, although areas of the ventromedial cortex superior to the orbitofrontal cortex seem to be much less associated with social functions. The orbitofrontal cortex has however been extensively researched and shown to have a strong association with emotional experience and social function (Davidson, 2004; Rolls, 2005). This brain region is poorly developed in rodents but well developed in primates including humans, so the majority of affect neuroimaging studies has either employed macaque monkeys or people.

There are direct connections to the orbitofrontal cortex from primary taste cortex, primary olfactory cortex (Rolls and Baylis, 1994), from the part of the visual system concerned with forming the representation of objects, from the inferior temporal visual cortex and, in addition, the cingulate cortex. Inputs also reach the orbitofrontal cortex from auditory areas (Barbas, 1993), somatosensory cortical areas and the insula (Carmichael and Price, 1995). The amygdala has robust reciprocal connections with the caudal orbitofrontal cortex and the hippocampus and is also connected, via the subiculum, to the medial orbitofrontal cortex (Carmichael and Price, 1995).

Current affect neuroimaging studies have explored the relationship between taste/olfactory cortex and the orbitofrontal cortex and have found evidence that activation in the human orbitofrontal cortex is related to subjective pleasantness, not to taste or smell *per se* (Rolls, 2005). Similarly, studies looking into visual, taste and olfactory cortex have found that neural activity in the orbitofrontal cortex of macaque monkeys decreases as food is fed to induce satiety and this suggests that positive affect information is represented in this area. Neuroeconomic investigations with abstract concepts such as monetary reward have also yielded similar results, with the magnitude of the activation of the lateral orbitofrontal cortex correlated with the amount of money lost and activation of the medial orbitofrontal cortex correlated with the amount of money won (O’Doherty, Kringelbach, Rolls, Hornak and Andrews, 2001).

The above cited studies are viewed, in the main, as consistent with the hypothesis that one of the main roles of the orbitofrontal cortex, in the generation of affect, involves assessing expected positive value through reinforced association learning and through reversal of this learning. Further evidence for this hypothesis is provided by studies assessing the effects of damage to the caudal orbitofrontal cortex in humans that produces impulsiveness and lack of affect (Berlin, Rolls and Iversen, 2005). Animal studies assessing models of affect and macaque monkeys with damage in this region have also found the animals display reduced aggression to snakes and humans and abnormal preferential ranking for different foods (Baylis and Gaffan, 1991). The modification in affect behaviour that has been observed after damage of the orbitofrontal cortex seems to be related to a failure to learn about which emotion eliciting stimuli are positive/rewarding and those that are negative/punishing and it has been suggested this is connected to the prefrontal cortex's role in interpreting emotion-related somatic sensations (Rolls, 2005).

The prefrontal cortex also seems to be important for self-insight into the appropriateness of social behaviour and the ability to evaluate behaviour in reference to the reactions of other people (Beer, John, Scabini and Knight, 2006). Self-insight and monitoring is explained as the conscious or unconscious process by which individuals appraise their behaviour as consistent with how other individuals expect them to behave or how they themselves want to behave. Both empirical research and clinical classification of individuals with frontal lobe damage frequently characterize these individuals' behaviour as socially inappropriate. For example, in one case study an individual with frontal lobe damage improperly approached members of the opposite sex and when told this behaviour was offensive was upset and confused (Prigatano, 1991). This type of inappropriate social behaviour, it is suggested, occurs due to damage of the prefrontal cortex because the area is essential for the generation of emotions useful for guiding social behaviour and in underpinning self-monitoring processes generally (Beer et al, 2006). As, intuitively in everyday life when social mistakes are made this is most often followed by emotions such as guilt, shame or embarrassment, so from an evolutionary perspective, these emotions have evolved to motivate individuals to repair social relations thereby promoting reproduction and survival (Goffman, 1956). A more recent review into the neural correlates associated with emotional experience, specifically pleasure and happiness, also seems to confirm that activity changes in regions of the orbitofrontal cortices and subgenual cingulate correlate to pathological changes in subjective experience (Kringelbach and Berridge, 2009). However, Kringelbach and Berridge (2009) caution against viewing the orbitofrontal cortex as programming pleasure and happiness as these experiences are also rooted in many other high-level psychological functions as well.

The dorsolateral prefrontal cortex is a region critically involved in regulating actions and, it is suggested, evolved from motor regions of the brain and developed much later than other prefrontal regions. The reciprocal connections of the dorsolateral prefrontal cortex are predominantly with non-emotional sensory and motor regions, for example the parietal cortex and basal ganglia, as well as performance monitoring regions (Wood and Grafman, 2003). However, it also has reciprocal connections with ventromedial prefrontal cortex, which is associated with social cognition and emotion (Wood and Grafman, 2003). This pattern of connectivity between the dorsolateral prefrontal cortex and other brain regions supports the region's involvement in the regulation, or monitoring, of emotion-related social behaviour.

The dorsomedial prefrontal cortex is viewed as an area that may support a "default state" of the human brain as it is active during resting states when the participant is not involved in any overt task, but may be involved in reflective mental activity (Raichle, MacLeod, Snyder, Powers, Gusnard and Shulman, 2001). A study by Iacoboni, Lieberman, Knowlton, Molnar-Szakacz, Moritz, Throop and Fiske (2004) however found that watching a film clip, showing two persons interacting, yielded increased activity in the dorsomedial prefrontal cortex and other default regions in comparison to a rest condition. Moreover, the dorsomedial prefrontal cortex also showed increased activation when the two person film clip (relationship film) was contrasted with a film clip featuring just one person (alone film). These findings led Iacoboni et al. (2004) to suggest that the dorsomedial prefrontal and medial parietal (precuneus) cortices are regions specifically programmed to assess, and respond to, social relationship situations. Additionally, with the pattern of activation found corresponding to either an *actual* social relations (two person film clip) or a *potential* social relation (one person film clip). Iacoboni et al. (2004) concludes that the dorsomedial prefrontal cortex, together with the medial parietal cortex system, is part of a default system that continuously (usually without effort or intention) assesses and analyses future, present or past social relations whenever other non-social tasks do not demand full attention. Given the importance of social relationships to everyday life a neural system which continuously monitors human relations may be a central element in sustaining social relations and important for both mental and physical health.

To summarize, the prefrontal cortex seems to be involved in ascertaining which emotional and social stimuli are positive/rewarding and which are negative/punishing and then in altering behaviour when the reinforcement contingencies change. The emotional information generated from this region seems to be a foundation on which a self-monitoring process is employed in order to guide social behaviour, or when an intuitive or emotional decision is required. Additionally, information about positive or negative stimuli seems to be represented by orbitofrontal cortex but projected to the dorsolateral prefrontal cortex where it is used in tasks needing planning. The dorsomedial prefrontal cortex also seems specifically programmed to constantly monitor social relationship situations.

1.1(c).Amygdala and Emotion.

The amygdala's key role in many aspects of emotional processing is now widely accepted due in part to the dramatic increase in neuroimaging investigations and subsequent data published. The amygdala is a subcortical area in the anterior part of the temporal lobe and receives substantial projections, in primates, from the temporal lobe cortex. These projections come from mainly the higher stages of sensory processing in the visual and auditory modalities (e.g. superior temporal auditory cortex) and not from early cortical processing regions (Rolls, 2005). However, there are some inputs to the amygdala from early stages of the sensory pathways (e.g. auditory inputs from the medial geniculate nucleus) but these inputs are unlikely to be involved in affect as cortical analysis of the stimulus is typically required (LeDoux, 2000). This would be consistent with the view that neural structures involved in emotion, for primates, generally receive from sensory systems environmental stimuli analysed to object level (for example, not to the frequency of a sound as characterized in the cochlea). The amygdala also receives inputs from somatosensory areas via the insula and from the posterior orbitofrontal cortex (Carmichael and Price, 1995). Amongst other subcortical inputs to the amygdala are projections from the hypothalamus, parts of the hippocampus, midline thalamic nuclei. The outputs from the amgydala include projections to the hypothalamus, with outputs from the medial amygdala (somewhat small in primates) to the medial hypothalamus via the stria terminalis. Correspondingly, there are projections from the lateral amygdala to the lateral hypothalamus via the ventral amygdalofugal pathway, and this pathway also provides a route for processed signals to reach the brainstem (Rolls, 2005). Additionally, the amygdala has direct projections back to many areas of the orbitofrontal, insular and temporal cortices from which, as mentioned above, it also receives inputs. The hippocampus is another region that receives information from the amygdala, via the entorhinal cortex, and it is suggested that via these pathways affect stimuli are introduced to the hippocampal memory system.

The anatomical connections of the amygdala, as briefly identified above, means the region is strategically placed to receive highly processed emotion and social information from a network of structures, including the prefrontal cortex, and to influence autonomic and motor systems. Confirmation of this for social behaviour was first revealed in early lesion studies on monkeys with bilateral removal of the amgydala, who exhibited striking behavioural changes including lack of responsiveness and tameness (Weiskrantz, 1956, as cited in Adolphs, 2010). Further selected amgydala lesion studies on monkeys confirmed impairment of similar types of social behaviour to both positive related stimuli as well as negative related stimuli (Rolls, 2005). Despite the reliability of these studies and the change in the lesion monkeys' social behaviour seeming stable (similar to a trait change in personality), not a change in mood as such, the contribution of the amgydala to this change is still somewhat unclear. Inasmuch as, attributing this permanent change of social behaviour to the structure is a rather untidy explanation given the fact that the amygdala is connected to a host of other structures, as mentioned above, whose functions the amygdala modulates (Adolphs, 2010). Similarly, lesion studies into social behaviour in humans and the consequences of amgydala damage to emotional experience and social cognition is also sometimes difficult to attribute selectively to the amygdala. For example, neuropsychological studies on epileptic individuals with amygdala damage found the cost of such lesions on social behaviour almost impossible to characterise separately. However, the social behaviour observed (e.g. impaired Pavlovian fear conditioning) for the epileptic individuals did bear some resemblance to that observed in primate lesion studies following selective amygdala lesions (LaBar, LeDoux, Spencer and Phelps, 1995, as cited in Adolphs, 2010).

More specific human amygdala affect investigations have been undertaken on individuals with Urbach-Wiethe disease, an extremely rare genetic disease which causes specific bilateral lesions of the amygdala. Adolphs (2010) studied in detail a woman with bilateral damage of the amygdala caused by Urbach-Wiethe disease and in respect to social behaviour found her particularly disinhibited with a tendency to approach and engage others. They also found she appeared to have no feeling of personal space whatsoever, which had occasionally resulted in social difficulties in real life. Adolphs (2010) concluded the findings for this individual did resemble social behaviours found in monkeys with bilateral amygdala lesions and are consistent with the proposed function of the amygdala to process salient affect stimuli especially when these signal potential menace or unpredictability. Phelps, Labarab, Anderson, O'connor, Fulbright and Spencer (1998) also examined emotion in a woman with bilateral damage to the amygdala, caused by Urbach-Wiethe disease, and consistent with other case studies found performance deficits for arousing stimuli and fear conditioning. Phelps et al. (1998) however concluded that based on the results of test cases the amygdala’s involvement in emotional behaviour is primarily via contributing an organizing principle, such as, a category or schema. This, in some way, supports Rolls (2005) proposal that imaging differences - in the magnitude of effects between categories of emotional stimuli or amygdala damage - should not be calculated as showing that the amygdala is only involved in particular emotions, but may just reflect evaluation of the emotional stimuli. From this perspective strength of engagement leads to differences in the magnitude per se of different emotions, thus making some effects more apparent for some emotions than others (Rolls, 2005).

The precise functional nature of the amygdala has also been considered in a variety of affect investigations employing neuroimaging techniques. In order to examine the effects of experimental characteristics on the probability of detecting amygdala activity a fairly recent meta-analysis of 385 functional neuroimaging studies of emotional processing was conducted by Costafreda, Brammer, David and Fu (2008).

Their main findings were firstly, all emotions were more likely to activate the amygdala than neutral stimuli; secondly, a significant difference was found between the subcategories in their capacity to generate amygdala activation; and thirdly, that the amygdala was predominantly activated by negative rather than positive stimuli. Costafreda et al. (2008) however, caution as in their meta-analysis positive emotions such as amusement and sex were both strong predictors of amygdala activation with amusement the third strongest emotion associated with amygdala activation. They conclude that if amusement and happiness are considered as having little differences as regards valence, but noteworthy differences in arousal, these findings may be viewed as indirect evidence that arousal drives amygdala activation, rather than valence per se. Costafreda et al's (2008) findings also adds to the body of evidence on the importance of human amygdala function to social behaviour (Adolphs, 2002), as social type of stimuli was a strong predictor of amygdala activation. Of particular interest for this study (discussed further in chapter two) Costafreda et al. (2008) found that type of baseline control condition was a significant predictor of amygdala activation, with, as expected, low level baseline tasks, such as rest or fixation, linked to a higher probability of activation than control conditions involving neutral or emotional material.

The importance of context and individual differences to amgydala function is just emerging and coming mostly from studies assessing sensory inputs. Currently, the sensory inputs to the amygdala seem gated by two mechanisms: a prefrontal-mediated inhibition via projections from the prefrontal cortex; and, a dopamine-mediated augmentation of sensory inputs to the amygdala (Adolphs, 2010). An investigation by Kienast, Hariri, Schlagenhauf, Wrase, Sterzer, Buchholz, et al (2008) looking into dopamine storage capacity in the amygdala found it positively correlated with fMRI BOLD signal changes in amygdala and dorsal anterior cingulate cortex that were evoked by negative stimuli. They surmised that individual dopamine storage capacity in the amygdala serves to modulate emotional processing in the amygdala and dorsal cingulate and may be correlated to a large extent with individual differences related to mood (Kienast, 2008). Further, investigations have found that systematic changes in the strength of both structural and functional connectivity between amygdala and medial parts of the prefrontal cortex are associated with trait anxiety, psychopathology and aspects of decision making (see Adolphs, 2010, for review).

The importance of lateralisation of amygdala activation and social emotional experience has also been the subject of several affect neuroimaging studies. Emotion and lateralisation was investigated by Baas, Alemana and Kahn (2004), who combined the results of 54 imaging studies in a meta-analysis in order to establish if a common pattern existed. They found that across studies the left amgydala was more active than the right amgydala and attributed this to the different roles for the left and right in emotional processing. Since, in the processing of emotional stimuli it was hypothesised that the left amygdala was more involved in local (fine-grained details of a stimulus or scene) processing, whereas the right amygdala was more involved in global (holistic aspects of a stimulus or scene) processing. Costafreda et al. (2008) also found evidence of hemispheric specialisation with the right amygdala potentially serving as a high-speed detection role for unconscious stimuli, while the left amygdala was employed when evaluation of language-related stimuli was required. These finding are supportive of the previously mentioned Phelps et al. (1998) investigation, which suggests the amygdala's input in emotional behaviour is primarily by way of contributing an organizing principle. Thus, one of the critical functions of the human amygdala in social processes could be to segregate the neural representations of the significant from the mundane, either during stimulus encoding or through later recollective processes (Anderson and Phelps, 2001)

This very brief review on the interconnectivity and role of the amygdala, as supported by lesion and neuroimaging investigations, points to the structure having a more general role in emotional experience and social interaction than maybe previously considered. Perhaps, the existing association of negative emotion with the structure is due to firstly, the predominance of negative mammalian lesion studies, and secondly, an overlooked association between arousal and direct survival value. However, the increase of imaging studies into positive emotion may lead to further association with additional emotions, such as happy and amusement, which also generate amygdala activation. In line with aforementioned reviews the present study considers the role of the amygdala as one mainly of emotional evaluation about incoming positive and negative stimuli and in which the emergence of individual and group differences maybe an important part of the processes.

Footnote: Some of the studies cited in this introduction on the human amygdala have mentioned past concerns about the robustness of BOLD fMRI as technique to study the human amygdala. Given that the hemodynamic response function in the amygdala is rather dissimilar in shape than that found in cortex. Consequently, most investigators agree that definitive findings about the structure will require convergent results from multiple approaches (e.g. human and primate lesion investigations).

1.1(d). Anterior Cingulate Cortex and Emotion.

The anterior cingulate cortex is typically considered an important part of the limbic system and involved with emotion formation and processing, learning, and memory. There are direct connections to the anterior cingulate cortex from the medial thalamic area, medial orbitofrontal area, parts of the lateral orbitofrontal and the amygdala (Carmichael and Price, 1995). The anterior cingulate cortex also receives input from the anterior end of the temporal lobe, somatosensory cortical areas and from the insula. Amongst other areas outputs from the anterior cingulate cortex also project to the ventral striatum and caudate nucleus through which behavioural responses could be formed (Rolls, 1995). The structural and functional organisation of the anterior cingulate cortex means that this area is ideally positioned to participate in the regulation of social behaviour. This is based on its connectivity to three key elements: the lateral prefrontal cortex providing access to cognitive functions; the thalamus and brainstem providing a strong influence on arousal; and, motor channels that provide access to skeletomotor output systems (Decety, 2011). Interestingly, the strong interconnections between the anterior cingulate cortex and other areas are predominantly only evolved in apes and humans maybe - as cytoarchitectonic studies indicate - due to the large spindle neurons uniquely found in the anterior cingulate cortex of humanoid primates (Allman, Watson, Tetreault and Hakeem, 2005, as cited in Decety, 2011). Moreover, this observation suggests that some functions provided by anterior cingulate cortex may not have materialized until late in evolution and may be specific to those species for which social relations and cooperation are particularly important (Lamm and Singer, 2010). This viewpoint would further support the vital role given to the anterior cingulate cortex in the processing of complex social relations and specific emotions such as empathy, compassion and fairness.

A fairly recent meta-analysis of 162 functional neuroimaging studies of emotion showed that the dorsal and ventral regions of the anterior cingulate cortex, together with the amygdala and the ventral striatum, are among the most frequently activated regions in studies of emotion (Kober, Barrett, Joseph, Bliss-Moreau, Lindquist and Wager, 2008). These neuroimaging studies as well as implicating the anterior cingulate cortex in a range of affect behaviours have also identified its involvement in a multitude of cognitive functions, together with mood change, anxiety disorders, depression and the perception of pain (Luu and Posner, 2003). The diversity of functions that have been attributed to the anterior cingulate cortex has led some affect investigators to divide this area into sub-regions that are separately responsible for affective and cognitive processes. Bush, Luu and Posner (2000) proposes given the dorsal part of the anterior cingulate cortex connection with the prefrontal cortex and parietal cortex as well as the motor system and the frontal eye fields makes the area ideal for processing bottom-up and top-down stimuli then conveying cognitive appropriate information (e.g. error detection, anticipation of cognitively demanding task, monitoring competition, etc.) to other brain structures. In contrast, the ventral part of the anterior cingulate cortex connection with hypothalamus, amygdala, anterior insula and nucleus accumbens makes this area more appropriate for assessing the salience of emotion and motivational information. Lamm and Singer (2010) have also speculated that the ventral region may be chiefly engaged in bodily and internal homeostatic regulation whereas the dorsal region may be engaged more in executive mechanisms connected to adaptive behaviour and converting emotive states into actions. Empirical support for the above suggestion comes from Kober et al's (2008) meta-analysis, as cited in Lamm and Singer (2010), who found specific activation of dorsal anterior cinculate cortex in executive control tasks.

Similarly, Rolls (2005) has divided the anterior cingulate cortex into the perigenual and mid-cingulate areas. Rolls (2005) cite the perigenual cingulate area as extending from cingulate areas BA32 and BA24 to subgenual cingulate area BA25 and involved in emotion. Whereas, the mid-cingulate area is further back than the perigenual cingulate and may be involved in response selection (see Rolls, 2005, page 178 Figure 4.60). Rolls provides the example of individuals with surgical lesions of the anterior/perigenual cingulate cortex who have impaired identification of subjective emotional states, together with some changes in social behaviour including a reduced ability to notice when people are angry, as support for this division (Rolls, 2005).

Further confirmation for the constant involvement of the anterior cingulate cortex in social emotional experience again comes from investigations in the previously mentioned discipline of neuroeconomics, in which phenomena such as fairness and cooperation have been investigated using methodology such as game theory and behavioural economics (Lamm and Singer, 2010). These neuroeconomic studies point to the important role of the anterior cingulate cortex in social relations and emotion and have established activation in this area for both negative affect such as disgust, pain, and also positive affect such as compassion, admiration, and fairness. The involvement of both negative and positive affective states in this region has prompted theorists to speculate on how valence is encoded in anterior cingulate cortex. A possible answer to this question is suggested by Craig (2009), that the left and the right anterior cingulate cortex are respectively preferentially encoding positive and negative affect. This suggestion is similar to that made by Davidson (2004), based on asymmetries in prefrontal cortex activation. The following section will consider in more detail the suggested significance of valence in emotional experience and social interaction.

To summarise, the investigations briefly reviewed firstly recommend that when assessing social emotion it is necessary to segregate the anterior cingulate cortex into sub-areas and distinguish between neural functions in dorsal and ventral regions. However, as mentioned in the Introduction, the practice of relating emotion and social cognition into divisible processes needs to be tempered with an understanding of how these processes are linked, given that the interconnectivity of these structures are becoming more apparent. Particularly, given that the current working hypothesis is that the anterior cingulate cortex receives inputs - about emotion/social stimulus - from the amygdala and orbitofrontal cortex, compares these signals, and then utilises them for functions such as producing autonomic responses and affective decision-making. Notwithstanding the above caution, in short, it seems one of the functions of the anterior cingulate cortex may be to operate as an output system for emotional experiences and social relations.

1.1(e). Positive and Negative Emotions.

Research in both social cognitive and affective neuroscience has predominantly focused on negative emotions, studying the factor that cause maladaptive behaviour and trigger a wide array of individual and social problems. Until recently, researchers have largely overlooked positive emotions maybe due to the predominant view that they are not disadvantageous to individuals' or society. Yet, there is evidence that positive emotions can modulate the effects and the experience of negative emotions. Fairly recent psychological research (Fredrickson and Branigan, 2005) shows that positive emotions can reduce the focus of negative emotions and are an active feature in coping. Moreover, that positive emotion could be an important area to study is recognized by health psychologists who propose that a range of psychological intervention strategies (relaxation therapies, coping schemes) work because they are aimed at increasing positive emotions. Thus, the identification of neural regions associated with both positive and negative emotion during social interaction, and exploring individual difference in the brain's response to these experiences, could be useful as a springboard for further theory-testing.

That emotion is a key component to human interaction, as mentioned in the previous section, is fairly well recognized but how best to characterize the positive and negative nature of the emotional experience has proved rather more problematical. Discrete emotion theorists (e.g. Ekman, 1992) have proposed that emotion is a limited set of discrete positive and negative categories - happiness, sadness, anger, fear, surprise and disgust – and each has a unique physiological and neural profile. Dimensional theories of emotion however have conceptualized emotion as represented by underlying factors such as emotional arousal (strength of emotion) or emotional valence (the degree of unpleasantness or pleasantness) with these dimensions linked with hemispheric asymmetry. Both theoretical approaches have been widely investigated, and are briefly reviewed below, but as mentioned in the previous section on the amygdala vigilance is needed when attributing particular activations to valence (Costafreda et al, 2008) or specific emotions (Ekman, 1992) as the differences found could be mainly due to arousal (Rolls, 2005). This concern is further discussed in chapter two in relation to the happy and sad procedure employed to elicit emotional experience in this investigation.

Valence is a feature that has been investigated most extensively as an influence on neural responses. With, as previously mentioned, neurological findings suggesting that if a stimulus is viewed as positive, associated neural patterns related to approach or reward systems are activated, whereas if a stimulus is viewed as negative associated neural patterns of withdrawal or punishment are activated; and that these positive and negative systems are implemented in partially distinct circuits (Davidson, 2003; Rolls, 2005). Evidence for this model of positive and negative emotion and the functional organisation of the brain was first provided by electroencephalogram (EEG) were it was found relative right frontal activity linked with the expression and experience of negative related emotions whereas relative left frontal activity linked with the experience and expression of positive related emotions (Davidson, 2003). Additional support for this model of valence and functional organisation of the brain comes from a meta-analysis of 106 neuroimaging studies of human emotion that concluded that left-side activation was observed for positive/approach emotions whereas negative/withdrawal emotions were associated with symmetrical activation (Murphy, Nimmo-Smith and Lawrence, 2003). Affect lesion studies, investigating the laterality of positive and negative valence, also indicate that the prefrontal cortex is involved in a pattern of neural activation and deactivation (Davidson, 2001) with studies observing an inhibitory pathway between the right and left sides of the prefrontal cortex and the amygdala (Canli, Zhao, Desmond, Kang, Gross and Gabrieli, 2001). In addition, activation levels in left-sided regions of the prefrontal cortex are viewed as facilitating the maintenance of positive feelings and it is suggested that this mechanism could have an association with individual affect style (Davidson, 2003) and gender (Bartels and Zeki, 2004).

Reservations about the above hypothesis however come from affect investigations that have found notable exceptions to the association of positive affect with neural patterns of approach, and negative affect with neural patterns of withdrawal. For example, anger, a negative emotion has been linked with approach related systems (Harmon-Jones, 2004). Additionally, very little is known about laterality for more complex/social positive and negative emotions as hemispheric asymmetry, like many aspects of emotional processing, has traditionally been studied via perception of basic emotions**.** An investigation by Tamietto, Adenzato, Geminiani and Gelder (2006) found no differences in interhemispheric asymmetry for the perception of two social emotions, flirtationess or arrogance. They subsequently concluded that the perception of social emotions was not hemispherically lateralized. Interestingly, Tamietto et al. (2006) found that responses were faster and more accurate in bilateral displays, with two emotionally congruent but physically different faces, and suggested that as social emotions are documented both by the left and right the involvement of both hemispheres may enhance social functioning (Tamietto et al, 2006).

The theory that the structure of emotion is a set of specific basic categories each with its own unique physiological and neural profile has also been well researched. The power and consistency of neuroimaging evidence supporting individual neural profiles for basic emotions was recently assessed by Vytal and Hamman (2010). They investigated in a voxel-based meta-analysis whether basic emotions, such as happiness and sadness, are characterized by discriminable regional brain activations. Vytal and Hamman (2010) found, consistent with basic emotion theory that each of the emotions they examined – fear, anger, disgust, sadness and happiness – had such a distinct neural character across the thirty studies analyzed. Their findings implicated the anterior cingulate cortex and medial frontal gyrus as uniquely associated with happiness and sadness respectively. The meta-analysis was successful in characterizing the neural activation associated with basic emotions however Vytal and Hamman (2010) importantly state that dimensional and basic emotion theories should not be characterized as being incompatible. They suggest a prudent view would be to study specific basic emotions but recognize additional characterization is provided by dimensional arousal and valence categories. This hybrid view will be further expanded in the following section where sociality, it is proposed, is an additional dimension that needs to understood and accounted for when studying positive and negative emotion.

With respect to the present investigation it is also important to note that Vytal and Hamman (2010) conclude that their results reflect brain regions associated with the induction of basic emotions as, like all meta-analytic studies, a wide range of emotion-related procedures were included. Consequently, the inclusion of investigations across a wide range of contexts meant that the question of what factors contributed variability to each basic emotion were not explored. Moreover, for happiness as well as including a variety of different procedures (e.g. facial expression, film clips etc.) the meta-analysis also included a variety of different positive emotions, such amusement, under the category of happiness. The importance of differentiating between different positive as well as negative emotions in imaging investigations, and the consequences for related neural activation, is further discussed in chapter two.

Empirical research into valence suggests that positive and negative emotional processing is implemented separately and it is suggested that activation levels in left-sided regions could facilitate the maintenance of positive feelings. Additionally, basic emotions, such as happiness and sadness, seem to be characterized by discriminable regional brain activations. Hence, currently it is proposed emotion should be viewed as grouped around basic emotions but with additional catergorization provided by dimensional, arousal and valence features. Thus, investigations assessing positive and negative emotions needs to account for the interplay between mechanisms underlying basic emotions, corresponding mechanisms associated with valence and arousal dimensions and the contribution of individual differences.

Concluding Comments Neural Basis of Emotion.

This introductory section has highlighted the primary role functional organisation of the brain seems to play in the elicitation of emotional and social processes. Additionally, the studies reviewed reiterate the importance of viewing these interactions as instantiated in a dispersed network. This Introduction has predominantly focused on the key regions of prefrontal cortex, amygdala and anterior cingulate cortex given these regions' apparent role in both emotional elicitation and social cognition. Nevertheless, other structures, such as the hypothalamus, hippocampus, nucleus accumbens, cerebellum and insula, as has been mentioned, do interact with the key regions and are directly related to emotional experience and social interaction.

The influence of social context, group and individual difference on emotional elicitation will now be further discussed.

1.2. Social Interaction and Emotion.

Emotion provides information about what is important - preparing individuals to respond to opportunities and challenges - and a number of theorists (Davidson and Irwin, 1999; Rolls, 2005) have speculated on the adaptive significance of this function for social interaction. Rolls (2005) punishment and rewards model provides a coherent foundation for understanding the function of emotion in social interactions, and associated brain mechanisms, within an established evolutionary context. Similarly, Davidson and Irwin's (1999) positive and negative valence model emphasizes the adaptive advantages that a system of this type would provide to individual and group interactions. The Fischer, Manstead and Zaalberg (2003) social cognitive model shows the emotional stimulus as embedded in a broad social context. With anger, for example, an unconscious response to restore the power balances in relationships. These models of emotion and social interaction are supported by epidemiological studies looking into emotions and health (Fredrickson, Mancuso, Branigan and Tugade, 2000).

Recent theoretical and methodological advances, together with the new discipline of social neuroscience, have meant imaging investigations into the neural mechanisms that underlie social and emotional processing are increasing. More recently, social psychologists have investigated how individuals interact dynamically with the social environment, and how knowledge about the self, perception of other social groups and interpersonal variables influence social functioning through unconscious and conscious mechanisms (Amodio and Frith, 2006). Social psychologists have also developed robust theoretical and methodological perspectives for understanding and examining social behaviour and recently have begun to consider its neural base. Similarity, neuropsychologists although initially exploring various aspects of social behaviour from the studies of individuals who had undergone brain surgery (Eslinger and Damasio, 1985) are now, with the development of non-invasive neuroimaging methods, exploring the neural correlates of social functioning in normal humans. Researchers from both these disciplines however have tended to study either social processes or emotional processes, but not both, and as mentioned have often assumed that the networks that subserve these processes are separate.

In spite of the current growth of studies addressing emotion and social process, identification of the brain regions activated when social interaction is the causation and constitution of emotional elicitation is somewhat under researched. Few imaging investigations make a distinction between social emotions, which are shaped by the presence of human forms using meanings, language and intentionality in cognitively complex ways, and non-social emotions, which predominantly reflect basic biological drives (Britton, Phan, Taylor, Welsh, Berridge and Liberzon, 2006). Similarly, few contemporary models of emotion have incorporated and investigated the brain mechanisms associated with emotion elicited by social interaction or the influence culture, gender and mood may play in the processing of these complex human situations. This prompted Hutcherson, Goldin, Ochsner, Gabrieli, Feldman, Barrett and Gross (2005) to suggest that affective investigations should begin to further characterize the neural regions activated by emotions evoked in social situations as sociality, it seems, plays an important role in people's emotional well-being. In addition, Ochsner (2008) also points out the need for more critical work on human social interaction in order to overcome the limitations of current affect models that are primarily based on animal studies.

In general theories of emotion, as previously discussed, emphasize features like valence, arousal and approach/withdrawal, however, given the evident role of emotion in social behavior, sociality may be a further important feature of emotional functioning. Analogous to a valence dimension (negative and positive emotions occupying two ends of a scale) it is proposed that emotions could also differ along a sociality scale that varies between social and non-social (Britton et al, 2006). Accordingly, the criteria of non-social emotion would be to reflect basic biological drives whereas the criteria of social emotion would be to reflect complex human interaction and elicit on the presence of human forms using meanings, language and intentionality in cognitively complex ways. Hence, non-social emotions are seen as promoting individual survival by directing behaviour towards or against biologically significant stimuli like food or sex, and are elicited by aversive or incentive stimuli that have direct physiological relevance. Social emotions, on the other hand, are elicited by interaction with other individuals characteristically, reliant on social meanings and relationships, they also occur in order to direct long-term social objectives. The above interpretation would correspond to both Rolls (2005) and Fisher et al's (2003) previously mentioned affect models.

The evidence that social and non-social emotions are differentiated within brain structures, in comparison to a neutral condition, and show a dissimilar pattern of activation is provided by Britton et al. (2006), who compared sociality versus valence. They found that the superior temporal gyrus, posterior cingulate, hippocampus and nucleus accumbens activated more during social emotional stimuli than non-social emotional stimuli; whereas, activations within the anterior cingulate, orbitofrontal cortex and the amygdala were modulated by both social and valence dimensions. Britton et al. (2006) propose that overall these results highlight that social interactions play a key part in processing emotional valence, which may have implications for individuals with social and emotional deficits. Likewise, an investigation by Immordino-Yang, McColl, Damasio and Damasio (2009) assessed the recruitment of neural systems of physically related and social related emotion. They assessed the BOLD responses of thirteen participants during the processing of two physically related emotions (e.g. compassion for physical pain and admiration for a skill) and two social related emotions (e.g. compassion for another person's social/psychological condition and admiration for a virtue). The results of the investigation, as predicted, found the experience of all four emotions engaged brain regions involved in homeostatic regulation and interoceptive representation including the anterior insula, anterior cingulate, hypothalamus, and mesencephalon. The investigation also revealed a pattern within the posteromedial cortex (precuneus, posterior cingulate cortex, and retrosplenial region), an area associated with the default mode of brain operation and in self-related/consciousness processes. Interestingly, given these findings Immordino-Yang et al. (2009) go on to suggest that emotions relating to physical situations and social/psychological situations engage different networks that are aligned, respectively, with exteroceptive and interoceptive neural systems. More specifically, that emotions related to another's psychological state (e.g. social pain or virtue) may preferentially recruit a network involving the posterior cingulate cortex, anterior middle cingulate, retrosplenial area, and the precuneus, which are affiliated with interoceptive information. Conversely, the investigation also found in a contrast of social related emotions versus physically related emotions, social emotions showed more activity in the anterior middle cingulate, hypothalamus and anterior insula, whereas physical emotions showed more activity in the lateral parietal cortices and posterior insula. These overall results, Immordino-Yang et al. (2009) propose, point to the processing of emotion associated with social related conditions as structured less around the category of emotion but more around the contents and context of the situation.

As was mentioned in the previous section on the prefrontal cortex and emotion, the existence of a neural system that continuously monitors human presence is now also under investigation. One study by Norris, Chen, Zhu, Small and Cacioppo (2004) has jointly investigated emotion and social mechanisms, and proposes that social and emotional information gains greater attentional resources than non-social emotional information. Norris et al. (2004) acquired whole-brain images while participants viewed affective pictures that varied on emotional content (neutral emotional) and social content (faces/people etc.). They found as expected, and consistent with past findings, that the amygdala and part of the visual cortex were more active to emotional pictures than to neutral pictures but they also found evidence that activation of the superior temporal sulcus and middle occipito-temporal cortex correlated with the processing of emotional and social information. Norris et al. (2004) propose these results indicate that interactive effects occur early in the stream of processing, suggesting that social and emotional information garner greater attentional resources and that the combination of social and emotional cues results in synergistic early processing.

The above assessment is somewhat different to a proposal by Rolls (2005) that emotion experienced through social processes would be less likely to engage affective responses in interconnecting co-structures in comparison to more basic non-social emotional experiences. Principally, this is because social emotional response in comparison to a non-social response is not only served by different mechanisms but also exhibits stronger individual differences related to social knowledge as well as personal preferences. Importantly, this suggests that emotion experienced through social interaction - because it requires more contextual assessment and relies more on trait and learned responses – could be less proficient in engaging affective responses in interconnecting areas than more basic non-social emotional experiences. That neural responses are more diverse and cognitively more complex for socially engaged emotions (e.g. sad films) is further considered in chapter two on emotional elicitation and film clips.

These above two positions - greater attentional resources *or* less likely to engage affective responses in interconnection co-structures - are, in many ways, an endorsement of a previous suggestion that within certain key regions there seems to be a changeable contribution depending on whether the aspect of emotion is perceptual, mnemonic, behavioural or experiential. Potentially, perception of emotional and social stimuli (e.g., faces) characteristically leads to early synergistic neural processing in a network that is distinct from the network of structures supporting the production of emotional and social situations.

In conclusion, given the evidence that social and non-social emotions are differentiated within brain structures, and show a dissimilar pattern of activation, further imaging investigations are desirable to strengthen current affect models. Particularly, it is important to explore whether processing of emotion associated with social interaction is structured around the category of emotion or the configuration of the human forms present in the eliciting stimuli.

1.3 Individual Differences and Emotion.

It is important to restate that all previous research cited into human affect models have emphasized and understood that emotion is a multi-faceted phenomenon. Neuroimaging studies investigating the processing of emotions have however traditionally considered variance between subjects as mainly statistical noise (Vuoskoski and Eerolaa, 2011), whereas, in behavioural studies individual differences in emotional processing are understood to be an inherent part of the process itself. Recently however affect neuroscientists now consider individual differences as a significant feature in emotion. The role of individual evaluation in all emotional and social experiences is now seen as an intrinsic part of the process and able to fundamentally change the neural pattern of response. Moreover, this individual modification of the neural pattern is viewed as altering the emotion experience itself - not merely a different interpretation of the same unprocessed sensation – and occurs outside an individual's awareness so not accessible to self-report (Oschner et al, 2004). Individual differences in emotional experience are now being established with evolution, sex related hormones, gender-typed traits, enculturation, personality and mood factors cited as influencing appraisal and response (Hamann and Canli, 2004). Some of these factors, and the impact they potentially have on emotional experience, are now briefly considered.

1.3(a) Biological Sex, Psychological Gender Identity and Emotion.

Biological sex differences tend to be the predominant factor controlled in imaging investigations given the proposal that, in the main, the brains of women and men differ in several respects due to the evolutionary processes of natural selection and sexual selection. Hence, many researchers use only a single sex (usually women) in affect imaging investigations also citing that in the majority of behaviour studies women usually have a differing (stronger) response to emotional stimuli than men (Wager, Phan, Liberzon and Taylor, 2003). This general judgment may be unsound, as neurological affect studies that have compared the responses of women and men to emotional eliciting stimuli have found more similarities than differences (Hamann and Canli, 2004; Wager et al, 2003). A further reason for being cautious in attributing a large proportion of individual difference to biological sex is that variability in emotional reactivity has been explained as originating from evolutionary factors (Sabatinelli, Flaisch, Bradley, Fitzsimmons and Lang, 2004), individual development (Davidson, 2001) and cultural responses learnt at a young age (Davis and Whalen, 2001).

Studies that have investigated emotional responses using a variety of measures, such as imaging, physiology, behaviour or self-report, have also often failed to correlate strongly with biological sex differences (Barrett, Robin, Pietromonaco and Eyssell, 1998). For example, Schneider, Habel, Kessler, Salloum and Posse (1999) compared sex differences to mood induced happiness and sadness. Overall, they found activity in the amygdala area of men during mood induced sadness but women did not display this pattern, this was despite women's and men's similar subjective ratings for sadness. Similarly, Wrase, Gruesser, Hermann, Flor, Mann, Braus and Heinz (2003) found mainly right-lateralized amygdala activations for women and men in response to aversive pictures but left amygdala activation only present for men in response to pleasant pictures. However, affect investigations that have focused on the emotion associated with fairly explicit sexual images have found a significant relationship between fMRI activations and biological sex. For example, Sabatinelli et al (2004) assessed biological differences in extrastriate visual cortex to emotional picture perception. Given previous research that suggested women reacted more strongly to unpleasant pictures, whereas, men reacted more strongly to pleasant pictures. They found that while both women and men had greater visual cortex reactivity to both unpleasant and pleasant pictures, in comparison to neutral pictures, men exhibited greater extrastriate visual cortex activity than women during erotic picture perception. These results are viewed as reflecting a sexual selection mechanism that may also be implicated in a greater role of visual stimuli in men’s sexual behaviour. Other investigators have also looked into whether biological sex differences occur in emotional reactivity to visual sexually arousing stimuli. These studies found that although women reported greater arousal (in comparison to men) it was men who showed greater activation in the hypothalamus and amygdala: although both women and men showed similar activations in reward-related regions (Hamann and Canli, 2004).

Currently, investigations examining sex differences in functional lateralisation have shown varying results, with some investigations providing evidence for males being more strongly lateralised than females, whilst other investigations have shown either no relationship or the opposite pattern of findings (Bourne and Maxwell, 2010). The supposition that psychological gender identity may be responsible for some of the conflicting results in biological sex differences and lateralisation was investigated by Bourne and Maxwell (2010). The main finding of their study was that individuals who were more psychologically masculine were more strongly lateralised for the processing of both positive and negative emotions. This suggests that being both chromosomally male and being psychologically masculine was related to being more strongly lateralised particularly as for females high levels of psychological masculinity were associated with weaker lateralisation, or even lateralisation to the left hemisphere for the processing of emotions. Bourne and Maxwell (2010) concluded that hormonal exposure was likely to provide a strong causal explanation for this relationship. Inasmuch as, there was no direct relationship between psychological gender identity and strength of lateralisation, but rather that hormonal exposure could be a causal factor for both.

This recent investigation by Bourne and Maxwell (2010) highlights how different aspects of an individual’s response to emotional actions may be influenced by hormones as well as by the different characteristics of the emotional stimuli. Additional evidence supporting the involvement of hormones in emotional processing comes from a recent investigation by Love, Smith, Persad, Tkaczyk and Zubieta (2010). They found that during negative emotional presentations areas of significant differences between combination hormone therapy and placebo conditions were identified in the orbital, frontal, cingulate and occipital cortices. However for positive emotional image presentations there were significant differences between placebo and combination hormone therapy conditions within the medial frontal cortex. Love et al. (2010) concludes that combination hormone replacement can modify emotional processing in postmenopausal women and hypothesized this maybe due to the influence of estrogen receptors, which seem to play a critical role in the emotion process (Love et al, 2010).

The influence of psychological gender identity or combination hormone therapy on emotional experience and social interaction is beyond the remit of this thesis but the above mentioned studies highlight two important issues. Firstly, the somewhat unconsidered attitude of many affect investigations that seem to assume if participants are all biologically female this, in many ways, controls the effect of individual differences. This approach to sampling will be further discussed in chapter two on film stimuli and emotional elicitation. Secondly, the above studies are an important reminder that hormones (e.g. testosterone and estrogen) are able to vary trait characteristics and stabilise mood, which seems to play a significant role in emotional processing, for both women and men. The importance of certain chemical messages, particularly given the comments of Kienast et al. (2008) - that individual dopamine storage capacity in the amygdala serves to modulate emotional processing and may be related to mood – is sometimes overlooked in many affect psychological imaging investigations. The relationship between mood traits and emotional elicitation is considered next.

1.3(b) Stable Mood and Emotion.

Few direct investigations have been undertaken on functional brain activation accompanying stable mood and positive and negative emotional elicitation in a non-clinical population. Commonly, investigations (Davidson and Irwin, 1999; Izard, Libero, Putnam and Haynes 1993; Gross, Sutton and Ketelaar, 1998) have demonstrated meaningful correlations between traits like extraversion with positive affect and neuroticism with negative affect and this pattern of correlation has been found across diverse populations with remarkable robustness (Wilson and Gullone, 1999). It is worth noting that the relationship between individual traits and positive and negative emotion seems unaffected by the methodology employed as, in the main, regardless of the procedure used to elicit an emotional response or the measure used to record the response the correlation appears stable. Recently, it has been suggested mood states, like stable personality traits, could influence the processing of emotions causing trait- and mood-congruent biases (Vuoskoski and Eerolaa, 2011).

Traditionally, studies into the relationship between traits or moods and the processing of emotional stimuli have mainly been the concern of personality and social psychological research. Moreover, these disciplines have tended to focus on negative emotions with in-depth research into positive emotions, as previously mentioned, relatively new and under researched in comparison (Fredrickson and Branigan, 2005). However, the importance of investigating the differential impact of stable mood traits on the processing of emotional stimuli is evident given the development of models on the function of positive disposition to individual well-being. For example, Fredrickson's (2000) broaden-and-build model suggests that learning how to cultivate positive qualities will ultimately enhance health and resilience. Similarly, Geers, Handley and McLarney (2003) propose that individuals with positive traits, such as optimism, are more likely to pay attention to positive personally relevant information and generate more positive thoughts about this information.

Generally, neuroimaging investigations assessing emotional elicitation and social processes in a normal population do not explore the potential role of mood, yet evidence from clinical investigations indicates that variability in mood can have a significant influence on neural activation (Mitchell and Phillips, 2007). In addition, like personality and social psychological research, the majority of imaging investigations into mood and emotional elicitation seem to explore only the potential role of negative mood in a clinical population (e.g. major depression, van Wingen, van Eijndhoven, Cremers, Tendolkar, Verkes, Buitelaar J.K. and Fernández, 2010). Similarly, the various meta-analyses that have been undertaken over the years have also concentrated on either individuals with mood disorders (Hajekabc, Kopecekcd, Kozenyc, Gundeb, Aldaac and Höschlc, 2009) or mood in vulnerable or clinical groups (Townsend, Walker, Sargeanta, Vostanisc, Hawtond, Stockera and Sitholeb, 2010). However, Mitchell and Phillips (2007) review into the neural effects of positive and negative mood in a non-clinical population, indicates that even mild fluctuations in mood has a significant influence on neural activation. They conclude that positive and negative mood causes differences in brain activity during the performance of executive functions in comparision to rest. Furthermore, that these activations are particularly prominent in the prefrontal cortex and may be lateralised with respect to negative and positive mood states (Mitchell and Phillips, 2007).

Of late, there is concurrence that systematic individual differences in patterns of brain activation, in response to affective stimuli, could provide evidence for some type of natural function for mood. With Marszał-Wiśniewska and Zajusz (2010), who assessed the role of mood for individual differences in cognition, concluding that mood operates much like any other piece of cognitive information. From their perspective, moods serve as an input in a configural processing system, with moods processed in parallel with stimuli information in such a way that the coding of the mood influences, and is influenced by, the coding of the external stimuli. Marszał-Wiśniewska and Zajusz (2010) conclude it is possible for either negative or positive moods to express as either negative or positive evaluative and motivational information, the implementation of which depends on the stimuli context. This suggests that an individual's evaluation, motivation and subsequent behaviour are dependent on the interaction of mood signals and stimulus signals.

The above hypothesis has similarities to theories that suggest an individual's response to affect stimuli arise from an interaction between cues generated internally (personal cues) and cues generated externally (situational cues). Moreover, individuals seem to differ as regards this interaction, with some individuals showing more responsiveness to cues arising internally whilst others are more responsive to cues arising from the world around them. This variability of responsiveness is a well documented phenomenon and has been linked to evolutionary factors (Strout, Sokol, Laird and Thompson, 2004) and heritable components (Laird and Bresler, 1992, as cited in Strout et al, 2004).

Given that the present investigation will assess the association of stable mood to emotion experienced through social interaction, it is important to stress that this investigation is not assessing induced mood. Typically, studies assessing mood on a task would firstly use a standardised mood induction method to provoke a positive or negative state (see chapter two for a discussion on emotional elicitation methods). Whether induced mood corresponds to a participant's customary individual response, maybe linked to heritable components (Geers et al, 2003), is unclear. Hence, the stable mood of participants in this study was evaluated by the extended positive and negative affect schedule (PANAS X) which assesses two self rated broad high order traits (negative affect or positive affect) and eleven specific lower level traits; fear, sadness, guilt, hostility, shyness, fatigue, surprise, joviality, self-assurance, attentiveness, and serenity (Watson and Clark, 1994). Additionally, the information on a participant's mood was collected prior to the imaging investigation with instructions to respond how they usually feel. The extensive data collected on the PANAS X scale means this measure (a) has discriminant validity; (b) is shown to have stability over time; (c) has been highly correlated with measures of aggregate state affect; and, (d) is strongly related to measures of personality. The PANAS X trait higher and lower order scales have been assessed for their similarity to measures of personality. Watson and Clark (1994) found that specific negative affects were moderately to strongly related with measures of neuroticism whereas individual positive affects were significantly related to extraversion. As mentioned at the start of this section, mood states, like stable personality traits, do influence the processing of emotions, causing trait-and mood-congruent biases (Vuoskoski and Eerolaa, 2011). The objective of this investigation is to assess the individual difference of stable mood, rather than personality per se. However, the interconnectivity of these constructs makes them, in many ways, difficult to differentiate completely.

This section has briefly reviewed proposals that individual differences in evaluation, motivation and subsequent neural activation in response to emotional experience are possibly dependant on the interaction of mood signals and affective stimulus signals. Consequently, the relationship between stable mood and emotion experienced through social interaction - given the costs and benefits of this association - is an area that would benefit from further investigation. That said ethnic origin – ancestral traditions and origins that an individual belongs to, as opposed to their current nationality – is now also considered an additional individual difference which could influence emotion when experienced in social situations.

1.3 (c). Ethnic Origin and Emotion.

The study of emotion in social psychology has fairly recently pointed to the importance of social variables, from context to culture, in altering processes within the brain and body. Social psychological research (Bond, 2004; Durik, 2006; Scherer and Brosch, 2009) has established that cultural reactions learnt at a young age influence emotional responses and currently ethnicity is now considered an important factor in the emotional eliciting process. With ethnicity, it is suggested, varying the development and mechanisms within the brain from an early age, which appear to have a demonstrable effect on the neural patterns of response (Davidson, 2001).

The way individuals think and feel is derived in part from their cultural heritage and differences in brain activation to emotional stimuli are also reflective of these early learnt reactions. For example, social theorists now view greater amygdala responsively to violent images in males as reflecting not only evolutionary but also culturally learnt responses (Davis and Whalen, 2001). Thus neural differences to aggressive images are due to girls - but not boys - being cultured to internalise (rather than externalise) their responses, leading to a biological sex difference in both neural and cardiovascular responses to anger (Davis and Whalen, 2001). Moreover, if emotional responses are analogous to learnt skills - rather than unchanging evolutionary characteristics - and cultural and individual variables vary the development and mechanisms within the brain, systematic instruction (especially if it occurs from an early age) could have a demonstrable effect on the neural patterns of response (Davidson, 2001). However, as previously mentioned in the Introduction current uncertainty, about the network of structures involved in social processes, means it would be very hard to empirically ascertain what pattern of response would transform culturally learnt aspects of behaviour. Therefore, given the significance of societal effects on emotions, not only in early development but throughout the lifespan, further understanding of the processes involved is desirable. Particularly, as societal effects sometimes can link emotion feelings to maladaptive thoughts like those that typify racism, sexism, ageism or terrorism that can have widespread consequences for individuals and ethnic groups (Izard, 2009).

Recent research (Bond, 2004; Durik, 2006) into cross-national differences in emotional elicitation has importantly highlighted the unreliability of the assumption in most affect studies, that emotion-related activation patterns are similar across all societies. Several investigations are now attempting to investigate the neglected linkages between ethnicity and emotions (Bond, 2004) and the little explored relationship between emotional expression, culture and gender (Durik, 2006). Yet, it is debatable whether studies that have documented cross-national differences in positive and negative emotion are correct in attributing the source of the observed difference to ethnic variables. It is possible that such differences may be accounted for by aggregate differences in personality, particularly, as several current investigations into the role of enculturation in emotion have stated that previously documented cultural differences could be entirely accounted for by such variables (Matsumoto, 2006; Scherer and Brosch, 2009). For example, Scherer and Brosch (2009) argue that appraisal factors could be the determinant for the relative frequency with which different types of emotion may occur in particular cultural settings. They suggest that appraisal and response tendencies - interacting with traits and the reoccurrence of specific events in socialization practices - contribute to the appearance of dispositional emotionality (or trait affect) that manifests as systematic culturally determined variation (Scherer and Brosch, 2009). Despite the uncertainty of a relationship between ethnic origin and emotion the aforementioned studies pose a challenge for current affect research as they emphasise the importance of the interconnection between the reoccurrence of specific environmental stimuli and learnt cultural responses in the study of emotional experience and social process.

Ethnicity is a multi-faceted concept and as mentioned above can be difficult to accurately describe. The Department of Health (2007) promotes the use of a set of 16 codes that are grouped under five headings (White; Mixed; Asian or Asian British; Black or Black British; Chinese or other ethnic group) to assess ethnic origin (see Appendix 7). However, these groupings are open to interpretation since individuals may identify differently with these ethnic subdivisions. For example, an individual asked to record their ethnic origin may not be clear what they are being asked for, is it their country of birth, the country of birth of their parents, a description of their appearance or their cultural behaviour such as language, religion, food and the people they associate with. The answer of interest for affect investigators is probably which particular ethnic subdivision of society the individual considers herself or himself to be a member of. Hence, although objective features - such as shared history, religion, common language, geographical origin and tradition - can help define ethnic origin, subjective self-assignment is an important feature when categorizing a participant's own ethnic group. Whereas some organisations (e.g. Department of Heath) may view and categorize a participant as having a distinct ethnic identity - dependent on more objective categories - the individual's view of their own ethnic identity is the priority as regards this investigation. Consequently, participants where asked to choose the ethnic origin that best described themselves from four succinct headings (European, Asian, African and Other) and those participants who regarded their ethnic origin as largely “mixed” (e.g. European and Asian) were advised to choose the “Other” heading.

Chapter 3 will discuss further ethnic differences and emotions experienced through social interacting film clips.

1.4. Aims of the Investigation

Group and individual differences, whether it is in biological sex, psychological gender identity personality, mood or learnt cultural responses, seem to modify the neural reactivity in the prefrontal cortex, amgydala and anterior cingulate cortex particularly when emotion is experienced through social interaction. The current study proposes to investigate which brain regions are involved in the emission of positive and negative emotion as a result of observed social interaction. In addition, the investigation will assess whether self-reported ethnic origin influence these neural responses. The present study also intends to explore whether individual differences, such as stable mood, modulate neural responses to observed positive and negative social interaction. The proposed study in endeavoring to map specific mechanisms of activity to particular brain regions recognizes the difficulties present, given the network of structures involved and the complexity of social processes discussed. Nevertheless, this investigation could be a small step in helping to establish the varying importance of culturally learnt and trait variables (i.e. ethnic origin and stable mood) to positive and negative emotions experienced through observed social interaction and associated processes within the brain.

2. EMOTIONAL ELICITATION AND FILM CLIPS.

The increase of imaging and neuropsychological research into the production of emotion, as mentioned in the introductory chapter, has reinforced the need for a replicable and valid emotion elicitation procedure. The growth of experimental psychological research that focuses on production of emotional processes in comparatively well-controlled imaging laboratory environments means a standardized elicitation procedure would allow for the potential replication of effects across studies. In addition, an important current consideration when investigating production of emotion is the commendable rise in ethical research standards. Hence, an additional challenge for many investigators now wishing to elicit particularly strong emotions in the laboratory is how to achieve this in an ethically acceptable fashion. One solution to the above challenges, Rottenberg, Ray and Gross (2007) argue, is to use film clips that ethically elicit intense positive and negative emotions combined with an ability to standardize stimulus content, viewing conditions and presentation procedure. Film clips, in comparison to other emotion elicitation procedures, can also provide a more ecologically valid and universal method. This chapter will firstly focus on the reliability and validity of currently available film clips to induce both happy and sad emotions. Secondly, difficulties particular to an imaging laboratory environment (e.g. physical context, relevant points of comparison, etc.) will be considered. Finally, consideration of why film clips have higher ecological validity for individuals in western societies, allowing the investigator a somewhat freer hand to elicit strong responses without incurring ethical concerns, is touched on throughout the chapter.

2.1 Film Clips, Validity and Reliability.

The first recorded use of films to elicit emotional reactions was in very early “stress” studies (Lazarus, Speisman, Mordkoff and Davidson, 1962). During the seventies and eighties, however, increasing interest in studying more differentiated emotions led to films being used to elicit specific states such as fear and sadness (Engel, Frader, Barry and Morrow, 1984, as cited in Gross and Levenson, 1995; Mewborn and Rogers, 1979). It is worth noting that early research supporting a discrete emotion perspective or investigating within a dimensional perspective (as reviewed in the Introduction), used film stimuli, respectively, to elicit specific states (e.g. sad, fear) or desired valence (e.g. pleasant/unpleasantness) and arousal. This early use of film clips as emotional elicitors was, in the main, based on investigators selecting individual films using relatively informal and unrecorded criterion. Hence with little empirical record of film-based emotion induction procedures many investigators at the time called into question the validity and reliability of the method (Polivy, 1981). This critique of the method was addressed in the 1990's by two meta-analyses (Gerrards-Hesse, Spies and Hesse, 1994; Westermann, Spies, Stahl and Hesse, 1996) that assessed whether the use of film stimuli was superior to other emotion elicitation methods. Similarly, during this period Phillipot (1993) and Gross and Levenson (1995) endeavoured to construct a scientific database of films by assembling a standardized library of stimuli to elicit specific target emotion states

2.1(a). 1990's: Meta Analysis and Film Stimuli.

The merit of key mood induction procedures were evaluated by Gerrards-Hesse et al in 1994 by means of a meta-analysis. Studies from 1979 to 1994 that involved the induction of elation or depressive moods in an adult non-clinical sample were reviewed. Gerrards-Hesse et al. (1994) classified the emotion stimuli employed into five groups: (a), free generation of mental states (imagination/hypnosis); (b), guided generation of mental states (instructed presentation); (c), presentation of emotion-inducing material (free presentation of stories/films); (d), need related emotional situations (false positive/negative feedback); (e), emotionally relevant psychological states (drugs/facial expression movement). The effectiveness of the different procedures was compared and analysed, with Gerrards-Hesse et al (1994) concluding that the effectiveness of mood induction differed between elation and depression. Interestingly, it appeared easier to place a participant into a negative state than make them feel positive maybe, they suggested, because the base mood in a non-clinical sample is biased in a positive direction. The presentation of stories or films was found to be the most effective in inducing both negative and positive mood states, with the effects for these procedures especially large when the participants were explicitly instructed to enter the target state. The results of the meta-analysis, Gerrards-Hesse et al (1994) concluded, were that if the same stimuli were to be used for both positive and negative induction, the film/story procedure should be an investigator's first choice.

A further meta-analysis on the validity and effectiveness of eleven mood induction procedures was conducted by Westermann et al in 1996. Two hundred and fifty effects of experimentally induced negative and positive mood in non-clinical adult samples were integrated in the analysis. The different induction procedures used in the literature were grouped into nine classifications: (a), imagination procedures; (b), Velten (self-referent-statement technique); (c), Film and Story procedures (with and without instruction); (d), music procedures (with and without instruction); (e), feedback procedures (predominantly false feedback on tests); (f) social interaction procedures (e.g. help a friend); (g), Gift procedure (assumption that people are delighted to receive a gift); (h), facial expression (manipulation of expressions); and (i), procedures that combined some of the above. Procedures that had been included in the previous meta-analysis by Gerrards-Hesse et al (1994) such as mood induction by hypnosis or drugs were excluded as Westermann et al (1996) concluded that these emotion elicitation procedures were only applicable to selected participants: willingness to take drugs or being hypnotizable respectively. Of particular interest to this study is that Westermann et al (1996) assessed the effects of gender on emotional elicitation and reported no overall relationship between sex of participants and magnitude of effects. However, the inconclusiveness of this finding was attributed to the fact that the published information only allowed them to distinguish between female samples on the one hand and mixed male and female samples on the other. Westermann et al (1996) also found a difference in the effect sizes for positive and negative mood induction with the latter generally larger. They concluded that the most effective procedure for elated mood induction was film and stories with participants explicitly instructed to enter the elated state: all other procedures were considerably less effective. They also conclude that if an investigation was intending to induce negative as well as positive emotional elicitation the story or film procedure without instruction was recommended. The final counsel by Westermann et al (1996) as regards emotional elicitation was that researchers need to take into account the particular research problem under investigation. Since, the presentation of films or stories may prime specific cognitions thus this may limit the potential value of this procedure in investigations of emotion on cognition. This particular point will be returned to in the final analysis.

2.1(b). 1990's: Database of Film Stimuli.

During the 1990's, as mentioned previously, affect investigators (eg. Martin, Ward, Achee and Wyer, 1993; Tomarken, Davidson and Henri, 1990) started increasingly to employ film stimuli to study emotion but many failed to empirically justify the film stimuli utilised or omitted to fully publish legitimizing pilot studies. For example, Tomarken et al (1990) employed a set of eight film clips for the induction of four target emotions (happy, sad, anger and disgust). However, although these clips were selected from an initial pool of approximately forty commercially available films, with one hundred and twenty-two participants rating these films as high for the target emotion, little published information is available to facilitate future investigators to replicate the procedure. Given this unmethodical situation Phillipot (1993) and Gross and Levenson (1995) endeavoured to construct a scientific database of films - by assembling a standardized library of stimuli to elicit specific target emotion states - that would be freely accessible to future affect investigators.

Phillipot (1993) assessed the effectiveness of twelve short film clips to reflect the targeted emotions of amusement, anger, fear, disgust, sadness and also a neutral state. The twelve short film clips were drawn from a pool of twenty candidate films and shown to sixty French-speaking Belgian university students. The students viewed the films then rated the strength of their responses in one of three ways: modified differential emotions scale (Izard, Dougherty, Bloxom and Kotsch, 1974); semantic differential scale; asked to freely label their feelings. Overall, the freely accessible results of the investigation indicated that film clips could elicit the predicted emotions in the same way in the majority of participants. The investigation also found that the differential Emotions Scale yielded a better discrimination between emotional states than the semantic differential scale. Phillipot's (1993) when discussing the implications and suitability of employing film clips in emotion research concluded that although films could reliably elicit specific target emotions, given the cognitive complexity of the medium, this type of stimulus would not be suitable for all investigations. Phillipot's (1993) comments reiterate those of Westermann et al

(1996) that investigators should carefully assess whether films are a suitable medium for their particularly area of study.

Gross and Levenson (1995) viewed film stimuli as superior to other emotional elicitation procedures. As firstly, film clips were dynamic, not static, and therefore have greater ecological validity given that emotions are often induced by vibrant auditory and visual stimulus external to the participant. Secondly, films involve no deception so are ethically superior (e.g. emotion elicited by false feedback on tests). Finally, for affect investigators wanting to study more dynamic aspects of emotion ("production" rather than "perception") in comparison to the other procedures (e.g. imagination procedures) films are more readily standardised. This aspect of film stimuli is of particular importance for investigators wishing to study emotion in an imaging setting. As mentioned previously Gross and Levenson (1995) felt an important limitation on the use of films was the lack of a widely established set of emotion eliciting film stimuli and so set about constructing one. Their research was based over five years and in total seventy eight film clips were shown to 494 participants in order to find the most effective films to elicit discrete emotions. Gross and Levenson (1995) measured participants emotional responses via a self-report questionnaire. Firstly twelve different emotional words (e.g. excited, upset, strong, etc.) to assess the power of the film clip to distinctively induce the specific target emotion. Secondly, two non-emotional words (i.e. confusion and interest) to assess how easy it was for the participant to understand the film clip and evaluate their interest. Finally, based on intensity and discreetness sixteen films clips were chosen as being the best films for eight predetermined target emotions: two films each for amusement, contentment, surprise, anger disgust, fear, sadness and neutrality. The films portraying amusement, sadness and disgust were the most successful in terms of targeted discreetness and intensity. The most difficult emotions to elicit discreetly were those films portraying anger, fear and contentment. Gross and Levenson (1995) found that the anger films also elicited high degrees of disgust and fear, with the films portraying fear confounded with interest and tension. Of particular interest to this study was the omission in Gross and Levenson's (1995) research of films that targeted the elicitation of happiness, although the films they employed to portray contentment also seemed to depict happiness. Since, the two films selected as eliciting the emotion of contentment produced very similar levels of happiness; this lead Gross and

Levenson (1995) to suggest that contentment could be considered a subtype of the superordinate category of happiness. This important finding will be further explored in chapter three Behavioral Film Set Studies. In general, Gross and Levenson (1995) were successful in establishing a robust set of film stimuli, particularly for amusement, disgust and sadness. However, they cautioned future affect investigators to recognise that even carefully selected and standardised films of similar length can elicit different intensities of emotional response. Furthermore, affect investigators who fail to fully assess such differences could erroneously attribute significant effects to discrete emotions when in fact they are due to differences in intensity of response.

Philpott (1993) and Gross and Levenson (1995) did not expect their films to be viewed as definitive and fully expected other investigators in the future to add to their sets in order to assemble a standardised library to elicit specific emotion states. As will be explored in the next section of this chapter, and chapter three Behavioural Studies, although additional film sets have been published no established normalised library is currently available.

2.1(c). 2000 to Present Day: Emotion Eliciting Film Stimuli.

During the 21st Century film clips continued to increase in popularity as an effective method of emotional elicitation (Schaefer, Sanchez and Philippot, 2010). However, the use of films in this context was still viewed as greatly limited given the lack of widely accepted sets of emotion eliciting film stimuli, particularly in comparison to the availability of picture sets (Zimmermann, Guttormsen, Danuser and Gomez, 2003). For example, an investigator wishing to explore perception of emotion in the laboratory would be able to resource several libraries of emotional pictures (e.g. International Affective Picture System, 1999), however, those wishing to investigate more dynamic aspects of emotion would not have access to such established resources. Given the lack of accepted film sets, in order to gauge usage, and sourcing, of film stimuli in contemporary psychological investigations, a literature search was undertaken using Google Scholar.

Google Scholar Advanced Scholar Search was used to search for articles: **with the exact phrase** “film clips”; **with all of the words** “emotion” “emotional” “elicitation” “mood” and “induction”; **published between** January 2000 and January 2010; and **in the following subject areas** “Social Sciences, Arts and Humanities”. The above criteria resulted in Google Scholar listing 144 articles, given the number found it was decided that an in-depth review of a range of articles would be more informative than a generalised review of the majority. Hence, 40 of these articles were then chosen at random to assess in-depth the usage and sourcing of film stimuli in current investigations. Table one lists the authors of the 40 chosen studies together with the number participants used, the experimental function of the stimuli and how many positive and negative emotions were employed in the investigation. In addition listed in Table one, and of particular relevance, a column entitled *Reliability and Validity* that provides information collected from each Methods section justifying the film stimuli employed. Lastly, the final column of Table one list the names of the film clips employed by the published article and utilised in the fMRI study (see chapter three Behavioural Film Set Studies). The question of “familiarity” - whether the film clip had been viewed before - was not assessed in this appraisal as the aim of the literary review was to gauge the accessibility of film sets for employment in the present study. However, a question on whether the film clip had been viewed before was included in the behavioural and fMRI self-report questionnaire.

A visual examination of Table one reveals that 25 of the articles employed film stimuli for “emotional elicitation” with 15 articles utilising the film clips for “mood induction”. The number of participants in each study varied from 11 female only participants (Aalto, Wallius, Naatanen, Hitunen, Metsahonkala and Sipila, 2005) to 324 mixed gender participants (Rafaeli and Revelle, 2006), 79 participants was the mean for the 40 studies. The articles chosen were slightly skewed towards the latter years with 15 articles published between January 2000 to December 2005 and 25 between January 2006 and January 2010. This could be attributed either to the randomness of the selection procedure or more probably the disciplines increasing interest in emotion and hence the rising publication of affect investigations. The majority of the articles employed negative, positive and neutral film clips, although four articles only employed negative film clips and two articles only positive film clips. The above variables visually did not seem to impact on the choice of, or justification for, the film clip(s) employed.

The most noteworthy, and surprising, outcome of the literature search was the information collected from each articles “methods” section that showed almost half of the articles (19 studies) verified the employment of some clips sourced from Gross and Levenson’s (1995) set of film stimuli. To further comprehend the rationale for employing the films the 40 articles were categorised into four groups: articles that provided modest information on their pilot study (UNPILOT); articles that included comprehensive details of their pilot study (SPILOT); articles that gave no explanation about the films validity or reliability (NOTS); and articles that cited a single, or several, published research paper(s) as validation (*). The approach chosen by each group to substantiate their employment of the film stimuli is briefly considered, together with comments about the viability of replicating these film clips for the present study.

The methods search found seven UNPILOT articles that informed the reader a pilot study had been undertaken but the information provided in the methods section was fairly sparse. For example, Updegraff, Gable and Taylor (2004) reported the title, length, scene portrayal and referencing for the films employed but gave little information about the soundness of the clips; e.g., *“Both clips were effective in eliciting PA and NA respectively, in pilot tests involving a sample of undergraduate students”* (Updegraff et al, 2004, page 498). The remaining six articles, in the UNPILOT category, supplied a similar degree of information about their selection of films making it difficult for this investigation to gauge the entirety of the elicitation procedure or for the film stimuli to be replicated.

The search found five SPILOT articles that provided fairly complete details of a pilot study and provided justification for their employment of the film stimuli. One such article by Phillips, Smith and Gilhooly (2002) highlight some of the difficulties investigators face in searching for reliable and valid film stimuli and then gives a fairly comprehensive account of their own pilot study; e.g.,*”7 young adults (aged 22–30) and 7 older adults (aged 61–77) viewed seven films in counterbalanced order. There were two positive, two negative, and three neutral film clips. After seeing each clip, participants rated on a 9-point scale the extent to which they felt the film was extremely depressing (1) to extremely uplifting (9). There were no significant age differences found in ratings of any of the clips, so we selected the three films that were* *rated as most appropriate to each condition (i.e., the most uplifting film for the positive condition, the clip rated as closest to neutral in the neutral condition, and the clip rated as most depressing for the negative condition). The film clips identified as successfully influencing mood in both age groups were extracts from a comedy film (positive), a funeral scene from a film (negative), and an extract from a document on copyright laws (neutral)" Phillips et al, (2002) page 265.* Unfortunately, the film titles, durations and referencing are omitted from Phillips et al (2002) methods section. The keen affect researcher could, however, surmise that the negative film was probably Steel Magnolias, a "sad" film clip taken from Fredrickson and Levenson's (1998) set. However, the positive film clip is rather more problematical to identify but could have been an "amusing" film clip from Gross and Levenson's (1995) set. The remaining six articles provide similar variable information about the films although upon closer inspection several of the SPILOT clips could have originated from the nine listed film sets in Table one. For instance the film stimuli in SPILOT article Gruber, Oveis, Keltner and Johnson (2008) investigation is reported as "*sad film clip was 170 seconds and depicted a young boy watching his father die and responding with denial and intense crying"* (page 27) this clip was very probably Gross and Levenson's sad film, The Champ. In general, the SPILOT articles provide validation for the film stimuli employed in their particular investigations. Unfortunately, the published data these SPILOT articles provide - duration, point in time of scene depicted, in some instance title, etc. - makes assessment of the suitability of these film clips for use in this investigation difficult.

The search only found four NOTS articles who gave no prior piloting or empirical reference for the film stimuli employed, although, each of the four articles did provide film titles. The pattern for these articles is similar to the other two categories reviewed as although no references were published the informed researcher would recognise the film titles employed as obtained from prior film sets. In Fredrickson and Branigan's (2005) article for example they name five film clips as the experimental manipulation in their research and although they fail to attribute the clips to any endorsed film set several of the clips (e.g. "Penguins" from Fredrickson and Kahnema,1993; "Sticks" from Fredrickson and Levenson, 1999) are easily documented. Fredrickson and Branigan (2005) did review the soundness of their film clips to elicit the required emotion (e.g. "Penguins elicited amusement") but once the experiment had been completed (see, Fredrickson and Branigan, 2005, Results, Manipulation Check, page 321). NOTS article Austin, Riniolo and Porges (2007) also empirically confirmed the films assumed emotional content post experimentation by asking participants' to rate the film clips using a Likert scale rating. They selected two clips to elicit a strong negative emotional response and one clip as a neutral event, participants' then rated the clips on a Likert scale ranging from 0 (not arousing) to 10 (extremely arousing). Importantly, for Austin et al (2007), post experimentation the negative clips did rate as significantly more arousing that the neutral event (p < .001). The soundness of retrospectively assessing whether the employed film clips elicit a targeted emotion - although successful in the two aforementioned studies – is, in many ways, not a practical strategy for high cost imaging investigations.

Table 1: Description of the 40 affect studies employing film stimuli.

Study	*N*	*Experimental Function*	*Films*	*Reliability & Validity*	*Films used in Present Study*
Aalto et al (2005)	*11f*	Emotional Elicitation	4P 4N 4Nu	SPILOT (51) 3* 6*	None
Anderson, L. Shimamura, A. P. (2005)	*26f 14m*	Emotional Elicitation	1P 2N 1NU	1*, 2*, 3*	None
Austin MA et al (2007)	*20f*	Emotional Elicitation	2N 1Nu	SPILOT	None
Bailenson et al (2008)	*151mix*	Emotional Elicitation	2P 2N 2Nu	3*	None
Brittain JC et al (2006)	*12f*	Emotional Elicitation	2P 2N 4Nu	UNPILOT 3*	None
Campbell-Sills L et al (2006)	*60mix*	Emotional Elicitation	1N	SPILOT	None
Chuang C et al (2008)	*66f 58m*	Emotional Elicitation	1P 1N	4*	Pretty Woman Positive
Christie IC & Friedman BH (2004)	*18f 16m*	Emotional Elicitation	2P 4N 1Nu	3*	
De Vries M et al (2007)	*51f 26m*	Mood Induction	1P 1N	UNPILOT	None
De Vries M et al (2008)	*52mix*	Mood Induction	1P 1N	cited De Vries et al 2007	
Fredrickson BL & Branigan C (2005)	*69f 55m*	Emotional Elicitation	2P 2N 1NU	NOTS	Sticks Neutral
Fucito LM & Juliano LM (2009	*60f 61m*	Mood Induction	1N 1nu	3*	None
Gable PA & Harmon-Jones E (2008)	*42mix*	Emotional Elicitation	2P 1Nu	NOTS	None
Greimel E et al (2006)	*18f 18m*	Mood Induction	1P 1N	3*	None
Goldin PR et al (2008)	*17f*	Emotional Elicitation	40N	SPILOT	None
Goldin PR et al (2005)		Emotional Elicitation	2P 2N 5Nu	UNPILOT & 3*	None
Gomez P et al (2009)	*37f 39m*	Emotional Elicitation	1P 1N 2NU	UNPILOT	None
Herring DR et al (2011)	*27f 12m*	Emotional Elicitation	2P	3* & cited Gruber J et al 2008	None (Happy/Joy)
Gruber J et al (2008)	*90mix*	Emotional Elicitation	2P 2N 1Nu	SPILOT	None
Kliegel MH et al (2003)	*52f 50m*	Mood Induction	1P 1N 1Nu	6*	
Kliegel M et al (2007)	*60mix*	Mood Induction	1N 1Nu	(cited Kliegel et al 2003)	
Knhbandner C et al (2009)	*27f 12m*	Mood Induction	1P 1N 1Nu	3*	Sticks Neutral
Kuhbandner C et al (2010)	*67f 17m*	Mood Induction	1P 1N 1Nu	3*	Sticks Neutral
Lerner JS et al (2004)	*80f 119m*	Emotional Elicitation	1P 1N 1Nu	UNPILOT (3*)	None
Macht M & Mueller J (2007)	*57f 61m*	Emotional Elicitation	1P 1N 1Nu	UNPILOT	Pretty Woman Negative
Marzillier SL & Davey GCL (2005)	*180mix*	Mood Induction	2N 1Nu	3*	None
Nasoz et al (2003)	*31mix*	Emotional Elicitation	3P 3N	3*	None
Rafaeli E & Revelle W (2006)	*324mix*	Mood Induction	1P 2N 1Nu	NOTS	None
Phillips LH et al (2008)	*69f 57m*	Emotional Elicitation	4N 1u	3* 5*	None

Phillips LH e al (2002)	*96mix*	Mood Induction	1P 1N 1NU	SPILOT (14 participants)	None
Richards JM & Gross JJ (2006)	*30f 27m*	Emotional Elicitation	2N	UNPILOT & 7*	None
Richards JM & Gross JJ (2000)	*29f 24m*	Emotional Elicitation	1N	UNPILOT	None
Sloan DM (2004)	*36f*	Emotional Elicitation	2P 3N 1Nu	3*	Sticks Neutral film
Staebler K et al (2009)	*30f*	Emotional Elicitation	2P 2N	SPILOT	None
Stephens CL et al (2010)	*27f 22m*	Emotional Elicitation	3P 3N 1Nu	1* 3*	Sticks Neutral film
Tice DM et al (2007)	*41f 52m*	Mood Induction	1P 1N	UNPILOT	Film titles not given
Tull M & Roemer L (2007)	*32f 4m*	Emotional Elicitation	1P 1N	9* Unpublished data	None
Tsai JL et al (2007)	*96mix*	Emotional Elicitation	1P 1N 1Nu	3*	None
Updegraff JA et al (2004)	*33f 44m*	Mood Induction	1P 1N	UNPILOT	None
Zimmermann et al (2003)	*46f 50m*	Mood Induction	2P 2N 2NU	UNPILOT	None

Notes:

Film Reliability and Validity obtained using previously validated film sets;), 1* Fredrickson and Levenson (1998), 2* Ekman and Friesen, (1974), 3* Gross and Levenson, ((1995) or Rottenberg et al (2007) 4*Adaval (2003), 5* Hosie, Milne, and McArthur (2005), 6* Philpott (1993), 7* Ekman, Friesen, and O'Sullivan (1988), 8* Hewig, Hagemann, Seifert, Gollwitzer, Naumann and Bartussek (2005), 9* Richards and Gross (2000),

SPILOT = Specified Pilot Study, UNPILOT = Unspecified Pilot Study and NOTS = No information given on validity or reliability of films used

The final group comprised of 24 (*) articles that referenced all, or several, of the films employed as sourced from a published research paper(s). An inspection of Table one showed that 19 of the articles employed a clip(s) from the Gross and Levenson (1995) film set with the same clips also featuring in Rottenberg et al (2007). The inclusion of so many clips from this film set is not surprising given the robustness of Gross and Levenson's (1995) study and the breadth of basic emotions they investigated. Two articles referenced Fredrickson and Levensons (1998) as the source of their film stimuli although several of these films were originally evaluated by Fredrickson and Kahnema (1993). Several articles also referenced Ekman and Friesen (1974), Ekman et al (1998) and Philpott (1993), as the source for the films employed, however these clips only featured either negative valenced amputation films or positive valenced nature films so given the criteria of this investigation these films were not further scrutinized. Inspection of Table one shows the remaining studies provide as a reference either a published study that does not include verifiable data about the film stimuli; or, a published study that references a further published study that does not include verifiable data. For example, Chuang, Kung and Sun (2008) article is listed as referencing Advaal (2003) in the *Reliability and Validity* column for the choice of Pretty Woman as a happy clip and Ordinary People as a sad clip. Upon examination Advaal's (2003) study (into the impact of emotion on brand choice) referenced Martin et al (1993) for the employment of Pretty Woman as a happy film and Ordinary People as a depressed film. However, an inspection of the methods section of Martin et al's (1993) study (into the motivational implications of people's mood) no verified information on the clips Ordinary People or Pretty Woman were found. Interestingly, the negative film clip Ordinary People in Chuang et al's (2008) article is cited as "sad" but in Advaal (2003) study this clip is employed to "depress" participants. To categorise a film clip as eliciting "depressed" emotion then employ the film clip to elicit a "sad" emotion maybe unproblematic when investigating behavioural motivation but could greatly confound comparisons of BOLD data across imaging investigations.

It is worth noting that Advaal (2003), in common with some of the other studies reviewed, probably employed Pretty Woman and Ordinary People film clips after personal communication with Martin et al (1993). Moreover the present study also assessed, and then included, neutral film clips after personal communication from Hewig et al (2005). The current system of personal communication between affect investigators, although providing sound film stimuli for the recipient investigator, does not aid the establishment of a freely available normalised library of films.

The above evaluation on the sourcing and justification of film stimuli employed by forty contemporary affect studies facilitated the choice of films for the present study. The next section, however, will address specific issues raised in several of these studies as regards discreetly eliciting sad and happy emotion. Additionally, given the important role neutral and/or control films play in imaging studies the criterion of such films to depict emotionally neutral scenes is also gauged.

2.1 (d). Sad, Happy and Neutral Film Stimuli.

It is important to note that despite Advaal (2003) and Chuang et al's (2008) reclassification of the film clip from "depressed" to "sad" negative film clips are seldom re-categorised between studies. However, as mentioned previously film clips that are targeted to discreetly elicit anger and fear seem more difficult to label but film clips that discreetly elicit sadness seem, on the basis of the literature search, fairly trouble-free to predict. Classifications of discrete positive clips, however, appear to be rather more challenging. The literature search found previously validated amusing, and contentment film clips renamed as "happy". For example, Sloan (2004) provides good methodological reasons for the employment of Gross and Levenson's film stimuli, but states when listing the emotions under investigation "*The film clips included scenes of slapstick comedy (happiness)*" (page 1260). Likewise, Kuhbandner, Pekrun and Maierb (2010) do not specify the Gross and Levenson (1995) film as targeting "amusement" but state that "*The positive film clip (2min 31 s) was a comedy segment from the commercial movie* '*When Harry met Sally*" (Kuhbandner et al, 2010, page 287). The above reclassification of these clips would be considered valid if the emotions amusing and contentment are considered, as suggested by Gross and Levenson (1995), subordinate to the category of "happiness".

As mentioned in the Introduction historically psychological research into emotion has adopted a fairly homogeneous view of positive emotions although Herring, Roberts and Devine (2011) in a very recent study have questioned this standpoint. The aim of Herring et al's (2011) study was to explore whether participants viewing two film clips, selected to elicit joy or amusement, would differ in cardiovascular, respiratory and behavioral characteristics. The thirty-nine participants, as predicted, exhibited less heart rate deceleration, an increase in respiratory amplitude and showed more positive facial expressions and laughter in response to the amusement clip than to the joy clip. Herring et al (2011) concludes these results add to a growing literature recommending affect investigations should adopt a more nuanced conceptualization of positive emotion. An important point that will be discussed further in the chapter, particularly in reference to the previously mentioned voxel-based meta-analysis of Vytal and Hamann, (2010) that combines amusing and contentment film data with positive picture data to report on the neural correlates of the basic emotion happy.

A recent study that wishes to expand the current conceptualization and choice of films is Schaefer et al (2010), who aimed to provide a new film set that allowed the researcher a more flexible selection of stimuli. They developed and robustly tested an emotional film set that provided a much larger normative data base than was currently available. Schaefer et al (2010) assessed, amongst others, sad, amusing and tenderness as well as fifteen "mixed feelings" films to measure the effectiveness of clips to produce blends of specific emotions. They produced the film set in three phases: asked fifty film experts to recall specific film scenes that elicited sad, amusing and tenderness; selected the ten most frequently mentioned film scenes; then asked three 364 participants individually to view the clips and rated each film on multiple dimensions. The ten films verified as sad were scenes depicting the death of a loved one or their suicide. The ten films verified as eliciting amusement were comedy scenes. The ten films verified as eliciting tenderness were achieved through scenes depicting the selfless love of an actress, or actor, towards another person or creature. The tenderness film with the highest score (mean 4.20), on the given criteria, was a scene from Forrest Gump showing a father and son reunited.

Finally, the above literature search for film scenes that will elicit happy and sad social emotion has produced somewhat contradictory results. Based on the film data available and the literature search the style of film scene to elicit a “sad” emotion seems fairly unambiguous and tends to feature the death of a loved person or creature. The most utilised sad clip is Gross and Levenson’s (1995) film The Champ featuring a boy crying after his father’s death. Fredrickson and Levenson’s (1998) sad clip Steel Magnolias, featuring a woman talking about her dead daughter, is also employed by various articles. Hence, films featuring similar types of death scenes were chosen to be further assessed in the behavioural study.

In contrast, based on the film data and literature search, the style of film scene to elicit a “happy” emotion was far more difficult to evaluate. Inasmuch as, the positive clips featured in Gross and Levenson’s (1995) popular film set are categorised as either “amusement” (comedy scenes) or “contentment” (waves or beach scenes). Similarly, Fredrickson and Levenson’s (1998) positive films were also either classified as “contentment (waves scene) and “amusement” (puppy playing with a flower). Even, the latest film set to be published by Schaefer et al (2010), and reviewed above, categorise positive films as either “amusement” (comedy scenes) or “tenderness” (selfless love). The most utilised positive film in the articles reviewed is Gross and Levenson’s “When Harry Met Sally” (woman acting out an organism in a café) with “Robin Williams Live” (a comedy routine) also popular. Currently, the film data reviewed would seem to confirm the suggestion of Herring et al (2011) that positive emotions are generally viewed as homogeneous and, in many cases, the label “happiness” applied to all types of positive stimuli. Given the above reviews the type of film scene to discreetly elicit happy emotion in the current investigation is rather unclear. Hence, based on personal observation of the positive films reviewed it was decided that clips featuring a loving relationship between two individuals in an amusing setting were chosen to be further assessed as happy in the behavioural study.

The style of film scene employed to provide a neutral, or control, stimuli was very varied with the many articles not providing enough data to assess the neutral clips. Also, it is worth noting that fifteen articles did not employ any neutral contrast. The neutral film clip Sticks, a dynamic display of geometric shapes (ScreenPeace screensaver), is one of the films in Gross and Levenson (1995) set and has also been utilised in various reviewed articles. The Sticks neutral clip is shown to robustly elicit a neutral affective state, characterised by low levels of negative and positive emotions. Hence, this film was chosen as the control stimuli for the imaging investigation reported in chapter four. However, given the lack of data available from the reviewed neutral films the clips chosen to be further assessed as a neutral contrast in the behavioural study were mainly based on personal communication from Hewig et al (2005).

Footnote: Given the account of films being circulated by personal communication it is worth noting that Schaefer et al's (2010) film set is the first to be made freely available on the internet (http://nemo.psp.ucl.ac.be/FilmStim/.) together with the facility for future investigators to add verified film and data. The film set from the present investigation will be uploaded once completed to hopefully help increase the collection of emotion and neutral films freely available to other affect investigators.

2.2 fMRI Investigations and Film Stimuli.

This section will briefly consider common issues related to employing film clips for brain imaging research. The information discussed will cover both general (e.g. complexity) and specific (e.g. physical context, relevant points of comparison, temporal resolution) obstacles that could be encountered when utilising film stimuli in an fMRI setting. Additionally, at the end of each section the procedure employed to try and overcome some of the reviewed obstacles is outlined.

2.2(a) Complexity: Film Stimuli.

That films are capable of eliciting activations across many response systems associated with affect is well documented (Damasio, Grabowski, Bechara, Damasio, Pontom Parvizi and Hichwa, 2000; Davidson and Erwin, 1999; Fredrickson and Levenson, 1998; Herring et al, 2010). However, current published data seems to indicate that while some film clips can adeptly generate strong multi-system activations, other film clips only produce more modest responses (e.g. Herring et al 2010). The main difficulty when assessing multiple or single responses is that film stimuli, like most elicitation procedures, are generally only standardized on the basis of self-reported emotional experience. As mentioned in the Introduction current research into the coupling of response systems is still vague so currently even the most robust self-reported standardization provides no guarantee that a film will generate both reliable behavioral responses and BOLD activations.

Conventionally, commercial films designed to elicit emotion tend to be dynamic, multi-faceted and are reliant upon meaningful sound tracks or narrative. These features therefore dictate that most commercial emotion-eliciting films are reasonably high in cognitive complexity. This ability of commercial films to elicit a variety of high-level emotional states is, in many ways, the stimuli's greatest strength. On the other hand, even stringent standardization cannot prevent the elicitation of unsolicited states, such as nostalgia, that can confound the pattern of BOLD results obtained. An illustration of how multifaceted films can be is Eldar, Ganor, Admon, Bleich and Hendle's (2007) investigation into the brain regions involved in the processing of real world scenes. They demonstrated that by simply combining music (rich in emotion) with neutral films (rich in real world scenes) this lead to an increase in activation in the amygdala, hippocampus and lateral prefrontal regions. Eldar et al (2007) found that emotional music on its own did not elicit a differential response and concluded that activation in the amygdala increases in response to the emotional stimulus associated with real world scenes. A further example of emotion-eliciting films increasing cognition complexity are clips employed to elicit disgust. Gross and Levenson (1993) found that even a simple film clip, featuring an arm being amputated, was likely to require considerably more appraisal to elicit disgust than the ingesting of a bitter taste that is dependent upon a participants' primitive reflex. The above two examples demonstrate the dynamic characteristics of film stimuli that can engage multiple modalities, and typically do require fairly high appraisal and attentional capabilities.

The potential problem of commercial films imposing a relatively high level of cognitive demand on participants is not a concern for this particular investigation however, for studies with special populations (e.g. young children or cognitively challenged adults) this could be problematical. The dilemma is that commercial films being dynamic and complex lead to the activation of multiple regions (e.g. visual, auditory etc.) and this is an expected outcome and one that this study will take into account in the results and discussion sections. On the other hand, the activation of unsolicited emotional responses, such as nostalgia, can occur. The study will try and control for nostalgia by employing films produced around a specified era, so as not to confound the pattern of BOLD results obtained.

2.2(b) Instructions: Film Stimuli.

The level of cognitive involvement that emotion-eliciting films provoke does vary quite considerably, but when specific instructions accompany a film viewing these can be especially influential on the BOLD results obtained. Goldin, McRaem Ramel and Gross (2008) investigated the BOLD responses of disgust-eliciting films under four conditions (watch neutral, watch negative, reappraise negative, and suppress negative) with participants also providing emotion experience ratings whilst having their facial expressions videotaped. The investigation predominantly examined cognitive reappraisal, a strategy thought to impact early in the emotion-generative process. Goldin et al (2008) found reappraisal of the disgust-inducing films resulted in early prefrontal cortical responses and decreased amygdala and insular responses. Suppression of the disgust-inducing films produced late prefrontal cortical responses and increased amygdala and insula responses. Similarly, Hutcherson et al (2005) investigated attention and emotion looking specifically at whether rating emotion altered the neural responses to amusing and sad films. They found that rating the emotional films, in contrast to passively viewing them, produced increased activity in anterior cingulate, insula, and several other areas associated with introspection of emotion. Hutcherson et al (2005) concluded that when viewing an absorbing, continuously varying, emotionally stimulating film "attention", although having little impact on the emotional response itself, did consistently engage a specific neuronal network. The findings of Hutcherson et al (2005) and Goldin et al (2008) also demonstrates the degree of difference specific instructions accompanying a film viewing can produce on neural responses.

As a consequence of demand concerns many investigators use a simple instruction such as "to please watch the film carefully" (Rottenberg et al. 2007). However, Hutcherson et al (2005) gave more precise instructions to their passive group before they viewed the films ''*we will now be showing you a set of film clips. Please watch them and just allow yourself to respond as naturally as possible to them*'' (page 658). The latest investigation to test the effectiveness of emotional films Schaefer et al (2010) instructed participants to watch the screen attentively, without diverting their attention from the screen. Given the importance of instructional cues after several pre-behavioural trials the present investigation found the instruction "just look and respond naturally" before each film clip the most effective directive. This instruction seemed to reminded participants to engage with the film stimuli whilst still allowing them to respond spontaneously.

2.2(c) Measurement: Film Stimuli.

Once a set of films are considered and chosen as the correct emotion elicitation procedure for the given research context, the next important issue is how to successfully organize the film stimuli. Several factors influence how well films work in an fMRI setting and like many other techniques employed to elicit emotion in a scanner success, or failure, of the method often hinge on how the emotion itself is measured. There are several issues central to the measurement of emotion when using film stimuli; chiefly, the subtraction of emotion, the measurement periods employed and proximity to activation. These important issues will now be briefly considered.

The subtraction of emotion from the films viewing periods is typically assessed as the overall epoch average. Rottenberg et al (2007) propose that, in the main, many investigators (including themselves) rely upon overall period averages to measure reactivity during film clips. Moreover, this overall average response provides an important summary statistic and starting point for data analysis. However, an ongoing concern when employing films is their relatively low temporal resolution which typically creates heterogeneous periods of data. This means that when employing film stimuli in a standardised block design, to obtain epoch averages, this will almost invariably lead to the inclusion of non-emotional periods and, or, periods when non-targeted sensations are elicited. Goldin, Hutcherson, Ochsner, Glover, Gabrieli and Gross (2005) directly addressed this subject when employing film stimuli in an fMRI experiment that examine the neural bases of sadness and amusement. They compared a block contrast analysis with a subject-specific regression analysis. The subject specific analysis was obtained by participants' continuous ratings the intensity of their sadness or amusement during the film viewing. Goldin et al (2005) found that specifically for sad films both the block contrast and subject-specific analyses resulted in significant BOLD responses ($p < .005$), with the block contrast analysis resulting in greater signal magnitude and an increased number of activation clusters. In comparison, they found for amusing films whilst both approaches yielded significant BOLD responses ($p < .005$) the subject-specific regression resulted in a greater number of BOLD responses. Goldin et al (2005) concluded that sadness, in comparison to amusement, appears to have a smoother and slower temporal evolution that gradually rises to a high point in response to sad films. They also suggested a further reason for the relative advantage of sad block contrasts, compared to subject-specific sadness ratings, was that sadness and neutral film experience were characterised by a more non-fluctuating neural sequence.

The investigation of Goldin et al (2005) emphasises the importance of not only focusing on whether the film clips are the right emotion elicitation procedure but also the sensitivity of different data diagnostic methods for identifying emotion related BOLD responses. This fMRI investigation, like others, when employing film stimuli needs to be aware that period averages could effectively dilute the principal emotion under investigation as well as detracting from other parameters of interest.

2.2(d) Contrast Baselines: Film Stimuli.

Regardless of the data diagnostic method employed to measure, and extract, the elicited emotion it is still necessary to estimate the impact of the emotional film compared to some point of reference. The investigation by Goldin et al (2005), mentioned above, stresses the importance of evaluating any neutral contrast employed. For in order to draw inferences about the emotion elicited by a film a relevant baseline, a point of comparison, is needed against which to assess the effects of a given clip. The type of baseline that should be used when using film stimuli is now briefly considered.

Traditionally, a resting state has been the main baseline employed in imaging investigations. However, in affect investigations there are two major drawbacks in employing this type of baseline; participants differ in their ability to comply with rest instructions and this can, and does, introduce unwanted variability; a resting state may not be a representative condition for the researched context. A neutral film baseline can limit some of the above factors and also has the advantageous feature of helping control the effects of viewing a dynamic film stimulus. For neutral film clips to be a useful comparison condition, however, they must be timed appropriately as levels of functioning responses are never static but fluctuate throughout the procedure. This is why for investigations that employ multiple emotion eliciting films, in their experimental design, the issue of individual variability of response and habituation is serious but can be mitigated by the use of multiple neutral baselines. These drawbacks are, in the main, well documented and the articles reviewed above do employ multiple neutral films as a baseline comparison.

The matching of neutral films to selected emotional eliciting films - which then allows for robust inferences about emotion effects - is an important related consideration. The affect investigator, as will be further explored in chapter three, when comparing two (or more) films will usually want to conclude that the observed effects are due to emotion rather than film differences (e.g. length, complexity, core themes, number of actors/actresses, colour, sound, etc). The problem of what characteristics to match and how, given the present pool of available films is addressed in chapter three. The related subject of which neutral film clips were featured in the present investigation, and why, is also considered.

2.2(e) Context, Timing, Order and How Many Clips: Film Stimuli.

The film review and fMRI related topics discussed so far have suggested several factors that could obscure BOLD activation of targeted emotional states. One solution proposed to counteract some of these factors is a strengthening of the affect “signal” by sampling for extensive periods via employing several film clips for the given emotion (Hutcherson et al, 2005). Three main difficulties are associated with this practice: (a), different films although standardised to target a particular emotion do not always generate comparable responses; (b), the attention span of participants, in some way, restrict the use of multiple clips for each target condition as this can lead to habituation or fatigue effects; and (c), longer films can become heterogeneous, so are less effective than shorter ones, also long neutral films can become aversive. The most common strategy utilised in the reviewed studies (see Table one) is the employment of two film clips that are as comparable as possible, and on average between one to three minutes long. This strategy is fairly accepted, as a method to increase BOLD activation for the targeted emotion however it does heavily depend on strong stimulus selection and standardisation.

The main facets of film stimuli that need to be monitored, and controlled, to standardise the viewing experience are order, timing and whether the film clips have been viewed previously (Gross and Levenson, 1995). The order, in which a film set is presented in order to avoid carryover effects, is considered in chapter three. Considerations on the timing of film stimuli in the both behavioural and scanner experiments (to counteract participant fatigue) and the threat to standardisation if the clip has been previously viewed are also presented. An additional factor that can skew participants' responses, and jeopardise norms, is the physical setting in which the film is viewed (Rottenberg et al, 2007). The procedure sections in chapters three and four set out the settings specified in order to control the physical milieu.

In the majority of imaging experiments that employ films the stimulus content, viewing conditions and presentation can be tightly controlled. Conversely, although imaging investigations can control these potential sources of reactive variability this still does not guarantee the film will be effective equally for all participants. The problems of individual and group and differences will be considered next.

2.2 (f) Individual Differences: Film Stimuli.

That individual differences influence reactivity to emotion eliciting film clips is well documented (Eugene, Levesque, Mensour, Leroux, Beaudoin, Bourgouin and Beauregard 2003; Fredrickson and Branigan, 2005; Gross et al, 1998; Tomarken et al, 1990). Biological traits, such as resting electroencephalographic asymmetry in anterior regions of the brain, have been shown to predict film reactivity (Tomarken et al, 1990). Similarly, as mentioned certain personality traits (neuroticism and extraversion) have also been shown as reliably predicting emotional reactions to negative and positive films (Gross et al, 1998). However, despite this well documented variability many imaging studies, as pointed out in the Introduction, seem to assume that by controlling "gender" the issue of individual difference is then chiefly isolated.

Eugene et al (2003) assessed several published fMRI investigations into basic emotions and found little consistency among the results of these studies. They hypothesised that individual differences could account for the inconsistencies among these investigations and conducted two fMRI affect film studies to identify whether this was the case. In Eugene et al's (2003), two methodologically identical studies, two different groups of healthy female subjects were scanned whilst experiencing a temporary state of sadness induced by viewing sad film clips. In the first study sadness was correlated with significant activation in the anterior temporal pole and insula ($p < 0.05$). In the second study, however, sadness was correlated with significant activation in the orbitofrontal and medial prefrontal cortices ($p < .05$). Additionally, the investigation found a marked degree of interindividual variability in both the first and second studies. Eugene et al (2003) conclude that these results strongly support the view that individual differences may be responsible for the present inconsistencies found in the literature for the neural substrates of sadness and of other basic emotions. The above study highlights how individual differences may constitute problem variance for investigations employing film stimuli and could interfere with the detection of other small but important effects.

It should be mentioned that individual difference, for a number of investigations, is the main focus of the research (e.g. positive characteristics, Fredrickson and Branigan, 2005) and variation of this factor is collected and assimilated into the research profile. Nevertheless, if individual difference is not fundamental to the investigation gender is accounted for but other characteristics such as personality, mood or ethnic origin are rarely screened. Rottenberg et al (2007) recommend affect investigators collect individual difference profiles for each participant which will then allow them to screen out candidates who do not fit the research profile. Additionally, individual profile data would also enable the investigator to conduct post-experiment statistical control.

The influence of group bias (e.g. gender, ethnic origin, socioeconomic, cohort) on neural reactivity to film stimuli is still at an early stage of investigation but is considered an important area for the future (Rottenberg et al, 2007).

2.3. Conclusion: Film Stimuli.

This chapter on the validity and reliability of film stimuli in affect fMRI investigations has raised concerns about film affect norms being totally reliant on self-report data, and the problem of the procedure being high in cognitive complexity. Additionally, important issues were clarified surrounding how film stimuli are measured (averaged periods), what neutral baseline to use and which standardisation procedures will allow for replication. The section that reviewed the published film sets also established several characteristics - the priming of specific cognitions and intensity of response – that need to be addressed when employing film stimuli. The literature search, via Google Scholar, on the justification and reproducibility of film scenes to elicit sad and happy emotions did, however, produce rather varied results and recommendations. Since, the articles reviewed confirmed and identified film scenes needed to successfully elicit sadness and a comparable control clip, whereas the film scenes needed to successfully elicit happiness or a neutral contrast, were more confused.

In conclusion, despite the above methodological issues, the employment of film stimuli would seem a robust induction procedure that allows for the ethical elicitation of dynamic happy and sad emotions. This review recommends as key to the successful employment of film stimuli, and resultant findings, extensive piloting of the film clips prior to imaging. Hence, the next chapter will address the above issues by comprehensively assessing the ability of the chosen film clips to discreetly elicit the target emotion states and neutral contrasts, prior to their employment in the fMRI setting.

3. BEHAVIOURAL FILM SET STUDIES.

The initial aim of the two behavioral studies was to explore whether self-rated mood and participants' ethnic origin modified the ratings of emotions elicited by film stimuli. A further aim was to develop a set of film clips that reliably elicited happy or sad social emotion, or else were emotionally neutral, and could be utilized in this fMRI investigation. Following the discussion in the previous chapter the decision to employ film clips for the present study was a fairly straightforward one. Rather more problematical was which film clips would accurately elicit the required social emotions within the specific requirements of the study.

3.1. Development of the selection criteria for Film Clips

The reported film sets have been predominantly developed from commercial feature films, television programmes, documentaries and abstract scenes. These film sets, in the main, provide important valid and reliable stimuli for the elicitation of emotion. However, particular limitations are present when employing these stimuli in the present investigation.

A first limitation is that in most cases the emotionally eliciting film clips are excerpts from commercial feature films: in contrast, the neutral film clips produced are not. Gross and Levenson (1995) used bars and shapes of colour, Phillipot (1993) used excerpts from a documentary on town policy and Hagemann, Naumann, Maier, Becker, Lurken and Bartussek (1999) used a television excerpt of a train journey, as a neutral contrast. As a result the content and format of the neutral stimuli is, in many ways, not directly comparable to the emotional stimuli. However, the composition of a neutral baseline, Rottenberg et al (2007) concludes, should be made with reference to the objectives of the investigation with affect investigators predominantly matching those features that are the highest priority for their given hypotheses. Hewig et al (2005) focused on the compatibility of neutral and emotional film stimuli and developed a set of neutral stimuli to complement the above reported emotional stimuli. This film set comprised of four selected neutral clips developed from commercial feature films and sixteen emotional film clips taken from earlier studies and was made available via personal communication for inclusion in this study

A second limitation in the use of film clips is that the imaging investigator will want to surmise that the observed condition effects are due to the targeted emotions rather than due to other film differences. For example, all the reported film clips mentioned differ from one another on a large number of potentially confounding characteristics (e.g. colour, length, brightness, number of actors, basic themes etc.). How to match emotional and neutral film stimuli is at present problematical given; (a), even minor editing of film clips can significantly alter their validity and reliability; (b), the number of potential dimensions of difference amongst films clips is considerable; and (c), the small pool of robust film clips available for specific target emotions. To date, investigators have tried to match film clips with reference to the goals of their study (e.g. Iacoboni et al, 2004, matched films on number of actors in each clip).

A third limitation is the variability in response due to psychological context and individual differences. As mentioned in chapter two most aspects of the psychological context can be controlled and monitored by standardizing timing, order and documenting prior viewing of the film set (Rottenberg et al, 2007). However, how to regulate film sets in order to avoid carryover effects is at present somewhat debatable with some studies presenting films of like valence in a blocked order (Britton et al, 2006), while other studies present emotion films sandwiched between a neutral contrast (Hutcherson et al, 2005) or a non-emotional distractor task (Gross, 1998). All the studies reviewed seem to collect information on, and control for, the effects of prior viewing. Controlling for individual differences, which as mentioned seem to have an influence on reactivity to emotion film clips, is more difficult. As previously stated, the influence of personality traits, mood, age and cohort effects are not scrutinized unless they are the focus of the study (Canli et al, 2001). In addition, the influence of ethnic origin on reactivity to film clips is at present unclear. The films sets reviewed seem to generalize to other western non-English speaking groups (Hagemann et al, 1999). Moreover of importance to this study are Gross and Levenson's (1995) findings as regard the impact of gender and ethnic origin on film stimuli. Their results confirmed that women significantly reported greater levels of the target emotions than did men, although, no differences between the four ethnic groups (African-American, Asian-American, Caucasian and Hispanic) in the elicitation of target emotions were found. However, a more recent study by Roberts and Levenson (2006), which examined whether the ethnic group of participant impacted on subjective and other responses to ethnically matched and mismatched emotional film clips, has raised questions about this universality of response. Roberts and Levenson (2006) examined four major ethnic groups (African American, Chinese American, European American and Mexican American) responses to a set of film clips (amusement, sadness and disgust) that featured actors of their own ethnic group compared with actors from the other three ethnic groups. They found greater responsivity to ethnically matched film clips for African Americans and European Americans, with the largest effect for African Americans. Importantly, their findings imply the emotional response system reacts to the ethnic content of film stimuli and, possibly of particular importance to this study, allows for enhanced responding to actors of one's own ethnic group.

A final limitation is the effect of adult participant age on emotional reactivity to film clips. This has been rarely reported on, although the effect of adults' age on emotional responses to the International Affective Picture System (1999) has been quite widely researched, but with results inconsistent across studies. For example, Reminger, Kaszniak and Dalby (2000) reported no significant difference with age, whilst in contrast Smith, Hillman and Duley (2005) found younger adults self-reported less arousal and valence than older adults. To further complicate the effect of age on emotional reactivity, Mather, Canli, English, Whitfield, Wais, Ochsner et al (2004) found older people rated negative pictures as less emotionally arousing than younger participants although emotional arousal for positive pictures was similar across the two groups. A study by Kliegel, Jäger and Phillips (2007) employed negative and neutral film clips to induce negative moods in order to explore age-related emotional reactivity. They found differential age-related effects of negative mood induction with older adults showing a substantial decrease in self-rated calmness, wakefulness and pleasantness than younger adults. However, of concern - particularly when using the genre of film to explore emotional elicitation - is whether the reported differences found between older and younger participants were truly age-related or in large measure due to cohort differences. In western society the graphic and emotionally explicit material present in today's films, it is suggested, differs considerably from films in the not so distant past. Pennington (2007) in reviewing the changes that have occurred in the sexual and graphic content of films produced by Hollywood, from 1960's to present day, found the genre has evolved alongside changing behavioral patterns in American society. Consequently, the primary advantages of employing film sets to elicit strong self-reported emotions in adult participants needs to be assessed, together with, issues relating to age, explicit content and cohort behavioral patterns.

This behavioural study is part of a larger investigation into brain reactivity to happy and sad social films and the potential influence of ethnic origin and mood. Given current uncertainty as regards the influence of ethnicity on emotional elicitation and film stimuli it was decided that in the current film set all main actors would be from the same ethnic group. Each film clip was to feature only two main adult actors given that previous studies have found evidence of a differing of response dependent on the number of actors featured in a clip (Iacoboni et al, 2004) and a potential differing of response to child actors (Bartels and Zeki, 2000). An additional criterion was to choose main themes for the emotional film clips. All sad film clips would feature the death of a loved one; all happy film clips would feature a female and a male actor in a loving exchange. The rationale for choosing these themes was centred on the results of the literature search undertaken in chapter two. The neutral film clips would feature a neutral exchange between actors and as mentioned in chapter two was based on personal communication from Hewig et al (2005). The film clips considered had to be produced around, and depicting, the period 1980's to early 1990's so as to limit confounding characteristics and the pre-defined age profile of participants (18 to early 20's) would hopefully not have previously viewed the film clips. Consequently, it was decided for reasons of accessibility and convenience to include only predominantly 1980's films that featured two white adult actors in the chosen main themes. However, one sad film that was produced in 2000 (Along for the Ride, Millennium Films) was included as it conformed to all other criteria and depicted the target period. Hence, the development and then assessment of the film set, to induce the target emotions of happiness and sadness in a social context, is specifically aimed at the goals of the larger investigation.

3.2. Overview of the Studies.

In behavioural study one eight neutral film clips were presented together with ten emotional film clips. These clips were developed from commercial feature films or edited from clips used in previous studies (Abele and Gendolla, 1999; Britton et al, 2006; Hagemann et al, 1999; Hewig et al, 2005; Rottenberg et al, 2007). In behavioural study two five neutral film clips were presented together with six emotional film clips extracted from behavioural study one.

The first aim of behavioural study one was to determine the influence of self-rated, general dimension moods (positive and negative affect) in emotional elicitation to film stimuli. The second aim was to see if the film clips were able to elicit the target emotions while also satisfying the goals of an imaging investigation to minimise other sources of variation. Specifically, to reiterate all film clips must conform to four criteria: only feature two predominant adult actors; depict the same period (e.g. 70's and 80's); have core themes as similar as possible (e.g. sad core theme death of a loved one); and be exactly 90 seconds in length. The final aim was to validate and replicate previous finding on the capacity of the emotional film clips to induce the target emotions of happiness and sadness and to validate and replicate previous findings on the emotionally neutral film clips.

The main aim of behavioural study two was to explore whether ethnic origin influenced the rating of target and non-target emotions and also the rating of "interest" and “confusion” for happy, sad and neutral film clips. The second aim was to investigate whether specific mood traits (fear, sadness, guilt, hostility, shyness, fatigue, surprise, joviality, self-assurance, attentiveness, and serenity) influence the rating of the target emotions (“happiness”, “joy”, “love”, amusement” and “sad”) and ratings of “interest” and “confusion” for happy, sad and neutral film clips, in addition to self-rated, general dimension moods (negative and positive affect). The final aim of behavioural study two was to confirm the results of behavioural study one for the selected film clips and pattern of ratings for positive, negative and neutral film clips.

3.3 Behavioural Film Set Study One,

3.3(a) Participants.

A total of 170 students of the University of Brunel participated in group film-viewing sessions (all were students of psychology, sociology, anthropology or media studies). The sample consisted of 147 females and 23 males. The ethnic origin of the sample consisted of 58 Asians, 32 Africans, 50 Europeans, 28 other ethnic origins (OEO). Two participants did not record their ethnic origin but this data was included in the study.

The sample was tested in four groups (A, B, C, D) on the basis of prior timetabled sessions. Group A consisted of 30 participants (27 female, 3 male; ethnic origin 6 Asians, 8 Africans, 14 Europeans, 2 OEO). Group B consisted of 47 participants (40 female, 7 male; ethnic origin 15 Asians, 11 Africans, 13 Europeans, 6 OEO, 2 unrecorded). Group C consisted 41 participants (35 female, 6 male; ethnic origin 17 Asians, 11 Africans, 6 Europeans, 7 OEO). Group D consisted of 52 participants (45 female, 7 male; ethnic origin 20 Asians, 2 Africans, 17 Europeans, 13 OEO). 97.6% of the sample had ages ranging from 18 to 26 years.

3.3(b) Stimulus Material and Rating Scales.

The film set comprised 18 clips (see Table two), extracted from commercially available films or edited from previous studies. Two film clips were edited from Abele and Gendolla's set (1999); a happy clip from *Love Story* (LSH) and a sad clip from *Love Story* (LSS). Five film clips were edited from Hewig et al's (1999) set, a happy clip from *An Officer and a Gentleman* (OGH), a sad clip from *An Officer and a Gentleman* (OGS), and three neutral clips *All the Presidents Men* (PM1N), *Crimes and Misdemeanours* (CMN) and *Hannah and her Sisters* (H1N). One film clip was edited from Britton et al's (2006) set, a sad clip from *Steel Magnolias* (SMS). As the aim was to include at least five films for each target emotion a further two sad clips were obtained, from one from *Terms of Endearment* (TRS) and one from *Along for the Ride* (RN). Three additional happy clips were also obtained, two from *Pretty Woman* (PW1H; PW2H) and one from *Invitation to the Wedding* (LFH). In addition, the aim was to include at least eight emotionally neutral film clips so a further five clips were obtained. A further one from *All the Presidents Men* (PM2N) and further one from *Hannah and her Sisters* (H2N) were edited. Plus two clips from *Endless Love* (EEN; END2N) and one from *Falling in Love (FLN).*

Thus, the final film set included eight emotionally neutral clips, five clips designed to elicit the target emotion of sadness and five clips designed to elicit the target emotion of happiness. The length of each clip was 90 seconds exactly and each film was in colour. The films were not shown silent as a main criterion for the larger (brain imaging) study was to elicit social emotions; defined as emotions shaped by the presence of human forms using meanings, language and intentionality in cognitively complex ways. Table two provides the core theme of each film clip.

Table 2: Title, Description and Target Emotion of Films in Behavioural Study One.

Film No.	*Film Title.*	Target Emotion.	Description (company, year)
1.	*An Officer and a Gentleman(OGS)*	Sad	A woman and man knock on a door enter and find their young male friend is dead. (Universal Pictures, 1981).
2	*Endless Love (EEN)*	Neutral	A scene in a busy street with couple and a single man walking around. (Universal Pictures, 1981).
3	*Love Story (LSH)*	Happy	A young woman and man playing in a snowy park. They laugh and kiss in the snow. (Paramount, 1971).
4	*All the Presidents Men (PM1N)*	Neutral	Two men are talking to each other in a courtroom. (Warner Bros/Wildwood, 1976).
5	*Along for the Ride (RN)*	Sad	A woman is talking to a man about her dead son and cries when asked his name. (Millennium Films, 2000)
6	*Falling in Love (FLN)*	Neutral	A woman and man are Christmas shopping in a bookshop they collide at the checkout. (Paramount, 1984).
7	*Pretty Woman (PW1H)*	Happy	Woman in a flat then a man comes with flowers, climbs up and kisses the woman. (Walt Disney Studio, 1990).
8	*Hannah and her Sisters (H1N)*	Neutral	Two women talking about an audition in a clothing warehouse. (Orion Pictures, 1989).
9	*Terms of Endearment (TRS)*	Sad	Woman and man in hospital room young woman dies leaving woman and man grieving. (Paramount, 1983).
10	*An Officer and a Gentleman(OGH)*	Happy	A young woman is greeted by a young man. He kisses her and carries her out of the room. (Universal Pictures, 1981).
11	*Crimes and Misdemeanours (CMN)*	Neutral	Two men are talking to each other in the garden. (Orion Pictures, 1989).
12	*Love Story (LSS)*	Sad	A sick woman in bed talking to a man about death and funerals. (Paramount, 1971).
13	*Presidents Men (PM2N)*	Neutral	In an office two men are talking about library books. (Warner Bros/Wildwood, 1976).
14	*Invitation to the Wedding (LFH)*	Happy	A man and a woman laughing in a boat, then fishing then riding together. (Pegasus

			Entertainment, 1983).
15	*Hannah and her Sisters (H2N)*	Neutral	A man and women talking in a book shop then buying a book and leaving the shop. (Orion Pictures, 1989).
16	*Steel Magnolias (SMS)*	Sad	At a funeral a woman is talking to other women about the death of her daughter. (UCA, 1989).
17	*Endless Love (END2N)*	Neutral	Two men talking about college work then phone rings and one man talks on phone (Universal Pictures, 1981).
18	*Pretty Woman (PW2H)*	Happy	Woman in the bath talking to a man about money, joking and laughing.

The inventory for the assessment of emotional reactions consisted of seventeen self report items, consisting of twelve different monopolar ratings to assess the power of the film clips to distinctively induce the specific target emotion and two monopolar ratings to assess how easy it was for the participant to understand the film clip and evaluate interest. The items, in the order indicated, interested, distressed, excited, upset, strong, guilty, scared, hostile, enthusiastic, proud, irritable, alert, ashamed, inspired, nervous, determined, attentive, jittery, active and afraid. The participants were asked to rate how they felt while watching the film clip on a 0-8 scale (0 indicated not at all and 8 indicated a great deal). 1 bipolar rating was included (see, Rottenberg et al, 2007, for a discussion on the use of different self-report measures) in which participants were asked to rate whether they felt the film clip was unpleasant (0) or pleasant (8). In addition, one item asked participants if they had seen the film before and another item asked whether they had looked away during any part of the clip.

The participants were given one minute to complete the emotion related inventory after each film viewing. This time allocation was established on the basis of feedback from several small (two - four participants) pilot studies.

The positive and negative affect schedule (PANAS) was employed to assess the trait affectivity dimensions of the participants (Watson and Clark, 1994). PANAS consists of ten adjectives describing negative moods (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery and afraid), and ten adjectives describing positive moods (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive and active). Participants were asked to rate the extent they generally have these emotions, on a five point scale (1 not at all and 5 extremely). Dispositional optimism was also assessed by means of the Life Orientation Test (Scheier and Carver, 1985). This consists of eight items that count towards the dispositional optimism score (four positively phrased, four negatively) together with four filler items designed to disguise the purpose of the test.

3.3(c) Procedure.

The four groups (A,B,C,D) viewed the film clips on a colour projector screen in a lecture room. Groups A and B viewed film clips 1 to 9 and groups C and D viewed film clips 10 – 18 (see Appendix 1). The order of the film clips was counterbalanced between the groups. Prior to presentation of the film set participants were asked to complete an informed consent sheet and the PANAS schedule. All participants were instructed to watch each film clip carefully and complete each self-report inventory immediately after the film presentation (as cued by instructional message on screen). Participants were told it was very important that they indicate how *they* felt while watching the film not how they would expect other people to feel. The one minute allocated for the completion of the inventory provided some time for any elicited emotion to lessen before the next film was presented. A neutral test film clip (taken from *All the Presidents Men)* was always presented first to familiarize participants with the requirements of the experiment. The subsequent 9 films were then presented; an emotion film always preceded a neutral film so no two emotion films followed each other.

Following the film set presentation all participants completed a general questionnaire to record demographic details were thanked for their time and given a debriefing form. See Appendix two for copies of material used.

3.3(d) Results.

The means and standard deviations of all ratings are presented in Table three. A visual examination of this data reveals two main findings. Firstly, the rating of the emotions “amusement”, “happiness”, “joy” and “love” were higher for the positive film clips than for the negative film clips, but were comparable for each positive film clip. Secondly, the rating of the emotion “sadness” was higher for the negative film clips than for the positive film clips, but was comparable for each negative film clip. The film clip that received the highest positive rating was “amuse” in LSH (M = 5.42, SD = 2.14). The film

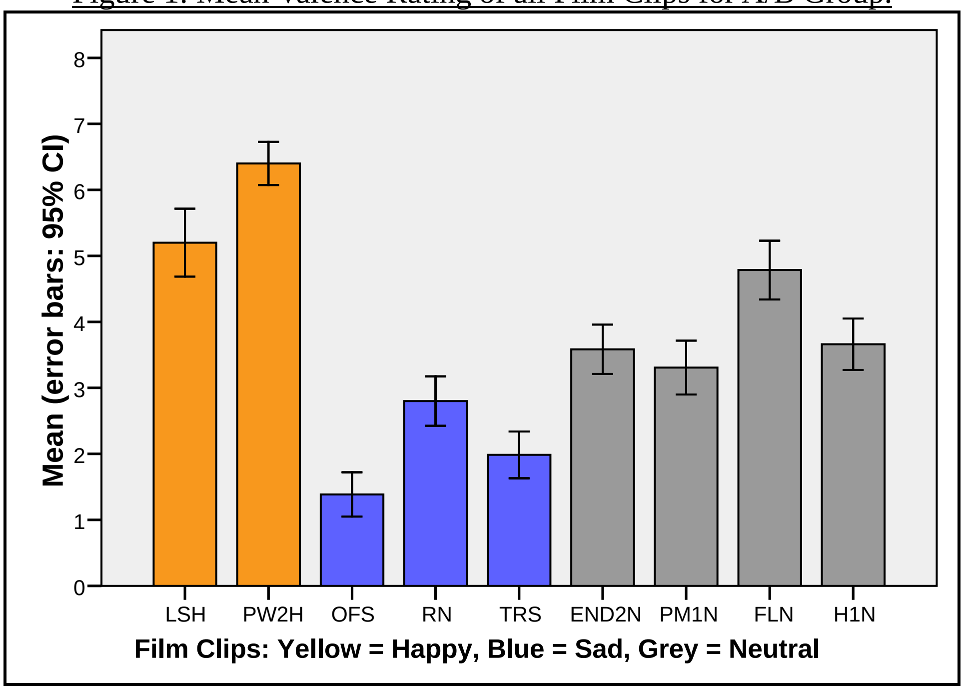
Table 3: Means and Standard Deviation of Film Ratings

FilmClip (emotion)	Amuse	Anger	Anxiety	Confusion	Disgust	Embarr-assment	Fear	Happy	Interest	Joy	Love	Pride	Sad	Surprise	Valance
An Officer and a Gentleman (Sad)	0.36 (1.27)	1.04 (1.86)	2.44 (2.29)	1.75 (2.10)	1.99 (2.22)	0.35 (0.67)	1.90 (2.17)	0.051 (0.22)	3.87 (2.40)	0.01 (0.11)	0.83 (1.87)	0.22 (1.00)	5.40 (2.48)	3.66 (2.84)	1.43 (1.31)
Endless Love (EEN)	0.86 (1.58)	0.34 (1.07)	1.32 (2.00)	5.19 (2.38)	0.42 (1.45)	0.19 (0.70)	0.71 (1.64)	0.54 (1.16)	3.52 (2.35)	0.38 (0.99)	0.35 (0.90)	0.78 (0.39)	0.26 (0.92)	0.92 (1.69)	3.55 (1.53)
Love Story (LSH)	5.42 (2.14)	0.13 (0.73)	0.16 (0.54)	1.09 (1.73)	1.84 (2.52)	1.75 (1.99)	0.09 (0.49)	4.00 (2.33)	3.74 (2.31)	3.49 (2.68)	3.25 (3.07)	0.82 (1.78)	0.13 (0.44)	1.45 (2.39)	5.16 (2.00)
All the Presidents Men (PM1N)	0.77 (1.57)	0.40 (1.06)	0.53 (1.07)	3.45 (2.77)	0.45 (1.44)	0.08 (0.39)	0.13 (0.47)	0.18 (0.60)	2.18 (2.38)	0.21 (0.71)	0.08 (0.48)	0.22 (0.99)	0.09 (0.49)	0.53 (1.23)	3.27 (1.660
Along for the Ride (RN)	0.50 (1.35)	0.43 (1.08)	0.97 (1.58)	0.64 (1.07)	0.10 (0.50)	0.27 (0.99)	0.57 (1.44)	0.70 (1.42)	3.41 (2.21)	0.54 (1.38)	1.26 (2.04)	0.35 (1.16)	4.90 (2.12)	0.68 (1.42)	2.91 (1.61)
Falling in Love (FLN)	3.09 (2.35)	0.04 (0.25)	0.50 (1.49)	1.79 (2.32)	0.04 (0.19)	0.53 (1.34)	0.05 (0.45)	2.38 (2.29)	2.92 (2.16)	2.06 (2.36)	1.12 (2.00)	0.34 (0.98)	0.09 (0.52)	0.56 (1.29)	4.75 (1.79)
Pretty Woman (PW1H)	4.00 (2.16)	0.00 (0.00)	0.19 (0.79)	0.14 (0.49)	0.03 (0.16)	0.44 (0.89)	0.04 (0.19)	4.90 (2.23)	4.56 (2.32)	4.41 (2.57)	3.64 (2.93)	1.00 (1.86)	0.04 (0.25)	0.62 (1.60)	6.42 (1.27)
Hannah and her Sisters (H1N)	2.21 (1.94)	0.39 (1.31)	0.48 (1.14)	1.61 (1.84)	0.27 (1.11)	0.87 (1.66)	0.13 (0.61)	1.09 (1.85)	2.56 (2.00)	0.77 (1.55)	0.27 (0.90)	0.41 (1.21)	0.44 (1.06)	0.71 (1.49)	3.76 (1.61)
Terms of Endeart. (TRS)	0.25 (0.78)	0.45 (1.36)	1.59 (1.87)	1.27 (1.79)	0.24 (0.95)	0.17 (0.78)	1.05 (1.67)	0.35 (1.24)	3.23 (2.19)	0.20 (0.90)	0.99 (1.81)	0.37 (1.17)	5.66 (1.95)	1.38 (1.95)	2.08 (1.41)
An Officer and a Gentleman(OGH)	4.70 (2.15)	0.13 (0.63)	0.32 (1.07)	0.80 (1.48)	0.39 (1.31)	1.15 (1.86)	0.12 (0.62)	4.76 (2.17)	4.05 (2.43)	4.26 (2.55)	3.98 (3.07)	1.47 (2.42)	0.21 (0.80)	1.69 (2.14)	6.28 (1.44)
Crimes and Misdemeanors(CMN)	0.64 (1.19)	0.57 (1.46)	1.30 (2.05)	3.31 (2.41)	0.61 (1.62)	0.17 (0.69)	0.63 (1.56)	0.26 (0.95)	2.55 (2.29)	0.30 (1.02)	0.14 (0.87)	0.48 (1.78)	0.54 (1.55)	0.42 (1.38)	3.41 (1.58)
Love Story (LSS)	0.36 (0.91)	0.40 (1.08)	1.42 (1.81)	2.04 (2.11)	0.25 (0.72)	0.20 (0.84)	1.03 (1.73)	0.13 (0.45)	2.14 (2.09)	0.18 (0.69)	1.37 (2.21)	0.35 (1.10)	4.33 (2.21)	0.31 (1.05)	2.53 (1.29)
Presidents Men (PM2N)	0.34 (0.82)	0.30 (1.07)	0.70 (1.42)	3.34 (2.63)	0.24 (0.94)	0.16 (0.66)	0.09 (0.38)	0.27 (0.75)	1.71 (2.02)	0.12 (0.39)	0.04 (0.25)	0.26 (1.22)	0.20 (0.72)	0.42 (1.22)	3.59 (1.34)
Invitation to the Wedding (LFH)	3.25 (2.28)	0.53 (0.34)	0.97 (0.36)	0.60 (1.34)	0.33 (1.11)	0.69 (1.57)	0.15 (0.88)	3.74 (2.32)	2.80 (2.30)	3.24 (2.37)	3.36 (2.84)	0.78 (1.85)	0.24 (1.06)	0.31 (1.03)	5.27 (1.94)
Hannah and her Sisters (H2N)	2.01 (2.03)	0.06 (0.35)	0.28 (0.80)	1.96 (2.86)	0.14 (0.56)	0.59 (1.51)	0.12 (0.55)	1.89 (2.07)	2.28 (1.99)	1.43 (2.05)	1.22 (2.05)	0.34 (1.10)	0.26 (0.92)	0.42 (1.25)	4.48 (1.40)
Steel Magnolias (SMS)	0.62 (1.52)	0.61 (1.57)	1.11 (1.88)	1.20 (1.62)	0.36 (1.26)	0.16 (0.66)	0.62 (1.54)	0.24 (0.78)	2.74 (2.27)	0.20 (0.67)	1.42 (2.22)	0.40 (1.01)	4.84 (2.21)	0.41 (0.99)	2.70 (1.35)
Endless Love (END2N)	1.16 (1.69)	0.27 (1.69)	0.73 (1.41)	3.70 (2.59)	0.21 (0.72)	0.31 (1.23)	0.44 (1.25)	1.15 (1.59)	2.41 (2.04)	0.75 (1.34)	0.49 (1.37)	0.45 (1.42)	0.43 (1.24)	0.82 (1.77)	3.93 (1.25)
Pretty Woman (PW2H)	5.27 (2.28)	0.27 (0.99)	0.24 (0.99)	0.31 (1.06)	0.46 (1.58)	0.69 (1.71)	0.08 (0.40)	4.68 (2.30)	5.29 (2.05)	4.27 (2.52)	2.22 (2.60)	0.74 (1.52)	0.24 (0.96)	1.07 (2.01)	6.51 (1.58)

Note: Standard Deviations in parentheses clip that received the highest negative rating was “sad” in TRS (M = 5.66, SD = 1.95), thus both these clips elicited their target emotions.

These observations were supported by corresponding statistical tests. To assess whether the film clips chosen as happy were more pleasant than the film clips chosen as neutral, which in turn were rated as more pleasant than the film clips chosen as sad, the average of the bipolar rating Valence (pleasant – unpleasant) was computed across all positive, negative and neutral film clips (see Figure one). For the A/B group the valence rating of all positive film clips (M = 5.79, SD = 1.36) were higher than the valence rating for all negative film clips (M = 2.13, SD = 1.13), $t(87) = 16.87$ and $p = .000$. The valence rating of all neutral film clips were (M = 3.83, SD = 1.31) as predicted sandwiched between the valence rating of the negative and positive film clips.

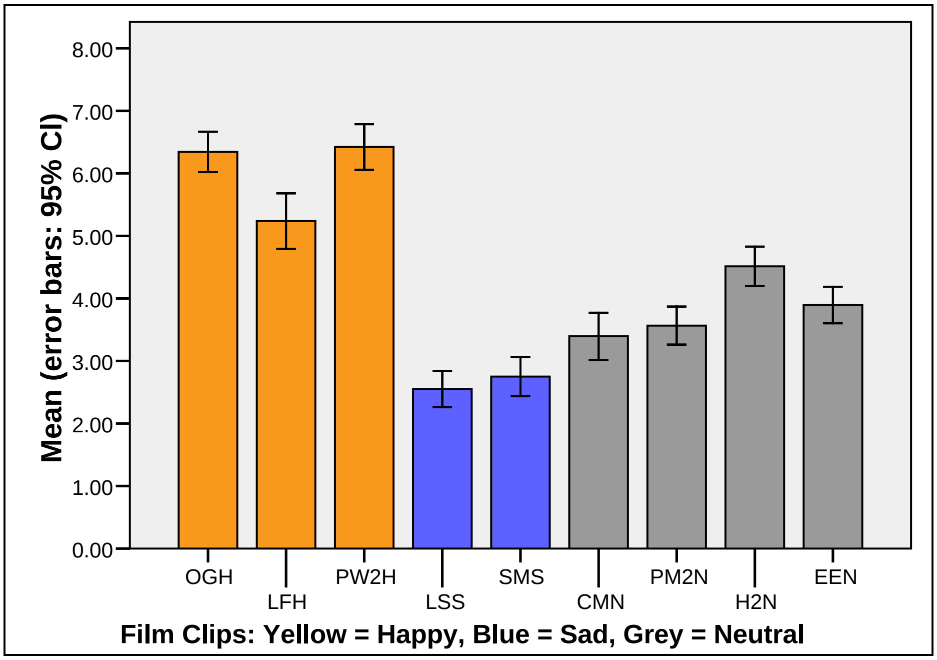
Figure 1: Mean Valence Rating of all Film Clips for A/B Group.



Correspondingly, for the C/D group the valence rating of all positive film clips (M = 6.01, SD = 1.25) were higher than the valence rating of all negative film clips ((M = 2.62, SD = 1.14), $t(87) = 16.87$ and $p = .000$. The valence rating of all neutral film clips (M =

3.83, SD = 1.04) were as predicted sandwiched between the valence rating of the negative and positive film clips (see Figure two).

Figure 2: Mean Valence Rating of all Film Clips for C/D Group.



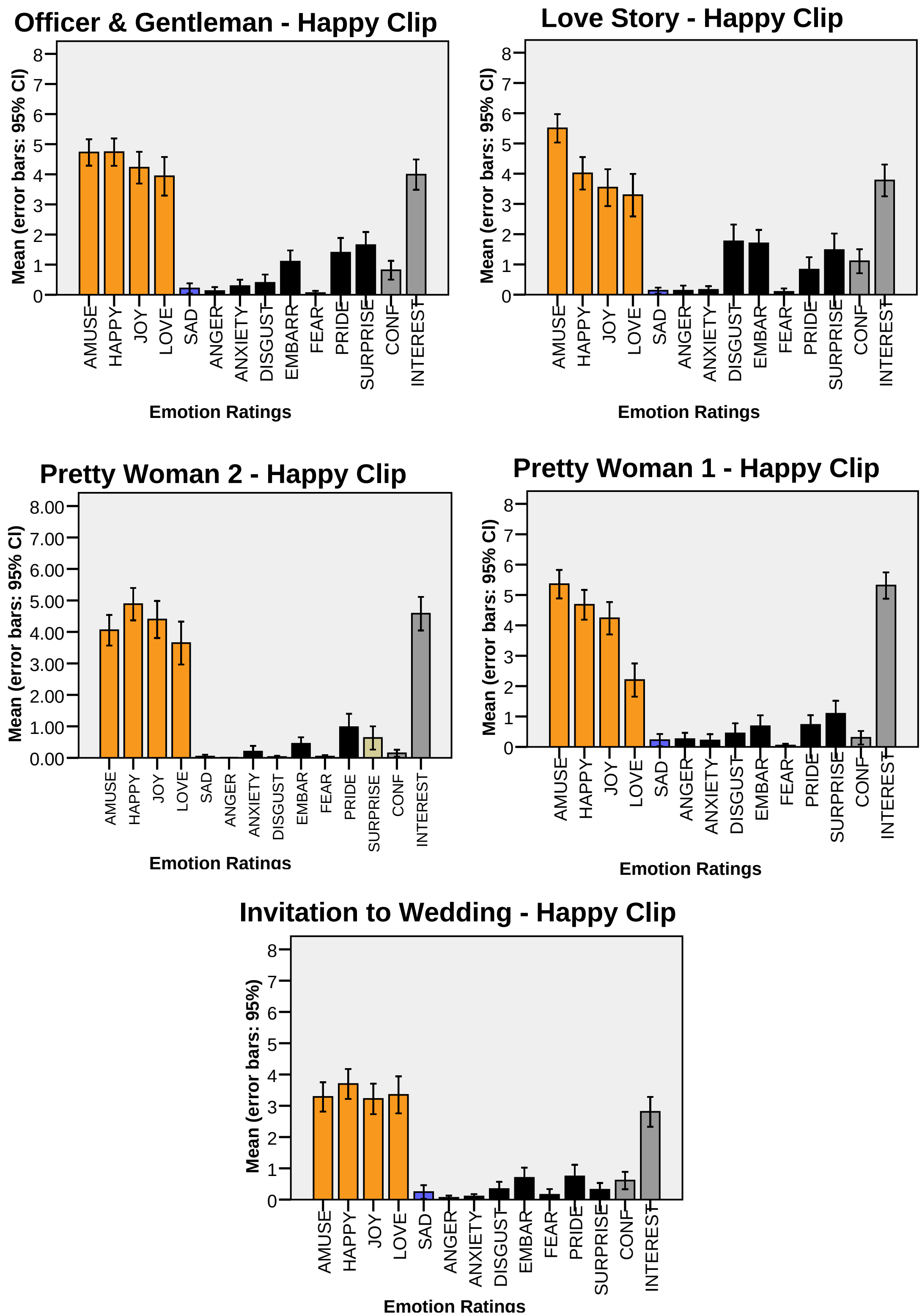
3.3(d.i) Film Clips and Emotion Ratings.

The emotion rating profiles of the individual film clips also differed from each other and was directly tested by t-tests (one for each film clip) in which the target emotion items of each film clips were tested against the highest non-target emotion items.

Positive film clips.

For the positive film clips the highest rating for *Love Story (LSH)* (M = 5.42, SD = 2.14) and *Pretty Woman2 (PW2H)* (M = 5.27, SD = 2.28) was “amusement”. For *Pretty Woman1 (PW1H)* (M = 4.90, SD = 2.23), *An Officer and a Gentleman (OGH)* (M = 4.76, SD = 2.17) and *Invitation to the Wedding (LFH)* (M = 3.74, SD = 2.32) “happiness” was the highest rated emotion. All positive emotion items received high ratings and were significantly higher than ratings on any of the negative emotion items for all five positive film clips (M between 0.00 to1.84, SD = 0.00 - 3.65; all t’s $\geq$ 8.62 and p’s $\leq$ .0005), see Figure 3.

Figure 3. Mean Rating of all Happy Film Clips for the A/B and C/D Groups.

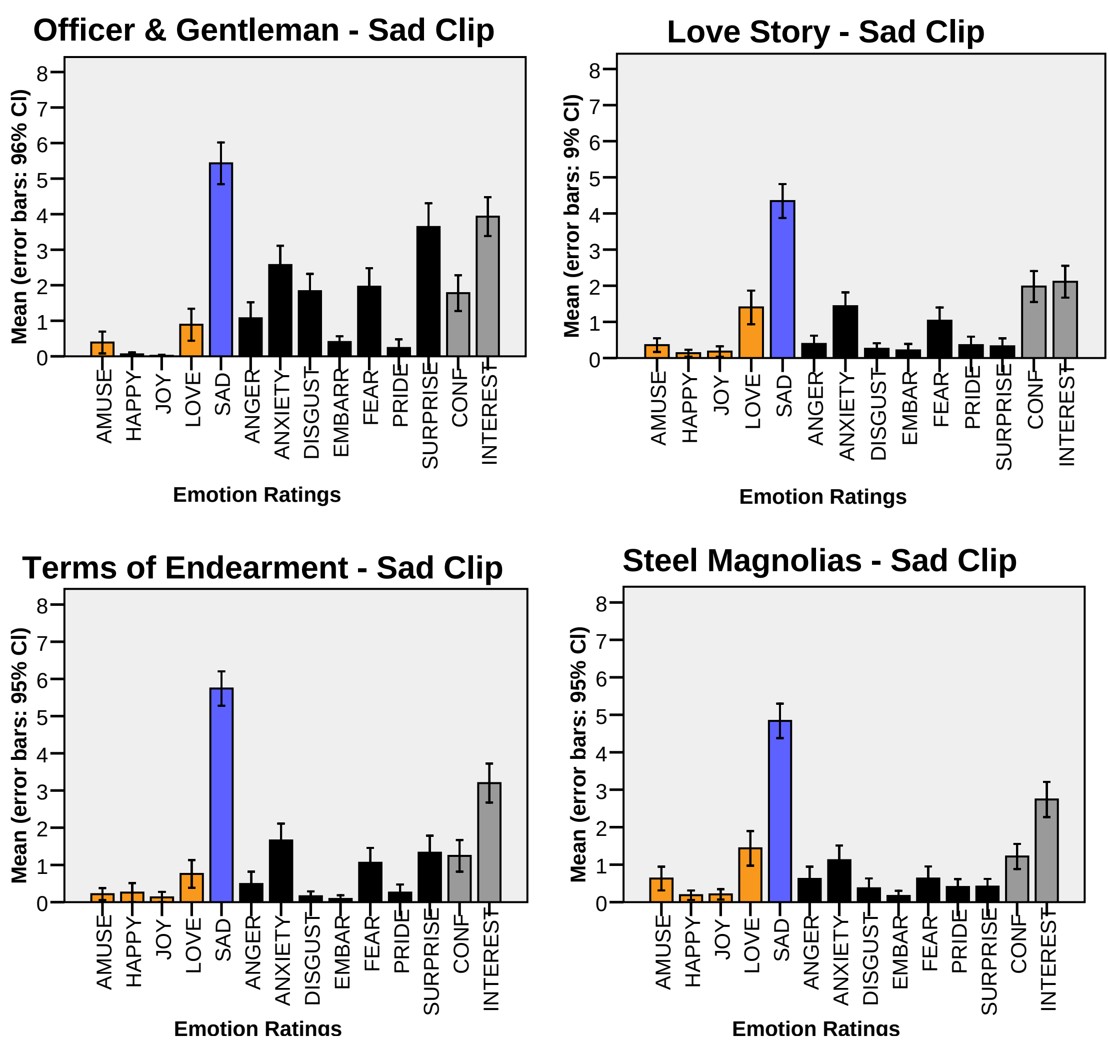


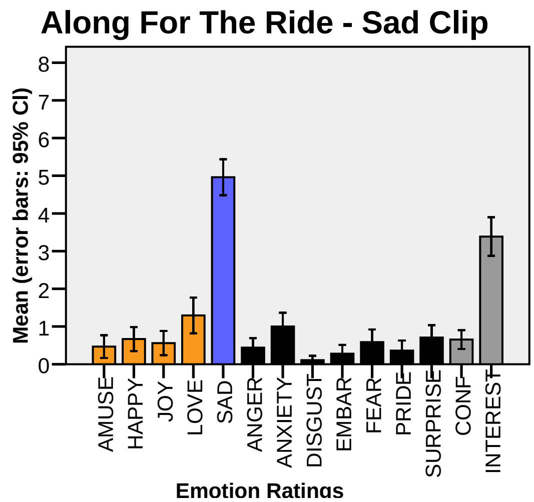
Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

Negative film clips.

For the negative film clips the highest rated emotion, for *An Officer and a Gentleman (OGS)* (M = 5.40. SD = 2.48), *Along for the Ride (RN)* (M = 4.90, SD = 2.12), *Terms of Endearment (TRS)* (M = 5.66, SD = 1.95), *Love Story (LSS)* (M = 4.33, SD = 2.21) and *Steel Magnolias (SMS)* (M = 4.84, SD = 2.21) was "sadness". For each of these film clips all other negative and positive emotion items received significantly lower ratings (M = 0.10 to 3.66, SD = 0.50 - 3.11; all *ts* $\geq$ 4.86 and *ps* $\leq$ .0005) see Figure 4.

Figure 4. Mean Rating of all Sad Film Clips for A/B and C/D Groups.



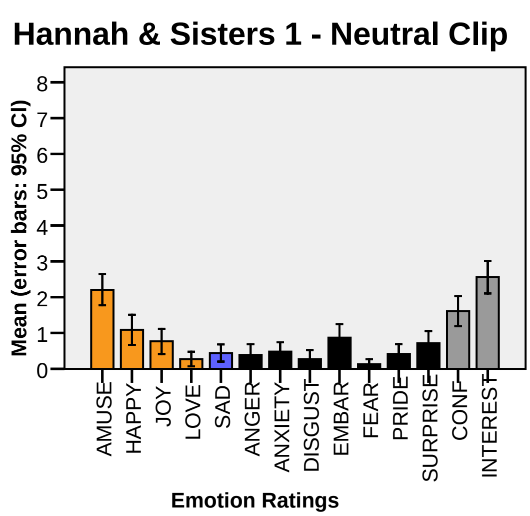


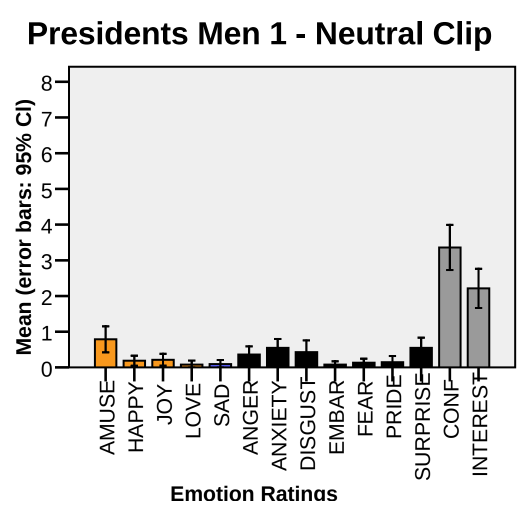
Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

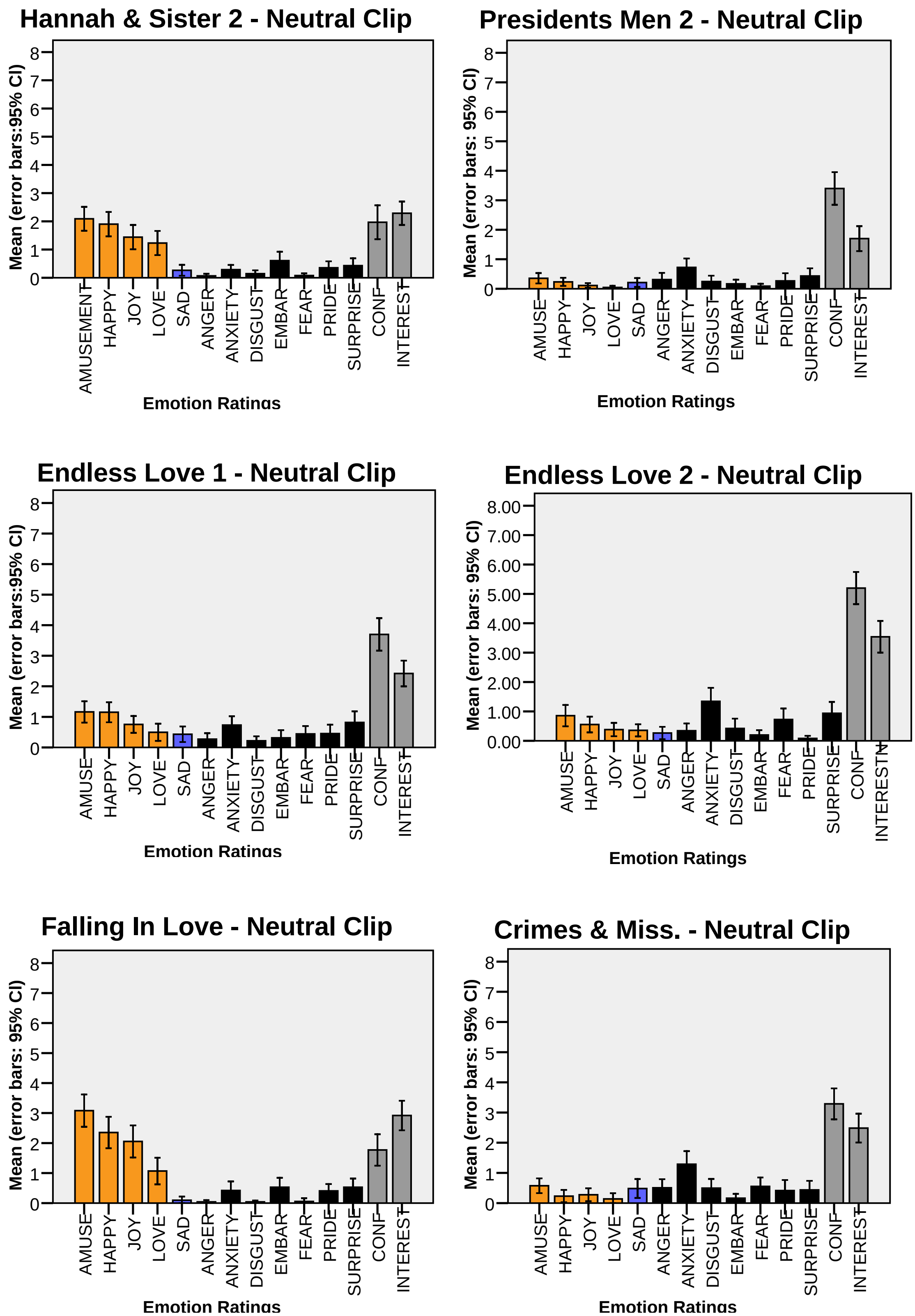
Neutral film clips.

For all the neutral film clips the highest mean rating for any emotional item was below 3.09. For *Endless Love1 (EEN)* (M = 1.32, SD = 2.00), *Crimes and Misdemeanours (CMN)* (M = 1.30, SD = 2.05) and *All the Presidents Men2 (PM2N)* (M = 0.70, SD = 1.42) the highest rated emotion was "anxiety". For *All the Presidents Men1 (PM1N)* (M = 0.77, SD = 1.57), *Falling in Love (FLN)* (M = 3.09, SD = 2.35), *Hannah and her Sisters1 (H1N)* (M = 2.21, SD = 1.94), *Hannah and her Sisters2 (H2N)* (M = 2.01, SD = 2.03) and *Endless Love2 (END2N)* (M = 1.16, SD = 1.69) the highest rated emotion was "amusement" see Figure 5.

Figure 5. Mean Rating of all Neutral Film Clips for A/B and C/D Groups.







Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

To assess whether the neutral film clips differed in essential positive (amusement, happy, joy, love) and negative (anger, anxiety, fear, sad) emotional rating these items were averaged across each neutral film clip. For *All the Presidents Men1* (PM1N), *All the Presidents Men2* (PM2N) and *Endless Love2* (END2N) the positive and negative rating did not differ (all *t's* ≤ 1.87 and *ps* ≥ .065), whereas for all the other neural film clips the difference was significant (all *t's* ≥ 2.75 and *ps* ≤ .007). These findings are considered in the following discussion section.

3.3(d.ii) Film Clips and other Ratings.

Rating of Confusion and Interest.

A visual inspection of the data (see Table three) showed that the monopolar items "confusion" and "interest" did differentiate between the clips and showed a specific pattern across the positive, negative and neutral films. To assess statistical significance these items were averaged across the positive, negative and neutral film clips (see Table four).

Table 4. Averaged means and standard deviations of "confusion" and "interest"

Target Films.	**A/B Group.**	**C/D Group.**
Interest Positive Films	4.15 (1.96)	4.06 (1.76)
Interest Negative Films	3.52 (1.81)	2.43 (1.88)
Interest Neutral Films	2.79 (1.55)	2.42 (1.56)
Confusion Positive Films	0.62 (0.94)	0.57 (0.95)
Confusion Negative Films	1.21 (1.24)	2.87 (1.86)
Confusion Neutral Films	3.01 (1.74)	3.45 (2.00)

For both groups the positive film clips were rated significantly less confusing than the negative film clips (both *t's* ≥ 4.08 and *p's* ≤ .0005). Similarly, for both groups the positive film clips were rated significantly more interesting than the negative film clips (both *t's* ≥ 2.40 and *p's* ≤ .019). Surprisingly, there was no difference between the rating of "interest" for the negative and neutral film clips for the C/D group.

Rating of Seen Before.

To gauge whether the films chosen had been viewed before the frequency scores for the self-reported rating “seen before” were calculated (see Table five). As expected all the films chosen, with the expectation of Pretty Woman, had fewer than 20% of participants who had watched the films previously.

Table 5. Frequencies of Seen Before rating for all Films.

	OGS	EEN	LSH	PM1N	RN	FLN	PW1H	H1N	TRS	OGH	CMN	LSS	PM2	LFH	H2N	SMS	END	PW2H
No	72	89	73	75	77	74	17	76	75	81	89	89	92	92	93	88	70	26
Yes	5	3	4	2	0	3	60	1	2	12	3	3	1	1	0	5	0	67

In order to assess whether previously viewing the film Pretty Woman influenced the valence ratings further statistical analyses were performed.

Firstly, for the Group A/B, to clarify whether previously watching the film Pretty Women influenced the valance rating of this clip of the film (PW1H) the bipolar rating Valance (pleasant – unpleasant) was subjected to a analysis of variance (ANOVA) with Seen Before (PW1H_Seen) an independent factor. The influence of Seen Before was not significant.

Secondly, for the Group C/D, to clarify whether previously watching the film Pretty Woman influenced the valance rating of this clip of the film (PW2H) the biopolar rating Valance (pleasant - unpleasant) was subjected to a analysis of variance (ANOVA) with Seen Before (P2_3) an independent factor. In comparison, to the first Pretty Woman film clip ANOVA tests indicated that there were statistically significant effects of P2_3 on the dependent variable ($F [1, 82] = 9.210$, $p = .003$).

The irregularity of these results would seem to indicate that the happy scene portrayed in the first Pretty Woman clip has a generality that the second Pretty Woman clip did not.

Rating of Looked Away.

To determine whether certain film clips were less observed than others the frequency scores for the self-reported rating "looked away" were calculated (see Table 6).

Table 6. Frequencies of Looked Away rating for all Films.

	OGS	EEN	LSH	PM1N	RN	FLN	PW1H	H1N	TRS	OGH	CMN	LSS	PM2	LFH	H2N	SMS	END	PW2H
No	66	84	67	69	71	72	69	70	70	88	75	77	72	88	82	85	70	87
Yes	11	9	10	8	6	5	8	7	6	5	17	15	20	4	11	8	7	6

As hoped all the films chosen, with the expectation of Presidents Men and Crimes and Misdemeanours had fewer than 20% of participants who had looked away during the viewing. However, to clarify whether "looking away" influenced the valance rating of the second film clip from All the Presidents Men the bipolar rating Valance (Un_Pleasant PM2N) was subjected to an analysis of variance (ANOVA) with Looked Away (PM2N_4) an independent factor. ANOVA tests indicated that there were statistically significant effects of PM2N_4 on the dependent variable (F [1, 85] = 7.581, p = 0.007). Secondly, to clarify whether "looking away" influenced the valance rating of the film clip from Crimes and Misdemeanours the biopolar rating Valance (UnPleasant CMN) was subjected to an analysis of variance (ANOVA) with Looked Away (CMN_4) an independent factor. In comparison, to the second All the Presidents Men film clip the influence of Looked Away was not significant.

It is worth noting that both these film clips featured only male actors and whether this predisposed the predominantly female audience to "look away" more during these two viewing is unclear. However, gender of actor and audience which will be further considered in the discussion chapter.

3.3(d.iii) Valence Rating of Film Clips and PANAS.

To assess whether aspects of mood influenced ratings of film clips, the averages of the bipolar rating Valence (pleasant – unpleasant) across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with Positive Affect (PA) and Negative Affect (PN) (as measured by PANAS) as covariates. Gender and ethnic group were entered into the analysis as fixed factors. The analysis was conducted separately for groups A/B and groups C/D.

Valence Rating & PANAS: Group A/B.

The assumptions for inclusion of gender as an IV in MANOVA were not met because the number of male participants in two of the ethnic categories was less than the number of dependent variables. Therefore the variables Gender and Ethnic origin were omitted from the analysis.

Multivariate tests indicated that there were statistically significant effects of the covariate PN (negative affect) on the dependent variables. (Wilks' Lambda = 0.874) (*F* [3, 6] = 3.118, *p* = .03). Tests of between-subject effects showed that the significant effect was due to the influence of negative affect (PN) on valence ratings of positive films (*F* [1, 67] = 9.5, *p* = .003). Bivariate correlation showed an unexpected positive correlation between PANAS PN score and valence rating of positive films (*r* = .358, *N*=71, *p* = .005). The influence of PA (positive affect) was not significant.

Valence Rating & PANAS: Group C/D.

The assumptions for inclusion of gender as an IV were again not met because the number of male participants in two of the ethnic categories was less than the number of dependent variables. Therefore the variables Gender and Ethnic origin were omitted from the analysis.

Multivariate tests indicated that there were statistically significant effects of the covariate PA (positive affect) on the dependent variables. (Wilks' Lambda = 0.711) (*F* [3, 75] = 10.16, *p* = .00005). Tests of between-subject effects showed that the significant effect was due to the influence of positive affect (PA) on valence ratings of positive films (*F* [1, 77] = 28.2, *p* = .00005). The influence of positive affect (PA) on valence ratings of negative films was also significant (*F* [1, 77] = 5.9, *p* = .05). The influence of negative affect (PN) on valence ratings of negative films showed a trend (F [1, 77] = 6.3, p = .05) which however was not borne out by the multivariate tests. Bivariate correlation showed a positive correlation between PANAS PA score and valence rating of positive films (r = .551, N = 82, p = .0005), and a non-significant negative correlation between PANAS PA and valence rating of negative films (r = .18, N = 82, *ns*.). The influence of PN (negative affect) was not significant.

Footnote: As mentioned above due to the small number of male participants in this study gender differences could not be investigated. Similarly, the small number of participants in each ethnic group prevented the investigation of self-reported ethnic origin. Hence, behavioural study two employed the fittest eleven films in order to explore whether gender or self-reported ethnic origin (given that these films are predicated upon conventions of western culture) shapes the interpretation of the film clips and examine whether the elicitation of emotions by emotional film clips are consistent across the ethnic groups.

3.4 Behavioural Film Set Study Two.

3.4(a) Participants.

A total of 163 students of the University of Brunel participated in group film-viewing sessions (all were students of psychology, sociology, anthropology or media studies). The sample consisted of 143 females and 19 males and 1 unrecorded. The ethnic origin of the sample consisted of 48 Asians, 29 Africans, 32 Europeans and 53 OEO. One participant did not record their gender or ethnic origin but this data was included in the study.

The sample was divided into four groups (H, HR, SR, S) on the basis of prior timetabled sessions. Group H consisted of 28 participants (25 female, 2 male; ethnic origin 7 Asians, 4 Africans, 7 Europeans, 9 OEO and 1 unrecorded). Group HS consisted of 43 participants (40 female, 3 male; ethnic origin 10 Asians, 7 Africans, 5 Europeans, 21 OEO). Group SR consisted 49 participants (41 female, 8 male; ethnic origin 16 Asians, 12 Africans, 11 Europeans, 10 OEO). Group S consisted of 43 participants (37 female, 6 male; ethnic origin 15 Asians, 6 Africans, 9 Europeans, 13 OEO). 98.8% of the sample had ages ranging from 18 to 24 years.

3.4(b) Stimulus Material and Rating Scales.

The film set comprised of 11 clips (see Table seven), extracted from commercially available films as edited for behavioural study one (see 3.3(b)). Behaviour study two film set included five emotionally neutral clips, three clips designed to elicit the target emotion of sadness and three clips designed to elicit the target emotion of happiness. All the film clips shown had been previously employed in behavioural study one. Hence, the length of each clip was 90 seconds exactly, each film was in colour and the films were not shown silent as a main criterion of the study was to elicit social emotions as previously defined.

Table 7: Film Titles and Target Emotion in Behavioural Study Two.

Film No.	*Film Title.*	Target Emotion.
1	*An Officer and a Gentleman*(OGH)	Happy
2	*All the Presidents Men* (PM1N)	Neutral
3	*Along for the Ride* (RS)	Sad
4	*Hannah and her Sisters* (HN4N)	Neutral
5	*Love Story* (LSH)	Happy
6	*Endless Love* (ENDN)	Neutral
7	*Terms of Endearment* (TS)	Sad
8	*Presidents Men* (PM2N)	Neutral
9	*Pretty Woman* (PW1H)	Happy
10	*Hannah and her Sisters* (H1N)	Neutral
11	*Love Story (LSS)*	Sad

As in behavioural study one the inventory for the assessment of emotional reaction consisted of the same seventeen self-report items with participants in behavioural study one following the same criteria for rating how they felt and the time allowed for completion of the emotion related.

The extended positive and negative affect schedule (PANAS X) was employed to self-rate two broad high order traits (negative affect or positive affect) and eleven specific lower level traits of the participants (Watson and Clark, 1994). PANAS X is a 60 item expanded version of the PANAS as in addition to the two original higher order scales (negative affect and positive affect) the PANAS X measures 11 specific affects (fear, sadness, guilt, hostility, shyness, fatigue, surprise, joviality, self-assurance, attentiveness, and serenity). The PANAS X thus provides for mood measurement at two different levels. The adjectives comprising each of the PANAS X scales are shown in Table eight. The criteria for completing the schedule was as behavioural study one

Table 8: Item Composition of the PANAS X Scales.

General Dimension Scales.	Negative Affect (10)	afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, distressed
	Positive Affect (10)	active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud, strong
Specific Negative Emotion Scales.	Fear (6)	afraid, scared, frightened, nervous, jittery, shaky
	Hostility (6)	angry, hostile, irritable, scornful, disgusted, loathing
	Guilt (6)	guilty, ashamed, blameworthy, angry at self, disgusted with self, dissatisfied with self
	Sadness (5)	sad, blue, downhearted, alone, lonely
Specific Positive Emotion Scales.	Joviality (8)	happy, joyful, delighted, cheerful, excited, enthusiastic, lively, energetic
	Self-Assurance (6)	proud, strong, confident, bold, daring, fearless
	Attentiveness (4)	alert, attentive, concentrating, determined

Other Specific Affective States.	Shyness (4) Fatigue (4) Serenity (3) Surprise (3)	shy, bashful, sheepish, timid sleepy, tired, sluggish, drowsy calm, relaxed, at ease amazed, surprised, astonished

Note. The number of terms comprising each scale is shown in parentheses.

The Cognitive Failures questionnaire (Wallace, Kass and Stanny, 2002) was modified as an un-related cognitive filler questionnaire to prevent the participants from automatically associating the self rated PANAS X information with the emotional eliciting film clips

3.4(c) Procedure.

The four groups (H, HR, SR, S) viewed the film clips on a colour projector screen in a normal lecture room. All groups viewed film clips 1 to 11 (see Table seven). The order of the film clips was counterbalanced between the groups and prior to presentation of the stimulus material participants were asked to complete an informed consent sheet. Group H were first asked to complete PANASX then the cognitive questionnaire prior to the happy-film-first set of film clips. Group HR viewed the happy-film-first set of film clips then were asked to complete the cognitive questionnaire prior to completing PANASX. Group SR viewed the sad-film-first set of film clips then were asked to complete the cognitive questionnaire prior to completing PANASX. Group S were asked to complete PANASX then the cognitive questionnaire prior to viewing the sad-film-first set of film clips.

The instructions for all participants were instructed to watch each film clip carefully and complete each self-report inventory immediately after the film presentation (as cued by instructional message on screen). As previously, participants were told it was very important that they indicate how *they* felt while watching the film not how they would expect other people to feel. The one minute allocated for the completion of the inventory provided some time for any elicited emotion to lessen before the next film was presented. As in behavioural study one a neutral test film clip (taken from *All the Presidents Men)* was always presented first to familiarize participants with the requirements of the experiment. The subsequent 11 films were then presented; an emotion film always preceded a neutral film so no two emotion films followed each other. Following the film set presentation all participants completed a general questionnaire were thanked for their time and given a debriefing form. See Appendix 3 for copies of material used.

3.4(d) Results.

The means and standard deviations of all ratings are presented in Table nine. As in behavioural study one a visual examination of this data reveals that the rating of the emotions "amusement", "happiness", "joy" and "love" were higher for the positive film clips than for the negative film clips, but were comparable for each positive film clip. Additionally, the rating of the emotion "sadness" was higher for the negative film clips than for the positive film clips, but was comparable for each negative film clip (see Figure 6).

Figure 6: Mean Valence Rating of all Film Clips for all Groups (H, HR, SR, S).

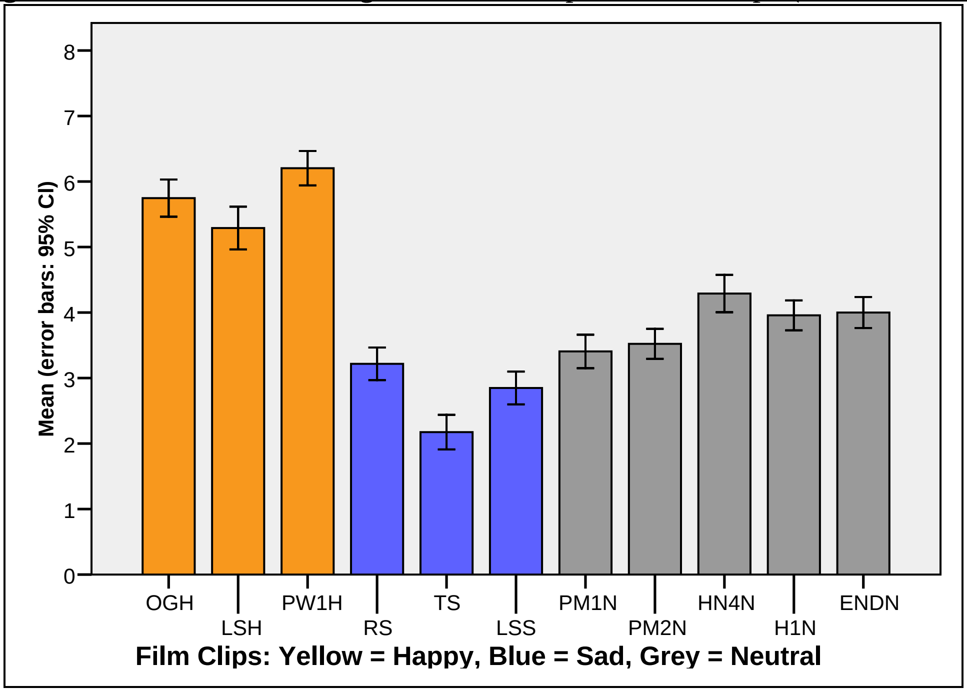


Table 9: Means and Standard Deviations of Film Ratings for All Groups Behavioural Study 2.

Film Clip	Amuse	Anger	Anxiety	Confusion	Dis-gust	Embarr-assment	Fear	Happy	Interest	Joy	Love	Pride	Sad	Surprise	Valance
An Officer and a Gentleman (OGH)	3.86 (2.19)	0.09 (0.34)	0.26 (0.76)	0.74 (1.40)	0.20 (.075)	0.88 (1.60)	3.87 (2.53)	3.87 (2.53)	3.41 (2.71)	3.47 (2.71)	3.10 (2.71)	0.96 (1.97)	0.18 (0.63)	1.41 (2.14)	5.73 (1.64)
All the Presidents Men (PMIN)	0.55 (1.21)	0.34 (0.98)	0.44 (1.03)	3.00 (2.69)	0.18 (0.60)	0.09 (0.60)	0.19 (0.60)	0.25 (0.70)	1.59 (2.14)	0.19 (0.75)	0.04 (0.19)	0.27 (1.00)	0.15 (0.49)	0.36 (1.08)	3.35 (1.57)
Along for the Ride (RS)	0.50 (1.19)	0.41 (1.88)	0.89 (1.47)	0.66 (1.28)	0.10 (0.43)	0.98 (0.42)	0.30 (0.96)	0.50 (1.17)	2.96 (2.29)	0.35 (1.03)	1.30 (2.03)	0.37 (1.11)	4.54 (2.36)	0.67 (1.39)	3.19 (1.45)
Hannah and her Sis-ters (H2N)	2.05 (2.06)	0.14 (0.59)	0.29 (0.84)	1.86 (2.19)	0.11 (0.57)	0.59 (1.26)	0.08 (0.46)	1.50 (1.88)	1.94 (1.96)	1.02 (1.69)	0.80 (1.57)	0.31 (0.94)	0.18 (0.65)	0.34 (0.86)	4.24 (1.65)
Love Story (LSH)	4.46 (2.46)	0.15 (0.69)	0.12 (0.39)	0.93 (1.80)	1.05 (1.82)	0.66 (1.30)	0.04 (0.26)	3.59 (2.64)	3.13 (2.27)	3.33 (2.76)	2.96 (2.94)	0.52 (1.28)	0.12 (0.50)	1.02 (1.68)	5.29 (1.88)
Endless Love (END2N)	1.20 (1.69)	0.16 (0.53)	0.55 (1.16)	3.28 (2.64)	0.09 (0.44)	0.20 (0.65)	0.23 (0.76)	0.83 (1.32)	2.05 (2.06)	0.51 (1.01)	0.52 (1.28)	0.45 (1.28)	0.27 (0.87)	0.72 (1.53)	3.96 (1.38)
Terms of Endeart (TRS)	0.29 (0.91)	0.56 (1.25)	1.41 (1.82)	0.99 (1.58)	0.21 (0.75)	0.16 (0.68)	0.89 (1.67)	0.11 (0.58)	2.48 (2.26)	0.18 (0.92)	0.89 (1.69)	0.24 (0.88)	5.10 (2.41)	0.97 (1.87)	2.15 (1.52)
Presidents Men (TRS)	0.47 (1.09)	0.34 (1/07)	0.47 (1.14)	3.08 (2.54)	0.14 (0.68)	0.12 (0.59)	0.10 (0.49)	0.25 (0.79)	1.52 (1.92)	0.17 (0.59)	0.07 (0.39)	0.17 (0.79)	0.17 (0.64)	0.27 (0.85)	3.46 (1.37)
Pretty Woman (PW1H)	3.77 (2.27)	0.04 (0.34)	0.18 (0.61)	0.19 (0.68)	0.15 (0.80)	0.59 (1.14)	0.14 (0.74)	4.50 (2.33)	4.42 (2.50)	4.07 (2.69)	3.35 (2.79)	0.90 (1.92)	0.12 (0.54)	0.71 (1.65)	6.09 (1.59)
Hannah and her Sis-ters (HIN)	2.01 (2.01)	0.42 (1.10)	0.57 (1.21)	1.47 (1.97)	0.15 (0.53)	0.61 (1.33)	0.13 (0.63)	1.01 (1.39)	2.39 (2.02)	0.74 (1.25)	0.25 (0.71)	0.40 (1.06)	0.58 (1.28)	0.71 (1.42)	3.93 (1.38)
Love Story (LSS)	0.45 (1.27)	0.48 (1.54)	1.40 (1.73)	1.78 (2.20)	0.18 (0.63)	0.21 (0.72)	0.83 (1.54)	0.25 (0.92).	2.25 (1.97)	0.26 (0.86)	1.36 (2.08)	0.38 (1.11)	3.99 (2.54)	0.33 (0.87)	2.88 (1.47)

The positive film clip that received the highest positive rating was “happy” in PW1H (M = 4.50, SD = 2.33). The negative film clip that received the highest negative rating was “sad” in TS (M = 5.10, SD = 2.41) as in behavioural study one. These observations were supported by corresponding statistical tests. To assess whether the film clips chosen as happy were more pleasant than the film clips chosen as neutral, which in turn were rated as more pleasant than the film clips chosen as sad, the average of the bipolar rating Valence (pleasant – unpleasant) was computed across all positive, negative and neutral film clips (see Figure six). For the valence rating of all positive film clips (M = 5.70, SD = 1.44) were higher than the valence rating for all negative film clips (M = 2.75, SD = 1.20), t (156) = -19.10 and p = .0005. The valence rating of all neutral film clips were (M = 3.79, SD = 1.09) as predicted significantly sandwiched between the valence rating of the negative (t [156] = -9.79 and p = .0005) and positive (t [157] = 16.59 and p = .0005) film clips.

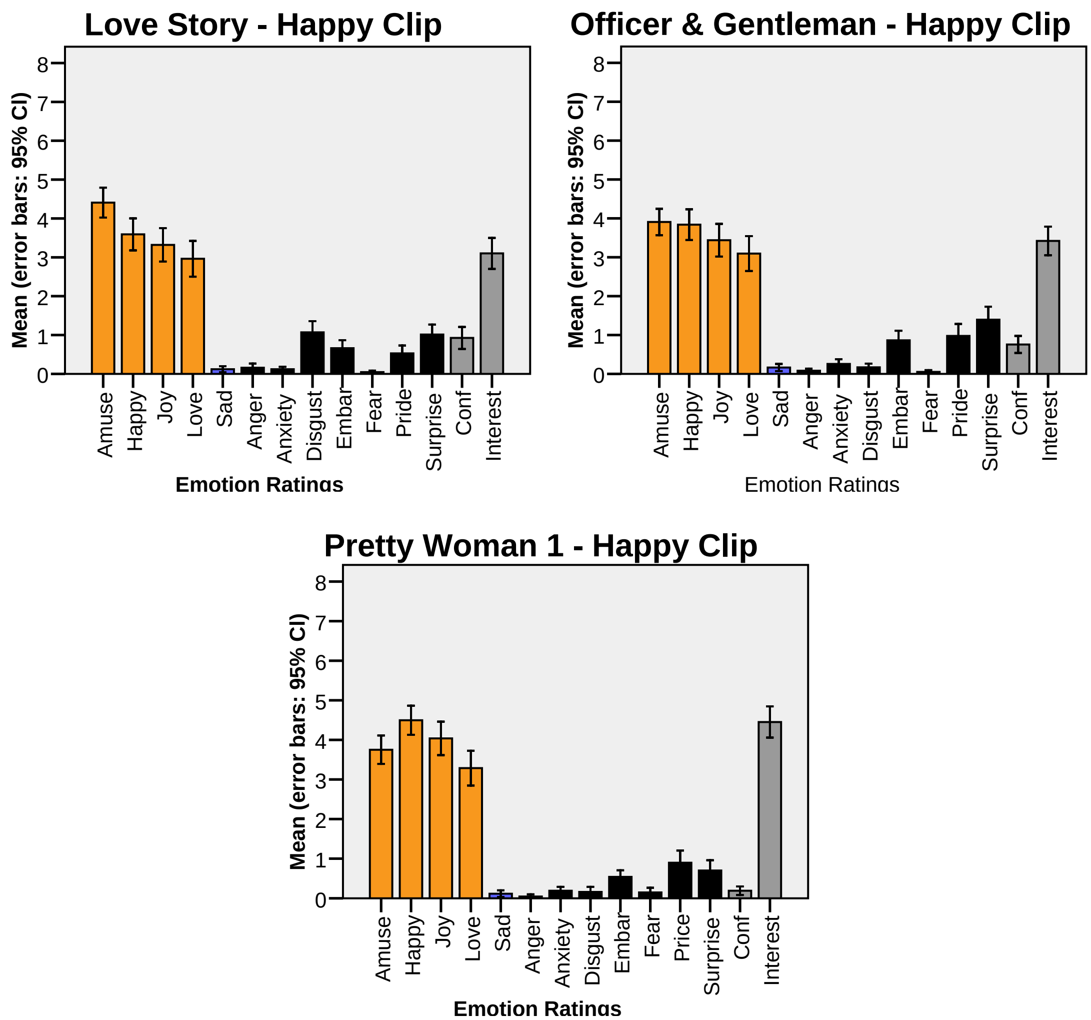
3.4(d.i) *Film Clips, Valance Ratings and Ethnicity.*

The emotion rating profiles of the film clips also differed from each other and was directly tested by t-tests (one for each film clip) in which the target emotion items of each film clips was tested against the highest emotional non-target emotion items.

Positive film clips.

For the positive film clips the significantly highest rating for *Love Story (LSH)* (M = 4.46, SD = 2.46) “amusement” was the highest rated emotion. For *Pretty Woman1 (PW1H)* (M = 4.50, SD = 2.33) and *An Officer and a Gentleman (OGH)* (M = 3.87, SD = 2.53) “happiness” was the highest rated emotion. For each of these film clips all positive emotion items received high ratings and were still higher than any of the negative emotion items for all three film clips (M between 0.04 to1.05, SD = 0.26 - 1.92; all $ts \geq$ 13.52 and $ps \leq$ .001), see Figure seven.

Figure 7. Mean Rating of all Happy Film Clips for all Groups (H, HR, SR, S).

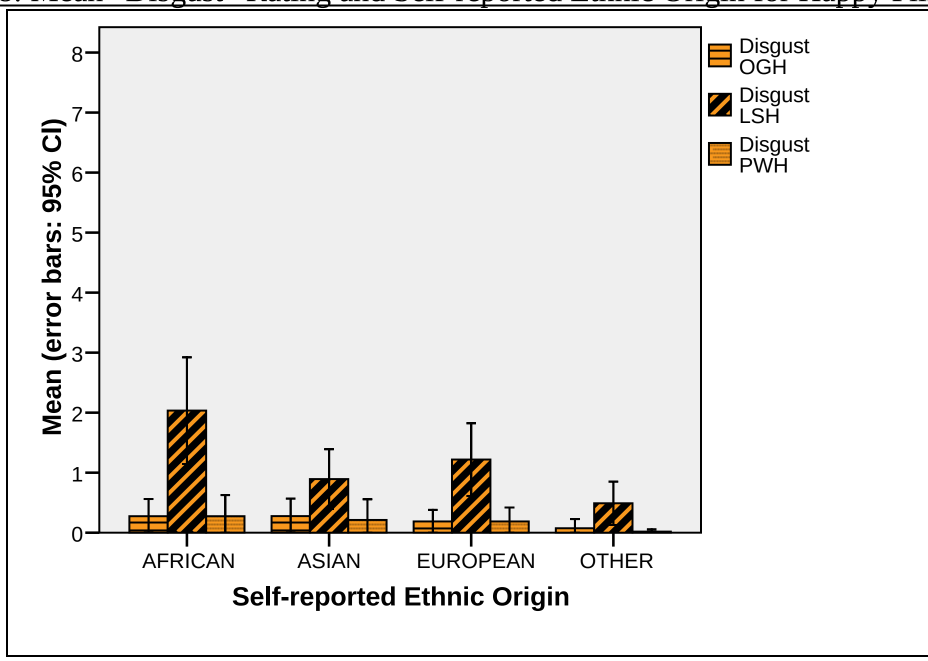


Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

To assess whether the ethnic origin of participants influenced the rating of the positive film clips the target monopolar rating of “amusement“, “happiness“, “joy” and then “love” across each positive film clip were subjected to a multivariate analysis of variance MANOVA, with Ethnic origin entered as a fixed factor. No significant effects for the target emotion ratings were found.

A visual inspection of Table nine shows that for the positive film clips two self-rated emotions exceeded a rating of 1 (surprise and disgust). To assess whether the ethnic origin of participants influenced the “disgust” rating of positive film clips the target monopolar rating of “OGH disgust”, “LSH disgust” and “PW1H disgust” were subjected to a multivariate analysis of variance (MANOVA) with Ethnic origin (ETHNICO) entered as a fixed factor. Multivariate tests indicated that there were statistically significant effects of the fixed factor ETHNICO on the dependent variables Disgust (Wilks’ Lambda = 0.897) (F [3, 160] = 1.918, p = .048). Tests of between-subject effects showed that the significant effect was due to ETHNICO on disgust ratings of LSH (F [3, 160] = 5.29, p = .002) (see Figure eight). To assess whether the ethnic origin of participants influenced the “surprise” rating of positive film clips the target monopolar rating of “OGH surprise”, “LSH surprise” and “PW1H surprise” were subjected to a multivariate analysis of variance (MANOVA) with Ethnic origin (ETHNICO) entered as a fixed factor. No significant effects for the emotion ratings surprise were found.

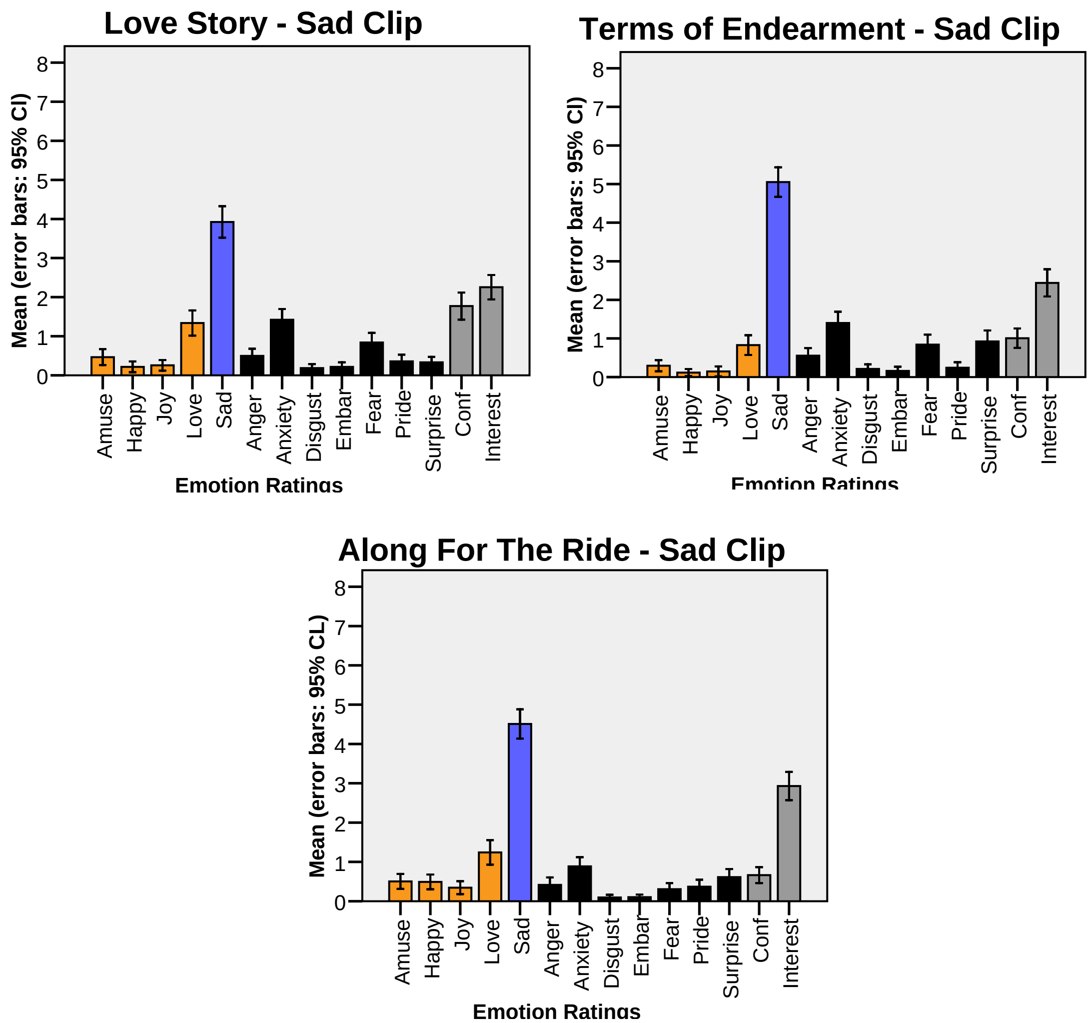
Figure 8: Mean “Disgust” Rating and Self-reported Ethnic Origin for Happy Film Clips.



Negative film clips.

For the negative film clips the significantly highest rating for Terms of Endearment (TS) (M = 5.10, SD = 2.41), Along for the Ride (RS) (M = 4.54, SD = 2.36) and Love Story (LSS) (M = 3.99, SD = 2.54) “sadness“ was the highest rated emotion (see Figure nine). For each of these film clips all other negative and positive emotion items received significantly lower ratings (M = 0.10 to 1.41, SD = 0.42 - 2.08; all *ts* ≥ 19.01 and *ps* ≤ .001).

Figure 9. Mean Rating of all Sad Film Clips for all Groups (H, HR, SR, S).



Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

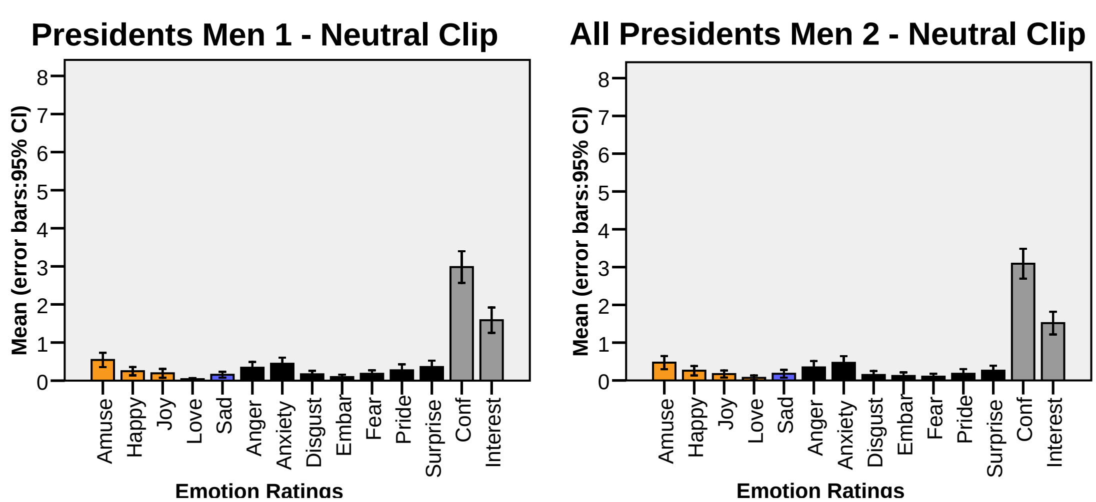
To assess whether the ethnic origin of participants influenced the rating of the negative film clips the target monopolar rating of "sadness" across each negative film clip were subjected to a multivariate analysis of variance (MANOVA), with Ethnic origin entered as a fixed factor. No significant effects for the target emotion rating sadness were found.

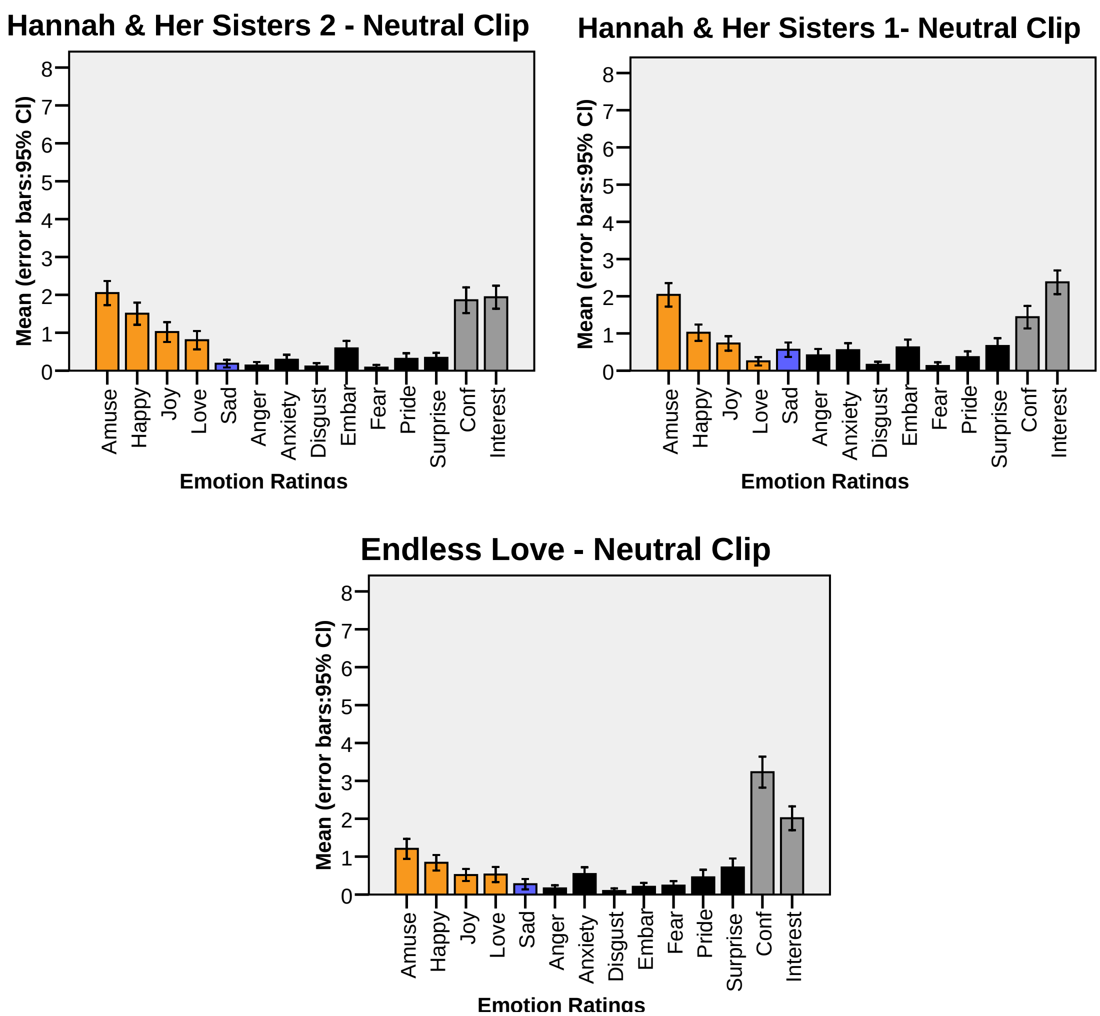
A visual inspection of Table nine shows that for the negative film clips two self-rated emotions exceeded a rating of 1 (love and anxiety). To assess whether the ethnic origin of participants influenced the monopolar rating of "love", and then "anxiety", across each negative film clip were subjected to a multivariate analysis of variance (MANOVA) with Ethnic origin (ETHNICO) entered as a fixed factor. No significant effects for the emotion ratings were found.

Neutral film clips.

For all the neutral film clips the highest mean rating for an emotional item was below 2.05 (see Figure ten). For *All the Presidents Men1 (PM1N)* (M = 0.55, SD = 1.21), *Hannah and her Sisters2 (HN4N)* (M = 2.05, SD = 2.06), *Endless Love2 (ENDN)* (M = 1.20, SD = 1.69) and *Hannah and her Sisters1 (H1N)* (M = 2.01, SD = 2.01), the highest emotion rating was "amusement". For *All the Presidents Men2 (PM2N)* (M = 0.47, SD = 1.14) the highest emotion rating was "anxiety", although "amusement" (M = 0.47, SD = 1.09) only differed by 0.0062.

Figure 10. Mean Rating of all Neutral Film Clips for all Groups (H, HR, SR, S).





Note: Yellow = Positive Emotion Ratings; Blue = Sad Emotion Rating; Black = Non-target Emotion Ratings; and Grey = Non-emotion Ratings.

To assess whether the neutral film clips in Behaviour Study Two also differed for essential positive (amusement, happy, joy, love) and negative (anger, anxiety, fear, sad) emotional rating, these items were averaged across each neutral film clip. As in behavioural study one for *All the Presidents Men1* (PM1N) and *All the Presidents Men2* (PM2N) the positive and negative rating did not differ (all t*'s* $\geq$ .67 and p*'s* $\geq$ .562). Likewise, for *Hannah and her Sisters2 (HN4N)* (t *[162]* = 10.07 and p = *.0005)* and *Hannah and her Sisters1 (H1N)* (t [162] = 10.09 and p = *.0005)* the film clips were rated significantly more positive. However, in contrast to behavioural study one *Endless Love (ENDN)* did differ and for this sample the film clip was rated significantly more positive

(t [162] = 5.61, p = .0005). The uniformity of these ratings and the importance of this result will be reflected on in the discussion section.

Finally, to assess whether the ethnic origin of participants influenced the rating of the neutral film clips the averages of essential positive (amusement, happy, joy, love) and negative (anger, anxiety, fear, sad) emotion rating across each neutral film clip were subjected to a multivariate analysis of variance (MANOVA), with Ethnic origin entered as a fixed factor. No significant effects for essential positive and negative emotion ratings were found.

A visual inspection of Table nine shows that for the neutral film clips three self-rated emotions exceeded a rating of 1 (amusement, happiness, and joy). To assess whether the ethnic origin of participants influenced the monopolar rating of “love”, “happiness” and then “joy”, across each neutral film clip were subjected to a multivariate analysis of variance (MANOVA) with Ethnic origin (ETHNICO) entered as a fixed factor. No significant effects for the emotion ratings were found.

3.4(d.ii) Film Clips and Rating of Confusion and Interest.

A visual inspection of the monopolar items “confusion” and “interest” showed that as in behavioural study one this sample also differentiated between the film clips and showed as before a specific pattern across the positive, negative and neutral films. To assess statistical significance these items across all groups were averaged across the positive, negative and neutral film clips (see Table 10).

Table 10. Averaged Means and Standard Deviations of “Confusion” and “Interest”

Target Films	**All Groups Mean (standard deviation)**
Interest Positive Films	3.64 (2.09)
Interest Negative Films	2.57 (1.76)
Interest Neutral Films	1.90 (1.48)
Confusion Positive Films	0.62 (0.98)
Confusion Negative Films	1.14 (1.36)
Confusion Neutral Films	2.45 (1.67)

The positive film clips were rated significantly less confusing than the negative film clips (*t* [162] = -4.93 and *p* =.0005) or the neutral film clips (*t* [162] = -15.71and *p* = .0005). The negative film clips were rated significantly less confusing than the neutral film clips (*t* [162] = 12.53 and *p = .0005).* Similarly, the positive film clips were rated significantly more interesting than the negative film clips (*t* [162] = 6.92 and *p = .0005)* or the neutral film clips (*t* [162] = 11.84 and *p = .0005).* The negative film clips were rated significantly more interesting than the neutral film clips (*t* [162] = -5.81 and *p = .0005).*

Confusion & Ethnicity.

To assess whether the ethnic origin of participants influenced the understanding of the film clips the averages of the monopolar rating “confusion” across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with Ethnic origin entered as a fixed factor. No significant effects for the ratings of confusion were found.

Interest & Ethnicity.

To assess whether the ethnic origin of participants influenced engagement with the film clips the averages of the monopolar rating “interest” across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with Ethnic origin entered as a fixed factor. Multivariate tests indicated that there were statistically significant effects of the fixed factor ETHNICO on the dependent variables (Wilks’ Lambda = 0.876) (*F* [3, 156] = 2.355, *p* = .014). Tests of between-subject effects showed that the significant effect was due to ETHNICO on interest ratings of Neutral film clips (*F* [3, 161] = 6.06, *p* = .038).

Figure 11 shows the mean “interest” rating of African, Asian, European and OEO participants for the collective positive, negative and neutral film clips.

Figure 11:.Mean "Interest" Rating and Self-reported Ethnic Origin of all Film Clips.

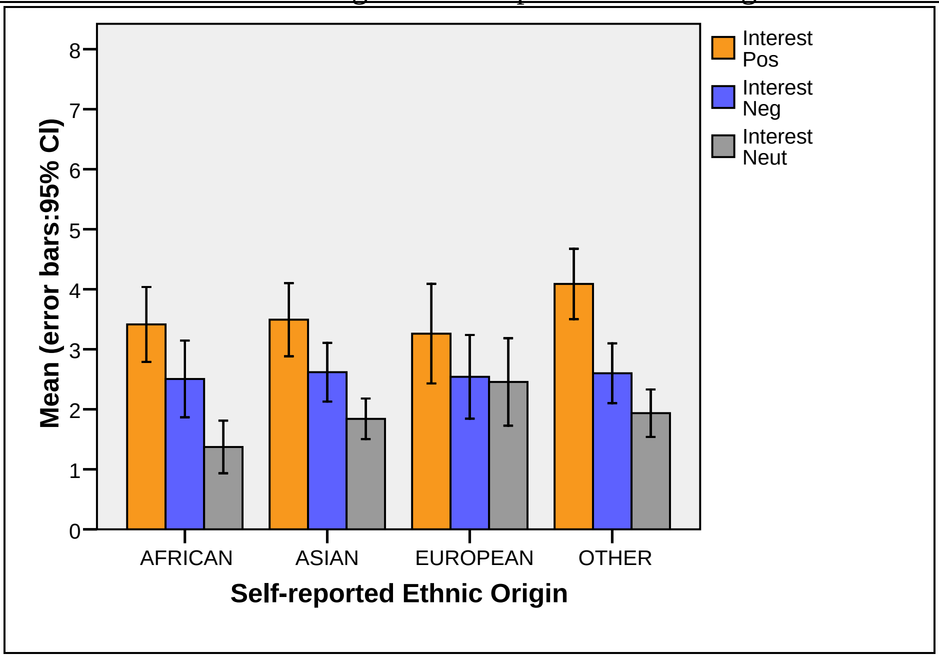
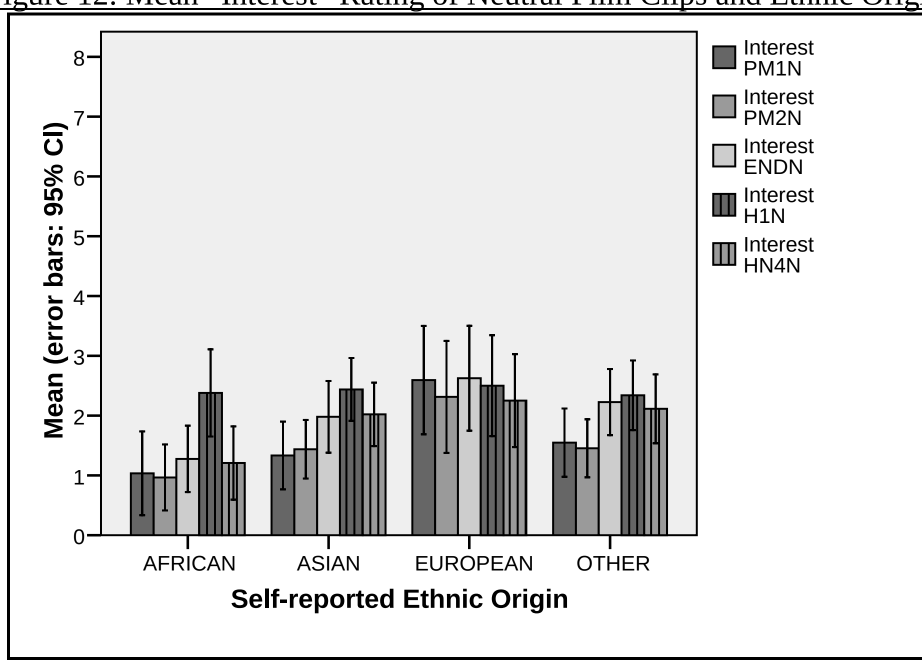


Figure 12 shows the mean "interest" rating of African, Asian, European and OEO participants for the individual neutral film clips.

Figure 12: Mean "Interest" Rating of Neutral Film Clips and Ethnic Origin.



3.4(d.iii) Valence Rating of Film Clips, PANAS X and Ethnicity.

Initially, to assess whether general traits (as measured by PANAS X) of participants influenced the ratings of the film clips, the averages of bipolar rating Valence (pleasant – un-pleasant) across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA) with positive affect (PANASPOS) and negative affect (PANASNEG) as covariates.

Next, to assess whether specific negative emotion traits (fear, sadness, guilt and hostility) of participants influenced the ratings of the film clips, the averages of bipolar rating Valence (pleasant – un-pleasant) across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA) with fear (PANASFEAR), sadness (PANASSAD), guilt (PANASGUILT) and hostility (PANASHOSTILE) as covariates.

Likewise, to assess whether specific positive emotion traits (joviality, self-assurance and attentiveness) of participants influenced the ratings of the film clips, the averages of bipolar rating Valence (pleasant – un-pleasant) across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA) with joviality (PANASJOVIALITY), self-assurance (PANASSELFASS) and attentiveness (PANASATTEN) as covariates.

Lastly, to assess whether affective traits (fatigue, shy and serenity) of participants influenced the ratings of the film clips, the averages of bipolar rating Valence (pleasant – un-pleasant) across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA) with fatigue (PANASFAT), shy (PANASSHY) and serenity (PANASSERENITY) entered independently as covariates. Table 11 lists the results of the above MANOVA analyses.

Table 11: Effects of Mood on Valence Rating of Film Clips.

	POSITIVE FILMS		**NEUTRAL FILMS**		**NEGATIVE FILMS**	
PANAS X	***F***	***p***	***F***	***p***	***F***	***p***
POSITIVE AFFECT	4.08	<.05	11.82	<.001	2.04	*ns*
NEGATIVE AFFECT	1.90	*ns*	0.52	*ns*	2.59	*ns*
FEAR	1.50	*ns*	1.26	*ns*	1.09	*ns*
SAD	0.67	*ns*	0.31	*ns*	0.14	*ns*
GUILT	0.04	*ns*	0.28	*ns*	0.21	*ns*
HOSTILE	0.01	*ns*	0.19	*ns*	0.35	*ns*
JOVIALITY	0.11	*ns*	1.82	*ns*	0.06	*ns*
SELF ASSURANCE	0.43	*ns*	0.95	*ns*	0.01	*ns*
ATTENTION	7.78	<.01	2.76	.09	1.00	*ns*
FATIGUE	0.05	*ns*	1.81	*ns*	7.11	<.01
SURPRISE	1.49	*ns*	0.96	*ns*	0.59	.06

In addition, to the above findings to assess whether the ethnic origin of participants had any significant effect on the above multivariate outcomes the variable Ethnic origin was entered as a fixed factor in the above significant analyses. However, no significant effects of Ethnic origin were found.

The multivariate tests that proved significant are detailed below.

General Dimension Traits.

Positive Affect.

Multivariate tests indicated there were statistically significant effects of the covariate PANASPOS (positive affect) on the dependent variables. (Wilks' Lambda = 0.921) (*F* [3, 144] = 4.135, *p* = .008). Tests of between-subject effects showed that the significant effect was due to the influence of positive affect (PANASPOS) on valence ratings of neutral films (*F* [1, 146] = 11.82, *p* = .001) and positive films (*F* [1, 146] = 4.08, *p* = .045). Bivariate correlation (1-tailed) showed a positive correlation between PANASPOS score and the valence rating of positive films (*r* = .149, *N* = 153, *p* = .033). Bivariate correlation (2-tailed) showed an unexpected positive correlation between PANASPOS score and the valence rating of neutral films (*r* = .272, *N* = 153, *p* = .001).

Specific Positive Emotion Traits.

Attention.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASATTEN (attentiveness) on the dependent variables (Wilks' Lambda = 0.937) (F [3, 140] = 3.133, p = .028). Tests of between-subject effects showed that the significant effect was due to the influence of attentiveness (PANASATTEN) on valence ratings of positive films (F [1, 142] = 7.82, p = .006). Bivariate correlation (2-tailed) showed a positive correlation between PANASATTEN score and the valence rating of positive films (r = .245, N = 153, p = .002).

Fatigue.

Multivariate tests indicated that there were no statistically significant effects of the covariate PANASFAT (Wilks' Lambda = 0.953) (F [3, 150] = 2.443, p = .066). However tests of between-subject effects showed a significant effect due to the influence of fatigue (PANASFAT) on the valence ratings of negative films (F [1, 152] = 7.11, p = .009). Bivariate correlation (2-tailed) showed a negative correlation between PANASFAT score and the valence rating of negative films (r = .211, N = 154, p = .009).

Serenity.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASSERENITY (Wilks' Lambda = 0.947) (F [3, 152] = 2.855, p = .039). Tests of between-subject effects showed a significant effect due to the influence of serenity (PANASSERENITY) on the valence ratings of positive (F [1, 154] = 4.08, p = .045) and neutral (F [1, 154] = 7.77, p = .006) films. Bivariate correlation (1-tailed) showed a significant correlation between PANASSERENITY and the valence rating of positive films (r = .151, N = 162, p = .029) with a scatter plot revealing the presence of some outline data. Bivariate correlation (2-tailed) showed a positive correlation between PANASERENITY score and the valence rating of neutral films (r = .218, N = 162, p = .006).

3.4(d.iv) Interest Rating of Film Clips, PANAS X and Ethnicity.

Given the significant variability in the interest ratings of the happy, sad and neutral film clips and the significant finding for "interest" and ethnic origin further analysis on interest ratings and mood traits seemed prudent.

Firstly, to assess whether general dimension traits of participants influenced the "interest" rating of film clips, the averages of the monopolar rating for "interest" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with positive affect (PANASPOS) and negative affect (PANASNEG) as covariates.

Next, to assess whether specific negative emotion traits (fear, sadness, guilt and hostility) of participants influenced the "interest" ratings of film clips, the averages of the monopolar rating for "interest" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with fear (PANASFEAR), sadness (PANASSAD), guilt (PANASGUILT) and hostility (PANASHOSTILE) as covariates.

Likewise, to assess whether specific positive emotion traits (joviality, self-assurance and attentiveness) of participants influenced the "interest" ratings of film clips, the averages of the monopolar rating for "interest" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with joviality (PANASJOVIALITY), self-assurance (PANASSELFASS) and attentiveness (PANASATTEN) as covariates.

Finally, to assess whether affective traits (fatigue, shy and serenity) of participants influenced the "interest" ratings of film clips, the averages of the monopolar rating "interest" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA) with fatigue (PANASFAT), shy (PANASSHY) and serenity (PANASSERENITY) entered independently as a covariate.

Table 12 lists the results of the above MANOVA analyses.

Table 12: Effects of Mood on "Interest" Rating of Film Clips.

	"interest" POSITIVE FILMS		**"interest" NEUTRAL FILMS**		**"interest" NEGATIVE FILMS**	
PANAS X	***F***	***p***	***F***	***p***	***F***	***p***
POSITIVE AFFECT	2.99	.09	10.27	<.01	6.02	<.01
NEGATIVE AFFEC	1.29	*ns*	0.77	*ns*	1.36	*ns*
FEAR	0.11	*ns*	0.53	*ns*	1.30	*ns*
SAD	2.36	*ns*	0.16	*ns*	0.01	*ns*
GUILT	1.19	*ns*	0.43	*ns*	0.44	*ns*
HOSTILE	0.00	*ns*	0.00	*ns*	0.14	*ns*
JOVIALITY	1.50	*ns*	1.10	*ns*	0.40	*ns*
SELF ASSURANCE	3.47	.06	0.01	*ns*	0.26	*ns*
ATTENTION	5.91	<.01	5.82	<.01	7.05	<.01
FATIGUE	0.82	*ns*	0.19	*ns*	3.97	<05
SURPRISE	7.68	<.01	5.55	<.05	3.25	.07
SHY	1.78	*ns*	7.66	<.01	3.47	.06
SERENITY	3.61	.06	7.47	<01	4.49	<.05

In addition, to the above findings to assess whether the ethnic origin of participants had any significant effect on the above multivariate outcomes the variable Ethnic origin was entered as a fixed factor in the above significant analyses. As expected given the previous "interest" findings significant effects of Ethnic origin were found.

The multivariate tests that proved significant are detailed below.

General Dimension Traits.

Positive Affect.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASPOS (positive affect) on the dependent variables (Wilks' Lambda = 0.932) (*F* [3, 149] = 3.639, *p* = .014). Tests of between-subject effects showed that the significant effect was due to the influence of positive affect (PANASPOS) on interest ratings of neutral (*F* [1, 151] = 10.27, *p* = .002) and negative (*F* [1, 153] = 6.02, *p* = .015) films. Bivariate correlation (2-tailed) showed a positive correlation between PANASPOS score and the interest rating of neutral films ($r = .253$, $N = 158$, $p = .001$). Bivariate correlation (2-tailed) also showed a positive correlation between PANASPOS score and the “interest” rating of negative films ($r = .199$, $N = 158$, $p = .012$). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variable (Wilks’ Lambda = 0.873) (F [2, 259] = 3.639, $p = .018$).

Specific Positive Emotion Traits.

Attention.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASATTEN (attentiveness) on the dependent variables (Wilks’ Lambda = 0.939) (F [3, 146] = 3.135, $p = .027$). Tests of between-subject effects showed that the significant effect was due to the influence of attentiveness (PANASATTEN) on interest ratings of positive (F [1, 148] = 5.91, $p = .016$), neutral (F [1, 148] = 5.82, $p = .017$) and negative (F [1, 148] = 7.05, $p = .009$) films. Bivariate correlation (2-tailed) showed a positive correlation between PANASATTEN score and the interest rating of positive films ($r = .226$, $N = 158$, $p = .004$). Bivariate correlation (2-tailed) showed a positive correlation between PANASATTEN score and the interest rating of neutral films ($r = .303$, $N = 158$, $p = .0005$). Bivariate correlation (2-tailed) showed a positive correlation between PANASATTEN score and the interest rating of negative films ($r = .264$, $N = 158$, $p = .001$). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variables (Wilks’ Lambda = 0.867) (F [9, 345] = 2.235, $p = .015$).

Fatigue.

Multivariate tests indicated that there were no statistically significant effects of the covariate PANASFAT (Wilks’ Lambda = 0.969) (F [3, 155] = 1.653, $p = .180$). However tests of between-subject effects showed a significant effect due to the influence of fatigue (PANASFAT) on the interest ratings of negative films (F [1, 157] = 3.97, $p = .048$). Bivariate correlation (2-tailed) showed a positive correlation between PANASFAT score and the interest rating of negative films ($r = .157$, $N = 159$, $p = .048$). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variables (Wilks' Lambda = 0.864) (F [9, 367] = 2.534, p = .008).

Surprise.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASSURPRISE (surprise) on the dependent variables (Wilks' Lambda = 0.946) (F [3, 156] = 2.996, p = .033). Tests of between-subject effects showed that the significant effect was due to the influence of surprise (PANASSURPRISE) on interest ratings of positive (F [1, 158] = 7.683, p = .006) and neutral (F [1, 158] = 5.546, p = .020) films. Bivariate correlation (2-tailed) showed a positive correlation between PANASURPRISE score and the interest rating of positive films (r = .215, N = 160, p = .006). Bivariate correlation (2-tailed) showed a positive correlation between PANASSURPRISE score and the interest rating of neutral films (r = .184, N = 160, p = .020). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variables (Wilks' Lambda = 0.876) (F [9, 370] = 2.3, p = .016).

Shy.

Multivariate tests indicated near statistically significant effects of the covariate PANASSHY (Wilks' Lambda = 0.951) (F [3, 150] = 2.560, p = .059), with (tests of between-subject effects showed a significant effect due to the influence of shy (PANASSHY) on the interest ratings of neutral films (F [1, 152] = 7.663, p = .006). Bivariate correlation (2-tailed) showed a positive correlation between PANASSHY score and the interest rating of neutral films (r = .219, N = 154, p = .006). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variables (Wilks' Lambda = 0.879) (F [9, 355] = 2.159, p = .024).

Serenity.

Multivariate tests indicated that there were statistically significant effects of the covariate PANASSERENITY (Wilks' Lambda = 0.952) (F [3, 152] = 2.677, p = .049). Tests of between-subject effects showed a significant effect due to the influence of serenity (PANASSERENITY) on the interest ratings of neutral (*F* [1, 160] = 7.47, *p* = .007) and negative (*F* [1, 160] = 4.49, *p* = .36) films. Bivariate correlation (2-tailed) showed a positive correlation between PANASSERENITY (*r* = .211, *N* = 162, *p* = .007) and the interest rating of neutral films. Bivariate correlation (2-tailed) showed a positive correlation between PANASSERENITY score and the interest rating of negative films (*r* = .165, *N* = 162, *p* = .036). In addition, multivariate tests indicate that there were statistically significant effects of the fixed factor Ethnic origin on the dependent variables (Wilks' Lambda = 0.863) (*F* [9, 374] = 2.591, *p* = .007).

3.4(d. v) Confusion Rating of Film Clips, PANAS X and Ethnicity.

Because of the significant variability in the confusion ratings of the happy, sad and neutral film clips further analysis on mood traits and confusion also seemed sensible.

Firstly, to assess whether general dimension traits of participants influenced the "confusion" rating of film clips, the averages of the monopolar rating for "confusion" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with positive affect (PANASPOS) and negative affect (PANASNEG) as covariates.

Next, to assess whether specific negative emotion traits (fear, sadness, guilt and hostility) of participants influenced the "confusion" rating of film clips, the averages of the monopolar rating for "confusion" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with fear (PANASFEAR), sadness (PANASSAD), guilt (PANASGUILT) and hostility (PANASHOSTILE) as covariates.

Likewise, to assess whether specific positive emotion traits (joviality, self-assurance and attentiveness) of participants influenced the "confusion" rating of film clips, the averages of the monopolar rating for "confusion" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with joviality (PANASJOVIALITY), self-assurance (PANASSELFASS) and attentiveness (PANASATTEN) as covariates.

Lastly, to assess whether affective traits (fatigue, shy and serenity) of participants influenced the "confusion" rating of film clips, the averages of the monopolar rating for "confusion" across all positive, negative and neutral film clips were subjected to a multivariate analysis of variance (MANOVA), with fatigue (PANASFAT), shy (PANASSHY) and serenity (PANASSERENITY) entered independently as a covariate.

The only multivariate tests that proved significant were the MANOVA analyses for specific negative emotion traits. These multivariate tests indicated that there were statistically significant effects of the covariate PANASGUILT (guilt) on the dependent variables (Wilks' Lambda = 0.907) (F [3, 140] = 4.776, p = .003). Tests of between-subject effects showed that the significant effect was due to the influence of guilt (PANASGUILT) on confusion ratings of positive (F [1, 142] = 12.09, p = .001) and negative (F [1, 142] = 10.31, p = .020) films. Bivariate correlation (2-tailed) showed a positive correlation between PANASGUILT score and the confusion rating of positive films ((r = .229, N = 161, p = .003). Bivariate correlation (1-tailed) showed a positive correlation between PANASGUILT score and the confusion rating of negative films (r = .150, N = 163, p = .029). In addition, to assess whether the ethnic origin of participants had any significant effect on the above outcome the variable Ethnic origin was entered as a fixed factor in the above analysis. No significant effects of Ethnic origin were found.

No other significant effects for the rating of "confusion" were found in any of the multivariate analyses.

Footnote: Unfortunately, again due to the predominance of female participants (143 females to 19 males) in behavioural study two no meaningful analysis on the effect of gender was possible.

3.4 Discussion.

A main objective for these behavioural studies was to match the film clips with reference to the goals of the imaging investigation with a main criterion to elicit social emotions. In defining social emotions as shaped by the presence of human forms using meanings, language and intentionality this meant, in contrast to some other studies, the film clips were shown with sound. This could have been the main reason for the difference found as regards the ratings of “interest” and “confusion” for behavioural study one and two in comparison to previous investigations (Hagemann et al, 1999; Hewig et al, 2005).

For “confusion” the pattern of rating was similar across behavioural study one and two with the positive films rated as least confusing whereas the neutral films were rated as most confusing. A visual inspection of the mean rating of the individual clips for both behavioural studies shows a reliable pattern with the neutral clips that feature female actor(s) rated as less confusing than those that feature only male actors. These findings would seem to confirm that the rating of “confusion” is mainly reliant on the thematic content and applicability of the film clips to the sample audience. For “interest” the pattern of rating did vary between the studies. In behavioural study one the C/D group, in comparison to all the other groups across both studies, displayed no difference in the interest of the negative and neutral films. A partial explanation for this finding could be due to the differences in the film clips themselves. Particularly, as having reviewed the material in the negative films for the C/D group the material could be conceived as less intense (e.g. in these clips the actors do not cry on screen). This explanation could in some way account for the mean differences (see Tables three and nine) found in behavioural study one and two which would indicate that “interest” in the film clips are, in the main, a product of intensity of material and this confluence of strong affect and interest most possibly a natural one (Philippot, 1993). For example, the film clip that obtained the highest interest rating *Pretty Woman*, was also the film clip that obtained the highest target emotion (Happy) and the highest valence rating across all film clips. However, an additional reason could be goal associated, as the study matched the core themes of the emotional eliciting films but no such core theme was allocated to the neutral contrasts, maybe an oversight given the present “interest” and “confusion” results.

The degree to which “interest” and familiarity were related, and influenced the rating of the films clips, was beyond the remit of the investigation. Still, it is worth noting that with the exception of *Pretty Women* few participants had viewed the film clips before. Moreover, further analysis on the rating of Pretty Women found that one clip significantly influenced the valance rating, but the other clip did not. The irregularity of these results would seem to indicate that the happy scene portrayed in the first Pretty Woman clip - woman in a flat then a man comes with flowers, climbs up and kisses the woman – has a generality that the second Pretty Woman clip - woman in the bath talking to a man about money, joking and laughing – did not. These findings would seem to ascertain that if the film clip relates too closely to the film story line the valance rating of participants who have seen the film before is prejudiced. These results would also seem to confirm the review in chapter two that a non-specific film scene depicting a loving relationship between two individuals in an amusing setting robustly elicits happy emotions.

It is important to note that current research using film stimuli for emotional elicitation do focus on the function of attention (Hutcherson et al, 2005) but rarely seem to formally assess the function of interest. The findings of this study would seem to suggest that how interesting and personally engaging the participants find the film clips has a significant bearing on facets of the results.

The chief aim of behavioural study one was to assess whether general dimension moods (positive and negative affect) influenced the ratings of the film clips and the findings indicate that self-rated mood modifies the emotion elicited by film stimuli. Interestingly, the pattern of response differed between these groups. For the A/B group negative affect (PN) seemed to influence the valence ratings of positive film clips and unexpectedly there was a positive correlation between PN and the valence rating of positive films. Whereas, for the C/D group positive affect (PA) seemed to influence the valence rating of both positive and negative film, with a positive correlation between PA and the valence rating of positive films. Hence, previous research showing that positive qualities such as extraversion influence positive reactions to film clips (Gross, 1998) are only tentatively supported by this first behavioural study. One reason for the variability in the findings could originate from the design of the first study. Insofar as, the A/B group viewed three sad film clips but only two happy film clips, in contrast, the C/D group viewed three happy film clips but only two sad film clips. The decision to present an emotional film clip sandwiched between neutral film clips, in order to avoid carryover effects, retrospectively could have been counterproductive given that these groups ended up viewing an unequal number of sad and happy film clips. In addition, for each group PANAS was completed just prior to the viewing of the film clips so whether this then influenced their emotional reaction and subsequent rating of the films is unknown.

Behavioural study two clarified what specific moods influenced the ratings of the film clips and the pattern of response obtained in this second sample for the general dimension traits (positive and negative affect) had a correspondence with the results of the C/D group in behavioural study one. With positive affect seeming to influence the valence rating of positive films and participants in the second sample exhibiting a positive correlation between PA and the valence rating of positive films. Hence, in general behavioural study one and two would support previous research that shows positive traits influence positive reactions to film stimuli (Gross, 1998). Behavioral study two would also appear to confirm that the differential pattern of response for behavioural study one A/B group (negative affect seemed to influence the valence ratings of positive film clips) seems to have originated from the design of the study. Since, the A/B group viewed three negative film clips but only two positive film clips. An alternative proposal for the differential results in behavioural study one, prior completion of the PANAS, has not been confirmed. Given, for the second sample completion of PANAS prior, or post, to viewing the film clips did not influence emotional reaction and subsequent rating of the films.

It is worth noting that a visual inspection of Table 9 reveals that only three specific mood traits seemed to influence the valence rating of the film clips for the second sample. Serenity seemed to influence both the valence rating of positive and neutral film clips. Attention influenced the valence rating of the neutral film clips. The only specific mood that influenced the valence rating of negative film clips was fatigue, a finding that seems easy to understand. Inasmuch as, the lower the self-reported fatigue score participants' provided the higher the unpleasant score they awarded the sad films. Whether, these findings further support proposals that overall positive traits of individuals influence emotional elicitation is questionable, particularly as positive affect, serenity and attention seemed to influence both the valence rating of positive and neutral film clips.

Self rated mood also seemed to influence the "interest" rating of selected film clips for the second sample. Unsurprisingly, attention influenced the interest rating of positive, negative and neutral clips, with positive affect, surprise, serenity and shy seeming to influence the interest rating of neutral and to some extent negative films. Again fatigue had a specific influence on the rating of interest accorded to negative films. However, in this condition the lower the self-reported fatigue score participants' provided the lower the interest score they awarded the sad films. Curiously, surprise was the only specific mood that influenced the interest rating of the positive films. As discussed above it is difficult to calculate what role self rated mood has on the interest rating of film clips. A speculative explanation for these results could be that positive mood broadens the scope of attention to then include additional information (Fredrickson, 2000; Geers et al, 2003). If positive mood influenced attention to personally relevant information this may perhaps account for some of the patterns of response to the film stimuli. Moreover, an explanation that could also account, in some way, for the variability of response found for self-reported ethnic origin.

Behavioural study two core aim was to explore whether the ethnic origin of participants impacted on their self-reporting of target and non-target emotions. No significant effects for ethnic origin for the target emotions (happiness, love, joy, amusement and sadness) were found across the positive, negative and neutral film clips. However, for the positive film clips the non-target emotion "disgust", that exceeded a rating of one, showed a significant difference for ethnic origin in the film *Love Story*. This film clip showed a young woman and man playing in a snowy park, rolling around laughing and kissing in the snow. African origin participants rated this clip as more disgusting than any of the other groups.

These overall findings for ethnic origin support the general view (Levenson, Soto and Pole, 2007) that in the area of emotional responding to stimuli that elicit basic emotions, as presented in this study, there are far more similarities than differences across ethnic groups. The particular finding for "disgust" and the film clip *Love Story* could be attributed to the *subtle* influence of culture as proposed by Roberts and Levenson (2006). They suggest that under particular conditions influences of culture assert themselves more strongly and then can produce discernable differences. In view of the fact that the two other positive films showed no difference as regards target and non-target ratings, and both included scenes of a young woman and man kissing, some element within the *Love Story* clip caused ethnic disparity for the rating of "disgust". This finding, although slight, could be of relevance to the fMRI investigation into social emotions particularly as social psychologists have argued that disgust is an emotion underpinning moral judgment (Haidt, Rozin, McCauley and Imada, 1997). A more recent study by Schaich Borg, Lieberman and Kiehl (2008), that employed film stimuli to investigate the neural correlates of disgust and morality, found evidence that despite eliciting similar self-report ratings nonsexual immoral acts, wrongness and sexual immoral acts revealed dramatically separate, but overlapping, brain networks. Schaich Borg et al's (2008) film set also elicited high amounts of anger replicating, in the main, Philippot's (1993) difficulty in separating disgust and anger, with disgust film clips elicited feelings of anger and vice versa. These results question the stance of many imaging investigations that treats disgust as a cohesive psychological and neurological construct by using disgusted pictures or faces to represent all spheres of disgust (Calder, 2003). The minor, but significant, results of the "disgust" rating for the present sample is a reminder that vigilance is necessary when utilizing film clips as, like pictures and faces, reliable emotional elicitation to a specified target emotion seems to rest on extensive piloting.

Behavioural study two found no significant variability for ethnic origin and the rating of confusion across positive, negative and neutral clips. However, significant variability was found for ethnic origin and the rating of "interest" across the neutral clips. This variability of "interest" in neutral film clips across ethnic groups suggests strong affect, as mentioned previously, may be only one feature. Since, the neutral contrast clips although defined as emotionally neutral did produce irregular degrees of interest across the ethnic groups (see Figure 11). A visual inspection of Figure 12 reveals that the only neutral clip to attain a comparable level of interest across the ethnic groups was unsurprisingly, given the mainly female sample, *Hannah and her Sister*1 (two women shopping and talking about a male relationship). Interest in the neutral clip *Hannah and her Sister1* was greater than for the negative clip *Love Story* that obtained the lowest sad rating. Intuitively level of interest and engagement with the film stimuli should, in many ways, be a prerequisite for the self report of emotion. A line of reasoning that would, in some measure, be supported by a recent empirical review on communication and self by Oatley (2009) who suggests that we experience emotions when events occur that are important. Nevertheless, Roberts and Levenson (2006) excluded the rating of interest and confusion in their investigation - reactivity to ethnically matched and mismatched film clips - as they proposed, for their study, these variables appeared to reflect attentiveness or concentration rather than emotion per se. Whether this would be the case for this particular study is uncertain.

The results of behavioural study one and substantiated in behavioural study two validate the capacity of the chosen emotional film clips to induce the target social emotions of happiness and sadness. All the film clips designed to elicit happiness were rated as more pleasant than the clips pre-classified as neutral, which in turn were rated as more pleasant than the film clips designed to elicit sadness. Thus, for first and second samples the pre-classification of film clips as positive, negative and neutral was valid.

The pattern of findings for the positive films, as eliciting–various cognate aspects of positive emotion (happiness, amusement, joy, love) was similar in both studies. However, the mean rating for “happiness”, “amusement”, “joy” and “love” in behavioural study two was smaller for each of the positive films that in behavioural study one. Interestingly, the mean valence rating of *Love Story* slightly increased in behavioural study two whereas the valence rating for the other two positive film clips decreased. The second study, although again verifying the ability of the selected negative film clips to elicit the specific and isolated target emotion of sadness, found the mean rating for “sadness” smaller than in behavioural study one. It is also worth noting that for the first sample one emotional film received somewhat higher non-target ratings than the other emotional films. This was a sad film clip from *An Officer and a Gentleman (OGS).* Therefore, the other negative film clips might be preferred to selectively elicit “sadness”. The slight variability in mean rating results between the two studies could be attributed to a variety of individualistic features (Rottenberg et al, 2007). Nevertheless, given that across the film clips the mean rating for “interest” in behavioural study two, as mentioned previously, was generally lower than in behavioural study one the decline in self-report of emotion in the second study could be due to a degree of difference as regards engagement with the film clips.

These results, like those of Hagerman et al (1999), point to positive films as eliciting various cognate aspects of positive emotion (happiness, amusement, joy, love) whereas the negative film clips had the ability to elicit a specific and isolated target emotion (sadness). As mentioned in the Introduction much research into emotional elicitation tends to use basic emotion categories (e.g. happiness, surprise, sadness, anger, fear, disgust; Ekman and Friesen, 1986) and propose that these distinct emotions are universal in nature. However, only one positive emotion tends to be utilized in basic emotion research and this is apt to be labelled “happiness”, whereas for negative emotions five or six distinctive emotions can be employed. In the present studies the structure of the emotional film clips would seem to support the distinctiveness of negative emotion but also indicates, as reviewed in chapter two, that positive emotion in comparison tends to be multifaceted in nature (Hutcherson et al, 2005).

The rating profile of the neutral film clips, in comparison to the emotional film clips, did differ between the studies.

In behavioural study one the five neutral clips showed a significant difference in the rating of basic positive and negative emotions. The film that received the highest mean rating for an emotional item was *Falling in Love*, a clip that included a women and man shopping, and for the first sample this clip was rated as more positive. A further inspection of all the neutral film clips showed that the three clips with no significant difference in the rating of basic positive and negative emotions featured two main male actors. Examination of *Crimes and Misdemeanours*, the only other film with two main male actors, reveals that the clip was viewed as more negative. The remaining neutral clips showed either two main female actors or a female and male actor were viewed as more positive. Consequently, given the predominance of female participants in the first sample the rating profile of the neutral clips could have been intuitively skewed depending on the sex of the actors featured in the clip.

In behavioural study two the rating profile of the neutral film clips also differed with three of the five neutral film clips showing a significant difference in the rating of basic positive and negative emotions. As previously the rating of the two *All the Presidents men* clips, which featured two male actors, showed no difference in rating. The two *Hannah and her Sisters* clips, that featured female actor(s), as before were rated as more positive. However, the *Endless Love* clip, which featured two male actors, for the second sample was rated as more positive.

The predominance of female participants in these samples could have intuitively skewed the neutral rating profile with participants responses largely centred on the biological sex of actor featured in the neutral clips. To date, there is little published research on gender of actor and differential rating of film clips although, as mentioned in chapter two, difference in women and men’s responses to gender of actor in erotic or sexually explicit film clips has been found (Chivers, Seto and Blanchard, 2007). Likewise, interactions between emotional facial expression and gender of the actor has also been reported with higher levels of pleasantness to female than male faces expressing surprise (Simon, Craig, Gosselin, Belin and Rainville, 2008). Related research has also reported that facial expressions seem to be recognized slightly better when acted by actresses than by actors (Battocchi, Pianesi and Goren-Bar, 2005). An alternative account of the differences found could be rooted in the variability of themes across the neutral clips with the more positively rated clips featuring shopping experiences or (for the second sample) college affairs. Whereas, the two clips situated in a work environments showed no difference for essential positive or negative ratings. Again limited research is available although a media study by Oliver, Weaver and Sargent (2000), who examined factors related to biological sex and gender differences in enjoyment of sad films found females (and feminine) participants reported greater enjoyment of films with a relational theme. In addition, the selecting of film clips for sex research was investigated by Janssen, Vorst, Finn and Bancroft (2002) who found that presenting women with film clips initially selected by men lead to lower levels of sexual arousal, compared with female-selected films. They go on to suggest that to maximize responses in women, film clips are probably best selected by women. The above findings may not be generally applicable to film stimuli but thematic content and gender of actor(s) may well be influential variables in predicting the levels of engagement reported by women.

The differences discussed above are on a very low intensity level in comparison to the emotions elicited by the positive and negative clips and this supports the view that these films can still be classified as emotionally neutral.

3.6 Conclusion of Behavioural Study One and Two.

The aim of the two behavioural studies to explore whether self-reported mood and ethnic origin influenced the ratings of the film stimuli was successful and merits further investigation in an fMRI setting. A further aim of the studies to develop clips from commercial feature films that reliably elicited the social emotions of happiness and sadness or were emotionally neutral was also successful. The final set of films the study proposes to utilize in the fMRI study are three positive films *Love Story* (LSH), *An Officer and a Gentleman* (OGH), and *Pretty Woman* (PW1H); three sad clips *Love Story*

(LSS), *Terms of Endearment* (TRS) and *Along for the Ride* (RN); and five neutral clips *All the Presidents Men* (PM1N), *All the Presidents Men* (PM2N), *Endless Love* (END2N), *Hannah and her Sisters* (H2N) and *Hannah and her Sisters* (H1N).

These behavioural studies have raised several important issues that should be considered when utilising film stimuli in an fMRI setting. Particularly, the unforeseen cues that gender of actresses/actors and thematic content of the film clip seemed to impact on the emotions elicited. Moreover, in these studies interest (as opposed to attention) appears to play a function in the elicitation and subsequent self report of target and non-target emotions. These factors may not be generally applicable to all studies employing film stimuli but interest in the thematic content of clips may well be an influential variable in predicting the level of engagement and resultant ratings reported.

4. fMRI INVESTIGATION.

4.1. Introduction.

The previous chapters have covered many topics and issues pertinent to this fMRI investigation of social emotions. Perception and production of emotion, valence, biological sex, psychological gender identity, stable mood, learnt culture responses, elicitation procedure and study design are all variables that have been considered as contributing to how individuals may perceive and appraise emotional stimuli. The impact of these external and internal sources of variability was a recurrent theme in the literature previously reviewed and important to reiterate given Davidson's (2003) emphasis that the neural circuits activated can vary as a function of many different processes.

In contrast, to other imaging investigations (e.g. Hutcherson et al, 2005) both women and men will be included in this study. Given, many imaging investigations who have employed a variety of measures fail to correlate biological sex as a strong determinate of neural activation (Hamann and Canli, 2004; Wager et al, 2003; Barrett et al, 1998). Nevertheless, as mentioned in the Introduction, research into emotion associated with fairly explicit sexual images found significant biological sex differences in patterns of activation (Chivers et al, 2007). Hence, the positive film stimuli selected - loving relationship between male and female - tried to minimize the sexual content in the scenes. This is in contrast to the most popular positive film clip employed "Harry met Sally" (see chapter two) portraying a women acting out an orgasm to a male friend in a public restaurant. Thus, investigations employing this amusing clip could be assessing, in the main, neural correlates for sexual excitement rather than generic "happiness" or "amusement".

The decision to employ female and male participants for the fMRI part of the investigation was followed by what age range to stipulate. The influence of participant age in affect investigations was briefly mentioned in chapter three in relation to cohort grouping and emotional reactivity to film clips (Kliegel et al, 2007; Reminger et al, 2000;

Smith et al, 2005). In chapter two Phillips et al (2002) also highlighted some of the difficulties faced when searching for reliable and valid film stimuli to investigate negative affect in relation to age. In addition, studies that have investigated biological sex and age in brain activation to emotional events have found specific differences in the prefrontal and amygdala systems during adolescence (Killgore and Yurgelun-Todd, 2001). With adolescent development, it is hypothesised, involving a redeployment of cerebral functions from lower subcortical regions to higher structures of the prefrontal cortex (Killgore and Yurgelun-Todd, 2001). Moreover, this redeployment, it is proposed, is due to gender-specific hormonal changes and occurs in order to provide greater self-control over emotional behaviour. These imaging and behavioural investigations would seem to suggest that variability of age in female and male participants can impact on the patterns of neural responses observed in relation to film stimuli. Finally, age can also influence the hemodynamic response so generally it is advantageous to limit the age range of participants in imaging investigations. Consequently, women and men aged around eighteen to twenty-one years old were largely selected for inclusion in the present investigation. In addition, to conform to the ethical approval of the Research Ethics Committee of the Brunel University School of Social Sciences (sees Appendix 4) the selected participants also had to have no history of brain injury or psychiatric illness and were not taking any regular medication.

The first aim of the fMRI investigation is to assess differences in neural activation when viewing happy and sad social films, as valance seems to be important in the processing of social relations. The second aim is to assess whether ethnic origin or stable mood influence the pattern of neural activation to these valenced social films. Given previous suggestions that mood and ethnic origin are internal sources of information that individuals use to help appraise what is positive and negative in their external environment.

4.2. fMRI Hypotheses.

1. There will be differences in the activations produced by positive and negative valenced social films, in comparison to the emotionally neutral social films.

2. There will be differences in the activations produced by positive and negative valenced social films, in comparison to the sticks control films.

3. There will be differences in the patterns of activation produced by positive and negative valenced social films between European and Non-European participants.

4. There will be differences in the patterns of activation produced by positive and negative valenced social films between high and low self-reported general and specific mood states.

4.3 Method.

4.3(a), Participants.

Forty one healthy participants took part in the experiment, 33 females and 8 males (age range 18 – 28 years, mean age 19.2). The ethnic origin of the sample consisted of 12 Asians, 7 Africans and 22 Europeans.

None of the 41 participants had a history of brain injury or psychiatric illness and were not taking any regular medication.

When enrolling participants for the study the nature of the experiment was thoroughly explained. In the description of the experiment it was highlighted that some of the film clips shown were of an emotional nature but all the films shown were rated by the British Board of Film Classification as suitable for persons aged 15 or over. Free transport was provided to and from the MRI scanner. However, for those who travelled independently travel expenses were available but this was the only payment made.

4.3(b) Stimulus Material and Rating Scales.

Picture and Sound Quality Evaluation.

The happy, sad and emotionally-neutral film clips, as validated by the previous behavioral studies, together with a sticks control film (Gross and Levenson, 1995) were shown in an fMRI setting to two female participants (both aged 21) for picture and sound quality evaluation. The two participants viewed all the film clips in a 3 Tesla Siemens Trio MRI scanner with an 8 channel array head coil and fMRI standardised headphones. This scanner was located at Royal Holloway University of London. Immediately after the films had been screened both participants were interviewed to see if the mode of screening had impacted on the viewing experience. Following these interviews and observations made on the difficulty in viewing some aspects of *Endless Love* (END2N) due picture quality and *Hannah and her Sisters* (H2N) due to sound quality, in the scanner, these films were omitted from the final fMRI experiment.

Emotion, Emotionally Neutral and Control Film Set.

The film set comprised of 12 clips (see Table 11), with the emotion and emotionally neutral clips extracted from commercially available films (edited for Behavioural Studies One and Two) and a control sticks film. The final fMRI film set included three emotionally neutral clips, four clips designed to elicit the target emotion of sadness, four clips designed to elicit the target emotion of happiness and one clip designed to act as a control. Table 13 lists the viewing order of the film clips and again provides the core theme of each film clip.

Table 13: Description and Viewing Order of fMRI Film Set.

Film No.	**Film Title.**	**Target Emotion.**	**Description (company, year)**
1	*Steel Magnolias* (SMS)	Sad	At a funeral a woman is talking to other women about the death of her daughter (UCA, 1989).
2	Sticks	Control	Screen saver film showing sticks moving across the screen with music (New Stories [Highway Blues] – Marc Seales).
3	*An Officer and a Gentleman*(OGH)	Happy	A young woman is greeted by a young man. He kisses her and carries her out of the room (Universal Pictures, 1981).
4	*Presidents Men* (PM2N)	Neutral	In an office two men are talking about library books (Warner Bros/Wildwood, 1976).
5	*Terms of Endearment* (TRS)	Sad	Woman and man in hospital room young woman dies leaving woman and man grieving. (Paramount, 1983).
6	*Hannah and her Sisters* (H1N)	Neutral	Two women talking about an audition in a clothing warehouse. (Orion Pictures, 1989).
7	*Love Story* (LSH)	Happy	A young woman and man playing in a snowy park. They laugh and kiss in the snow (Paramount, 1971).
8	Sticks (ST)	Control	Screen saver film showing sticks moving across the screen with music (New Stories [Highway Blues] – Marc Seales).
9	*Along for the Ride* (RSN)	Sad	A woman is talking to a man about her dead son and cries when asked his name. (Millennium Films, 2000)
10	*All the Presidents Men* (PM1N)	Neutral	Two men are talking to each other in a courtroom (Warner Bros/Wildwood, 1976).
11	*Pretty Woman* (PWH)	Happy	Woman in a flat then a man comes with flowers, climbs up and kisses the woman. (Walt Disney Studio, 1990).
12	Sticks	Control	Screen saver film showing sticks moving across the screen with music (New Stories [Highway Blues] – Marc Seales).
13	*Love Story (LSS)*	Sad	A sick woman in bed talking to a man about death and funerals. (Paramount, 1971).
14	*Invitation to the Wedding* (LFH)	Happy	A man and a woman laughing in a boat, then fishing then riding together. (Pegasus Entertainment, 1983).

Extended Positive and Negative Affect Schedule (PANAS X).

PANASX (Watson and Clark, 1994) was employed to self rate two broad high order traits (negative affect or positive affect) and eleven specific lower level traits of the participants. The scale was successfully employed in behavioural study two and consists of a number of words and phrases that describe different feelings and emotions, thus provides for mood measurement at two different levels. The adjectives comprising each of the PANAS X scales are shown in chapter three, Table 8. As in behavioural study two participants were instructed to read each adjective and then mark the appropriate answer in the space next to that word (see Appendix 3). They were asked to indicate to what extent they felt this way in general on a five point scale (1 very slightly or not at all, 2 a little, 3 moderately, 4 quite a bit and 5 extremely). The sixty items were, in the order indicated, cheerful, sad, active, angry at self, disgusted, calm, guilty, enthusiastic, attentive, afraid, joyful, downhearted, bashful, tired, nervous, sheepish, sluggish, amazed, lonely, distressed, daring, shaky, sleepy, blameworthy, surprised, happy, excited, determined, strong, timid, hostile, frightened, scornful, alone, proud, astonished, relaxed, alert, jittery, interested, irritable, upset, lively, loathing, delighted, angry, ashamed, confident, inspired, bold, at ease, energetic, fearless, blue, scared, concentrating, disgusted, shy, drowsy and dissatisfied with self.

Self-Assessment of Emotional Reaction.

The inventory for the self assessment of emotional reaction was the same as the behavioral studies and consisted of seventeen self report items (see chapter three, Appendix two). However, in contrast to the behavioral studies the participants rated the film clips during a second viewing but were asked to rate how they felt the first time they viewed the clips in the scanner. Hence, the self assessment instructions differed from the behavioral studies with participants asked to write down how they felt while watching the film clip **in the scanner** on a 0-8 scale (0 indicated not at all and 8 indicated a great deal). For the 1 bipolar rating participants were asked to rate whether **in the scanner** they felt the film clip was unpleasant (0) or pleasant (8). In addition, one item asked participants if they had seen the film before and 1 item asked whether they had looked away during any part of the clip whilst viewing the film **in the scanner**.

The participants were allowed 45 seconds to complete the emotion related inventory after each film clip at the second viewing.

4.3 (c), Experimental Design.

The experiment was a block design, whereby each 90 second film clip was presented in order to measure the Blood Oxygenation Level Dependent (BOLD) changes in blood properties, an indirect measure of neuronal activity, in a discrete epoch of time.

The "blocked" task paradigm is one of the most commonly used fMRI experimental models, whereby the signal acquired during one blocked condition is then contrasted to other blocks involving dissimilar task conditions. A blocked procedure was chosen as the regions of activity that change between one film condition and another can be identified with considerable statistical power (Friston, Jezzard and Turner, 1994). The block design included both *loose* and *tight* condition comparisons (Donaldson and Buckner, 2001) in order to test the fore-mentioned hypotheses. The tight comparison - emotionally neutral film clips - aimed to hold as many extraneous variables constant across the tasks. Whereas, the loose comparison - sticks control film clip - was not closely matched but employed a broad screen comparison across the tasks. The merits of employing both tight and loose comparisons in the block design are that multiple associations can become apparent. Inasmuch as, the closely matched (emotion social film clips contrasted to emotionally neutral social film clips) conditions will reveal BOLD changes that differ in relation to the emotional content of the social film clips. Whereas, the loosely matched (sticks control film clip contrasted to social film clips) condition will reveal the entire set of BOLD regions activated when viewing the social films.

The film clips and sequence of the final fMRI blocked design depended on three factors: the picture and sound quality evaluation undertaken in the scanner; regulation of the film clips in order to avoid carryover effects; and the differential pattern of response observed due to the design of behavioral study one. Problematical in behavioral study one was groups A/B viewed three sad film clips but only two happy film clips and this seemed to significantly influence the PANAS and valence ratings. Consequently, the final fMRI blocked design included two surplus emotion film clips. With a sad film clip shown first to familiarise participants with their surroundings and with the requirements of the experiment and a happy film shown as the final clip in order to balance the study design. These clips (one and fourteen in Table 13) were not used in the final fMRI analysis but behavioral data for these films were collected. Similarly, the sticks control film shown with music, in order to loosely match the other conditions, was included three times (clips two, eight and twelve in Table 13) for reasons of symmetry. Finally, the films sequence was alternate in order with an emotion film always preceding a neutral or sticks control film so no two emotion films followed each other in order to avoid carryover effects (Hutcherson et al, 2005).

The final design also included two instructional cues - ten seconds in total - before each film clip. These cues instructed participants on the order of the film for comprehensibility and instructions to remind them to respond as naturally as possible to the clip (e.g. Just look and respond as naturally as possible).

In order to assess whether scanner participants observations of the film clips were analogous to the behavioural study participants a second viewing of the film clips for the scanner participants was organised and self-report data collected. However, due to major problems in organizing a second viewing and collecting the self report data from the first nine participants completing the self-report questionnaire straight after the scan - although not ideal - was instigated for the remaining 34 participants.

An example of the first section of the final experimental design is shown in Figure 13.

Figure 13: An example of the fMRI Film Sequence and Time Line of Events shown in Seconds.

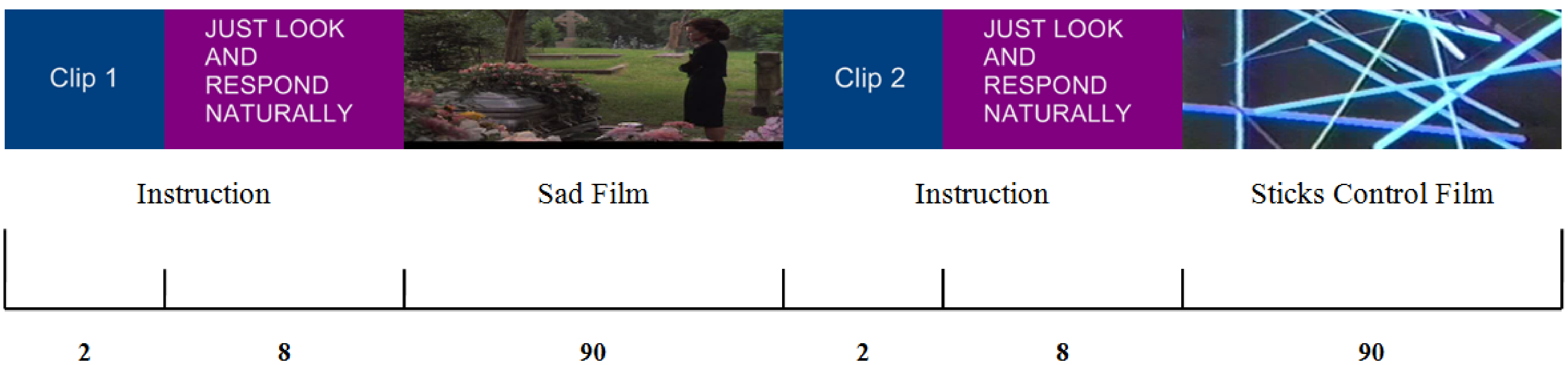


Figure 13 is an example of the time line of events shown in seconds. The films were alternate in order with an emotion film always preceding a neutral or sticks control film so no two emotion films followed each other.

4.3(d) Procedure.

Between four and two weeks prior to the viewing the film clips participants completed and returned the extended positive and negative affect schedule (PANAS X) (Watson and Clark, 1994).

fMRI poses no known health risks (Jacobson, Roberts, Berns and McGlinchey, 1999); however, the use of human subjects in this type of experiment requires great awareness to safety and participant welfare. Consequently, all participants were given written information regarding the fundamental principles of fMRI, requirements for entering the MRI environment and scanning procedure. A two stage procedure was implemented with the initial screening prior to the scanning session; allowing participants to thoroughly review the information sheet ask any questions about the procedure and carefully consider their involvement. This was followed by receipt of written informed consent by the participants. The second screening procedure was employed just before the scanning session began to again review participant fitness. See Appendix 5 for copies of material used.

Inside the MR Scanner all participants were shown the 14 film clip series of happy, sad, emotionally neutral and control film clips in a single functional run (see Table 13 for film order). Participants viewed the films without making ratings. As previously stated, however, two instructional cues were shown before each film clip to inform participants of the order of the film and to respond as naturally as possible to the clip.

Immediately following the first viewing of the film clips in the scanner, 34 participants then had a second viewing of the film clips shown on a 15” Sony Vaio laptop in a room separate from other participants. During this second viewing participants completed the self-assessment inventory recording how they felt the first time they viewed the clips in the scanner.

Following both film set presentations and completion of the questionnaire all participants were thanked for their time, debriefing and provided with information about the study. See Appendix 5 for copies of material used.

4.3 (e) Ethical Considerations.

The research was carried out in accordance with Brunel University's ethical guidelines and measures for research involving human participants (http://intranet.brunel.ac.uk/registry/minutes/researchethics/ethicsguidelinesv2.pdf). Administration of the fMRI experiments was in accordance with the Rules of Operation of the Combined University's Brain Imaging Centre (CUBIC) and was given ethical approval by the Research Ethics Committee of the Brunel University School of Social Sciences (see Appendix 4).

It was made apparent to all participants that the fMRI experiment was for research purposes only and should not be a replacement for medical opinion. The nature of the study was thoroughly explained and informed consent obtained. Participants were informed of the emotional nature of the films used but it was emphasised that all the films shown were rated by the British Board of Film Classification as suitable for persons aged 15 or over. Nevertheless, if participants felt at all uncomfortable during the experiment they could withdraw at any time.

These experiments were conducted in accordance with all the principles outlined in the British Psychological Association Code of Ethics and Conduct (August 2009); http://www.bps.org.uk/what-we-do/ethics-standards/ethics-standards

4.3(f) fMRI Image Acquisition.

Imaging was performed using a 3 Tesla Siemens Trio MRI scanner with an 8 channel array head coil and MR compatible head phone, made by "MR Confon". The scanner is jointly owned and run by Brunel University, Royal Holloway College, Roehampton

University and the University of Surrey, Guilford and housed at Royal Holloway College London and provides research-dedicated MRI facilities.

Participants were positioned supine in the scanner and a MR compatible head phone fitted, the head was then supported to minimise movement. An alarm buzzer was placed near the participant's right or left hand, and communication between the examiner and participants was facilitated via an intercom system. In case of an emergency, or breakdown in communication, this alarm button was available to the participant in the scanner at all times.

The scanner operated a ***liquid crystal display*** projection system (Sanyo projector: PLC-XP40L) that transmitted the film stimulus onto a screen situated behind the participants' head. A mirror mounted in participants' visual field – viewing distance about 88 cm – then reproduced the film stimulus from the screen. The picture and sound presentation was controlled from a Sony Vaio laptop computer connected to the scanner. The laptop displayed directly onto the projector with no intervening software.

For each functional run, an ultra fast echo planar gradient echo imaging sequence sensitive to blood-oxygenation-level-dependent (BOLD) contrast was used to acquire slices per TR (3-mm thickness). The following parameters were used; TR = 4000 ms, TE = 35 ms, flip ANGLE = 90°. Four hundred and twenty whole brain volumes were collected per participant. Post functional image acquisition, high resolution (1x1x1 mm), whole brain, T1-weighted structural images for each participant were acquired using a standard three dimensional sequence. Anatomical images were acquired using an MP-RAGE three dimensional T1-weighted, gradient echo sequence (Mugler and Brookeman, 1990).

4.3(g) fMRI Image Analysis.

Statistical parametric mapping software (http://www.fil.ion.ucl.ac.uk/spm/doc/) was used for the statistical processing. Statistical Parametric Mapping (SPM) refers to the formation and assessment of spatially extended statistical processes used to test hypotheses about, amongst others, functional imaging data and is implemented in MATLAB (The MathWorks, Inc). SPM software is freely available and an analysis method that is commonly used across imaging studies. The latest version (SPM8) released in April 2009 was used. Preceding statistical analysis, the data was outputted from the scanner in Digital Imaging and Communications in Medicine (DICOM) format - a standardized medical image - and converted using SPM8 to Neuroimaging Informatics Technology Initiative (NIFTI) data format (http://nifti.nimh.nih.gov/); the default file format in SPM 8.

The formatted DICOM images, acquired from the same subject, were realigned using a least squares approach and a 6 parameter (rigid body) spatial transformation. The primary aim of this process was to remove movement artefact, with the first image in the list used as a reference to which all subsequent scans were realigned. For each subject details of the transformation were displayed in a SPM8 results window as plots of translation and rotation. Where translation was greater than 2 mm and/or more than 2° rotation during acquisition, the participant data set was discarded. This resulted in the elimination of two participants' data.

The remaining functional images were co-registered with the T1 image, spatially normalised into standard space, re-sampled to 3x3x3 mm voxels and smoothed with a Gaussian kernel of 6mm full width at half maximum (FWHM). The T1 images were spatially normalised and resampled to 1x1x1 mm voxels. The fMRI time series in each voxel of the functional image was high pass filtered to 1/128 Hz.

4.3 (h) Statistical Analysis of fMRI Data.

Analyses of BOLD responses in a *tight* and *loose* condition were conducted using a conventional block contrast approach. The unit of design blocks were specified in seconds. Initially, analysis was performed on the total run time (90 seconds) of the film clips. Then, to further assess the social emotion element the final 45 seconds of the social emotion film clips were assessed. The reason for choosing these sections is they included the most emotional scenes with actors and actresses crying, hugging or embracing.

For the block analysis reference vectors were coded 1 and -1 to compare BOLD responses for three happy or three sad film clips versus three neutral or three control sticks film clips. The reported significant changes in activation are based on the following criteria. Based on mainly SPM8 pre-selected parameters and a voxel-wise threshold of $p < .001$ in whole brain analyses.

Building on the output of SPM in generating individual participant contrast maps an independent one sample second-level *t* test was conducted to produce random effects group *t* maps. Block contrast analyses of the group then identified regions displaying significant activation associated with passive viewing of happy or sad films in a *tight* or *loose* condition.

Independent two sample second-level *t* tests between Non- European and European groups were conducted to identify areas demonstrating a significant different impact when passively viewing happy or sad films in a *tight* or *loose* condition. Likwise, Independent two sample second-level *t* tests between various PANAS X groups were also conducted.

4.4 Results.

4.4 (a) Behavioral Results.

In behavioural studies one and two the participants viewed the film in a classroom then immediately rated the clips in groups of approximately 30 to 50 students. The scanner participants viewed the film clips in discomforted conditions (lieing vertically and told to remain still at all times) and rated the film clips retrospectively at a second individual viewing. Hence, observation checks were performed on scanner participants' emotion rating profiles of the film clips to see if they followed a pattern similar to the behavioural participants. The means and standard deviations of all scanner participant ratings are presented in Table 14.

A visual examination of the data revealed that the emotion rating profiles of the film clips for the scanner participants followed a similar pattern to the behavioural participants. As in behavioural studies one and two the scanner participants data reveals that the rating of the emotions “amusement”, “happiness”, “joy” and “love” were higher for the positive film clips than for the negative film clips, but were comparable for each positive film clip. In addition, the rating of the emotion “sadness” was higher for the negative film clips than for the positive film clips, but was comparable for each negative film clip (see Table 14). In contrast to the behaviour studies the positive film clip that received the highest positive rating was “happy” in OGH (M = 5.24, SD = 2.04). In addition, for the scanner group two negative film clips received the same high negative rating for “sad” TS (M = 5.43, SD = 2.43) and RS (M = 5.43, SD = 2.22).

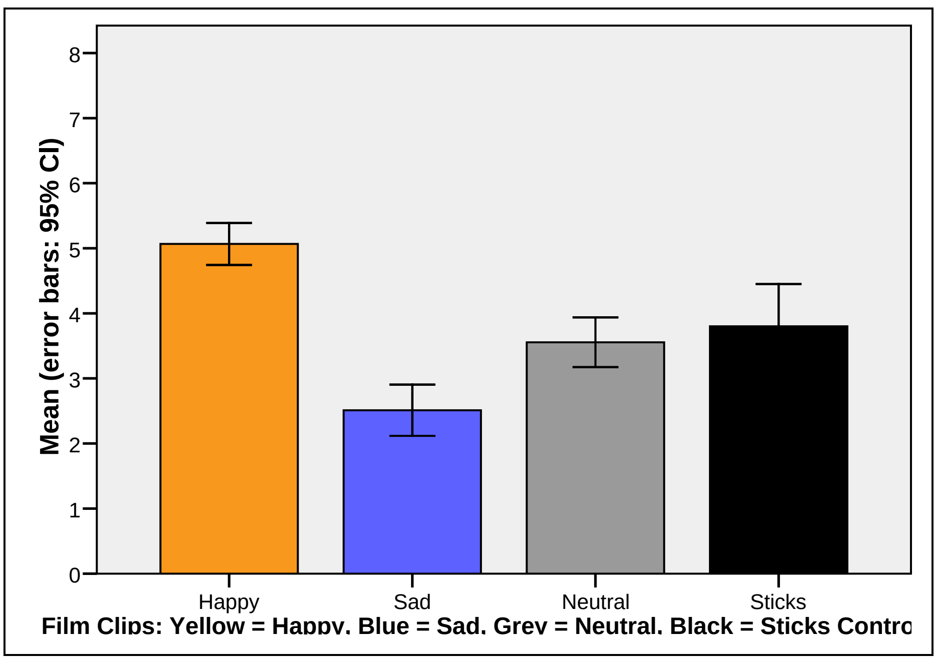
Table 14: Means and Standard Deviation of Film Ratings.

Film Clip (emotion)	**Amuse**	**Anger**	**Anxiety**	**Conf.**	**Disgust**	**Emb.**	**Fear**	**Happy**	**Interest**	**Joy**	**Love**	**Pride**	**Sad**	**Surprise**	**Valence**
An Officer and a Gentleman (OFH)	4.30 1.95	0.3 0.84	0.53 1.16	1.10 1.66	0.4 1.32	1.03 1.49	0.17 0.76	5.24 2.04	4.53 2.23	4.9 2.26	3.8 2.96	1.4 1.99	0.17 0.46	1.7 1.66	6.0 1.5
All the Presidents Men (PM2N)	0.66 1.37	0.4 1.07	0.6 1.4	4.97 2.37	0.24 0.69	0.17 0.46	0.13 0.43	0.4 1.10	2.3 2.3	0.43 1.07	0.3 1.11	0.36 1.29	0.2 0.48	0.75 1.55	3.63 1.35
Terms of Endear. (TRS)	0.16 0.74	1.13 1.74	2.16 2.06	1.76 1.9	0.5 1.0	3.0 0.87	1.14 1.66	0.2 0.55	3.56 2.34	0.13 0.51	1.03 1.51	0.17 0.59	5.43 2.43	1.67 2.2	2.13 1.38
Hannah & Her Sisters (H1N)	1.8 1.95	0.77 1.63	0.6 1.3	1.86 2.01	0.3 0.7	1.13 2.16	0.13 0.57	0.96 1.51	2.56 2.16	0.56 1.25	0.23 0.89	0.4 1.24	0.87 1.5	1.13 1.77	3.83 1.49
Love Story (LSH)	4.73 1.87	0.23 0.62	0.26 0.86	0.60 1.10	0.40 1.30	0.90 1.60	0.06 0.36	5.23 2.19	4.16 2.00	4.83 2.42	3.96 2.53	0.90 2.05	0.43 1.07	1.20 1.78	6.0 1.57
Sticks 1. (S1)	2.06 2.06	0.43 0.89	0.60 1.00	2.73 2.88	0.06 0.36	0.67 0.36	0.10 0.40	1.86 2.23	2.16 2.27	1.66 2.15	0.30 0.83	0.27 1.16	0.10 0.30	1.86 2.25	3.93 1.92
Along for the Ride (RS).	0.53 1.47	0.96 1.47	2.03 2.18	1.26 1.82	0.36 1.06	0.43 0.81	0.50 1.43	0.40 1.22	3.80 2.10	0.43 1.25	1.86 2.11	0.33 0.75	5.43 2.22	1.03 1.56	2.83 1.31
Presidents Men 1 (Neutral)	0.93 1.04	0.56 1.33	0.46 0.97	3.70 2.21	0.36 0.96	0.26 0.82	0.10 0.41	0.43 1.16	1.90 1.81	0.30 1.12	0.13 0.57	0.16 0.59	0.37 0.96	0.90 1.62	3.20 1.21
Pretty Woman (Happy).	4.23 2.14	0.13 0.43	0.36 0.96	0.27 0.95	0.24 0.95	0.86 1.25	0.10 0.40	5.03 1.86	4.30 2.10	4.20 2.65	3.66 2.96	1.20 2.07	0.16 0.46	1.20 1.64	6.03 1.38
Sticks 2. (S2)).	1.43 2.08	0.46 0.86	0.90 1.86	1.90 2.53	0.06 0.25	0.07 0.25	0.03 0.18	1.50 2.41	1.56 1.96	1.36 2.20	0.37 1.07	0.37 1.45	0.13 0.43	1.10 1.95	3.66 1.88
Love Story (Sad).	0.47 1.07	0.96 1.47	1.66 1.67	2.00 2.05	0.33 0.84	0.23 0.63	1.06 1.66	0.23 0.50	2.83 2.16	0.37 1.27	1.80 2.45	0.23 0.97	4.50 0.90	0.90 1.70	2.57 1.22

Note: Standard Deviations in parentheses.

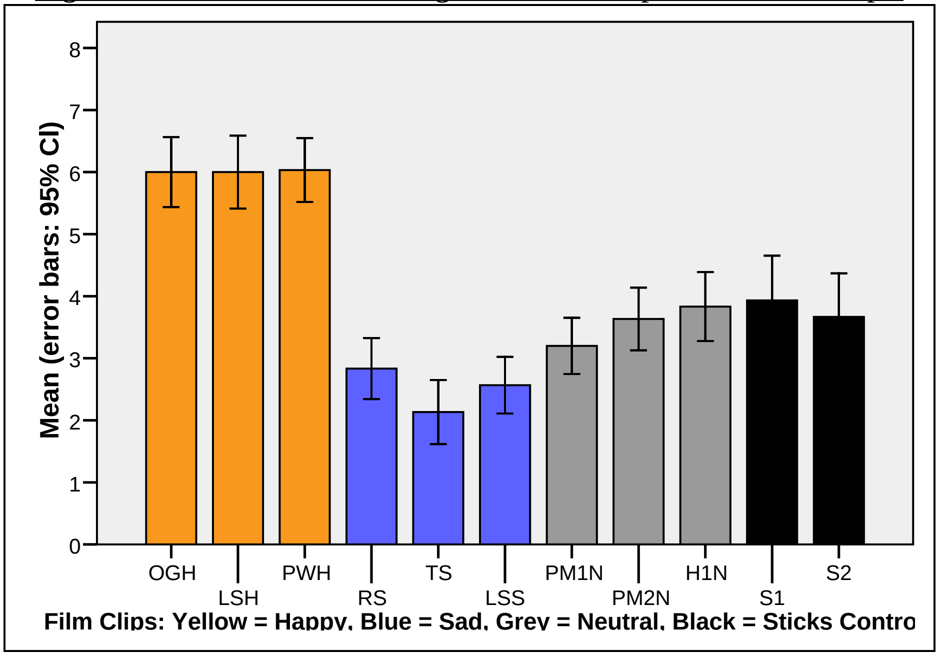
To view whether the film clips verified as happy were more pleasant than the film clips verified as neutral, or control, which in turn were rated as more pleasant than the film clips verified as sad, the average of the bipolar rating Valence (pleasant – unpleasant) was computed across all positive, negative, neutral and control film clips (see Figure 15). The average mean valence rating for happy clips (M = 5.07, SD = 0.86) sad clips (M = 2.51, SD = 1.06) and neutral clips (M = 3.56, SD = 1.02) followed behavioural studies one and two verification. Interestingly, the Control Sticks film clips (M = 3.80, SD = 1.74) were rated as less pleasant than the happy film clips but rated as more pleasant than the neutral clips featuring a human figures in a social exchange (see Figure 15).

Figure 15: Mean Valence for all Film Clips for fMRI Group.



The valence rating profiles of the individual film clips also differed from each other and again followed a pattern very similar to the two Behavioural studies (see Figure 16).

Figure 16: Mean Valence Rating of all Film Clips for fMRI Groups.



Note: Mean and Standard Deviations OGH (M = 6.00, SD = 1.50), LSH (M = 6.00, SD = 1.57), PWH (M = 6.03, SD = 1.37), RS (M = 2.83, SD = 1.310), TS (M = 2.13, SD = 1.38), LSS (M = 2.56, SD = 1.22), PM1N (3.20, SD = 1.21), PM2N (M = 3.63, SD = 1.35), H1N (M = 3.83, SD = 1.48), , S1 (M = 3.93, SD = 1.92) and S2 (M = 3.66, SD = 1.88).

A visual inspection of the monopolar items "confusion" and "interest" showed that as in the Behavioural Studies the fMRI participants also differentiated between the film clips and showed an identifiable pattern across the positive, negative and neutral films. As expected the Control Sticks clip were the least interesting film, but was rated as less confusing than the neutral films (see Table 15).

Table 15. Averaged means and standard deviations of "confusion" and "interest"

Target Films	**fMRI Group** **Mean (standard deviation)**
Interest Positive Films	4.33 (1.87)
Interest Negative Films	3.40 (1.92)
Interest Neutral Films	2.26 (1.74)
Interest Control Films	1.87 (1.94)
Confusion Positive Films	0.66 (0.94)
Confusion Negative Films	1.68 (1.47)
Confusion Neutral Films	3.51 (1.71)
Confusion Control Films	2.32 (2.59)

To gauge whether the ethnic origin of scanner participants orientated engagement with the film clips the averages of the monopolar rating "interest" across all positive, negative, neutral and control film clips were assessed. Figure 17 shows the mean "interest" rating of African, Asian and European fMRI participants for the collective positive, negative, neutral and control film clips showing a pattern comparable to the behavioral studies.

Figure 17: Mean "Interest" Rating of Film Clips and Ethnic Origin.

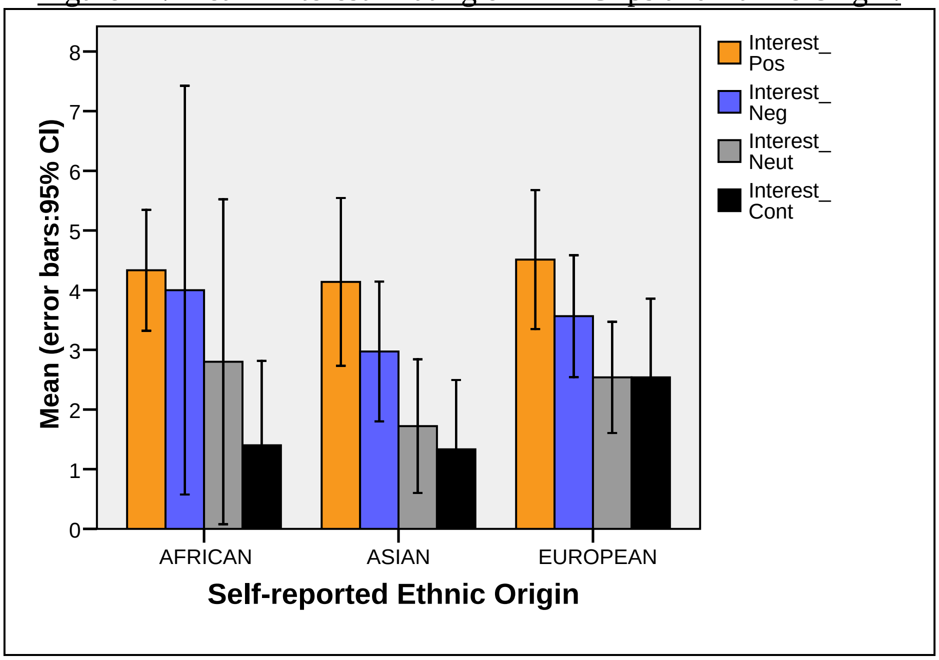
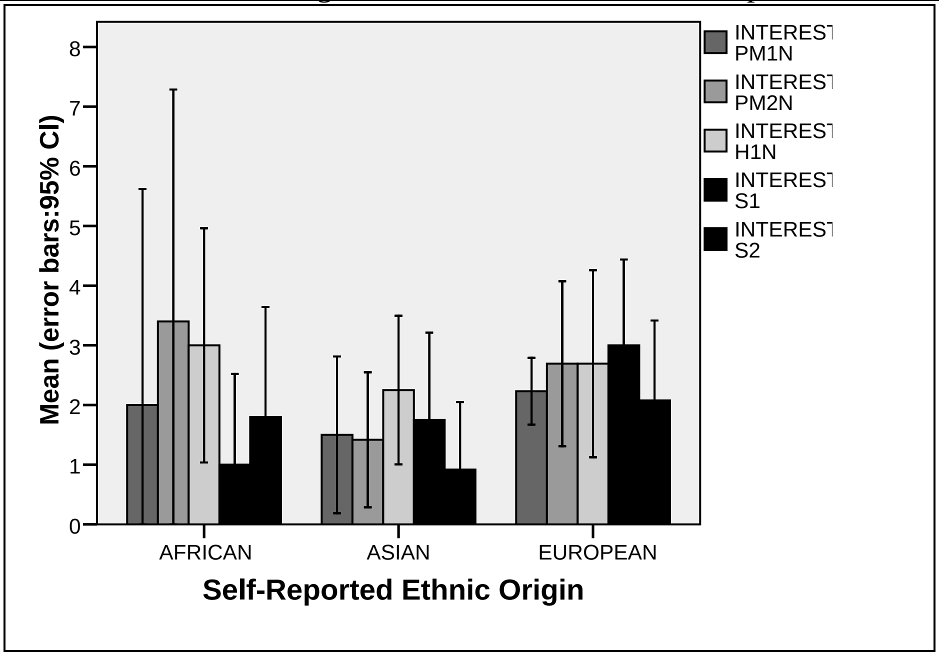


Figure 18 below shows the mean "interest" rating of African, Asian and European scanner participants for the individual neutral and control sticks film clips. A visual inspection of the mean ratings for "interest" across these clips reveal the diverse scores between the groups but - as verified in behavioral study two - the European group has the least variable scores for neutral film clips.

Figure 18: Mean “Interest” Rating of Neutral and Control Film Clips and Ethnic Origin



The means and standard deviations presented indicate that despite the differences in viewing and rating the film clips the emotion self report profiles for the behavioural and fMRI participants followed a similar pattern. Consequently, these observations support the fMRI results presented below as representative of happy and sad social emotion.

4.4 (b) fMRI Results.

A general premise throughout this investigation is that the prefrontal cortex, amgydala and anterior cingulate cortex are key regions when social factors are the causation and constitution of positive and negative emotions. Additionally, that a contemporary model of emotion should value the distinctions made by the brain, for empirical and theoretical consistency. Consequently, as mentioned in the Introduction, the results section will predominantly concentrate on the significant activation present in frontal and limbic regions. Nevertheless, when comparing film stimuli, which has distinct visual and auditory variability, responses in the visual (Brodmann areas 8, 17, 18, 37), somatosensory (Brodmann areas 3, 5), motor (Brodmann area 6, 4) and auditory (41, 42,

22) regions are to be expected.

As point out in chapter 4.3,c the experiment is a block design that includes both *tight* and *loose* condition comparisons in order to answer the aforementioned hypotheses. Hence, the initial analyses hopes to reveal the neural correlates activated when social meanings are the causation and constitution of positive and negative emotions. Further analyses hope to reveal the neural correlates activated for more general positive and negative social and emotional factors. Accordingly, the block results presented for happy films versus emotionally neutral films are viewed as brain regions activated in a *tight* positive condition and in part reflect the happy social emotion aspect of the films (PSE). With, the block results presented for sad films versus emotionally neutral films viewed as brain regions also activated in a *tight* sad condition and in part are viewed as a reflection of the sad social emotion aspect of the films (NSE). Similarly, the results presented for happy films versus the control stick film are viewed as brain regions activated in a *loose* positive condition and reflect the entire set of regions activated when viewing happy films (PG). With, the results presented for sad films versus control stick film viewed as brain regions activated in a *loose* sad condition and reflect the entire set of regions activated when viewing sad films (NG). Whether, self-reported ethnic origin or stable mood influence neural responses was also hypothesized. Thus, independent two sample second-level *t* tests between European in comparison to non-European groups were also conducted for PSE, NSE, PG and PN. Similarly, independent two sample second-level *t* tests between various PANAS X groups were also conducted on the above contrasts.

As stated in the Introduction negative affect is more widely researched than positive affect so a main aim of this investigation was to assess both positive and negative social emotions. Furthermore, it is important to reiterate that a further objective was to study and compare differences in activations between the happy and sad social films. Accordingly, the results section has been structured that firstly happy and sad film results for all participants are presented, followed by the happy and sad results for European versus Non-Europeans and finally PANAS X high mood groups versus PANAS X low mood groups.

4.4 (b)i. Bold Responses for All Participants: PSE and NSE design One.

Firstly to assess the BOLD responses for all participants and PSE a second- level one sample *t* test was conducted on Block Design One. For all 39 participants viewing the happy vs. neutral film clips activated regions of left and right superior and right middle temporal cortex, left and right occipital lobe/precuneus and several other regions (see Table 18 and Figure 17A).

Table 18: BOLD activation to Happy (versus neutral) film clips all Participants whilst viewing Block Design One (90 seconds clips).

Brain Region	**Brodmann Area**	**Z value**	**Size (voxels)**	***X***	***y***	***z***
Left Superior temporal gyrus	22	Inf	1539	-63	-16	4
Left Superior temporal gyrus	22	7.33		-60	-34	7
Left Superior temporal gyrus	41	7.13		-51	-22	7
Right Superior temporal gyrus	22	Inf	1874	63	-16	1
Right Superior temporal gyrus	41	7.30		51	-37	13
Right Middle temporal gyrus	22	6.79		66	-25	1
Left Occipital Lobe/Precuneus	31	6.26	1155	-15	-61	22
Right Occipital Lobe/Precuneus	31	5.87		18	-58	22
Right Parahippocampal Gyrus	30	5.79		15	-37	-8
Right Cerebellar Tonsil		5.94	212	6	-52	46
Declive		5.52	147	0	-70	-20
Anterior Lobe/Culmen		4.38		0	-64	-8
Anterior Lobe/Culmen		4.30		0	-55	-26
Left Precentral Gyrus	6	4.53	19	-48	-7	55
Left Fusiform Gyrus	37	4.46	20	-42	-55	-17

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise p < .001, uncorrected, k = 5.

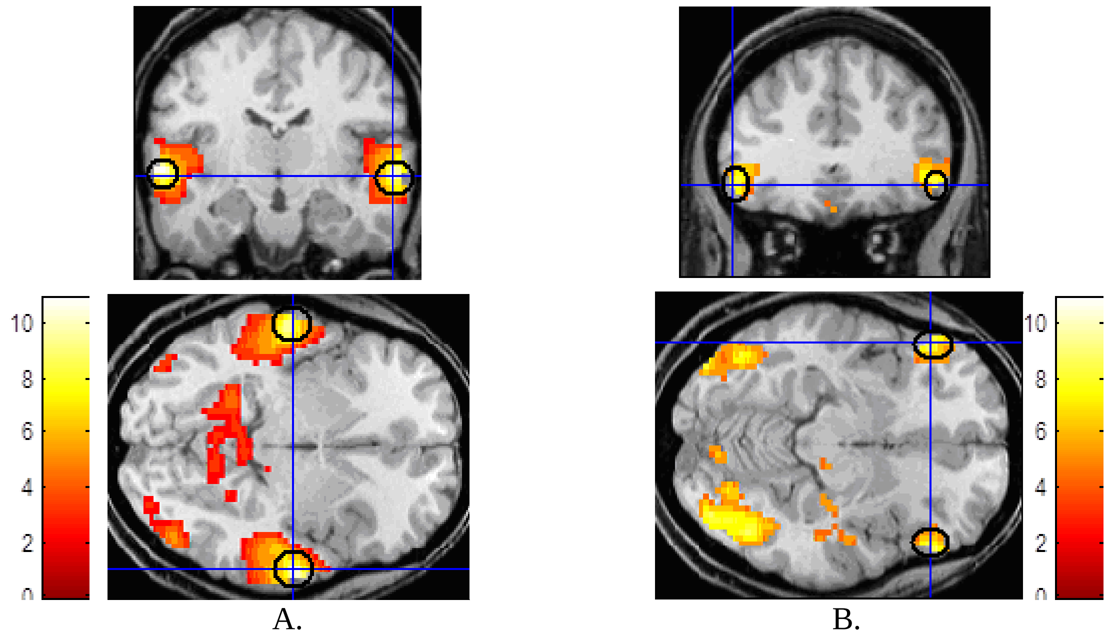
Secondly, to assess the BOLD responses of all participants and NSE a second- level one sample *t* test was conducted on Block Design One. For all 39 participants viewing the sad vs. neutral film clips the regions activated were very different to the above all participants PSE analysis. With BOLD responses for NSE observed in left and right superior temporal cortex, orbitofrontal cortex, left Amygdala, right and left pulvinar thalamus and several other regions (see Table 19 and Figure 17B).

Table 19: BOLD activation to Sad (versus neutral) film clips all Participants whilst viewing Block Design One (90 seconds clips).

Brain Region	Brodmann Area	z Value	Size (voxel)	X	y	Z
Right Middle Occipital Gyrus	18	6.04	1129	21	-91	13
Right Inferior Temporal Gyrus	20	5.96		39	-64	-8
Right Fusiform	37	5.79		48	-58	1
Right Putamen		5.84	309	27	-7	-17
Right Superior Temporal Gyrus	38	5.59		42	5	-20
Right Sub-Gyral	21	4.87		42	-4	-14
Left Superior Temporal Gyrus	38	5.09	69	-45	5	-20
Left Superior Temporal Gyrus	38	3.65		-48	5	-11
Left Superior Temporal Gyrus	38	3.64		-51	17	-32
Left Inferior Frontal Gyrus	47	5.06	127	-51	29	-5
Left Middle Frontal Gyrus	47	4.95		-45	32	1
Left Inferior Frontal Gyrus	47	3.19		-36	23	-11
Right Inferior Frontal Gyrus	47	5.00	103	54	32	-5
Right Inferior Frontal Gyrus	45	4.14		60	23	7
Left Inferior Occipital Gyrus	18	4.76	330	-39	-85	-5
Left Middle Temporal Gyrus	37	4.69		-45	-67	-5
Left Middle Temporal Gyrus	19	4.49		-57	-64	13
Right Superior Frontal Gyrus	6	4.51	23	9	11	70
Medial Frontal Gyrus	11	4.22	13	0	38	-14
Medial Frontal Gyrus	11	3.54		0	29	-17
Right Medial Frontal Gyrus	9	3.95	20	6	53	28
Left Medial Frontal Gyrus	9	3.59		-3	53	25
Left Amygdala		3.91	21	-21	-10	-14
Left Amygdala		3.43		-30	-4	-17
Left Limbic Lobe/Sub-Gyral	28	3.35		-24	-19	-11
Right Thalamus/A. Nucleus		3.87	17	9	-4	7
Left Postcentral Gyrus	5	3.81	17	-30	-43	67
Left Postcentral Gyrus	5	3.39		-24	-43	73
Right Thalamus/Pulvinar		3.79	29	12	-31	4
Right Substania Nigra		3.51		12	-22	-5
Right Thalamus/Pulvinar		3.59		3	-31	1
Right Inferior Frontal Gyrus	45	3.68	8	60	17	25
Left Thalamus/Pulvinar		3.40	5	-12	-34	7

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $p < .001$, uncorrected, $k = 5$.

Fig 17: Comparison of PSE and NSE for All Participants in Block Design One.



HAPPY vs. NEUTRAL. SAD vs. NEUTRAL.

*Note: Figure A. shows circled bilateral Superior Temporal Gyrus (STG) activated by 90 second Happy vs. Neutral film clips (the centre of the cross-hair is the activation peak within the right STG [63 -16 1] see table 18). Figure B shows circled bilateral Inferior Frontal Gyrus (IFG) activated by 90 second Sad vs. Neutral film clips (the centre of the cross-hair is the activation peak within the left IFG [-51 29 -5] Table 19). Activations shown are based on a voxelwise **p** < .001, uncorrected,* **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

4.4 (b)ii. Bold Responses for All Participants: PSE and NSE design Two.

To further evaluate the positive and negative social emotion element the final 45 seconds of the happy and sad film clips was subject to further analysis. The reason for choosing these sections, as stated previously, is that they included the most emotional scenes of an actor and actresses hugging, kissing, embracing or crying.

Accordingly, to further assess the BOLD response for the final 45 seconds and PSE a second- level one sample *t* test was conducted on Block Design Two. Across all 39 participants when viewing the happy vs. neutral film clips around fourteen regions were activated - a number similar to that found in Block Design One. Although, the numbers of activations were similar surprisingly these clusters predominantly differed from the all participants PSE Design One comparision. Amongst the regions activated for PSE and Design Two were right precuneus, left superior and middle occipital cortex, and bilateral cingulate cortex (see Table 20 and Figure 18A).

Table 20: BOLD activation to Happy (versus neutral) film clips across all Participants whilst viewing Block Design Two (45 seconds clips).

Brain Region	Brodmann area	z value	Size (voxels)	X	y	z
Right Occipital Lobe/Cuneus	17	3.97	67	30	-73	28
Right Parietal Lobe/Precuneus	19	3.63		33	-79	34
Right Parietal Lobe/Precuneus	39	3.54		39	-70	34
Left Middle Occipital Gyrus	19	3.89	29	-33	-79	16
Left Superior Occipital Gyrus	19	3.23		-30	-73	25
Right Cingulate Gyrus	31	3.71	8	9	-34	46
Left Cingulate Gyrus	31	3.55	10	-9	-31	43
Left Cingulate Gyrus	31	3.47		-15	-37	40
Right Fusiform Gyrus	37	3.54	23	48	-70	-5
Right Middle Temporal Gyrus	39	3.49		48	-76	7
Right Anterior Cingulate Gyrus	24	3.44	8	3	-7	40
Left Superior Occipital Gyrus	39	3.41	7	-33	-79	31
Right Parietal Lobe/Precuneus	7	3.38	9	15	-79	49
Right Superior Parietal Lobule	7	3.26		21	-73	52

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected**,** $\boldsymbol{k} = 5$.

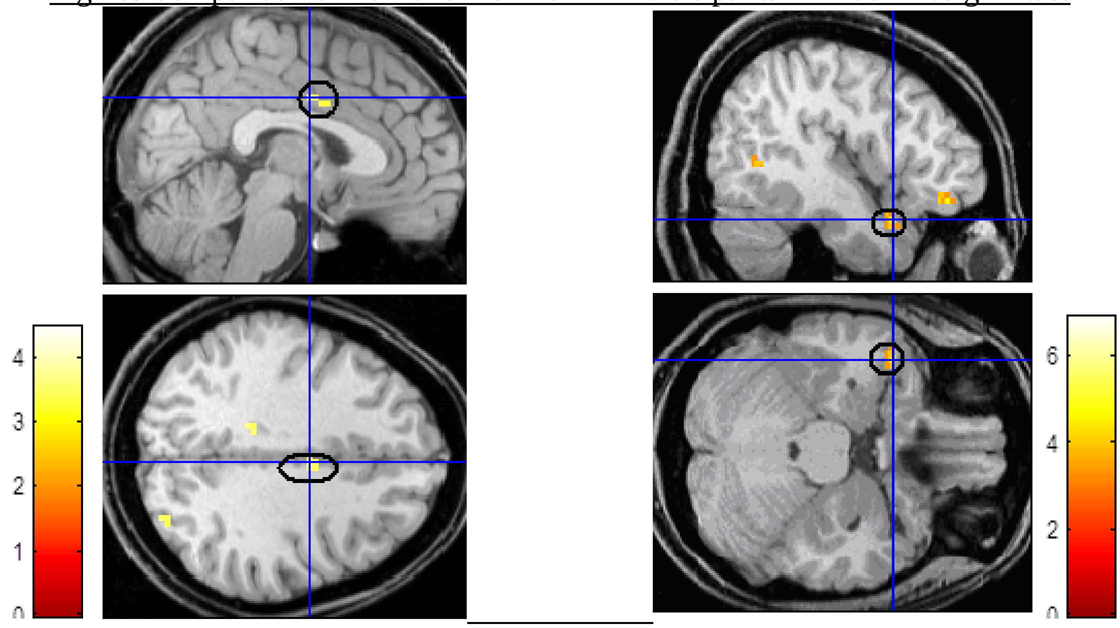
Similarly, to further evaluate the BOLD response and NSE for the final 45 seconds a second- level one sample *t* test was conducted on Block Design Two. In comparison to the above PSE contrasts (similar number but mainly differnt regions activated between Block Design One and Two) for all 39 participants when viewing the final 45 seconds of the sad vs. neutral film clips far fewer regions were activated than in the 90 second comparison. Certain regions activated by Block Design Two were similar to Block Design One, however, like PSE Block Design One and Two, many regions were dissimilar such as left orbitofrontal cortex, left medial frontal cortex and left insula (see Table 21 and figure 18B).

Table 21: BOLD activation to Sad (versus neutral) film clips all Participants whilst viewing Block Design Two (45 seconds clips).

Brain Region	Brodmann area	z value	Size (voxels)	X	y	z
Right Occipital Lobe/Cuneus	19	5.52	197	12	-94	22
Right Lingual Gyrus	18	5.07		9	-76	1
Right Superior Parietal Lobule	5	4.59	45	24	-46	67
Right Inferior Parietal Lobule	40	4.57	83	66	-37	25
Right Superior Frontal Gyrus	6	4.33	72	6	11	64
Right Superior Frontal Gyrus	6	4.05		12	2	73
Right Middle Temporal Gyrus	21	4.11	45	48	-46	10
Right Superior Temporal Gyrus	22	3.95		54	-52	13
Right Postcentral Gyrus	3	3.87	18	33	-31	55
Left Superior Temporal Gyrus	38	3.86	20	-45	8	-20
Left Superior Temporal Gyrus	11	3.85	14	-45	35	-11
Left Precentral Gyrus	6	3.77	33	-36	-10	58
Left Middle Frontal Gyrus	6	3.44		-36	-4	40
Left Precentral Gyrus	6	3.18		-33	-13	67
Right Inferior Frontal Gyrus	47	3.66	13	51	32	-2
Left Insula	13	3.50	18	-30	23	10
Left Middle Temporal Gyrus	39	3.40	5	-48	-61	10
Left Medial Frontal Gyrus	10	3.19	5	-12	50	16

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $p < .001$, uncorrected, $k = 5$.

Fig 18: Comparison of PSE and NSE for All Participants in Block Design Two.



A. HAPPY vs. NEUTRAL

B. SAD vs. NEUTRAL

Note: Figure A shows circled right anterior cingulate cortex (ACC) activated by 45 second Happy vs. Neutral film clips (the centre of the cross-hair is the activation peak within the right ACC [9 -34 46] Table 20). Figure B shows circled left superior temporal gyrus (STG) activated by 45 second Sad vs Neutral film clips (the centre of the cross-hair is the activation peak within the left STG [-45 8 -20] see Table 21). Activations shown are based on a voxelwise ***p*** *< .001, uncorrected,* **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

4.4 (b)iii. Bold Responses for All Participants: PG and NG Design One.

The BOLD responses viewed as reflecting the entire set of regions activated when viewing happy and sad films was analysed using a second- level one sample *t* test conducted on Block Design One (90 second clips).

The PG contrast for all 39 participants activated regions of right and left middle temporal cortex. For this contrast BOLD activations were also observed in several other regions including the bilateral orbitofrontal cortex and bilateral dorsolateral prefrontal cortex (see table 22 and Figure 19A).

Table 22: BOLD activation to Happy (versus control sticks) film clips all Participants whilst viewing Block Design One (90 seconds clips).

Brain Region	**Brodmann area**	**Z value**	**Size (voxels)**	**X**	**y**	**Z**
Right Middle Occipital Gyrus	19	7.29	4083	48	-76	1
Left Middle Temporal Gyrus	39	6.81		-48	-67	19
Right Middle Temporal Gyrus	39	6.51		54	-67	10
Right Precentral Gyrus	6	4.88	40	42	-7	58
Right Precentral Gyrus	4	3.99		51	-10	55
Right Medial Frontal Gyrus	11	4.52	69	3	44	-14
Left Medial Frontal Gyrus	10	4.38		-9	41	-8
Left Medial Frontal Gyrus	11	4.16		6	29	-14
Left Precentral Gyrus	6	4.17	27	-42	-7	61
Left Middle Frontal Gyrus	46	3.73	12	-42	14	28
Right Middle Frontal Gyrus	46	3.60	14	42	17	28
Right Medial Frontal Medial	9	3.42	11	3	53	31

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected**,** $\boldsymbol{k} = 5$.

Interestingly, the NG contrast for all 39 participants, like the PG contrast, activated regions of bilateral dorsolateral prefrontal cortex (see table 23 and Figure 19B). For this contrast BOLD activations were also observed in several other regions including many auditory and motor regions that had not been observed in the PG all participants analysis

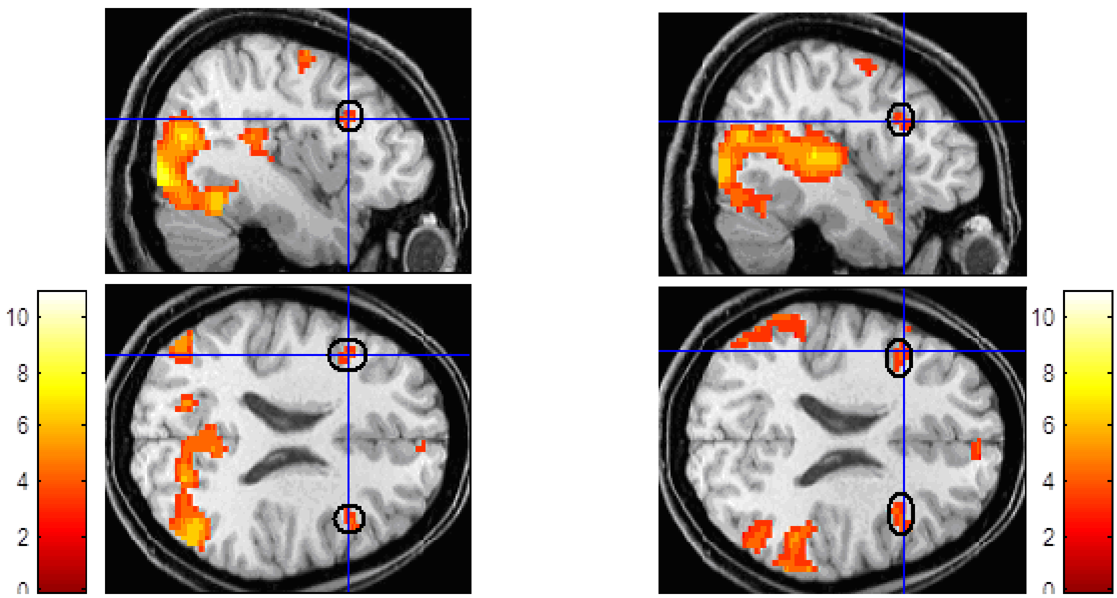
Table 23: BOLD activation to Sad (versus control sticks) film clips all Participants whilst viewing Block Design One (90 seconds clips).

Brain Region	**Brodmann Area**	**Z value**	**Size (voxels)**	**X**	**Y**	**z**
Left Superior Temporal Gyrus	22	7.65	1904	-60	-16	4
Left Superior Temporal Gyrus	41	7.36		-57	-31	7
Left Middle Temporal Gyrus	21	6.93		-60	-10	-5
Right Inferior Temporal Gyrus	18	7.64	2979	45	-79	-2
Right Superior Temporal Gyrus	41	7.41		54	-31	7
Right Middle Temporal Gyrus	22	6.96		54	-43	10
Posterior Lobe/Declive		4.69	80	0	-70	-20
Right Posterior Lobe/Declive		4.60		6	-73	-14
Right Middle Frontal Gyrus	46	4.19	31	42	14	25
Right Superior Frontal Gyrus	6	4.18	9	9	5	73
Left Middle Frontal Gyrus	46	4.16	19	-45	14	28
Anterior Lobe/Culmen		4.07	15	0	-55	-29
Left Precentral Gyrus	6	4.07	20	-48	-4	55
Right Medial Frontal Gyrus	9	3.99	39	3	53	31

Right Medial Frontal Gyrus	9	3.91		6	47	37
Right Inferior Frontal Gyrus	47	3.77	33	51	26	-5
Right Precentral Gyrus	6	3.51	16	51	-1	52
Right Precentral Gyrus	6	3.32		42	-4	46
Right Precuneus	7	3.48	9	6	-55	37
Left Middle Frontal Gyrus	9	3.37	5	-57	17	28
Left Inferior Frontal Gyrus	44	3.35		-57	17	19

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** $<$ .001, uncorrected**,** ***k*** = 5.

Fig 19: Comparison of PG and NG for All Participants in Block Design One.



A.
HAPPY vs. CONTROL.

B.
SAD vs. CONTROL.

Note: Figure A shows circled bilateral dorsal prefrontal cortex (DPFC) activated by 90 second Happy vs. Control sticks film clips (the centre of the cross-hair is the activation peak within the left DPFC [-42, 14, 28] see Table 22). Figure B shows bilateral dorsal prefrontal cortex activated by 90 second Sad vs. Control sticks film clips (the centre of the cross-hair is the activation peak within the left DPFC [-45, 14, 28] see Table 23). Activations shown are based on a voxelwise ***p*** *< .001, uncorrected,* **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

4.4 (b)iv BOLD Responses for European Participants vs. Non-European Participants: PSE and NSE Design One.

Given the suggestion that the emotional response system reacts to ethnic content of film stimuli - with possibly enhanced responding to actors of one's own ethnic group – second level, two sample *t* tests were conducted with one group comprising of self-reported non-European participants (African and Asian) and another group comprising of self-reported European participants.

Firstly, to assess PSE a second- level two sample *t* test was conducted on block design one with group one comprising of 22 European participants (7 males/15 females) and group two 17 Non-European participants (17 females). In comparison to the Non-European participants enhanced BOLD responses were observed for the European participants in several brain regions including left medial orbitofrontal cortex and left anterior cingulate cortex (see Table 24 and Figure 20A). Of particular interest is that all activation clusters, as observed below, occurred in the left hemisphere.

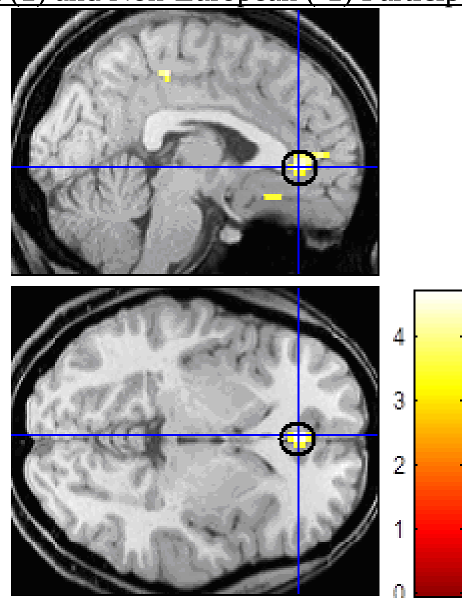
Table 24: Bold Activation to Happy (versus neutral) film clips comparison of European Participants (1) and Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	Z value	Size (voxels)	x	y	Z
Left Anterior Cingulate	24	4.12	32	-3	35	4
Left Anterior Cingulate	32	3.53		-3	47	10
Left Superior Frontal Gyrus	6	4.00	30	-12	17	58
Left Superior Frontal Gyrus	6	3.95		-12	26	55
Left Paracentral Lobule	5	3.85	6	-3	-31	52
Left Middle Frontal Gyrus	6	3.84	5	-27	8	46
Left Posterior Cingulate	30	3.75	12	-9	-49	22
Left Superior Frontal Gyrus	9	3.66	12	-15	41	43
Left Middle Frontal Gyrus	10	3.64	19	-27	41	25
Left Middle Frontal Gyrus	9	3.33		-27	41	37
Left Superior Parietal Lobule	7	3.62	16	-30	-67	46
Left Anterior Cingulate	32	3.62	18	-6	23	-11
Left Anterior Cingulate	32	3.43		-9	32	-8
Left Anterior Cingulate	32	3.39		-15	26	-8
Left Inferior Parietal Lobule	40	3.45	6	-42	-55	40

Left Angular Gyrus	39	3.20	6	-42	-67	34

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected***, k*** = 5.

Fig 20: PSE for European (1) and Non-European (-1) Participants in Block Design One.



A

HAPPY vs. NEUTRAL

Note: Figure A. shows left anterior cingulate (ACC) activated by 90 second Happy vs. Neutral film clips for European participants in contrast to Non-European participants (the centre of the cross-hair is the activation peak within the left ACC [-3, 35, 4] see Table 24). Activations shown are based on a voxelwise ***p*** *< .001, uncorrected***, k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

Likewise, to assess NSE a second- level two sample *t* was conducted on block design one with again group one compromising of 22 European participants (7 males/15 females) and group two 17 Non-European participants (17 females). Surprisingly, in comparison to the Non-European participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5 were displayed for European participants. This result was rather unexpected given the observed left lateralised activation clusters in the previous PSE European<Non-European contrast.

Of particular concern when evaluating the above results is whether the biological sex of participants' skewed these PSE and NSE block design one results, as the European group included 7 males and 15 females, whereas the Non-European group included 17 females only. Consequently, additional two sample second-level *t* test were conducted on block design one with group one comprising of 15 female Europeans and group two 17 female Non-Europeans.

In the PSE analysis, in comparison to the Non-European female participants, enhanced BOLD responses were observed for the European female participants in left anterior cingulate cortex, right medial orbitofrontal cortex, left posterior cingulate cortex and superior frontal cortex (see Table 25 and figure 21A).

<u>Table 25: Bold Activation to Happy films (versus neutral) comparison of Female European Participants (1) and Female Non-European Participants (-1) whilst viewing Design One (90 second clips).</u>

Brain Region	Brodmann area	Size (voxels)	z value	x	Y	z
Left Posterior Cingulate	31	27	4.07	-9	-55	22
Left Anterior Cingulate	32	44	3.99	-3	47	10
Left Anterior Cingulate	24		3.79	-3	35	4
Right Medial Frontal Gyrus	10		3.30	6	50	13
Left Superior Frontal Gyrus	8	7	3.50	-15	26	55
Left Superior Frontal Gyrus	9	5	3.47	-15	41	43

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected, $\boldsymbol{k} = 5$.

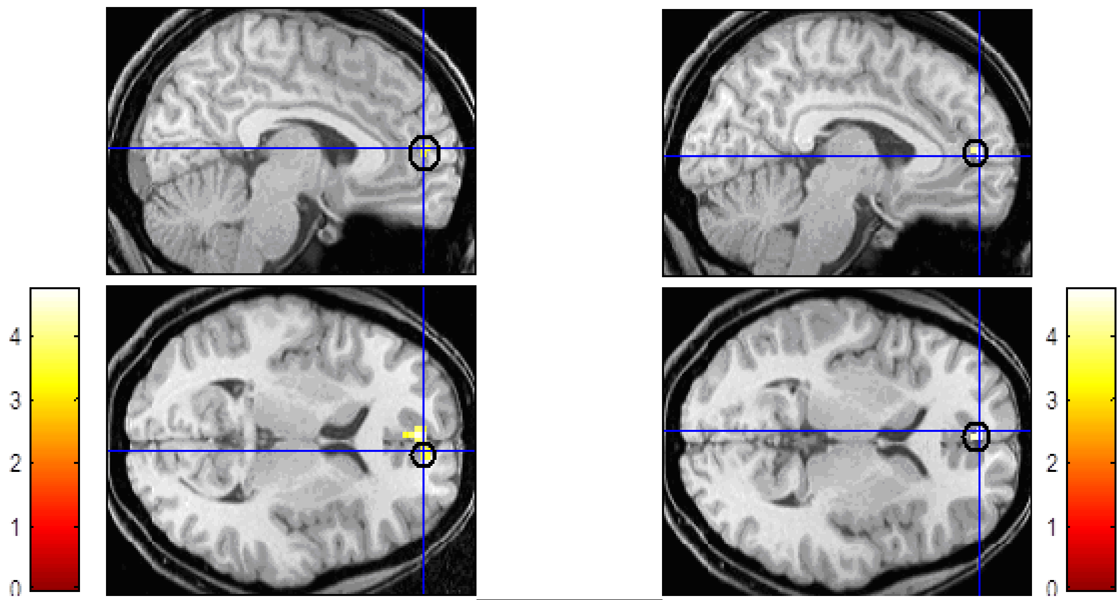
In the NSE analysis, in comparison to the Non-European female participants, an enhanced BOLD response was observed for the European female participants in left medial frontal cortex. This single activation is of particular interest for two reasons: firstly, it is in contrast to the lack of activation clusters observed for the initial European<Non-European NSE comparision; and secondly, the left medial prefrontal cortex stronger BOLD response is almost identical to the area of right medial prefrontal cortex observed in the PSE and European<Non-European female analysis (see Table 26 and Figure 21B).

Table 26: Bold Activation to Sad films (versus neutral) comparison of Female European Participants (1) and Female Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	z
Left Medial Frontal Gyrus	10	3.48	6	-6	50	10

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected**,** ***k*** = 5.

Fig 21: Comparison of PSE and NSE Female-only European (1) and Non-European (-1) Participants in Block Design One.



A.
HAPPY vs. NEUTRAL

B.
SAD vs. NEUTRAL

.

Note: Figure A. shows circled right medial cortex activated by 90 second Happy vs. Neutral film clips for female European participants in contrast to female Non-European participants (the centre of the cross-hair is the activation peak within the right medial cortex [6, 50, 13] see Table 25). Figure B. shows circled left medial cortex activated by 90 second Sad vs. Neutral film clips for female European participants in contrast to female Non-European participants (the centre of the cross-hair is the activation peak within the left medial cortex [-6, 50, 10] see Table 26). Activations shown are based on a voxelwise ***p*** *< .001, uncorrected*, **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

4.4 (b)v BOLD Responses for European Participants vs. Non-European Participants: PSE and NSE Design Two.

As stated previously - in relation to the all participants' analysis - further evaluation of the positive and negative social emotion element in the final 45 seconds of the happy and sad film clips was considered worthwhile. Hence, the BOLD responses for the final 45 seconds of the happy and sad clips film clips were further evaluated for all European in contrast to Non-European participants and all female European in contrast to female Non-European participants.

Firstly, the PSE second- level two sample conducted on block design two found in comparison to the Non-European participants no activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$, were displayed for the European participants. Once again, this result was very surprising given the left lateralised stronger BOLD responses observed for PSE European>Non-European block design one analysis.

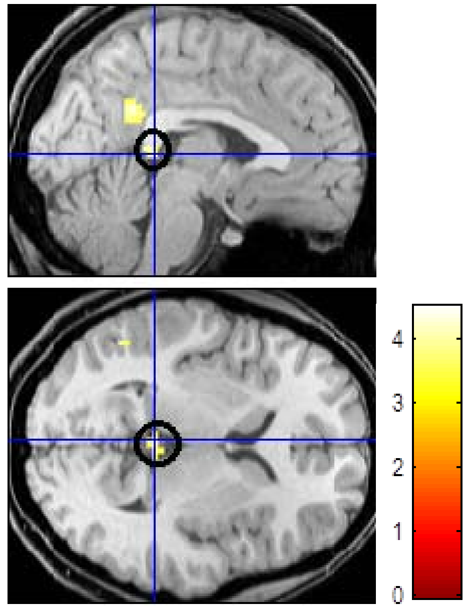
Secondly, the NSE second- level two sample *t* test performed on block design two found in comparison to the Non-European participants stronger BOLD responses observed for the European participants in the left precuneus, right hippocampus, retrosplenial cortex and left superior temporal cortex (see Table 27 and Figure 22A). Yet again, these observations are in complete contrast to the initial NSE European>Non-European analysis that had resulted in no activation clusters being observed.

<u>Table 27: Bold Activation to Sad (versus neutral) films comparison of European Participants (1) and Non-European Participants (-1) whilst viewing Design Two (45 second clips).</u>

Brain Region	Brodmann area	z Value	Size (voxels)	X	Y	z
Left Occipital Precuneus	31	4.00	38	-6	-52	34
Right Hippocampus		3.93	7	24	-16	-14
Left Retrosplenial	29	3.78	15	-3	-37	10
Left Superior Temporal Gyrus	39	3.45	7	-51	-55	10

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected**,** $\boldsymbol{k} = 5$.

Fig 22: NSE for European (1) and Non-European (-1) Participants in Block Design Two.



A.

SAD vs. NEUTRAL

*Figure A. shows left Retrosplenial activated by 45 second Sad vs. Neutral film clips for European participants in contrast to Non-European participants (the centre of the cross-hair is the activation peak within the left retrosplenial [-3, -37, 10] see Table 27). Activations shown are based on a voxelwise **p** < .001, uncorrected*, **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

Subsequent, PSE block design two female-only analysis found in comparison to the Non-European female participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5, were displayed for the female European participants. This result would seem to confirm that no stronger BOLD responses were apparent for the final 45 seconds of the film for PSE and European>Non-European participants.

Finally, the NSE block design two female-only analysis found in comparison to the Non-European female participants stronger BOLD responses observed for the Female European participants in mainly the left cingulate cortex and left retrosplenial cortex (see Table 28). Of particular interest is the stronger BOLD response observed for retrosplenial cortex in this female only analysis was also observed in the previous European>Non-

European NSE Design Two contrast a result that will be further considered in the discussion section.

Table 28: Bold Activation to Sad (versus neutral) films comparison of Female European Participants (1) and Female Non-European Participants (-1) whilst viewing Design Two (45 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	Y	Z
Left Cingulate Gyrus	31	4.14	52	-3	-46	31
Retrosplenial	29	4.02	19	-3	-37	10
Right Lingual Gyrus	18	3.46	7	12	-79	-11

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected**,** $\boldsymbol{k} = 5$.

4.4 (b)vi BOLD Responses for European Participants vs. Non-European Participants: PG and NG Block Design One.

The final European>Non-European enquiry undertaken was an evaluation of BOLD responses for the entire set of regions activated when viewing happy and sad films. Accordingly, for PG and NG a second-level two sample *t* test was conducted on block design one with, as previously, the initial analysis on group one comprising of 22 European participants (7 males/15 females) and group two 17 Non-Europeans (17 females). A further analysis was conducted on female European in contrast to female Non-European participants.

The initial PG analysis found, in comparison to the Non-European participants, significant clusters were observed for the European participants in the right and left precuneus, left posterior cingulate and as expected other regions mainly associated with auditory, visual and motor functions (see Appendix 6, Table 29). The NG analysis found in comparison to the Non-European participants' enhanced BOLD responses were observed for the European participants in the left occipital precuneus and, as also expected for this contrast, other regions mainly associated with auditory and motor functions (see Appendix 6, Table 30).

The second PG analysis found in comparison to the Non-European female participants enhanced BOLD responses were observed for the European female participants in several motor/somatosensory regions and in left superior temporal cortex (see Appendix 6, Table 31). Finally, the NG analysis found in comparison to the Non-European female participants enhanced BOLD responses were observed for the European female participants in several motor and somatosensory regions (see Appendix 6, Table 32).

4.4 (b)vii Variation in BOLD Responses for Self-Report Interest Rating: PSE, NSE, PG and NG.

Behavioral studies one and two established significant variability in the self-reported interest rating for happy and sad film clips in comparison to the neutral film clips. Behavioral study two also demonstrated that PANAS X self-reported rating for Positive affect, Attention, Fatigue and Serenity significantly influenced the self-reported interest ratings of sad film clips. In addition, PANAS X self-reported ratings for Attention and Surprise significantly influenced the self-reported interest ratings of happy film clips. Consequently, to investigate whether these behavioural finding transferred to the fMRI investigation the self-reported interest ratings for the three happy clips for each participant was summed and were used to allocate participants into “High” and “Low” happy film interest groups. Likewise, the self-reported interest ratings for the three sad clips for each participant was summed and were used to allocate participants into “High” and “Low” sad film interest groups. In order to be sure that participants in the High Interest Group had particular interest in the happy or sad films, as opposed to interest in the films per se, an additional criterion was determined. For inclusion in the High Interest film group each individual participant’s summed neutral, or control sticks, film interest rating had to be half, or less, than the summed happy or sad film interest score.

Firstly, in order to evaluate the impact of self-reported interest for happy films on BOLD responses a second-level two sample *t* test for PSE was conducted on block design one with group one comprising of 12 High Interest Happy film participants (11 female/1 male; 7 Non-European/5 European; summed positive film score ≥13, mean 16.58) and group two 12 Low Interest Happy film participants (11 female/1 male; 7 Non-European/5 European; summed positive film score ≤11, mean 6.75). In comparison to the Low Interest Happy film participants BOLD responses were observed for the High Interest Happy film participants in left posterior cingulate cortex (see Table 33 and Figure 23A).

Table 33: Bold Activation to Happy (versus neutral) films comparison of High Interest Happy film participants (1) and Low Interest Happy film Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Posterior Cingulate Gyrus	23	3.73	6	-3	-13	31

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected**,** ***k*** = 5.

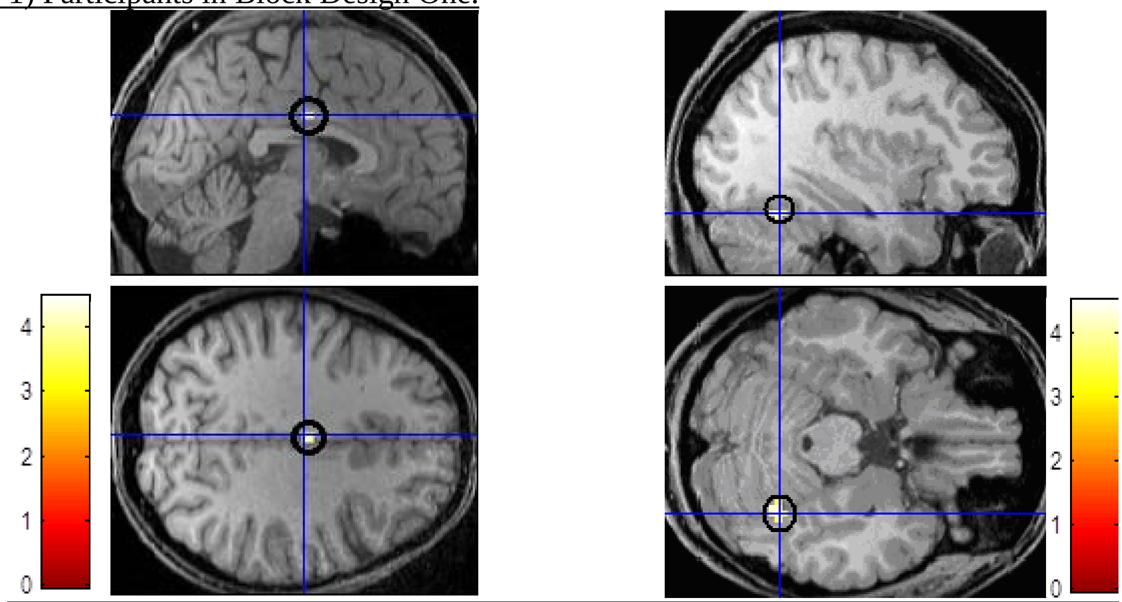
Similarly, in order to evaluate the impact of self-reported interest for sad films on BOLD responses a second-level two sample *t* test for NSE was conducted on block design one with group one comprising of 11 High Interest Sad film participants (10 female/1 male; 5 Non-European/6 European; summed positive film score ≥12, mean 14.18) and group two 12 Low Interest Sad film participants (12 females; 9 Non-European/3 European; summed positive film score ≤ 8, mean 4.91). In comparison to the Low Interest Sad film participants, enhanced BOLD responses were observed for the High Interest Sad film participants in right fusiform cortex and right precuneus (see Table 34 and Figure 23B).

Table 34: Bold Activation to Sad (versus neutral) films comparison of High Interest Happy film participants (1) and Low Interest Happy film Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Right Precuneus	7	3.81	22	27	-67	34
Right Fusiform Gyrus	19	3.73	22	27	-61	-17
Right Fusiform Gyrus	37	3.71		36	-55	-20

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected**,** ***k*** = 5.

Fig 23: Comparison of PSE and NSE for self-reported High Interest (1) and Low Interest (-1) Participants in Block Design One.



A. B.

HAPPY vs. NEUTRAL SAD vs. NEUTRAL

Note: Figure A. show circled Left Posterior Cingulate Gyrus (circled) activated by 90 second Happy vs. Neutral film clips for High Interest in contrast to Low Interest participants (the centre of the cross-hair is the activation peak within the left posterior cingulate [-3, -13, 31] see Table 33). Figure B. shows circled right fusiform cortex activated by 90 second Sad vs. Neutral film clips for High Interest in contrast to Low Interest participants (the centre of the cross-hair is the activation peak within the right fusiform cortex [36, -55, -20] seeTable 34). Activations shown are based on a voxelwise ***p*** *< .001, uncorrected****,*** **k** *= 5. The axial sections shown are from a single subject registered to the T1 standard space image with SPM software.*

Finally, to further assess High Interest > Low Interest groups analysis of the BOLD responses for PG and NG were undertaken.

For PG a second-level two sample *t* test was conducted on block design one with group one comprising of 14 High Interest Happy film participants (14 females; 9 Non-European/5 European; summed positive film score ≥13, mean 16.28) and group two 12 Low Interest Happy film participants (11 female/1 male; 7 Non-European/5 European; summed positive film score ≤ 11, mean 6.75) . However, surprisingly in comparison to the

Low Interest Happy film participants no activation clusters based on a voxelwise $\boldsymbol{p} <$ .001, uncorrected and $\boldsymbol{k} = 5$ were displayed for the High Interest Happy film participants.

Likewise, for NG a second-level two sample *t* test was conducted on block design one with group one comprising of 11 High Interest Sad film participants (11 females; 7 Non-European/4 European; summed positive film score ≥13, mean 16.8) and group two 12 Low Interest Sad film participants (11 female/1 male; 7 Non-European/5 European; summed positive film score ≤ 9, mean 5.25) . The result for NG was also surprising as in comparison to the Low Interest Sad film participants no activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$ were displayed for the High Interest Sad film participants.

As a consequence of the fairly robust behavioural studies findings, for self-reported interest, it seemed advisable to further analyse the above interest groups. Hence, second-level two sample *t* tests for PSE, NSE, PG and NG were conducted by comparing the Low Interest participant groups (1) to the High Interest Participant groups (-1) whilst viewing Design One. Each PSE, NSE, PG and NG analysis produced the same result with in comparison to the High Interest participants no activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$ were displayed for the Low Interest film participants. This result would seem to confirm that in comparison to the significant findings of the Behavioural Studies few stronger BOLD responses were observed for scanner participants who retrospectively self-reported high, or low, interest in the happy and sad films.

4.4 (b)viii Variations in BOLD Responses for PANAS X Self-Report Ratings: PSE, NSE, PG and NG.

Behavioral studies one and two had shown that self-reported mood ratings had significantly influenced the valence responses to happy films. With, behavioral study two demonstrating that PANAS X self-reported rating for Positive Affect, Attention and

Serenity significantly influenced the valence rating of the happy film clips. Conversely, behavioral studies one and two had shown that, in the main, self-reported mood ratings had not significantly influenced the valence responses to sad films: with only PANAS X self-reported ratings for Fatigue significantly influencing the valence rating of the sad film clips in behavioral study two. Consequently, it seemed worthwhile to investigate whether these behavioral findings transferred to the fMRI investigation by using PANAS X self-reported ratings for Positive Affect, Negative Affect, Fatigue, Attention and Serenity to allocate participants into "High" and "Low" mood groups and then assess BOLD responses for PSE, NSE, PG and NG.

It is important to note that in the behavioural studies Negative Affect and Fatigue did not significantly affect the valence rating of the happy films, or Positive Affect, Negative Affect, Attention and Serenity the valence rating of the sad films. Nevertheless, analysis of stronger BOLD responses for all these PANAS X High>Low mood groups and PSE, NSE, PG and NG were undertaken for reasons of symmetry. In addition, the analysis undertaken was always to compare the "high" mood group with the "low" given, as mentioned in the introduction, a similarity between PANAS X scales and certain measures of personality. For example, extraversions association with positive affect and neuroticisms association with negative affect.

Variation in BOLD Responses with self-reported Positive Affect.

Firstly, in order to evaluate the impact of self-reported positive affect and PSE a second-level two sample *t* test was conducted on block design one with group one comprising of 12 High Positive Affect participants (1 male/ 14 females; 6 Non-European/6 Europeans; score $\geq$ 36, mean 38) and group two 11 Low Positive Affect participants (2 males/9 females; 4 Non-European/ 7 European; scores$\leq$31, mean 29.54). In comparison to the Low Positive Affect participants, stronger BOLD responses were observed for the High Positive Affect participants in right insula, right anterior cingulate cortex and other regions (see Table 35, Figure 24A).

Table 35: Bold Activation to Happy (versus neutral) films comparison of High Positive Affect participants (1) and Low Positive Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	z
Left Posterior Lobe/Declive		4.56	37	-15	-67	-20
Left Posterior Lobe/Declive		3.16		-15	-55	-23
Left Anterior Lobe/Culmen		4.14	33	-21	-34	-29
Left Anterior Lobe/Culmen		3.66		-9	-28	-32
Left Anterior Lobe/Dentate		3.64		-21	-46	-26
Left Lingual Gyrus	17	4.08	48	-21	-82	4
Left Occipital Lobe/Precuneus	31	3.78		-24	-79	13
Right Insula	13	3.75	16	36	26	13
Right Medial Frontal Gyrus	6	3.67	8	18	-10	58
Right Cingulate Gyrus	32	3.62	9	21	17	37
Left Medial Frontal Gyrus	6	3.35	8	-18	-13	52
Right Caudate		3.33	5	3	20	1
Right Cingulate Gyrus	24	3.82	5	12	-1	28

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected***, k*** = 5.

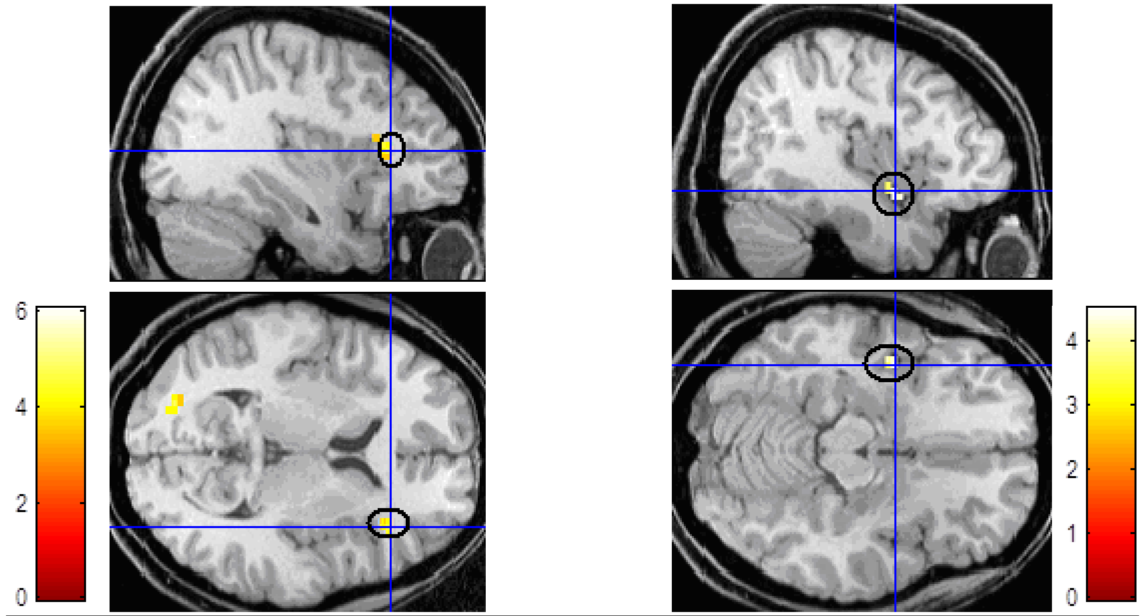
Secondly, to evaluate the impact of self-reported positive affect and NSE a second- level two sample *t* test was conducted on block design one with group one comprising of the same 12 High Positive Affect participants and group two the same 11 Low Positive Affect participants. In comparison to the Low Positive Affect participants' stronger BOLD responses were observed for the High Positive Affect participants in the left insula and culmen (see Table 36 and Figure 24B).

Table 36: Bold Activation to Sad (versus neutral) films comparison of High Positive Affect participants (1) and Low Positive Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Insula	13	3.72	11	-42	-1	-8
Anterior Lobe/Culmen		3.72	17	0	-49	-5

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected***, k*** = 5.

Fig 24: Comparison of PSE and NSE for self-reported High Positive Affect (1) and Low Positive Affect (-1) Participants in Block Design One.



A. HAPPY vs. NEUTRAL

B. SAD vs. NEUTRAL

Note: Figure A. shows circled right Insula activated by 90 second Happy vs. Neutral film clips for High Positive in contrast to Low Positive participants (the centre of the cross-hair is the activation peak within the right insula [36, 26, 13] see Table 35). Figure B. shows circled left Insula activated by 90 second Sad vs. Neutral film clips for High Positive in contrast to Low Positive participants (the centre of the cross-hair is the activation peak within the left insula [-42, -1, -8] see Table 36). Activations shown are based on a voxelwise $\mathbf{p} < .001$*, uncorrected,* $\mathbf{k} = 5$*. The axial anatomical sections shown are from a single subject registered to the T1 standard space image with SPM software.*

To assess the influence of Positive Affect on BOLD responses for PG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 12 High Positive Affect participants and group two the same 11 Low Positive Affect participants. In comparison to the Low Positive Affect participants stronger BOLD responses were observed for the High Positive Affect participants in visual cortex areas (see Table 37).

Table 37: Bold Activation to Happy (versus Control sticks) films comparison of High Positive Affect participants (1) and Low Positive Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	Z
Right Parietal Lobe/Precuneus,	7	3.74	7	-30	-1	-14
Right Superior Parietal Lobule	7	3.59	25	15	-67	61
Right Superior Parietal Lobule	7	3.54		15	-73	52
Left Middle Occipital Gyrus	19	3.30	5	-39	-85	13

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $p < .001$, uncorrected, $k = 5$.

Finally, to assess the influence of Positive Affect on BOLD responses and NG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 12 High Positive Affect participants and group two the same 11 Low Positive Affect participants. In comparison to the Low Positive Affect participants stronger BOLD responses were observed for the High Positive Affect participants in left precentral cortex and right middle temporal cortex (see Table 38).

Table 38: Bold Activation to sad (versus control sticks) films comparison of High Positive Affect participants (1) and Low Positive Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Precentral Gyrus	43	3.78	10	-60	-10	10
Right Middle Temporal Gyrus	39	3.68	8	42	-64	-8

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $p < .001$, uncorrected, $k = 5$.

Variation in BOLD Responses with self-reported Negative Affect.

The influence of self-reported negative affect was then assessed. Firstly, to evaluate the impact of self-reported negative affect and PSE a second-level two sample *t* test was conducted on block design one with group one comprising of 15 High Negative Affect participants (1 male/14 females; 6 Non-European/9 Europeans; score$\leq$ 21, mean 24.53) and group two 14 Low Negative Affect participants (3 males/11 females; 9 Non-European/ 5 European; scores$\geq$18, mean 16.07). In comparison to the Lo w Negative

Affect participants stronger BOLD responses were observed for the High Negative Affect participants in right superior orbitofrontal cortex, right caudate and left posterior cingulate cortex (see Table 39, Figure 25A).

Table 39: Bold Activation to Happy (versus neutral) films comparison of High Negative Affect participants (1) and Low Negative Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	z
Right Sub-lobar,Caudate		3.77	9	6	14	4
Right Superior Frontal Gyrus	10	3.72	5	18	50	4
Left Posterior Cingulate	30	3.59	7	-15	-55	10
Left Posterior Cingulate	31	3.52		-24	-61	16

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise p < .001, uncorrected, k = 5.

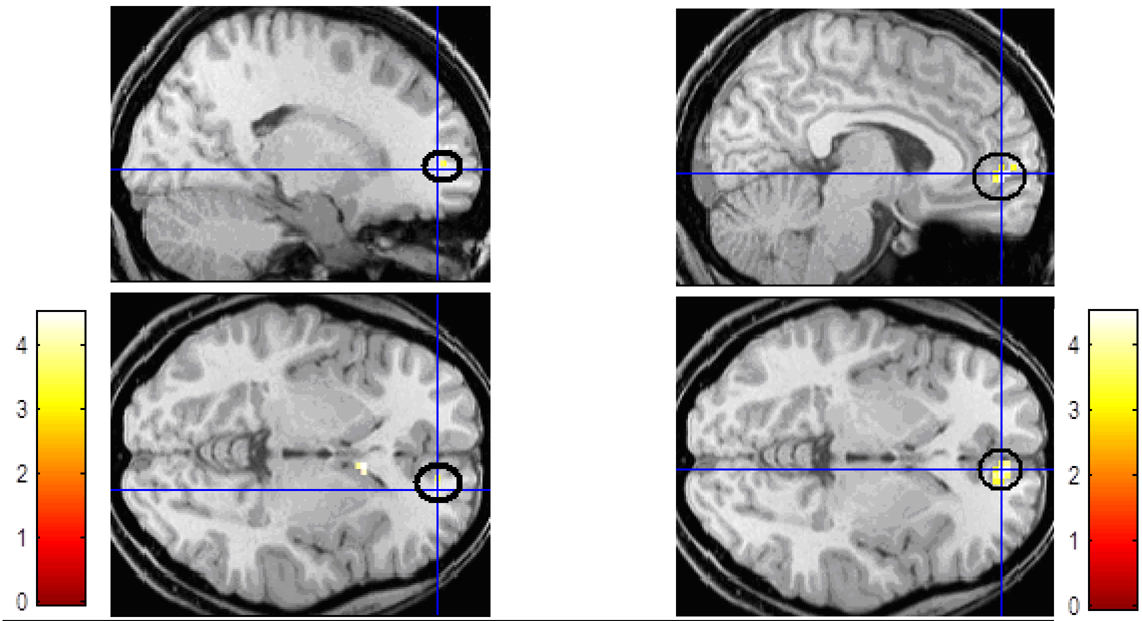
Likewise, to assess the influence of Negative Affect and NSE a second-level two sample *t* test was conducted on block design one with group one comprising of the same 15 High Negative Affect participants and group two the same 14 Low Negative Affect participants. In comparison to the Low Negative Affect participants, stronger BOLD responses were observed for the High Negative Affect participants in the right medial frontal cortex (see Table 40 and Figure 25B).

Table 40: Bold Activation to Sad (versus neutral) films comparison of High Negative Affect participants (1) and Low Negative Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	Y	z
Right Medial Frontal Gyrus	10	4.08	19	6	50	4
Right Middle Temporal Gyrus	39	3.44	5	36	-70	25

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise p < .001, uncorrected, k = 5.

Fig 25: Comparison of PSE and NSE for self-reported High Negative Affect (1) and Low Negative Affect (-1) Participants in Block Design One.



A. HAPPY vs. NEUTRAL

B. SAD vs. NEUTRAL

Note: Figure A. shows circled right superior frontal cortex activated by 90 second Happy vs. Neutral film clips for High Negative in contrast to Low Negative participants (the centre of the cross-hair is the activation peak within the superior frontal cortex [18, 50, 4] see Table 39). Figure B. shows circled right medial frontal cortex activated by 90 second Sad vs. Neutral film clips for High Negative in contrast to Low Negative participants (the centre of the cross-hair is the activation peak within the right medial frontal cortex [6, 50, 4] see Table 40). Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, *uncorrected*, **k** = 5. *The axial anatomical sections shown are from a single subject registered to the T1 standard space image with SPM software.*

To assess the influence of Negative Affect on BOLD responses to PG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 15 High Negative Affect participants and group two the same 14 Low Negative Affect participants. In comparison to the Low Negative Affect participants stronger BOLD responses were observed for the High Negative Affect participants in right inferior orbitofrontal cortex and bilateral subgenual cingulate cortex (see Table 41).

Table 41: Bold Activation to Happy (versus control sticks) films comparison of High Negative Affect participants (1) and Low Negative Affect Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	Y	z
Right Subgenual Cingulate	25	3.76	23	9	20	-11
Right Subgenual Cingulate	25	3.62		3	20	-2
Right Inferior Frontal Gyrus	10	3.66	20	36	47	-2
Left Subgenual Cingulate	25	3.60	6	-9	20	-8

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected, $\boldsymbol{k} = 5$.

Finally, to assess the influence of Negative Affect on BOLD responses to NG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 15 High Negative Affect participants and group two the same 14 Low Negative Affect participants. No activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$ were displayed.

Variation in BOLD Responses with self-reported Fatigue.

Behavioral study Two found that fatigue had significantly influenced the self-reported ratings of sad but not happy films. However, for reasons mentioned previously PSE, NSE, PG and PN were all assessed for enhanced BOLD responses.

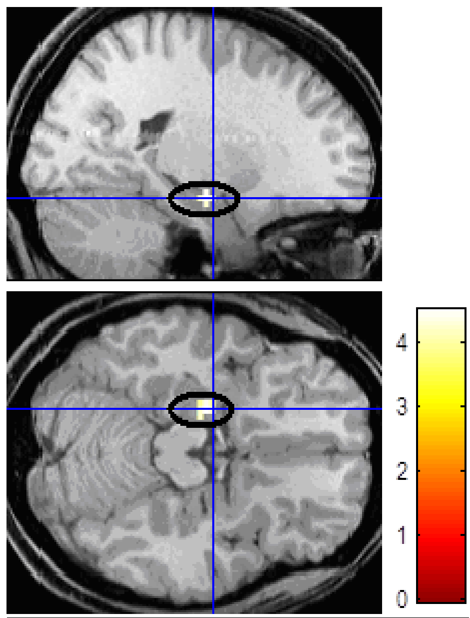
Firstly, in order to evaluate the impact of self-reported fatigue and PSE a second-level two sample *t* test was conducted on block design one with group one comprising of 17 High Fatigue participants (17 females; 10 Non-European/7 Europeans; score≥11, mean 13.05) and group two 17 Low Fatigue participants (5 males/12 females; 8 Non-European/ 9 European; scores≤10, mean 9.29). Unexpectedly, in comparison to the Low Fatigue participants a BOLD response was observed for the High Fatigue participants in the left amygdala (see Table 42, Figure 26A).

Table 42: Bold Activation to Happy (versus neutral) films comparison of High Fatigue participants (1) and Low Fatigue Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Amygdala .		3.53	12	-21	-13	-11

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected, $\boldsymbol{k} = 5$.

Fig 26: PSE for self-reported High Fatigue (1) and Low Fatigue (-1) Participants in Block Design One.



A.
HAPPY vs. NEUTRAL

Note: Figure A. shows circled left amygdala activated by 90 second Happy vs. Neutral film clips for High Fatigue in contrast to Low Fatigue participants (the centre of the cross-hair is the activation peak within the left amygdala [-21, -13, -11] see Table 38). Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, *uncorrected*, $\mathbf{k} = 5$. *The axial anatomical sections shown are from a single subject registered to the T1 standard space image with SPM software*

Similarly, to further assess the influence of Fatigue on BOLD responses to NSE a second-level two sample *t* test was conducted on block design one with group one comprising of the same 17 High Fatigue participants and group two the same 17 Low Fatigue participants. In comparison to the Low Fatigue participants a stronger BOLD response was observed for the High Fatigue participants in the right superior temporal cortex and right lingual cortex (see Table 43).

Table 43: Bold Activation to Sad (versus neutral) films comparison of High Fatigue participants (1) and Low Fatigue Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	Z
Right Superior Temporal Gyrus	22	3.96	6	63	4	-7
Right Lingual Gyrus	19	3.72	7	27	-73	-2

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected, $\boldsymbol{k} = 5$.

To evaluate the impact of self-reported fatigue and PG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 17 High Fatigue participants and group two the same 17 Low Fatigue participants. In comparison to the Low Fatigue participants a BOLD response was observed for the High Fatigue participants in the left inferior occipital cortex (see Table 44).

Table 44: Bold Activation to Happy (versus Control sticks) films comparison of High Fatigue participants (1) and Low Fatigue Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	z
Left Inferior Occipital Gyrus	18	3.65	7	-27	-85	-14

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected, $\boldsymbol{k} = 5$.

Finally, to evaluate the impact of self-reported fatigue and NG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 17 High Fatigue participants and group two the same 17 Low Fatigue participants. In comparison to the Low Fatigue participants a stronger BOLD response was observed for the High Fatigue participants in the right middle frontal cortex (see Table 45).

Table 45: Bold Activation to Sad (versus control sticks) films comparison of High Fatigue participants (1) and Low Fatigue Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	z
Right Middle Frontal Gyrus	6	3.40	5	42	2	43

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{p} < .001$, uncorrected**,** $\boldsymbol{k} = 5$.

Variation in BOLD Responses with self-reported Serenity.

In contrast to fatigue behavioral two analysis found that serenity had significantly the self-reported ratings of happy but not sad films. Nevertheless, for reason stated previously the influence of self-reported serenity on BOLD responses for PSE, NSE, PG and PN was assessed.

Firstly, to assess the influence of self-reported Serenity on PSE a second-level two sample *t* test was conducted on block design one with group one comprising of 11 High Serenity participants (8 females/3 males; 2 Non-European/9 Europeans; score≥12, mean 13.09) and group two 12 Low Fatigue participants (12 females; 7 Non-European/ 5 European; scores≤10, mean 8). In comparison to the Low Serenity participants n o activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$ were displayed for the High Serenity participants.

Likewise, to assess the influence of self-reported Serenity on NSE a second-level two sample *t* test was conducted on block design one with group one comprising of the same 11 High Serenity participants and group two the same 12 Low Fatigue participants. In comparison to the Low Serenity participants no activation clusters based on a voxelwise $\boldsymbol{p} < .001$, uncorrected and $\boldsymbol{k} = 5$ were displayed for the High Serenity participants.

Secondly, to measure the influence of self-reported Serenity on PG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 11 High Serenity participants and group two the same 12 Low Fatigue participants. In comparison to the Low Serenity participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5 were displayed for the High Serenity participants.

Lastly, to measure the influence of Serenity on BOLD responses to NG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 11 High Serenity participants and group two the same 12 Low Serenity participants. In comparison to the Low Serenity participants a stronger BOLD response was observed for the High Serenity participants in the right and left precuneus, left paracentral and left superior frontal cortex (see Table 46).

Table 46: Bold Activation to Sad (versus control sticks) films comparison of High Serenity participants (1) and Low Serenity Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	Y	Z
Left Paracentral Lobule	31	3.64	10	-3	-16	49
Right Precuneus	7	3.59	13	3	-46	52
Left Paracentral Lobule	5	3.42		-6	-43	52
Right Precuneus	7	3.56	10	3	-76	37
Left Superior Frontal Gyrus	6	3.51	7	-21	-13	73
Left Occipital Precuneus	31	3.45	13	-3	-73	22

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected**,** ***k*** = 5.

The above findings were contrary to the behavioural study two results and will be further considered in the Discussion section.

Variation in BOLD Responses with self-reported Attention.

The final analysis undertaken was to measure the influence of attention on BOLD responses.

Again firstly, to assess the influence of Attention on PSE a second-level two sample *t* test was conducted on block design one with group one comprising of 12 High Attention participants (10 females/2 males; 5 Non-European/7 Europeans; score ≥15, mean 16.08) and group two 13 Low Attention participants (11 females/2 males; 7 Non-European/ 6 European; scores ≤13, mean 11.92). In comparison to the Low Attention participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5 were displayed for the High Attention participants.

Likewise, to assess the influence of Attention on NSE a second-level two sample *t* test was conducted on block design one with group one comprising of the same 12 participants and group two the same 13 Low Attention participants. In comparison to the Low Attention participants a stronger BOLD response was observed for the High Attention participants in the left transverse temporal cortex (see Table 47).

Table 47: Bold Activation to Sad (versus neutral) films comparison of High Attention participants (1) and Low Attention Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	X	y	Z
Left Transverse Temporal Gyrus	42	3.45		-60	-13	7

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***p*** < .001, uncorrected**,** ***k*** = 5.

Secondly, to assess the influence of Attention on responses to PG a second-level two sample *t* test was conducted on block design one with group one comprising of the same 12 High Attention participants and group two the same 13 Low Attention participants. In comparison to the Low Attention participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5 were displayed for the High Attention participants.

Finally, to assess the influence of Attention on NG BOLD a second-level two sample *t* test was conducted on block design one with group one comprising of the same 12 High Attention participants and group two the same 13 Low Attention participants. In comparison to the Low Attention participants no activation clusters based on a voxelwise ***p*** < .001, uncorrected and ***k*** = 5 were displayed for the High Attention participants.

Table 48: Summary of Significant Activations in Emotion-related Regions of Particular Interest.

All Participants

Area	Block Design One (90 seconds)				Block Design Two (45 seconds)	
	PSE	NSE	PG	NG	PSE	NSE
Orbitofrontal cortex		Table 19	Table 22			Table 21
Dorsolateral prefrontal			Table 22	Table 23		
Dorsomedial prefrontal		Table 19	Table 22	Table 23		
Inferior Frontal Gyrus BA47		Table 19				
Superior temporal BA38		Table 19				Table 21
Superior temporal BA22	Table 18					
Occipital Lobe Precuneus	Table 18					
Posterior Cingulate BA31					Table 20	
Anterior cingulate BA24					Table 20	
Insula						Table 21
Thalamus		Table 19				
Amygdala		Table 19				

European>Non-European *(European>Non-European female only)*

Area	Block Design One (90 seconds)				Block Design Two (45 seconds)	
	PSE	NSE	PG	NG	PSE	NSE
Orbitofrontal cortex	Table 24					
Superior frontal BA9	Table 24 *(Table 25)*					
Medial Frontal cortex BA10	*(Table 25)*	*(Table 26)*				
Occipital Lobe Precuneus			Table 25	Table 26		Table 27
Posterior Cingulate	Table 24		Table 25			
Anterior cingulate BA24	Table 24 *(Table 25)*					
Anterior cingulate BA32	Table 24 *(Table 25)*					
Hippocampus						Table 27
Retrosplenial						Table 27 *(Table 28)*

Note: Yellow = Happy contrasts and Blue = Sad contrasts; Italics = female only comparisons

High Interest>Low Interest

Area	**Block Design One (90 seconds)**			
	PSE	**NSE**	**PG**	**NG**
Posterior Cingulate BA23	Table 33			

High Positive Affect>Low Positive Affect

Area	**Block Design One (90 seconds)**			
	PSE	**NSE**	**PG**	**NG**
Occipital Lobe Precuneus	Table 35			
Anterior cingulate BA32	Table 35			
Posterior cingulate BA31	Table 35			
Insula	Table 35	Table 36		

High Negative Affect>Low Negative Affect

Area	**Block Design One (90 seconds)**			
	PSE	**NSE**	**PG**	**NG**
Superior Frontal BA10	Table 39			
Medial frontal cortex BA10		Table 40		
Inferior frontal cortex BA10			Table 41	
Posterior cingulate BA31	Table 39			
Subgenual Cingulate BA25			Table 41	

High Fatigue>Low Fatigue

Area	**Block Design One (90 seconds)**			
	PSE	**NSE**	**PG**	**NG**
Amgydala	Table 42			

High Serenity>Low Serenity

Area	**Block Design One (90 seconds)**			
	PSE	**NSE**	**PG**	**NG**
Occipital Lobe Precuneus				Table 46

Note: Yellow = Happy contrasts and Blue = Sad contrasts.

5. DISCUSSION.

The aim of this investigation was firstly to identify differences in BOLD responses in participants viewing films that elicit positive and negative social emotions and provide information on whether activation in particular neural regions (e.g. the prefrontal cortex, amgydala and anterior cingulate cortex) was observed. A further aim was to determine whether self-reported ethnic origin and mood traits were correlated with these BOLD signals and whether these individual differences influenced responses in these neural regions.

In support of the initially premise, observations of the fMRI participants' self-report ratings supported the position set out in Chapter 4 that the neural activations identified in this investigation are representative of happy and sad social emotion elicited by film. The robustness with which the film clips elicit comparable happy, sad and neutral ratings in dissimilar settings is validation of the rigorous methodology employed, as discussed in chapters two and three, and provides confidence in attributing the activations observed as affect-related.

An all-participants analysis supported the first hypothesis; as differences in BOLD responses were observed for PSE and NSE t-contrasts. In addition, an all-participants analysis also confirmed the second hypothesis as differences in BOLD responses were observed for PG and NG t-contrasts. Building on the results of the behavioural studies the third hypothesis was also accepted; as differences between BOLD responses were observed for PSE/NSE or PG/NG and self-reported ethnic origin, indicating some function for culturally learnt responses in emotional elicitation. The final hypothesis was also accepted as differences between BOLD responses were observed for PSE/NSE in higher order mood traits (positive affect and negative affect). However, relatively few differences in significant BOLD responses were observed for PSE/NSE in specific mood traits (serenity, fatigue and attentiveness).

The results of the fMRI participants' self-report data is firstly considered followed by a discussion on the BOLD responses observed for all participants, for European in contrast to non-European participants, and finally, for self-reported higher order and specific moods. The results of this investigation are discussed and compared, where applicable, to previously cited investigations.

5.1 Behavioural Self-Report Data.

The pattern of results for the behavioural self-report data of fMRI participants - collected retrospectively at a second viewing – showed that the emotion rating profiles of this group were very similar to that of both independently assessed behavioural study groups. It is important to state that this self-report similarity between the groups was found despite the different conditions for fMRI participants viewing the films. Firstly, they rated their experience of the films retrospectively; secondly, the first viewing was in uncomfortable conditions (i.e. unfamiliarly of surroundings, instructions to remain immobile, background scanner noise etc.); and, thirdly, they viewed the films individually without any audience involvement (e.g. vocal enjoyment to some of the happy scenes was present for the behavioural participants in the group audiences). This similarity of finding is supportive of Gross and Levenson (1995), and similar investigations, who propose that the employment of film stimuli is a particularly robust induction procedure that allows the ethical elicitation of dynamic emotions. The reliability of the film clips in eliciting comparable happy, sad and neutral responses in very dissimilar settings, as previously mentioned, reflects the rigorous methodology employed in order to select the films. In addition, the findings support Hutcherson et al's (2005) view that rating films at second viewing, in comparison to rating at initial viewing, does not cause participants' subjective report of the emotion experienced to differ. Moreover, these finding imply that employing engaging and socially active film clips in an fMRI setting – due to their familiarity in everyday life – could be more reflective of a participant's customary individual response both behaviourally and any subsequent neural activation. Hence, the results are supportive of Gross and Levenson's

(1995) suggestion that films, even when shown in laboratory conditions, are more ecologically valid than other emotion induction procedures.

Participants' mean valence ratings when viewing the positive, negative and happy film clips, together with the interest and confusion mean ratings, were very similar in the fMRI and in the behavioural studies. The sticks film clip was not included in the behavioural study as it was employed as a control stimulus for the imaging investigation. Given the clip had been reported in previous studies to robustly elicit a neutral affective state, characterised by low levels of negative and positive emotions (Gross and Levenson, 1995). Hence, the sticks film clip was only included in the fMRI participants' retrospective self-report questionnaire for reasons of consistency (second film set viewing to imitate the initial film set viewing), so the finding that this clip was rated as slightly more pleasant (M = 3.80, SD = 1.02) than the neutral film clips (M = 3.56, SD = 1.74) was rather unexpected. As mentioned in chapter three there were differences in valence between the neutral clips, in comparison to the rating of emotions elicited by the positive and negative clips, so the sticks film clips can still be classified as emotionally neutral. Further validation for the use of this clip as a control stimulus also comes from the very low interest rating obtained, with the sticks clip rated as the least interesting film. Conversely, the sticks clip (M = 2.32, SD = 2.59) was rated as less confusing than the neutral clips (M = 3.51, SD = 1.71). This could be explained as due to the relatively high level of cognitive demand needed when viewing neutral social films, as previously discussed, and does not represent a challenge to the control status of the sticks clip.

The low ratings for confusion, in all positive and negative films, were attributed to the precondition that all 90 second emotion clips subscribe to a specified theme. As mentioned in chapter three the lack of a specified theme for the neutral clips did seem to impact on understandability. However, the inclusion of a mainly unambiguous social relationship theme - as was evident in the amusement rating for the neutral clip *Falling in Love*, (M = 3.09, SD = 2.35) showing a women and man shopping – seemed to amplify the emotion content of the film. The interconnectivity of social and affect phenomenon was a recurrent premise in the Introduction and the above behavioural findings would seem to confirm Ochsner et al's (2004) proposal that it is difficult to comprehend of any social situation completely devoid of emotion.

Lastly, observations were made on the interest ratings of positive, negative and neutral film clips and it was confirmed that the influence of self-reported ethnic origin on these ratings followed a comparable pattern in the fMRI participants and the behaviour groups. Observations on fMRI participants' self-reported ethnic origin and the rating of individual neutral film clips ratings showed a trend similar to the behavioural groups (see chapter four, figure 18). Similarly, the effect of ethnic origin on the fMRI participants' interest rating of the sticks film clip was also dissimilar. As expected the sticks film was rated as the least interesting film but surprisingly the European participants seemed to rate the sticks control film as equally engaging as the neutral films. The reason for such a finding is unclear and could be attributed to the inclusion of music with the sticks film: in order to loosely match the other stimuli. Eldar et al (2007) found that when music was included with neutral scenes this produced a differential response. This factor was not catered for in the self-report questionnaire as although participants were asked to rate their interest, no clarification was given as to what aspect (e.g. music, dialogue, etc) of the film was deemed most engaging. Given, as clarified in chapter three, that interest appears to play a function in the elicitation and subsequent self report of emotions, future investigations using film stimuli in an fMRI setting should further clarify what aspect of the films most caught participants' attention.

In general, observations on the fMRI participants' self-report ratings, in comparison to the larger behavioural study, supported the position set out in chapter four that the neural correlates identified in this investigation are representative of happy and sad social interactions. Moreover, despite some ambiguity in the interest rating of the control film clip, similarity between the self-report ratings of the fMRI and behavioral studies by different ethnic groups warranted the further exploration of whether self-reported ethnic origin fundamentally changed the neural pattern of response during the elicitation of happy and sad social films. Additionally, the self-report pattern observed also allowed for a European versus Non-European comparison of sufficient statistical power, given

Desmond and Glover’s (2002) suggestion that about twelve subjects and a liberal threshold of 0.05 is required to achieve 80% power at the single voxel level for typical activations. These recommendations on group numbers were implemented for all but three analyses (Interest, Positive Affect and High serenity) and a more stringent threshold of 0.01 was adopted to account for multiple comparisons. Albeit, as mentioned in the Introduction, the coupling amongst response systems - such as fMRI and self-report - is still under investigation and currently even the most robust self-report standardization provides no guarantee that film stimuli will generate coherent behavioral and BOLD activations (Herring et al, 2010).

5.2. fMRI: BOLD Responses.

The discussion of the BOLD responses observed in this investigation will mainly focus on the regions of the prefrontal cortex, amygdala and anterior cingulate cortex. Many affect studies reviewed in the Introduction, (e.g. Rolls, 2005; Davidson, 2001; Gross and Levenson, 1995) propose that these regions are greatly involved in social and emotional processing. Whereas some BOLD responses in the prefrontal cortex and amygdala were observed, the more predominant responsive regions were the anterior and posterior cingulate cortex. As expected, given the vibrant nature of film stimuli, regions involved in motor, somatosensory, auditory and visual processing were strongly activated. Consequently, where appropriate these and other structures implicated in the production of social emotions (e.g. insula, precuneus and thalamus) will also be explored in relation to the present and aforementioned studies.

5.2 (a) All Participants.

5.2 (a) i. All Participants: PSE and NSE design One.

The initial PSE finding for all participants was that most activation seemed focused around the bilateral superior temporal regions. The superior temporal cortex (BA 41) is considered responsible for sound and the processing of speech in order for it to be comprehended as language. However, the superior temporal cortex (BA 22) is also a region which has been implicated in the perception of emotions in facial stimuli (Ekman, 2003, as cited in Rolls, 2005). The right superior temporal cortex (BA 22) is an area that Vytal and Hamann's (2010) voxel-based meta-analysis also linked with the basic emotion "happiness". A closer inspection of the investigations included by Vytal and Hamann's (2010) shows that of the twenty-four studies included only fourteen had employed facial stimuli to investigate positive affect. The present studies' findings would also seem to suggest that this region has a more general role in emotion processing than just positive emotional facial perception. In addition, given the diverse elicitation procedures employed to elict positive emotion in Vytal and Hamann's (2010) voxel-based meta-analysis (as reviewed in chapter two) this would seem to indicate that right superior temporal cortex does not necessarily have a particular association with "happy" but rather with positive social experiences. Additionally, activation in the present study was also observed in the bilateral visual areas of the precuneus (BA 31) which, it is proposed, is involved in mental imagery and activated when a person takes a third-person versus first-person visual point of view (Vogeley, 2004). The left fusiform gyrus (BA 37) was also activated and this is consistent with previous studies that suggest this area is involved in the perception of positive emotions in facial stimuli (Davidson, 2004). BOLD responses in the right parahippocampal cortex, declive and culmen were also observed. Surprisingly, the initial finding for PSE across all participants was the lack of significant activation in orbitofrontal cortex and anterior cingulate cortex as these regions - as emphasised in the Introduction - have been documented as important for social/emotional experiences.

As predicted, for all participants NSE activated dissimilar, but unexpectedly, far more neural regions than was the case for PSE. Many of the BOLD responses observed for all participants and NSE were found in regions associated with visual (BA 18), somatosensory (BA 5), auditory (BA 45) and motor (BA 6) functions. The additional sensory responses observed for NSE, in contrast to PSE, could be accounted for in several ways. Firstly, some fundamental visual and auditory difference between the sad and happy films, although given the careful matching of the film clips a rather unlikely explanation. Secondly, the differing sensory responses observed could be pivotal in understanding the top-down and bottom-up mechanisms involved in experiencing sad or happy emotion: given that the elicitation of emotion, unlike most other psychological experiences, are instantiated in both the brain and the body. Panksepp (1998) stipulated that one of the neural criteria that defined a system as emotional is that it must be capable of elaborating subjective feeling states that are affectively valenced. However, Berridge et al (2001) considers this explanation of the emotional process as somewhat incomplete as it defines neural circuits as unemotional if they don't directly produce affective feelings. The question of what role regions, like the prefrontal cortex, play in the establishment of subjective feeling states is beyond the remit of this investigation but could be a parcial explanation for the differing sensory responses observed.

As had been envisaged, medial orbitofrontal cortex (BA 11) was activated for NSE although, as mentioned above, activation in this region had not been observed for all participants and PSE. Whether observation of NSE orbitofrontal activation can be accounted for as a difference in basic socially determined emotion is doubtful. Given the strong association between appraising positive social situations and activation in this region (Kringelbach and Berridge, 2009; Rolls, 2005). This unanticipated finding will be discussed further in relation to PG and ethnic origin results.

A NSE result that does correspond to findings in previous studies (Goldin et al, 2005; Vytal and Hamann, 2010) was the observed activation in bilateral inferior frontal cortex (BA 47) for all participants. This finding endorses Goldin et al's (2005) results obtained via a block design of "sad versus neutral" films and also the "sad" activation cluster results in Vytal and Hamann's (2010) voxel-based meta-analysis. This would seem to suggest that this region has an association with the understanding of basic "sad" social experiences. Similarly, the observation of left amygdala activation for NSE was consistent with the results found by Britton et al (2006) and Goldin et al (2005) for a sad social relative to neutral social contrast. While both aforementioned studies found activation in the right as well as left amygdala, the findings of the present investigation are consistent with Baas et al's (2004) meta-analysis, which showed that in general across studies the left amgydala is more active than the right amgydala. Bass et al's (2004) study examined whether laterality of amygdala activation is related to stimulus type (language and pictorial), task instructions (implicit and explicit) or habituation due to repetitive exposure to uniform stimuli. Subsequently, Baas et al's (2004) suggestion that during the processing of emotional stimuli the left amygdala is more involved in the fine-grained details of a stimulus or scene processing could also be correct for the present investigation. However, Costafreda et al's (2010) proposal is that the left amygdala is engaged when evaluation of language-related stimuli is required and this would seem, on balance, a more plausible (given the elicitation procedure employed) explanation of the finding. It is worth reiterating that the main findings of Costrafreda et al's (2008) meta-analysis were that all emotions were more likely to activate the amygdala than neutral stimuli but that the amygdala was predominantly activated by negative rather than positive emotions: with the caveat that amusement and sex were both strong predictors of amygdala activation. They further surmise that, because amusement and happiness have few differences as regards valence, but differences in arousal, arousal may drive amygdala activation rather than valence per se. In the present investigation NSE, but not PSE, was associated with amgydala activation. Given, that the happy and sad film clips mean ratings were similar the observed left amgydala activation for NSE across all participants would seem to be related to the negative content of the stimuli rather than arousal itself.

The present investigation also revealed BOLD responses in the right ventral thalamus for NSE and this result is comparable to Britton et al's (2006) social emotion investigation, which found right thalamus activation for social negative, relative to social neutral conditions. This result of right ventral thalamus activation is, however, contrary to Vytal and Hamann's (2010) and Goldin et al's (2005) sad relative to neutral investigations, wherein sad stimuli, activated the left thalamus. An area also activated for NSE was bilateral superior anterior temporal cortex (BA 38) and although the functional significance of this area is still not certain it is suggested it may bind complex, highly processed perceptual inputs to visceral emotional responses (Ding, Van Hoesen, Cassell and Poremba, 2009). An additional explanation for activation in this region is proposed by Zhan, Moll, Krueger, Huey, Garrido and Grafman (2007), who found anterior temporal activation when participants judged the semantic relatedness of social concepts (e.g., honour–brave) in comparison with concepts describing general animal functions (e.g., nutritious–useful). Zhan et al (2007) propose their results demonstrate that the superior anterior temporal cortex plays a key role in social understanding by providing abstract conceptual knowledge of social behaviours. Maybe, given the themed nature of the sad clips in the present investigation, Zhan et al's (2007) explanation is the more plausible for the observed activation in this region.

Finally, bilateral dorsomedial prefrontal cortex (BA 9) activation was observed for NSE. Iacoboni at al. (2004) found dorsomedial prefrontal cortex activation corresponding to an actual social relation (two person film clip) relative to a potential social relation (one person film clip). Whether the present findings support this interpretation is doubtful as the films contrasted in PSE and NSE both included two actors. Additionally, the lack of significant activation in dorsomedial prefrontal cortex for PSE in this investigation would not substantiate Iacoboni et al's (2004) observation that dorsomedial prefrontal regions continuously assesses and analysis social relations (whenever other non-social tasks do not demand full attention).

5.2 (a) ii. All Participants: PSE and NSE Design Two.

To further evaluate the BOLD responses for social emotion, analysis on the final 45 seconds of the happy and sad film clips for all participants was conducted. As was clarified in chapter four the rationale behind this additional analysis was related to the design of the experiment that had intentionally used matched similar-themed emotional films. Consequently, each happy film clip theme – female meets male, they express their love for each other and then embrace – had tended to build to a finale. Similarly, each sad film clip theme - death of a loved one, the heartbroken grieving relative and supportive other – had portrayed stronger emotions towards the end of the clip. These emotion films had been contrasted to neutral films in which the emotions were of low intensity and did not build to a climax. The result that had been expected, therefore, was that PSE and NSE design two would exhibit stronger activation in aforementioned areas of interest, in comparison to PSE and NSE 90 second block design one.

The initial finding for PSE design two was that around fourteen clusters were activated and this number was comparable to design one. Contrastingly, PSE design two across all participants activated regions associated with visual (BA 17, 19), language (BA 39) and somatosensory (BA 7) functions that had not been observed in PSE design one. Somewhat unexpectedly, PSE design two activated the right fusiform gyrus (BA 37) which was again dissimilar to the full 90 second block contrast which had activated the left fusiform gyrus (BA 37). As mentioned previously, activation levels in left-sided regions are viewed as facilitating the maintenance of positive feelings and PSE design one observation of stronger left fusiform gyrus activation would support this position. However, stronger right fusiform gyrus activation in PSE design two could be due to the oscillation of sensations specific to the happy films (the inclusion of non-emotional or non-targeted sensations) an explanation expanded on below.

Of particular interest and a result that coincides with other studies (Kober et al, 2008, as cited in Lamm and Singer, 2010) was the activation of the right ventral anterior cingulate area (BA 24). As mentioned in the Introduction, the ventral part of the anterior cingulate cortex is thought to be an area that assesses the salience of emotion and motivational information, however, for all participants this activation was only observed during the second half of the film clips. Observation of right ventral anterior cingulate activation is, however, contrary to Vytal and Hamann’s (2010) voxel-based meta-analysis in which left anterior cingulate cortex activation was observed for “happiness”. The PSE design two also activated bilateral dorsal posterior cingulate cortex (BA 31) which has been implicated as a region for pain and episodic memory retrieval but may also be involved in the capacity to understand what other people believe (Rolls, 2005). Observation of activation in bilateral posterior cingulate cortex, for the PSE design two (climactic section only) was also found by Goldin et al (2005), who compared block contrast and subject-specific emotion intensity regression approaches. As mentioned in chapter two

Goldin et al (2005) found that for amusing film clips, continuous emotion ratings, assessed using subject-specific regression analysis, identified significant activations in posterior cingulate that were not detected by the two minute block design contrast. Hence, they concluded that amusing clips induced acuter shifts and tended to oscillate over time so were more closely coupled to continuous emotion rating than to a fixed block design. Whether activation observed in the cingulate area for PSE design two could be explained in this way is indistinguishable. However, the inconsistency of activations observed for PSE design one and two are a reminder, as mentioned in the Introduction, of the inexact relationship between emotions elicited by continuous film stimuli and the block design method for identifying the related neural responses. For instance, if the emotion participants elicited during the happy films oscillated (as found by Goldin et al, 2003) over the 90 seconds this would lead to periods were non-targeted sensations were included and generating differing epoch averages between the two designs.

The NSE design two analysis for all participants activated regions associated with visual (BA 18, 19), auditory/language (BA 21, 39, 40), motor (BA 6) and somatosensory (BA 3, 5) functions which has also been observed for NSE design one. Somewhat unexpectedly, and contrary to what had been forecast, in NSE design two across all participants BOLD responses were almost half the level that had been observed for NSE design one. Whether the variation in activation clusters observed between the sad 90 and 45 second designs could be related to the block design of the study is again unclear. As Goldin et al (2005) suggest, sadness has a much smoother and slower temporal evolution and in response to sad films associated neural activation would be characterized by a more stable, non-fluctuating profile that can be estimated by a box-car regressor as employed in block contrasts. The NSE design two analysis also found activation in left superior anterior temporal cortex (BA 38). Similarly, bilateral activation in this region had been observed for NSE design one and the strong conceptual meanings portrayed in the sad clips was suggested as potentially explaining the activation observed (Zhan et al, 2007). Why the superior anterior temporal activation for NSE design two was left lateralised is puzzling, although activations observed for orbitofrontal cortex and medial frontal cortex were also lateralised to the left. Given the association of right frontal activity linked to negative related emotions and left frontal activity linked to positive related emotions (Davidson, 2003) the left lateralisation of these regions for NSE design two was somewhat contrary to expectations. Note however that the final 45 seconds of all three film, as mentioned, had portrayed a distressed individual (female in two films and male in one film) visibly crying and being comforted by an actor of the opposite sex. One rationale for this finding could be the self-reported feelings of love fMRI participants expressed in relation to the three sad films, as “love” was rated the third highest emotion term after “sad’. The ability of films to elicit and measure mixed emotions was assessed by Schaefer et al (2010), as mentioned in the Introduction, who successfully produced fifteen “mixed feelings” films that produced blends of emotions. Whether, the final scenes of the sad films blended “sad” and “love” and this contributed to left lateralisation in superior anterior temporal, orbitofrontal and medial frontal cortices is unclear but at present the most likely explanation. Finally, NSE design two, in contrast to any of the above findings, activated the left insula, an area reported for its role in subjective emotional experience (Damasio et al, 2000). The role of the insula will be further discussed in relation to stable mood.

5.2 (a) iii. All Participants’: PG and NG Design One.

Even though PSE design one and PSE design two did not generate the expected prefrontal BOLD response, PG recorded significant activation in bilateral medial orbitofrontal cortex (BA 11). Similarly, observation of BOLD responses in left medial frontal cortex (BA 10) was also found for the PG analysis. Finally, BOLD responses were observed for PG across all participants in bilateral dorsolateral prefrontal cortex and right dorsomedial prefrontal cortex. These findings support previous research as regards the dorsolateral prefrontal regions involvement in the regulation or monitoring of emotion-related social behaviour (Rolls, 2005; Wood and Grafman, 2003). Finally as had been expected for PG analysis across all participants, activation regions were associated with visual (BA 19), auditory (BA39) and motor (BA 6 and 4) functions.

The contrasting NG analysis revealed activation in similar motor regions (BA 6) and also regions associated with visual (BA 18) and auditory (BA 22, 41) functions. Similarly, for all participants NG, like PG, resulted in bilateral activations of the dorsolateral prefrontal cortex and right dorsomedial prefrontal cortex.

The observed activation of bilateral dorsolateral prefrontal cortex in PG and NG is further confirmation of their involvement in the assessment of and responsivity to general social relationship situations. Significantly, as activation for both PG and NG was observed for bilateral dorsolateral prefrontal cortex, this would also seem to verify that this region's involvement, in the present investigation, was not related to basic emotion or valence. Additionally, given the medial orbitofrontal cortex activation observed for all participants – for NSE design one and PG - so far this would also seem to verify that orbitofrontal cortex involvement, in the present investigation, is not linked to either basic emotion or related valence.

5.2 (a) iv. All Participants. Concluding Comments.

As predicted, across all participants NSE activated dissimilar but, somewhat unexpectedly, far more neural regions than was the case for PSE. In addition, anticipated BOLD responses were observed in the orbitofrontal, cingulate regions and amygdala for NSE across all participants. The absence of any significant activation in these regions (particularly the orbitofrontal cortex) for PSE across all participants was, however, disappointing given the emphasis in the Introduction for these regions' connectivity and importance for positive social experience. However, the resultant bilateral medial orbitofrontal cortex activation for PG across all participants would suggest that while this region failed to respond when *social meanings* were the causation of positive emotions, activation was observed for more general social and emotional factors. A cautious explanation for the variability of activation in orbitofrontal cortex and cingulate regions is that whilst social meaning was the causation of emotion in both happy and sad films, the grief theme could be considered a more universal experience: mediated by a distributed neural network which accounts for the unique, subjective quality of grief (Gündel, O'Connor, Littrell, Fort and Lane, 2003). Hence, some of the unexpected differences observed between PSE and NSE could be attributed to participants' more universal and primary response to the grief themed films.

The activation observed in PSE design two was comparable to that of design one but design two found significant activation in the anterior and posterior cingulate cortex. In comparison and contrary to what had been forecast, NSE design two analysis generated almost half of the level of activation that had been observed for design one. As discussed whether these neural patterns could be related to their differing patterns of temporal recitation is unclear but will be further discussed in relation to the ethnic origin findings below. However, it is worth reiterating that the varied findings of previously cited studies may also be due to a mismatch between the emotional phenomenon being examined and the data analytic model employed to deduce underlying neural activations. This mirrors comments made in chapter four that fMRI investigators when employing emotional film stimuli need to be aware that period averages could effectively moderate the specific emotion under investigation.

5.2 (b) Ethnicity.

The Introduction proposed that the way individuals think and feel, in part, is derived from their ethnic heritage and that differences in brain activation to emotional stimuli could reflect these early learnt reactions (Scherer and Brosch, 2009). However, as was emphasised in the introduction ethnic origin is a multi-faceted concept that can be difficult to accurately define: with the prime definition, for affect investigators, probably which particular ethnic group the individual considers themselves to be a member of. Hence, it is worth reiterating that although objective features - such as shared history, religion, common language, geographical origin and tradition - can help define ethnic origin, subjective self-assignment was the only characteristic this investigation used to categorize membership of an ethnic group.

On this basis behavioural study three found a significant difference according to participants' ethnic origin in their self-reported interest in the neutral clips, although no significant effect of ethnic origin was found for the emotional films. Subsequently, also on this basis hypothesis three was accepted as second-level two-sample t-tests revealed differences in BOLD responses to social emotion films between different ethnic groups. This could be evidence that self-reported ethnic origin impacts on responses to positive and negative valenced social films. The absence of behavioural effects and presence of physiological effects, or via versa, is not uncommon in affect imaging investigations (as mentioned in the introductory chapter on biological sex differences). Hence, this finding would be upheld by affective animal, neuroimaging and neuropsychological researchers who propose self-reported subjective experience provides an incomplete picture of emotion (Hamann and Canli, 2004). Given, as previously mentioned, subjective experience is the end product of a predominantly unconscious process reaching awareness (LeDoux, 2000). It is important to note that only differences between BOLD responses to NSE, PSE, PG and NG in European, in contrast to non-European, participants were assessed. The combination of different ethnicities as Non-European helped to improve the statistical power in the fMRI study. In addition, a further possible justification for only including this analysis was that studies (e.g. Roberts and Levenson, 2006) show enhanced responding only in the direction of actresses or actors of one's own ethnic group. This factor was reflected in the design of the study as all the main actresses or actors included in the film clips were Caucasian.

5.2 (b) i. Ethnicity: PSE and NSE Design One.

The first significant observation for second level ethnic origin analysis of BOLD responses to PSE was that activation in the left ventral anterior cingulate cortex (BA 24) was greater in the European group in comparison to the Non-European group. Activation in right ventral anterior cingulate cortex had been observed in PSE design two (final 45 seconds) across all participants, but was not left lateralised. The variability between the groups could be due to participants' differential engagement with the positive scenes -

given this areas suggested role in attention to, as well as, modulation of emotional responses – and in strongly empathising with the emotion or motivation aspects of the actors (Lamm and Singer, 2010). This explanation would also in some way support the findings of the behavioural studies that engagement is a key feature of the elicitation process. This first observation also endorses the "happiness" activation cluster in Vytal and Hamann's (2010) voxel-based meta-analysis and would appear to suggest that left ventral anterior cingulate cortex for the European participants has an association with positive social experience. This second level PSE design two analysis also revealed significantly greater activation in the region of the left dorsal anterior cingulate cortex (BA 32) for European in comparison to non-European participants. This finding could also be related to the European participants enhanced monitoring of the happy scenario as dorsal anterior cingulate cortex has been associated with converting emotive states into actions and tasks connected to adaptive behaviour (Kober et al, 2008, as cited in Lamm and Singer, 2010). Correspondingly, observed left posterior cingulate cortex (BA 30) activation could also be related to executive function. A stronger BOLD response pattern similar to PSE design two across all participants was also observed in auditory/language (BA 39, 40) somatosensory (BA 5, 7) and motor (BA 6) regions for European in contrast to non-European participants. Finally, stronger BOLD responses were observed for the European group in left medial frontal cortex (BA 10) and left dorsolateral prefrontal cortex (BA 9). As previously mentioned the dorsolateral prefrontal region has an association with the assessment of and responsiveness to general social relationship situations (Wood and Grafman, 2003). The interpretation of stronger left middle frontal cortex (BA 10) activation for European participants in this second level PSE analysis is somewhat uncertain given, as mentioned previously, the function of this region is still very much under investigation.

Finally, all the significant differences in activation observed for PSE in the second level ethnic origin analysis were left lateralised. As mentioned in the Introduction previous studies (Canli et al, 2001; Davidson, 2003; Rolls, 2005) have proposed that left frontal activity ought to be considered as related to positive related emotions. However, for the present investigation observed activation for PSE across all participants were bilateral, in comparison to the greater activation to PSE in European participants which was left lateralised. Given the tentative suggestions above, that greater activation in anterior cingulate cortex for the European participants has an association with enhanced engagement, the left lateralised only observation could also be similarly related. With speculatively, the European participants emotional response system reacting to the ethnicity of the actors – all were Caucasian – as suggested by Roberts and Levenson (2006), or else the westernised content of the happy films (Pennington, 2007).

As stated in the Introduction, in contrast to other imaging studies (e.g. Hutcherson et al, 2005) both women and men were included in this fMRI investigation. Predominantly, as affect studies that have compared the emotional responses of women and men have found more similarities than differences (Hamann and Canli, 2004; Wager et al, 2003). In addition, gender is only one of many (e.g. personality, mood and ethnic origin) potentially confounding variables which contribute to the perception and appraisal of emotional stimuli (Davidson, 2003). However, as gender was one possible confounding factor in the first ethnic origin comparison (the European group comprised of females and males in comparison to the non-European group that was only females) a further second level PSE ethnic origin female only analysis had been undertaken. Similar greater activations to the first PSE ethnic origin analysis were observed in left ventral anterior cingulate cortex (BA 24), left dorsal anterior cingulate cortex (BA 32) and left dorsolateral prefrontal cortex (BA 9) and would seem to confirm some contribution of cultural in these regions.

In complete contrast to the above differences observed for PSE, the initial second level NSE analysis produced a negative result. However, since gender was also a possible confounding factor in this comparison (same groups as above) a further second level NSE ethnic origin female only analysis was undertaken. In contrast to the initial negative result the second level NSE ethnic origin female only analysis observed a single activation in the left medial frontal cortex (Talairach coordinates: x = -6, y = 50, z = 10). Intriguingly, the second level ethnic origin female only PSE analysis revealed very similar right medial frontal cortex activation (Talairach coordinates: x = 6, y = 50, z = 13). As previously mentioned the role of this region has recently been associated with self-generated actions and self-reflection (Passingham, Bengtsson and Lau, 2010). Given this suggestion and activation in this specific area for PSE/NSE in European > non-European females this association may be worthy of future exploration.

5.2 (b) ii Ethnicity: PSE and NSE Design Two.

In comparison to the effect of ethnic origin on responses to PSE in design one, somewhat surprisingly, the results of the second level ethnic origin PSE design two analysis found no difference between the European in contrast to the non-European group. Since, gender was still a possible confounding factor in the first comparison (the European group comprised of females and males in comparison to the non-European female only group) a second level ethnic origin PSE design two female only analysis had been undertaken. Likewise, no significant differences were observed between the female only groups. The greater activations observed for PSE design one and subsequent possibility that ethnicity of the actors or the westernised content of the happy films contributed to the result, was not confirmed for design two.

The second level ethnic origin NSE design two analysis, in contrast, found stronger activations in Europeans in right hippocampus, left retrosplenial (BA 29), left occipital precuneus (BA 31) and left superior temporal cortex (BA 39). However, since gender was also a possible confounding factor in this comparison a further second level NSE ethnic origin female only analysis was again undertaken This female only analysis revealed a similar stronger activation in Europeans in the left retrosplenial (BA 29) region which would appear to confirm some involvement of culturally learnt responses in this region. Maddock (1999) reviewed the functional neuroimaging literature and revealed a previously overlooked pattern of observations for the retrosplenial cortex and its activation by emotionally salient stimuli. More recently, Immordino-Yang et al (2009) suggest emotion related to another's psychological state may preferentially recruit a network involving the retrosplenial area, posterior cingulate cortex, anterior middle cingulate and the precuneus. However, as the retrosplenial was the only region activated in both between-group comparisons, even though the final sad scenes portrayed female and male actors weeping, it is uncertain whether this particular activation could be related to European participants' engagement with another's psychological state. Nevertheless, such an explanation would in some ways correspond to earlier suggestions as regards PSE design one and European participant enhanced engagement with the happy films.

5.2 (b) iii Ethnicity: PG and NG Design One.

In the second level PG ethnic origin analysis, stronger activations in Europeans than in non-Europeans were predominantly found in regions associated with auditory (BA 22, 41), somatosensory (BA 3, 5, 7) and motor (BA 6) functions. In contrast to the left posterior cingulate cortex activation observed in the PSE design one ethnic origin analysis, bilateral posterior cingulate cortex (BA 30) was observed for PG for Europeans relative to non-Europeans. These posterior cingulate cortex PG findings support Britton et al's (2006) investigation into the neural correlates of social and non-social emotion, which found that positive social in contrast to social neutral emotions activated posterior cingulate and this brain region was implicated in assessing others' intentions. An additional result, which corresponds to bilateral occipital precuneus activation for PSE design one across all participants, was observation of left occipital precuneus activation (BA 31) for PG and European > non-European participants. The greater activation of occipital precuneus for these contrasts is further discussed in relation to specific mood. As mentioned in relation to ethnic origin and PSE design one and two, gender was also a possible confounding factor in the between group ethnic origin PG analysis. Hence a further female only second level ethnic origin PG analysis was undertaken which did reveal a similar stronger activation in Europeans in the right postcentral cortex (BA 3), left medial frontal cortex (BA 6) and left precentral cortex (BA 6).

The observed activations for the European > non-European contrasts in the second level ethnic origin NG were again predominantly regions associated with auditory (BA 22, 40, 42), somatosensory (5) and motor (6) functions. The left paracentral lobule (BA 31) and left occipital precuneus (BA 31) were the only other observed greater activation for this contrast. Interestingly, the female only second level ethnic origin NG analysis found all the European > non-European differences revealed were also present in the initial PG ethnic origin analysis. The similar activations found were in the left inferior parietal lobule (BA 40), left supramarginal cortex (BA 40), left superior frontal cortex (BA 6) and medial frontal cortex (BA 6).

5.2 (b) iv. Ethnicity: Concluding Comments.

The neural pattern observed for the PSE and NSE design one ethnic origin analysis (European > non-European) was left lateralised activation in cingulate and prefrontal regions for PSE and no significant activation for NSE. In contrast the neural pattern observed in the PSE and NSE design two ethnic origin analysis (European > non-European) revealed no significant activation for PSE and activation in retrosplenial, precueus and posterior cingulate regions for NSE. This pattern may suggest that European, in contrast to non-European, participants did differ in their appraisal of the happy and sad films across time segments. These contrasts in activation clusters for European participants however would need further research to establish if they were significantly related to the differing temporal resolutions of the specific emotions. However, speculatively, significant activation in the current happy film clips could have been induced by an initial acute overture which then tended to fluctuate over time, whereas significant activation in the sad film clips could have been induced by the slower, smoother resolution which over time rose to a gradual peak. Within this differing chronology, as was discussed in the Introduction, some individuals could have been more responsive to these external positive and negative fluctuations. Potentially in the current investigation, learnt cultural responses would help individuals to internally appraise what external features in the films were perceptible as positive or negative.

It is also worth observing that in contrast to the significant activation observed for PSE/PG across all participants in visual areas little difference in activation between Europeans and non-Europeans was found in this second level PSE/PG ethnic origin analysis. Likewise, although some group differences in activation in auditory regions were observed in the second level ethnic origin PSE/PG analysis the main differences between the groups seem to occur in somatosensory, motor and cingulate regions. A potential explanation for the mainly dissimilar somatosensory and motor neural patterns observed could, in part, be due to the suggested connectivity between ventral anterior cingulate cortex and bodily and internal homeostatic regulation (Lamm and Singer, 2010).

5. 2 (c) Interest.

The results of behavioral studies one and two had established significant variability in the self-reported interest ratings for happy film clips in comparison to both sad and neutral film clips. Given these findings, fMRI participants who rated interest in the direction of “a great deal” were contrasted to fMRI participants who rated interest in the direction of “not at all”. The forecast of a difference in BOLD responses to PSE and PG and high interest > low interest groups, with the opposite sign difference for NSE and NG, was based on the aforementioned association being found in the behavioural studies. However, the second level PSE and high interest analysis found only a single activation cluster in the left ventral posterior cingulate (BA 23) for high interest participants in comparison to low interest participants; a result that had not been expected. The activations observed for second level NSE comparing high interest > low interest groups, revealed stronger BOLD responses in the right fusiform region (BA 37) and right precuneus (BA 7) a visual attention area that may be related to increased interest. Similarly, the second level PG and NG analysis for high interest participants, in comparison to low interest participants, found no significant activations although again dissimilarity between these two groups had been expected.

As a result of the fairly robust behavioural studies findings further analysis on low interest, in comparison to high interest, participants were undertaken. However, these negative findings would seem to confirm that, in comparison to the significant findings of the Behavioural Studies, few stronger BOLD responses were observed for scanner participants who retrospectively self-reported high, or low, interest in the happy and sad films.

Given the conclusion in chapter three that interest had significantly impacted on the results of the behavioural studies, the above results, in many ways, are confirmation that even the most robust self-reported standardization provides no guarantee of coherent behavioral and BOLD responses (Herring et al, 2010). However, the single observation of left ventral posterior cingulate activation for PSE together with right fusiform and precuneus for NSE could suggest that these BOLD responses are consequential, as was discussed previously, on interest related specifically to the emotional relationship aspects of the film clips. Further, it is consistent with the idea perhaps that participants who engage and strongly relate to another's psychological emotional state may recruit a network involving the posterior cingulate cortex and precuneus (Immordino-Yang et al, 2009).

5.2 (d) Stable Mood (PANAS X).

The behavioural versus BOLD response findings for high interest > low interest groups were somewhat incongruous. This made the decision of which PANAS X traits to analyse further rather difficult. If, as had been expected, a difference in BOLD response with high versus low interest had been observed, the intention of the investigation had been to further analyse only those traits that had reached significance in the behaviour studies. In response to the above disappointing result, additional higher order traits were analysed, despite the behavioural negative findings. Consequently, differences between BOLD responses of high and low scorers for the higher order traits of positive and negative affect and the specific traits of high serenity, attentiveness and fatigue are assessed and discussed. Moreover, in order to eliminate those participants who self-reported traits were somewhat standard only those participants who self-reported high scores in comparison to low scores were compared. The motive for this is the association reported so far that accentuated appraisal could be a potential link to explain the significant findings. Finally, it is important to note that unlike positive and negative affect, that are considered to be higher order traits, serenity, attentiveness and fatigue are considered to be precise traits. Consequently, this provided for mood measurement at just two different levels (Watson and Clark, 1994).

5.2 (d) i. Stable Mood: Positive Affect.

The differences observed between high positive, in contrast to low positive affect participants are fairly supportive of the behavioural studies and other affect investigations (e.g. Davidson, 2001; Gross et al, 1998) in which there were significant associations between positive affect trait scores and responses to positive, but not negative, films. The high positive affect participants, in comparison to the low, showed, for PSE, stronger activation of the left occipital precuneus (BA 31), right dorsal anterior cingulate (BA 32), ventral anterior cingulate (BA 24), right insula (BA 13) and other visual/motor regions. Whereas, in comparison the high positive affect participants for NSE showed stronger activation only of the left insula (BA 13) and culmen. Hence, as envisaged, the more significant clusters were observed for PSE and high versus low positive participants than for NSE and high versus low positive participants.

The only region in which stronger BOLD responses were observed for both PSE/NSE and high positive > low positive participants was the right and left insula respectively. This finding is contrary to Britton et al (2006) who found insula activation only in the non-social emotion condition. Moreover, Britton et al (2006) found as expected the left insula correlated with positive non-social stimuli and right insula correlated with negative non-social stimuli. Vytal and Hamann's (2010) voxel based meta-analysis also found corresponding left and right insula activation clusters with happiness and sadness respectively. The somewhat contrary observation of left lateralised insula activation for NSE design two across all participants was discussed in relation to the alliance of love and sad emotions towards the final scenes of the sad films. However, the activation of right insula for PSE, and the left insula for NSE, in high positive affect relative to low positive participants would seem to imply that in the present investigation the involvement of the insula has some connection with arousal rather than valence per se.

Right ventral anterior cingulate (BA 24) activation was also observed for PSE and high > low positive affect participants. Similarly, activation in this region was also observed for PSE design two across all participants and it was suggested this may relate to the final film emotion and motivational information. Finally, the last region of importance observed for PSE and high > low positive affect participants was activation in the right dorsal anterior cingulate (BA 32). Likewise, second level PSE analysis also observed significant activation in the region of the left dorsal anterior cingulate cortex (BA 32) for European in comparison to non-European participants and this was possibly linked to European participants' extra monitoring of the happy scenario depicted.

Interestingly, the second level PG and NG conditions for high > low positive participants produced activation in visual (BA 19), somatosensory (BA 7) and language (BA 39, 43) regions. These observations would seem to suggest that in this investigation high positive affect individuals' stronger BOLD responses in the cingulate and insula regions were associated with emotions for social meanings, rather than general emotional factors.

In essence, the neural pattern observed for PSE in high versus low positive affect participants would seem to support studies who propose that individuals with positive traits are more likely to attend to positive-relatable information. Inasmuch as, the stronger BOLD responses for PSE and high positive individuals were in the ventral and dorsal anterior cingulate regions which are viewed as involved in the appraisal and monitoring of emotions associated with social features (Lamm and Singer, 2010; Rolls, 2005). Moreover, individual variability in heightened appraisal and monitoring of specific emotions was also the reason specified for differences in cingulate activation in PSE for different ethnic groups.

5.2 (d) ii. Stable Mood: Negative Affect.

In the behavioural studies no significant correlations were found between trait negative affect and the valence rating of positive or negative films. Consequently, it seemed probable that no differences in BOLD responses would be observed for high negative affect participants in comparison to low. Second level PSE analysis, however, did reveal for high negative participants greater activation in the left dorsal posterior cingulate (BA 31) and right superior frontal cortex (BA 10). Additionally, second level NSE analysis observed for high negative participants greater activation in medial temporal cortex (BA 39) and right medial frontal cortex (BA 10) (Talairach coordinates: x = -6, y = 50, z = 4). Interestingly, female only NSE design one ethnic origin analysis had also revealed activation in the left medial frontal cortex (Talairach coordinates: x = -6, y = 50, z = 10) in contrast to the female only PSE design one ethnic origin analysis which revealed right medial frontal cortex (Talairach coordinates: x = 6, y = 50, z = 13). An inspection of the participants included in the high negative group in the NSE 90 second analysis showed the breakdown as 1 male and 14 females with 6 non-Europeans and 9 Europeans, in contrast to the low negative group which comprised of 3 males and 11 females with 9 non- Europeans and 5 Europeans. Moreover the NSE and PSE 90 second female only analysis comprised of 15 European (8 high/3 low negative affect and 5 high/5 low positive affect) in contrast to 17 non-Europeans (6 high/9 low negative affect and 6 high/4 low positive affect). The sampling variability found across these between-subjects groups is confirmation of the difficulties present when investigating group and individual differences in an fMRI setting, where there are practical limitations on sample size, data acquisition time and recruitment. Furthermore, it highlights the many problems that can occur when trying to accurately match participants on a wide range of group (age, biological sex and ethnic origin) and individual differences (mood, personality and psychological gender identity). This limitation in the experimental design will be further addressed in the final section of the Discussion. As was mentioned in the Introduction several affect studies (Kienast et al, 2008; Love et al, 2010) have stressed that hormones (e.g. testosterone and estrogen) are able to vary trait characteristics, also influence mood, and play a significant role in the emotional processing for women. Whether, such a factor could underlie the present high negative affect versus low negative affect finding is unclear, and outside the remit of this investigation.

Finally, the second level PG and NG analyses for high negative participants, in comparison to low, found few activation clusters, which seems to support the behavioural studies which found that self-report negative affect did not correlate with the valence rating of positive or negative films. The second level PG analyses for high negative affect participants, in comparison to low, activated predominantly the bilateral anterior cingulate (BA 25) and inferior frontal (BA 10) regions. Moreover, second level NG analysis failed to observe any significant BOLD responses. This would suggest that in this investigation high negative affect was not as associated with valenced general emotions.

5.2 (d) iii. Stable Mood: Fatigue.

The result of note for high fatigue participants, in comparison to low, was that significant activation was observed in the left amgydala for PSE. Additionally, the second level NSE high fatigue analysis revealed activation in the right superior temporal cortex (BA 22) and right lingual cortex (BA 19). The other two second level analyses for PG and NG revealed stronger activations in the inferior occipital cortex (BA 18) and middle frontal cortex (BA 6) respectively for high versus low fatigue participants.

The present investigation's finding that activation in the left amygdala was observed for PSE with high > low fatigue participants, reiterates the importance of assessing individual characteristics in affect investigations. As was stated in the Introduction the significance of individual differences to amgydala function is just emerging, although to date affect investigations which have focused on individual differences and BOLD signal changes in the amygdala predominantly employ negative stimuli (e.g. Kienast et al, 2008). In this investigation individual difference in fatigue - a trait that could be viewed as detrimental – was linked with left amygdala and positive social stimuli. This, in some way, supports Rolls (2005) proposal that imaging differences which show that the amygdala is only involved in negative emotions may just reflect an individuals' evaluation of the emotional stimuli. Interestingly, ethnic origin or higher order traits did not influence observed amgydala activation in any of the other positive or negative film contrasts. So although, as stated in the Introduction, strength of engagement/accentuated appraisal may guide the magnitude per se of different emotions the causal factor for strong engagement/accentuate appraisal is hugely wide-ranging. For example, in this investigation second level PSE stimuli activated the left amygdala specifically in high versus low fatigue groups. Presumably fatigue does not depend on culturally learnt responses or broader mood; evidence maybe of a dopamine related individual difference (Kienast et al, 2008). However NSE design one across all participants revealed activation in the left amygdala which was evaluated as originating from the language-related content of the sad films (Costafreda et al, 2008). Whether these two amgydala findings relate to Adolphs (2010) two suggested separate mechanisms - external and content related (e.g. prefrontal-mediated inhibition via projections from the prefrontal cortex) and internal and mood related (e.g. a dopamine-mediated augmentation of sensory inputs to the amygdala) - could be worthy of further investigation.

5.2 (d) iv. Stable Mood: Serenity.

As mentioned previously unlike positive and negative affect scores, which evaluated participants’ higher order traits, serenity was included to evaluate a precise characteristic viewed as potentially beneficial to social relations. The initial second level analysis of PSE and NSE for high serenity, in comparison to low serenity, participants produced a null result. Likewise, second level PG high serenity analysis also produced a null result. However, a difference in BOLD responses for NG and high versus low serenity participants was observed in left superior frontal (BA 6), left paracentral regions, bilateral precuneus (BA 7) and left occipital precuneus (BA 31).

The occipital precuneus is a region were BOLD responses have been observed for many of the different analyses undertaken. Previously, a BOLD response has been observed in occipital precuneus for four separate conditions: (1), bilateral PSE design one across all participants; (2), PG and left for NG and European>non-European participants; (3), left for NSE design two and European>non-European participants; and, (4), left for PG and high > low positive affect participants (see chapter four, Table 48). The previous analyses had connected negative and positive social emotional stimuli with activation in the occipital precuneus and, it was suggested, this region's involvement in mental imagery and third-person versus first-person visual point of view (Vogeley, 2004) was potentially an explanation for the findings. However, this particular area has also been associated - in connection with the superior frontal and orbitofrontal cortex – with greater activation for studies assessing when people make judgments that need understanding as whether to act out of empathy and forgiveness (Farrow, Zheng, Wilkinson, Spence, Deakin, Tarrier, Griffiths and Woodruff, 2001). Given that activation of the occipital precuneus in this investigation was independent of valence maybe the greater activation found in this region for high > low serenity groups was due to heightened empathic understanding. It is worth noting that the activations observed for high > low serenity participants greatly differed from the positive affect findings. The reason for differences in specific traits and more general traits are further discussed in the concluding comments section.

5.2 (d) v. Stable Mood: Attentiveness.

Behavioural study two found significant variability in self-reported attentiveness, which had influenced the valence rating of happy film clips, but not the valence rating of sad or neutral film clips. Surprisingly, the second level PSE and NSE for high attentiveness participants, in comparison to low, analyses produced null results. Likewise, second level PG high attentiveness analysis also produced a null finding. However, a difference in the BOLD responses for NG and high attentiveness participants was observed in left transverse temporal cortex (BA 42) a region, as previously mentioned, considered responsible for sound and the processing of speech. These mainly negative findings, although unanticipated, are supportive of Hutcherson et al. (2005) who concluded that in general, attention did not disrupt the rating of amusing and sad films. Moreover, their findings that the rating of amusing and sad films, relative to passive viewing produced increased activity in the anterior cingulate, occipital precuneus as well as other regions have similarities to this investigations findings. Hutcherson et al's (2005) proposal, however, that rating films and activation in the anterior cingulate and occipital precuneus are related to introspection would seem only partly confirmed given the previous discussion as regards culturally learnt responses.

5.2 (d) vi. Stable Mood: Concluding Comments.

The stronger BOLD responses observed for high > low positive and high > low negative affect and social emotion films would seem to support Marszał-Wiśniewska and Zajusz (2010) proposal that mood is one influence on the appraisal of emotional stimuli. In addition, the neural pattern observed for PSE and high affect participants would seem to relate to studies (Fredrickson, 2000; Geers et al, 2003) who propose that individuals with positive traits are more likely to attend to positive relatable information. Since, stronger BOLD responses were observed for PSE and high > low positive participants, in the ventral and dorsal anterior cingulate regions, but not observed for high > low positive participants and NSE. The stronger BOLD responses observed for both PSE and NSE and high > low positive participants in the right and left insula respectively, however, were viewed as related to arousal.

As was mentioned in the Introduction the PANAS X trait scales have similarities to measures of personality (Watson and Clark, 1994) and although the objective of this investigation was to assess stable mood - rather than personality per se - these constructs are somewhat difficult to differentiate completely. The findings of this investigation would seem to suggest that stable positive and negative higher order mood states, like stable personality characteristics as discussed, do to some extent influence neural activation during the processing of social emotions. However, given that the investigation measured participants customary mood the activation revealed for high positive and high negative participants could also be associated with participants' personality characteristics - extraversion and neuroticism respectively – rather than mood per se.

Serenity, attentiveness and fatigue were viewed as evaluating specific traits, unlike positive and negative affect that measured participants' general higher order traits. The sparse activation observed (see chapter four, Table 48) for the effect of specific mood on PSE, NSE, PG or NG would seem to suggest that these moods had limited influence on the processing of the social emotion films. The only stronger BOLD response of particular interest was left amygdala activation for PSE and high > low fatigue participants. The left amygdala activation for PSE and high > low fatigue participants was discussed as maybe due to the influence of dopamine-mediated factors (Adolphs, 2010). In comparison, the anterior cingulate findings for PSE and high > low positive participants were discussed as maybe related to studies who found activation in this region influenced by characteristic bias in the processing of positive stimuli (Wilson and Gullone, 1999). This would seem to suggest that the differing BOLD responses observed for general mood and specific mood in the amygdala, prefrontal and cingulate regions could be related to the two different levels of mood measurement provided by the PANAS X (Watson and Clark, 1994). Further support, in many ways, for the above proposal that the positive and high negative traits measured in this investigation are to some extent related to participants' personality characteristics.

Finally, the results of this investigation, in many ways, counter Mitchell and Phillips (2007) meta-analysis, that in non-clinical populations the prefrontal cortex is most frequently activated during positive and negative mood states. This inconsistency could be due to the present investigation measuring participant's customary individual response in contrast to the majority of affect studies that tend to measure induced mood.

5.3. Limitations and Future Research.

There were several limitations of the present investigation. On reflection the happy and sad films although matched as regards a theme were contrasted to un-themed neutral clips. In addition, all emotion film clips included one male and one female actress/actor, whereas the neural clips featured two male actors for two of the three clips. Future fMRI studies using film clips could remove these potential confounds and also monitor what aspects (e.g. music or dialogue) the participants found most engaging.

The inclusion of stable mood and ethnic origin, to facilitate a more detailed understanding of the influence of group and individual differences, was a key element in this investigation. However, whether both women and men should also have been included, despite the sound reasons given, is in retrospect debatable. Given, although the groups compared generally comprised of twelve or more participants the between-group comparisons were always to some extent unbalanced on some variable (e.g. gender, mood or ethnic origin). The fMRI sample in the present investigation was too small to implement a factorial design in order to be balanced on all the between-participant variables measured. This differed from the behavioural study in which a factorial MANOVA was employed to manage ethnic origin and stable mood factors. Consequently, given that gender was a possible confounding factor in many of the analyses an argument could be made that the female-only comparisons presented are the most interpretable. However the underlying assumption, in most imaging literature, is that gender is the prime confound in affect investigations employing emotion eliciting films. In this investigation effects on BOLD responses were observed in the prefrontal, anterior cingulate and amgydala for ethnic origin and to some extent stable mood for social meanings and social general emotional film contrasts. This is confirmation, that these group and individual variables can also be significant confounds.

The major surprise in the investigation was that although differences in BOLD responses were observed for both social and general film t-contrasts the initial across all-participants analysis for PSE did not reveal activation in the prefrontal or anterior cingulate regions. The initial across all-participants NSE analysis, however, did reveal activation in prefrontal regions and this was potentially linked to the universal and primary response of the grief themed films. As mentioned in the film review and supported by the behaviour studies, sad films elicit the specific and isolated target emotion of sadness, whereas happy films tend to elicit rather cognate aspects of positive emotions (e.g. love, joy, contentment and amusement). Consequently, the blend of positive emotions elicited by happy films may make them more varied and subject to individual engagement and appraisal. This account would in some ways confirm suggestions made in the behavioural study that positive emotion although generally viewed as homogeneous needs a more nuanced conceptualisation.

The results of this investigation would recommend that any future fMRI study into self-reported ethnic origin, mood and social emotions might benefit from employing within-gender comparisons and pre-screening of mood in order to include only participants with similar stable mood traits. For example, if female participants from two ethnicities (e.g. European and Asian) were included this would allow the inclusion of Bollywood style (Indian English in dialogue film clips) as well as equivalent western style films in order to study the effect of the interaction between actors' and participants' ethnic origin on brain reactivity to happy and sad films.

In conclusion, the research described here has shown the influence of self-reported ethnic origin and stable mood on brain reactivity to social and emotional stimuli. This is an area that to some extent has been overlooked in many imaging investigations. Similarly, research on the neural correlates activated when *social meanings* are the causation and constitution of positive and negative emotions is not that often addressed. Further research in both these areas is important in order to better understand how specific regions of the brain associated with emotional and social experience form and change: particularly, given the importance of this adaptive feature for stable mental and emotional behaviour.

6. CONCLUSION.

The pattern of results for fMRI participants' self-report ratings showed that the emotion profiles of this group were very similar to that of both independently assessed behavioural study groups. This finding supported the position set out in chapter two that film stimuli are an induction procedure that allows for ethical and ecological elicitation of dynamic happy and sad emotions. The robustness of the film clips to elicit comparable happy, sad and neutral ratings in dissimilar settings also provided confidence in attributing the activations observed as affect-related. As predicted an across all participants analysis established that negative emotion films activated dissimilar neural regions than positive emotion films. The significant activation in prefrontal, amygdala and cingulate regions when social meaning was the causation of sad emotion, in contrast to happy emotion, was related to the more universal grief themed films. The differences between BOLD responses observed for happy films or sad films and self-reported ethnic origin would suggest that European, in contrast to non-European, participants did differ in their appraisal of the happy and sad films across time segments. With possibly learnt cultural responses helping individuals to appraise what features of the films were perceptible as positive or negative. The variability in activation observed for self-reported ethnic origin in design one and two suggests that when employing emotional film stimuli period averages could effectively moderate the specific emotion under investigation. The activation observed for serenity or fatigue suggests that specific moods had little influence on the processing of happy and sad films with the activation observed for high positive and high negative participants perhaps also associated with extraversion and introversion characteristics. This investigation would seem to suggest that for this non-clinical sample cultural information and stable mood were two internal mechanisms participants used to help appraise what was positive and negative in the observed happy and sad films. In conclusion, the research described here indicates that ethnic origin and mood are potentially significant influences on elicited emotion and brain reactivity to positive and negative social and emotional situations.

7. REFERENCES.

Aalto, S. Wallius, E., Naatanen, P., Hitunen, J., Metsahonkala, L. & Sipila, H. (2005). Regression analysis utilizing subjective evaluation of emotional experience in PET studies on emotions. *Brain Research Protocols.* 15 (3), 142-154.

Abele, A.E., & Gendolla, G.,H.E. (1999). Satisfaction Judgments in Positive and Negative Moods: Effects of Concurrent Assimilation and Contrast Producing Processes. *Personality and Social Psychology Bulletin.* 25(7), 883-895.

Adaval, R. (2003). How good gets better and bad gets worse: Understanding the impact of affect on evaluations of known brands. Journal of Consumer Research. 30, 352-367.

Adolphs, R. (2010). What does the amygdala contribute to social cognition? *Annals of the New York Academy of Sciences.* 1191(1), 42–61.

Adolphs, R., Baron-Cohen, S., & Tranel, D. (2002). Impaired Recognition of Social Emotions following Amygdala Damage. *Journal of Cognitive Neuroscience.* 14(8), 1264-1274.

Allman, J. M., Watson, K. K., Tetreault, N. A., & Hakeem, A. Y. (2005). Intuition and autism: A possible role for von economo neurons. *Trends in Cognitive Sciences*. 9, 367–373. Cited in Decety, J., (2011). Dissecting the Neural Mechanisms Mediating Empathy. *Emotion Review.* 3(1), 92–108.

Amodio, D.M., & Frith, C.D. (2006). Meeting of minds: the medial frontal cortex and social cognition. *Nature Reviews: Neuroscience*. 7, 268-277.

Anderson, A.K., & Phelps, E.A. (2001). Lesions of the human amygdala impair enhanced perception of emotionally salient events. *Nature.* 411, 305-309.

Anderson, L., Shimamura, A. P. (2005). Influences of emotion on context memory while viewing film clips. *American Journal of Psychology*. 118(3), 323-338.

Austin, M.A., Riniolo, T.C., & Porges, S.W. (2007). Borderline Personality Disorder and Emotional Regulation: Insights from the Polyvagal Theory. *Brain and Cognition.* 65(1), 69-76.

Baas, D., Alemana, A., & Kahn, R.S. (2004). Lateralization of amygdala activation: a systematic review of functional neuroimaging studies. *Brain Research Reviews*. 45(2), 96 – 103.

Bailenson, J.N., Nikakis,E.D., Mauss, I.B., Gross, J.J., Jabon, M.E., Hutcherson, C.A., Nass, C., & John, O. (2008). Real-time classification of evoked emotions using facial feature tracking and physiological responses. *International Journal of Human-Computer Studies.* 66(5), 303-317.

Barbas, H. (1993). Organization of cortical afferent input to **orbitofrontal** areas in the rhesus monkey. *Neuroscience*, 56(4), 841-64.

Barrett, L.F., Robin, L., Pietromonaco, P.R., & Eyssell, K.M. (1998). Are women the "more emotional" sex? Evidence from emotional experiences in social context. *Cognition and Emotion.* 12, 555-578.

Bartels, A., & Zeki, S. (2000). The neural basis of romantic love. *NeuroReport.* 11(17)., 3829-3834.

Bartels, A., & Zeki., S. (2004). The neural correlates of maternal and romantic love. *NeuroImage*, 21, 1155-1166.

Battocchi, A., Pianesi, F., & Goren-Bar, D. (2005). A first evaluation study of a database of kinetic facial expressions. In *Proceedings of the 7th international conference on Multimodal interfaces.* (pp. 214–221) ACM Press.

Baylis, L.L., & Gaffan, D. (1991). Amygdalectomy and ventromedial prefrontal ablation produce similar deficits in food choice and in simple object discrimination learning for an unseen reward. *Experimental Brain Research*. 86(3), 617-622.

Beer, J.S., John, O.P., Scabini, D., & Knight, R.T. (2006). Orbitofrontal Cortex and Social Behavior: Integrating Self-monitoring and Emotion-Cognition Interactions. *Journal of Cognitive Neuroscience.* 18(6), 871-879.

Berlin, H.A., Rolls, E.T., & Iversen, S.D. (2005). Borderline Personality Disorder, Impulsivity, and the Orbitofrontal Cortex. *American Journal of Psychiatry*. 162, 2360-2373.

Bond, M.H. (2004). Culture and Aggression—From Context to Coercion. *Personality and Social Psychology Review*. 8(1), 62-78.

Bourne, V.J., & Maxwell, A.M. (2010). Examining the sex difference in lateralisation for processing facial emotion: Does biological sex or psychological gender identity matter? *Neuropsychologia.* 48(5), 1289-1294.

Britton, J.C., Phan, K.L., Taylor, S.F., Welsh, R.C., Berridge, K.C., & Liberzon, I. (2006). Neural correlates of social and nonsocial emotions : An fMRI study. *NeuroImage*, 31(1), 397-409.

Bush, G., Luu, P., & Posner, M.I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *Trends in cognitive sciences*. 4(6), 215-222.

Calder, A.J. (2003). Disgust discussed. *Annals of Neurology*. 53(4), 427 - 428.

Campbell-Sills, L., Barlow, D.H., Brown, T.A., & Hofmann, S.G. (2006). Effects of suppression and acceptance on emotional responses of individuals with anxiety and mood disorders. *Behaviour Research and Therapy*. 44(9), 1251-1263.

Canli, T., Zhao, Z., Desmond, J.E., Kang, E., Gross, J, & Gabrieli, J.D. (2001).An fMRI study of personality influences on brain reactivity to emotional stimuli. *Behavioral Neuroscience*. Vol. 115(1). 33-42.

Carmichael, S.T., & Price, J.L. (1995). Sensory and premotor connections of the orbital and medial prefrontal cortex of macaque monkeys. *Journal of Comparative Neurology*. 363(4), 642-664.

Chivers, M. L., Seto, M. C., & Blanchard, R. (2007). Gender and sexual orientation differences in sexual response to sexual activities versus gender of actors in sexual films. *Journal of Personality and Social Psychology*. 93, 1108–1121.

Christie, I.C, & Friedman, B.H. (2004). Autonomic specificity of discrete emotion and dimensions of affective space: a multivariate approach. *International Journal of Psychophysiology*. 51, 143–153

Chuang, S.C., Kung, C., & Sun, Y.C. (2008). The Effect of Emotions on Variety-Seeking Behaviour. *Social Behavior and Personality: an international journal.* 36(3), 425-432.

Costafreda, S.G., Brammer, M. J., David, A.S., & Fu, C.H. (2008). Predictors of amygdala activation during the processing of emotional stimuli: a meta-analysis of 385 PET and fMRI studies. *Brain Research Reviews* 58, 57–70.

Craig, A.D. (2009). How do you feel-now? The anterior insula and human awareness. *Nature Reviews Neuroscience.* 10, 59–70. In Lamm, C., & Singer, T. (2010). The role of anterior insular cortex in social emotions. *Brain Structure and Function*. 214, 579–591.

Damasio, A.R., Grabowski, T.J., Bechara, A., Damasio, H., Ponto, L.,L.B., Parvizi, J., & Hichwa, R.D. (2000). Subcortical and cortical brain activity during the feeling of self-generated emotions. *Nature Neuroscience.* 3(10),1049-1056.

Davidson, R.J. (2001). The neural circuitry of emotion and affective style: prefrontal cortex and amygdale contributions. *Social Science Information*. (pp 11-37). Sage Publications. London.

Davidson, R.J. (2003) Seven sins in the study of emotion: Correctives from affective neuroscience. *Brain and Cognition.* 52, 129-132.

Davidson, R.J. (2004). What does the prefrontal cortex “do” in affect: Perspectives in frontal EEG asymmetry research. *Biological Psychology*. 67, 219-234.

Davidson, R.J., & Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences.* 3(1), 11-21.

Davis, M, & Whalen, P.J. (2001). The amygdala: vigilance and emotion. *Molecular*. *Psychiatry*. 6, 13 – 34.

Decety, J. (2011). Dissecting the Neural Mechanisms Mediating Empathy. *Emotion Review.* 3(1), 92–108.

Desmond, J.E., & Glover, G.H. (2002). Estimating sample size in functional MRI (fMRI) neuroimaging studies: Statistical power analyses. *Journal of Neuroscience Methods.* 118(2), 115-128.

De Vries, M., Holland, R.W., & Witteman, C.L.M. (2007). Fitting decisions: Mood and intuitive versus deliberative decision strategies. *Cognition & Emotion.* 22 (5), 931 – 943.

De Vries, M., Holland, R.W., & Witteman, C.L.M. (2008). In the winning mood: Affect in the Iowa gambling task. *Judgment and Decision Making*. 1, 42–50.

Department of Health (2007). http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/Browsable/DH_5319155

Ding, S.L., Van Hoesen, G.W., Cassell, M.D., & Poremba, A. (2009). Parcellation of human temporal polar cortex: A combined analysis of multiple cytoarchitectonic, chemoarchitectonic, and pathological markers. *Journal of Comparative Neurology*. 18/514(6), 595-623.

Dolan, R J. (2002) Emotion, Cognition and Behavior. *Science.* 298, 1191-1194.

Donaldson, D. I., & Buckner, R. L. (2001). Effective paradigm design. In P. Jezzard, P. Mathews, and S. M. Smith (Eds.) Functional MRI: An introduction to methods (pp. 177–195). Oxford University Press, Oxford.

Durik, A.M., Hype, J.S., Marks, A.C., Roy, A.L., Anaya, D., & Schultz, G. (2006). Ethnicity and Gender Stereotypes of Emotion. *Sex Roles.* 54(7-8). 429-445.

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion.* 6, 169-200.

Ekman, P. (2003). Emotions Revealed: Understanding Faces and Feelings. *Weidenfeld and Nicolson, London.* Cited in Rolls, E.T. (2005). Emotion Explained. *Oxford University Press.* Oxford.

Ekman, P. & Friesen, W.V. (1974). Detecting deception from body or face. *Journal of Personality and Social Psychology*. 29(3), 288-298.

Ekman, P., & Friesen, W.V. (1986). A new pan-cultural facial expression of Motion *Motivation and Emotion.* 10(2), 159-168.

Ekman, P., Friesen, W.V., & O'Sullivan, M. (1988). Smiles when lying. *Journal of Personality and Social Psychology.* 54, 414-420.

Eldar, E., Ganor, O., Admon, R., Bleich, A., & Hendler, T. (2007). Feeling the real world: Limbic response to music depends on related content. *Cerebral Cortex*. 17(12), 2828 – 2840.

Engel, G.L., Frader, M., Barry, C. Morrow, G.R. (1984). Sadness evoked by a film on grief: An experimental study *International Journal of Psychiatry in Medicine.* 14, 1–30. Cited in Gross, J.J., & Levenson, R.W. (1995). Emotion Elicitation Using Films. *Cognition and Emotion.* 9(1), 1-87.

Eslinger, P.J., & Damasio, A.R. (1985). Severe disturbance of higher cognition after bilateral frontal lobe ablation: patient EVR. *Neurolgy.* 35, 1731-1741

Eugene, F., Levesque, J., Mensour, B., Leroux, J., Beaudoin, G., Bourgouin, P., & Beauregard M. (2003). The impact of individual differences on the neural circuitry underlying sadness. NeuroImage. 19, 354-364.

Farrow, T. F., Zheng, Y., Wilkinson, I.D., Spence, S.A., Deakin, J.F., Tarrier, N., Griffiths, P.D., & Woodruff, P. W., (2001). Investigating the functional anatomy of empathy and forgiveness. *Neuroreport*. 12(11), 2433 – 2438.

Fischer, A.H., Manstead, S.R., & Zaalberg. (2003). Social influences on the emotion process. *European Review of Social Psychology.* 14(6), 171-201.

Fredrickson, B.L., & Kahnema, D. (1993). Duration neglect in retrospective evaluations of affective episodes J*ournal of Personality and Social Psychology*, 65(1), 45-55.

Fredrickson, B.L., & Levenson, R.W. (1998). Positive Emotions Speed Recovery from the Cardiovascular Sequelae of Negative Emotions. *Cognition and Emotion*, 12(2), 191-220.

Fredrickson, BL., Mancuso, RA., Branigan, C., Tugade, M.M. (2000). The Undoing Effect of Positive Emotions. *Motivation and Emotion*, 24(4), 237-256.

Fredrickson, B.L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion*. 19, 313–332.

Friston, K.J., Jezzard, P., & Turner, R. (1994). Analysis of functional MRI time-series. *Human Brain Mapping*. 1(2), 153 -171.

Fucito, L.M., & Juliano, L.M. (2009). Depression Moderates Smoking Behavior in Response to a Sad Mood Induction. *Psychologists in Addictive Behaviors*. 23(3), 546-551.

Gable, P.A., & Harmon-Jones, E. (2008). Approach-Motivated Positive Affect Reduces Breadth of Attention. *Psychological Science*. 19(5), 476-482.

Geers, A.L., Handley, I.M., & McLarney, A.R. (2003). Discerning the Role of Optimism in Persuasion: The Valance-Enhancement Hypothesis. *Journal of Personality and Social Psychology*. 85(3), 554-565.

Gerrards-Hesse, A., Spies, K., & Hesse, F.W. (1994). Experimental inductions of emotional states and their effectiveness: A review. *British Journal of Psychology*. 85(1), 55 -78.

Goffman, E. (1956). Embarrassment and social organization. *American Journal of Sociology*. 62, 264-271.

Goldin, P.R., Hutcherson, C.A., Ochsner, K.N., Glover, G.H., Gabrieli, J.D,. & Gross, J.J. (2005). The neural bases of amusement and sadness: A comparison of block contrast and subject-specific emotion intensity regression approaches. *NeuroImage*. 27, 26-36.

Goldin, P.R., McRae, K., Ramel, W., & Gross, J.J. (2008). The Neural Bases of Emotion Regulation: Reappraisal and Suppression of Negative Emotion. *Biological Psychiatry*. 63(6), 577-586.

Gomez, P., Zimmermann, P.G., Guttormsen Schar, S., & Danuser, B. (2009). Valence Lasts Longer than Arousal. *Journal of Psychophysiology*. 23(1), 7-17.

Greimel, E., Macht, M., Krumhuber, E., & Ellgring, H. (2006). Facial and affective reactions to tastes and their modulation by sadness and joy. *Physiology and Behavior*. 89, 261-269.

Gross, J.J. (1998) The emerging field of emotion regulation: An integrated review. *Review of General Psychology*. 2(3), 271-299.

Gross, J.J., & Levenson, R.W. (1993). Emotional suppression: Physiology, self-report and expressive behaviour. *Journal of Personality and Social Psychology*. 64, 970-986.

Gross, J.J., & Levenson, R.W. (1995) Emotion Elicitation Using Films. *Cognition and Emotion* 9(1), 1-87.

Gross, J.J., Sutton, S.K., & Ketelaar, T. (1998). Relations between affect and personality: Support for the affect-level and affective-reactivity views. *Personality and Social Psychology Bulletin*. 23(3), 279.

Gruber, J., Oveis, C., Keltner, D., & Johnson, S.L. (2008). Risk for Mania and Positive Emotional Responding: Too Much of a Good Thing? *Emotion.* 8(1), 23-33.

Gündel, H.M.D., O'Connor, M., Littrell, L., Fort, C., & Lane, R.D. (2003). Functional Neuroanatomy of Grief: An fMRI Study. *American Journal of Psychiatry*. 160, 1946 - 1953.

Haidt, J., Rozin, P., McCauley, C. R,. & Imada, S. (1997). Body, psyche and culture: The relationship between disgust and morality. *Psychology and Developing Societies*. 9, 107–131.

Hagemann, D., Naumann, E., Maier, S., Becker, G., Lurken, A., & Bartussek, D. (1999). The assessment of affective reactivity using films: Validity, reliability and sex differences. *Personality and Individual Differences.* 26, 627-639.

Hajekabc, T., Kopecekcd, M., Kozenyc,. J., Gundeb, E., Aldaac, M,. & Höschlc, C. (2009). Amygdala volumes in mood disorders — Meta-analysis of magnetic resonance volumetric studies. *Affective Disorders*. 115(3), 395-410.

Hamann, S., & Canli, T. (2004). Individual differences in emotion processing. *Current Opinion in Neurobiology.* 14(2), 233-238.

Harmon-Jones, E. (2004). Contributions from research on anger and cognitive dissonance to understanding the motivational functions of asymmetrical frontal brain activity. *Biological Psychology.* 67, 51–76.

Harmon-Jones, E. & Winkielman, P. (2007). Social Neuroscience: Integrating Biological and Psychological Explanations of Social Behavior. New York: Guildford Press.

Herring, N.A., Roberts, & Devine, M.J. (2010). Coherent with laughter: Subjective experience, behavior, and physiological responses during amusement and joy. *International Journal of Psychophysiology*. 79(2), 211-218.

Hewig, J., Hagemann, D., Seifert, J., Gollwitzer, M., Naumann, E., & Bartussek, D. (2005). A revised film set for the induction of basic emotions. *Cognition and Emotion*. 19, 1095-1109.

Hosie, J.A., Milne, A. B., & McArthur, L. (2005). The after-effects of regulating anger and anger-related emotions on self-report ratings and behavior: Divergent consequences for men and women. *Psychologia*, 48, 288-305.

Hutcherson, C.A., Goldin, P.R., Ochsner, K.N., Gabrieli, J.D., Feldman Barrett, L. and Gross, J.J. (2005). Attention and emotion: Does rating emotion alter neural responses to amusing and sad film? NeuroImage 27(3), 656-668.

Iacoboni, M., Lieberman, M.D., Knowlton, B.J., Molnar-Szakacz, I., Moritz, M., Throop, C.J., & Fiske, A. (2004). Watching social interactions produces dorsomedial prefrontal and medial parietal BOLD fMRI signal increases compared to a resting baseline. *NeuroImage.* 21(3), 1167-1173.

Immordino-Yang, M.H., McColl, A., Damasio, H., & Damasio, A. (2009). Neural correlates of admiration and compassion. *Proceedings of the National Academy of Sciences of the United States of America.* 106(19), 8021-8026.

International Affective Picture System. Cited in Lang, P., Bradley, M., & Cuthbert, B. (1999). International Affective Picture System (IAPS): *Technical Manual and Affective Ratings.* NIMH CSEA, Gainsville, Florida. USA.

Izard, C.E., Dougherty, F.E., Bloxom, B.M., & Kotsch, N.E. (1974). The Differential Scale: a method of measuring the meaning of subjective experience of discrete emotions. Cited in Gross, J.J., & Levenson, R.W. (1995). Emotion Elicitation Using Films. *Cognition and Emotion* 9 (1), 1-87.

Izard, C.E., Libero, D.Z., Putnam, P., & Haynes, O.M. (1993). Stability of emotion experiences and their relations to traits of personality. *Journal of Personality and Social Psychology.* 64, 847-860.

Izard, C. E. (2009). Emotion Theory and Research: Highlights, Unanswered Questions, and Emerging Issues. *Annual Review of Psychology*. 60, 1–25.

Jacobson, N. S., Roberts, L. J., Berns, S. B., & McGlinchey, J. B. (1999). Methods for defining and determining the clinical significance of treatment effects: description, application, and alternatives. *Journal of Consulting and Clinical Psychology*. 67, 300–307.

Janssen, E., Vorst, H., Finn, P., & Bancroft, J. (2002). The Sexual Inhibition (SIS) and Sexual Excitation (SES) Scales: II. Predicting psychophysiological response patterns. *Journal of Sex Research.* 39, 127–132.

Killgore, W.D.S., & Yurgelun-Todd, D.A. (2001). Sex differences in amygdala activation during the perception of facial affect. *Neuroreport.* 12(11), 2543-2547.

Kliegel, M., Horn, A.B., & Zimmer, H. (2003). Emotional after-effects on the P3 component of the event-related brain potential. *International Journal of Psychology*. 38, 129 - 137.

Kliegel, M., Jäger, T., & Phillips, L.H. (2007). Emotional Development Across Adulthood: Differential Age-Related Emotional Reactivity and Emotion Regulation in a Negative Mood Induction Procedure. *The International Journal of Aging and Human Development.* 64 (3), 217 – 244.

Kienast, T., Hariri, A.R., Schlagenhauf, F., Wrase, J., Sterzer, P., Buchholz, H.G., Smolka, M.N., Gründer, G., Cumming, P., Kumakura, Y., Bartenstein, P., Dolan, R.J., & Heinz, A. (2008). Dopamine in amygdala gates limbic processing of aversive stimuli in humans. *Nature Neuroscience.* 11, 1381–1382.

Kober, H., Barrett, L.F., Joseph, Bliss-Moreau, E., Lindquist, K., & Wager T.D. (2008). Functional grouping and cortical-subcortical interactions in emotion: a meta-analysis of neuroimaging studies. *Neuroimage.* 42, 998–1031. Cited in Lamm, C., & Singer, T. (2010). The role of anterior insular cortex in social emotions. *Brain Structure and Function*. 214, 579–591.

Kringelbach, M.L., & Rolls, E.T. (2004). The functional microanatomy of human orbit frontal cortex: evidence from neuroimaging and neuropsychology. *Progress in Neurobiology*. 72, 341-372.

Kringelbach, M.L., & Berridge, K.C. (2009). Towards a functional neuroanatomy of pleasure and happiness. *Trends in Cognitive Science.* 13(11), 479-487.

Kuhbandner, C., Hanslmayr, S., Maier, M.A., Pekrun, R., Spitzer, B., Pastotter, B., & Bauml, K. (2009). Effects of mood on the speed of conscious perception: behavioural and electrophysiological evidence. *Social Cognitive and Affective Neuroscience*. 4(3), 286-293.

Kuhbandner, C., Pekrun, R., & Maierb, M.A. (2010). The role of positive and negative affect in the “mirroring” of other persons' actions. *Cognition and Emotion*. 24 (7), 1182 - 1190

LaBar, K.S., LeDoux, J.E., Spencer, D.D., & Phelps, E.A. (1995). Impaired fear conditioning following unilateral temporal lobectomy in humans. *Journal of Neuroscience.* 15, 6846–6855. Cited in Adolphs, R. (2010). What does the amygdala contribute to social cognition? *Annals of the New York Academy of Sciences.* 1191(1), 42–61.

Laird, J.D., & Bresler, C. (1992). The process of emotional experience: A self-perception theory. *Emotion: Review of Personality and Social Psychology. Vol. 13, 213-234.* Cited in Strout, S.L., Sokol, R.I., Laird, J.D., & Thompson, N.S. (2004). The Evolutionary Foundation of Perceiving One's Own Emotions. *Behaviour and Philosophy.* 32, 493-502.

Lamm, C., & Singer T. (2010). The role of anterior insular cortex in social emotions. *Brain Structure and Function*. 214, 579–591.

Lazarus, R. S., Speisman, J. C., Mordkoff, A.N., & Davidson, LA. (1962). A laboratory study of psychological stress produced by emotion picture film. *Psychology Monogram General Appl. Vol. 76.* Cited in Gross, J.J., & Levenson R.W. (1995) Emotion Elicitation Using Films. *Cognition and Emotion* 9 (1), 1-87.

LeDoux, J.E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience.* 23, 155-184.

Lerner, J.D., Small, A., & Loewenstein, G. (2004). "Heart Strings and Purse Strings: Carryover Effects of Emotions on Economic Decisions ". *Psychological Science*. 15(5), 337-341.

Levenson, R.W., Soto, J., & Pole, N. (2007). Emotion, biology, and culture. *Handbook of cultural psychology* (pp. 780-796). New York: Guilford.

Lewis, M.D. (2005). Bridging emotion theory and neurobiology through dynamic systems modeling. *Behavioural and Brain Sciences*. 28, 169-245.

Love, T., Smith, Y.R., Persad, C.C., Tkaczyk, D.A., & Zubieta, J. (2010). Short-term Hormone Treatment Modulates Emotion Response Circuitry in Postmenopausal Women. *Fertile Sterilisation.* 93(6), 1929–1937.

Luu, P., & Posner, M.I. (2003). Anterior cingulate cortex regulation of sympathetic activity. *Brain.* 126(10), 2119-2120.

Maddock, R.J. (1999). The retrosplenial cortex and emotion: new insights from functional neuroimaging of the human brain. *Trends Neuroscience*. 22, 310–316.

Macht, M., & Mueller, J. (2007). Increased negative emotional responses in PROP supertasters. *Physiology and Behavior.* Vol. 90(2-3): 466-472.

Marziller S.L. Davey G.C.L. (2005). Anxiety and disgust: evidence for a unidirectional relationship. *Cognition and Emotion.* 19,729–750.

Mather, M., Canli, T., English, T., Whitfield, S., Wais, P., Ochsner, K., Gabrieli, J., & Cartensen, L. (2004). Amygdala responses to emotionally valenced stimuli in older and younger adults. *Psychological Science.* 15, 259–263.

Marszał-Wiśniewska, M., & Zajusz, D. (2010). Mood as Information: The Regulatory Role of Personality. *Handbook of Individual Differences in Cognition.* Handbook of Individual Differences. Cited in Cognition on Human Exceptionality (pp 383-402). The Springer Series.

Martin, L.L., Ward, D.W., Achee, J.W., & Wyer, J R.S. (1993). Mood as Input: People Have to Interpret the Motivational Implications of Their Moods. Journal of Personality and Social Psychology. 64(3), 317-326.

Matsumoto, D. (2006). Are Cultural Differences in Emotion Regulation Mediated by Personality Traits? *Journal of Cross-Cultural Psychology*. 37(4). 421-437.

Mewborn, C.R., & Rogers, R.W. (1979). Effects of threatening and reassuring components of fear appeals on physiological and verbal measures of emotion and attitudes. Journal of Experimental Social Psychology. 15(3), 242 – 253.

Mitchell, R.L., & Phillips, L.H. (2007). The psychological, neurochemical and functional neuroanatomical mediators of the effects of positive and negative mood on executive functions. *Neuropsycholgia*. 45, 617-629.

Mugler, J.P., & Brookeman, J.R. (1990). Three-dimensional magnetization-prepared rapid gradient-echo imaging (3D MP-RAGE). *Magnetic Resonance in Medicine*. 15, 152–157.

Murphy, F.C., Nimmo-Smith, I.J., & Lawrence, A.D. (2003). Functional neuroanatomy of emotions: A meta-analysis. Cognitive, Affective and Behavioral Neuroscience. 3(3), 207-233.

Nasoz, F., Lisetti, C.L., Avarez, K., & Finkelstein, N. (2003). Emotion Recognition from Physiological Signals for User Modeling of Affect. The 3rd Workshop on Affective and Attitude User Modeling, USA.

Norris, C.J., Chen, E.E., Zhu, D.C., Small, S.L., & Cacioppo, J.T. (2004). The Interaction of Social and Emotional Processes in the Brain. *Journal of Cognitive Neuroscience.* 16. 1818-1829.

Oatley, K. (2009). Communications to Self and Others: Emotional Experience and its Skills. *Emotion Review*. 1(3), 206-213.

Ochsner, K.N. (2004). Current directions in cognitive neuroscience. *Current Opinion in Neurobiology*. 14, 254-258.

Ochsner, K.N. (2008). The Social-Emotional Processing Stream: Five Core Constructs and Their Translational Potential or Schizophrenia and Beyond. *Biological Psychiatry*. 64, 48-61.

Ochsner, K.N., Ray, R.K., Cooper, J.C., Robertson, E.R, Chopra, S., Gavrieli J.D.E., & Gross, J.J. (2004). For better or for worse: neural systems supporting the cognitive down- and up-regulation of negative emotion. *NeuroImage.* 23, 483-499.

O'Doherty, J., Kringelbach, M.L., Rolls, E.T., Hornak, J., & Andrews, C. (2001). Abstract reward and punishment representations in the human orbitofrontal cortex. Cited in Rolls, E.T. (2005). Emotion Explained. *Oxford University Press.* Oxford.

Oliver, M. B., Weaver, J. B., & Sargent, S. (2000). An examination of factors related to sex differences in enjoyment of sad films. *Journal of Broadcasting and Electronic Media.* 44, 282–300.

Olsson, A., & Ochsner, K.N. (2008). The role of social cognition in emotion. *Trends in Cognitive Sciences*. 12(2), 65 - 71.

Passingham, R.E., Bengtsson, S.L., & Lau, H.C. (2010). Medial frontal cortex: from self-generated action to reflection on one's own performance. *Trends in Cognitive Science.* 14(1), 16–21.

Pennington, J.W. (2007). The history of sex in American film. *Westport*, Connecticut. USA.

Philippot, P. (1993). Inducing and assessing differentiated emotion-feeling states in the laboratory. *Cognition & Emotion*. 7(2), 171-193.

Phillips, L.H., Smith, L., & Gilhooly, K.J. (2002). The Effects of Adult Aging and Induced Positive and Negative Mood on Planning *Emotion.* 2(3), 263-272.

Phillips, L.H., Henry, J.D., Hosie, J.A., & Milne, A.B. (2008). Effective Regulation of the Experience and Expression of Negative Affect in Old Age. *Journal of Gerontology.* 63B(3), 138-145.

Phelps, E. A., Labarab, K.S., Andersona, A.K., O'connora, K.J., Fulbright, R.K., & Spencer, D.D. (1998). Specifying the contributions of the human amygdala to emotional memory: a case study. *Neurocase.* 4, 527–540.

Polivy, J. (1981). On the induction of emotion in the laboratory: Discrete mood or multiple affect states? *Journal of Personality and Social Psychology*. 41, 803-817.

Prigatano, G. P. (1991). Awareness of deficit after brain injury: Clinical and theoretical issues (pp. 111-126). *New York: Oxford University Press.* Cited in Beer, J.S., John, O.P., Scabini, D., & Knight, R.T. (2006). Orbitofrontal Cortex and Social Behavior: Integrating Self-monitoring and Emotion-Cognition Interactions. *Journal of Cognitive Neuroscience.* 18(6), 871-879.

Rafaeli, E., & Revelle, W. (2006). A premature consensus: are happiness and sadness truly opposite affects? *Motivation and Emotion.* 30(1), 1-12.

Raichle, M.E., MacLeod, A.M., Snyder, A.Z., Powers, W.J., Gusnard, D.A., & Shulman, G.L. (2001). A default mode of brain function. *Proceedings - National Academy of Science. U.S.A.* 98(2), 676 - 682.

Reminger, S.L., Kaszniak, A.W., & Dalby, P.R. (2000). Age-invariance in the asymmetry of stimulus-evoked emotional facial muscle activity. *Aging, Neuropsychology and Cognition.* 7, 156–168.

Richards, J.M., & Gross, J.J. (2000). Emotion regulation and memory: The cognitive costs of keeping one's cool. *Journal of Personality and Social Psychology*. 79, 410 –424.

Richards, J.M., & Gross, J.J. (2006). Personality and emotional memory: How regulating emotion impairs memory for emotional events. *Journal of Research in Personality.* 40(5), 631-651.

Roberts, N.A., & Levenson, R.W. (2006). Subjective, behavioral, and physiological reactivity to ethnically-matched and ethnically-mismatched film clips. *Emotion.* 6(4), 635–646.

Rolls, E.T. (2005). Emotion Explained. Oxford, Oxford University Press.

Rolls, E.T., & Baylis, L.L. (1994). Gustatory, olfactory, and visual convergence within the primate orbitofrontal cortex. *Journal of Neuroscience.* 14, 5437-5452.

Rottenberg, J., Ray, R.D., & Gross, J.J. (2007). Cited in Coan, J.A., & Allen, J.J.B. The Handbook of emotion elicitation and assessment, *Emotion elicitation using films* (pp 9 – 28). New York, Oxford University Press.

Sabatinelli, D.C., Flaisch, T., Bradley, M.M., Fitzsimmons, J.R., & Lang P.J. (2004). Affective picture perception: gender differences in visual cortex? *Neuroreport*. 15(7), 1109-1112.

Salzman, C.D., & Fusi, S. (2010). Emotion, Cognition, and Mental State Representation in Amygdala and Prefrontal Cortex. *Annual Review of Neuroscience*. 33, 173-202.

Schaefer, A.N.D., Sanchez, X., & Philippot, P. (2010). Assessing the effectiveness of a large database of emotion-eliciting films: A new tool for emotion researchers. *Cognition and Emotion.* 24(7), 1464-0600.

Schaich Borg, J., Lieberman, D., & Kiehl, K.A. (2008). Infection, incest, and iniquity: Investigating the neural correlates of disgust and morality. *Journal of Cognitive Neuroscience*. 20, 1529–1546.

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping and health: Assessment and implications of generalised outcome expectancies. *Health Psychology*. 4, 219–247.

Schneider, F., Habel, U., Kessler, C., Salloum, J.B., & Posse, S. (1999). Gender differences in regional cerebral activity during sadness. *Human Brain Mapping*. 9(4), 226-238.

Scherer, K., & Brosch, T. (2009). Culture-Specific Appraisal Biases Contribute to Emotion Dispositions. *European Journal of Personality*. 23, 265–288.

Sloan, D.M. (2004). Emotion regulation in action: Emotional reactivity in experiential avoidance. *Behaviour Research and Therapy*. 42, 1257–1270.

Simon, D., Craig, K.D., Gosselin, F., Belin, P., & Rainville, P. (2008). Recognition and discrimination of prototypical dynamic expressions of pain and emotions. *Pain*. 135(1-2), 55-64.

Smith, D.P., Hillman, C.H., & Duley, A.R. (2005). Influences of age on emotional reactivity during picture processing. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences*. 60, 49–56.

Staeblera, K., Gebharda, R., Barnettb, W., & Renneberga, B. (2009). Emotional responses in borderline personality disorder and depression: Assessment during an acute crisis and 8 months later. *Journal of Behavior Therapy and Experimental Psychiatry*. 40(1), 85 – 97.

Stephens, C.L., Christie, I.C., & Friedman, B.H. (2010). Autonomic specificity of basic emotions: Evidence from pattern classification and cluster analysis. *Biological Psychology*. 84(3), 463-473.

Strout, S.L., Sokol, R.I., Laird, J.D., & Thompson, N.S. (2004). The Evolutionary Foundation of Perceiving One's Own Emotions. *Behaviour and Philosophy*. 32, 493-502.

Tamietto, M., Adenzato, M., Geminiani, G., & Gelder, B. (2006). Fast recognition of social emotions takes the whole brain: Interhemispheric cooperation in the absence of cerebral asymmetry. *Neuropsychologia*. 45, 836–843.

Tice, D.M., Baumeister, R.F., Shmueli, D., & Muraven, M. (2007). Restoring the self: Positive affect helps improve self-regulation following ego depletion. *Journal of Experimental Social Psychology*. 43(3), 379–384.

Tomarken, A. J,. Davidson, R.J., & Henri, J.B. (1990). Resting Frontal Brain Asymmetry Predicts Affective Responses to Films. *Journal of Personality and Social Psychology.* 59 (4), 791-801.

Townsend, E., Walker, D., Sargeanta, S., Vostanisc, P., Hawtond, K., Stockera, O. & Sitholeb, J. (2010). Systematic review and meta-analysis of interventions relevant for young offenders with mood disorders, anxiety disorders, or self-harm. *Journal of Adolescence.* 33(1), 9-20.

Tsai, J.L., Levennson, R.W., & Carstensen, L.L. (2007). Autonomic. Subjective, and Expressive Responses to Emotional Films in Older and Younger Chinese Americans and European Americans. Psychology and Aging. 15(4), 684-693.

Tull, M.T, & Roemer, L. (2007). Emotion Regulation Difficulties Associated with the Experience of Uncued Panic Attacks: Evidence of Experiential Avoidance, Emotional Nonacceptance, and Decreased Emotional Clarity. *Behavior Therapy*. 38(4), 378 – 391.

Updegraff, J.A., Gable, S.L., & Taylor, S.E. (2004). What Makes Experiences Satisfying? The Interaction of Approach-Avoidance Motivations and Emotions in Well-Being. *Journal of Personality and Social Psychology.* 86(3), 496–504.

Van Wingen, G.A., van Eijndhoven, P., Cremers, H.R., Tendolkar, I., Verkes, R.J., Buitelaar, J.K., & Fernández, G. (2010). Neural state and trait bases of mood-incongruent memory formation and retrieval in first-episode major depression. *Journal of Psychiatric Research.* 44(8), 527-534.

Vogeley, K., May, M., Ritzl, A., Falkai, P., Zilles, K., & Fink, G.R., (2004). Neural correlates of first-person perspective as one constituent of human self-consciousness. *Journal of Cognitive Neuroscience.* 16 (5), 817–27.

Vuoskoski, J.K., & Eerolaa, T. (2011). The role of mood and personality in the perception of emotions represented by music. *Cortex Online* April 2011.

Vytal, K., & Hamann, S. (2010). Neuroimaging Support for Discrete Neural Correlates of Basic Emotions: A Voxel-based Meta-analysis. *Journal of Cognitive Neuroscience*. 22(12), 2864 - 2885.

Wager, T.D., Phan, K.L., Liberzon, I., & Taylor, S. (2003). Valence gender and lateralization of functional brain anatomy: a meta-analysis of finding from neuroimaging. *NeuroImage.* 19, 513-531.

Wallace, J.C., Kass, S. J., & Stanny, C. J. (2002). The cognitive failures questionnaire revisited: Dimensions and correlates. *The Journal of General Psychology*. 129(3), 238–256.

Watson, D., & Clark, L.A. (1994). The PANAS-X. Manual for the Positive and Negative Affect Schedule-Expanded Form. Iowa City, IA: The University of Iowa; 1994.

Weiskrantz, L. (1956). Behavioral changes associated with ablation of the amygdaloid complex in monkeys. *Journal of Comparative Physiology and Psychology.* 49, 381–391. Cited in Adolphs, R. (2010). What does the amygdala contribute to social cognition? *Annals of the New York Academy of Sciences.* 1191(1), 42–61.

Westermann, R., Spies, K., Stahl, G., & Hesse, F.W. (1996). Relative effectiveness and validity of mood induction procedures: A meta analysis. *European Journal of Social Psychology*. 26(4), 557-580.

Wilson, K., & Gullone, E. (1999). The relationship between personality and affect over the lifespan. *Personality and Individual Differences.* 27, 1141 -1156.

Wrase, J., Klein, S., Gruesser, S.M., Hermann, D., Flor, H., Mann, K., Braus, D.F., & Heinz, A. (2003). Gender differences in the processing of standardized emotional visual stimuli in humans: a functional magnetic resonance imaging study. *Neuorscience Lett.* 348, 41-45.

Wood, J.N., & Grafman, J. (2003). Human Prefontal Cortex: Processing and Representational Perspective. *Nature Reviews Neuroscience.* 4, 139-147.

Zhan, R., Moll, J., Krueger, F., Huey, E.D., Garrido, G., & Grafman, J. (2007). Social concepts are represented in the superior anterior temporal cortex. *PNAS.* 104(15), 6430-6435.

Zimmermann, P., Guttormsen, S., Danuser, B., & Gomez, P. (2003). Affective Computing-A Rationale for Measuring Mood with Mouse and Keyboard. *International Journal of Occupational Safety and Ergonomics.* 9(4), 539-551.

APPENDIX 1:

FILM ORDER OF THE DIFFERENT GROUPS FOR BEHAVIOURAL STUDY ONE.

<u>Film order of the different groups.</u>

GROUP A

Film Clip 1. *An Officer and a Gentleman* (OGS)
Film Clip 2. *Endless Love* (EEN)
Film Clip 3. *Love Story* (LSH)
Film Clip 4. *All the Presidents Men* (PM1N)
Film Clip 5. *Along for the Ride* (RN)
Film Clip 6. *Falling in Love (FLN)*
Film Clip 7. *Pretty Woman* (PW1H)
Film Clip 8. *Hannah and her Sisters* (H1N)
Film Clip 9. *Terms of Endearment* (TRS)

GROUP B

Film Clip 9. *Terms of Endearment* (TRS)
Film Clip 8. *Hannah and her Sisters* (H1N)
Film Clip 7. *Pretty Woman* (PW1H)
Film Clip 6. *Falling in Love (FLN)*
Film Clip 5. *Along for the Ride* (RN)
Film Clip 4. *All the Presidents Men* (PM1N)
Film Clip 3. *Love Story* (LSH)
Film Clip 2. *Endless Love* (EEN)
Film Clip 1. *An Officer and a Gentleman* (OGS)

GROUP C

Film Clip 10. *Officer and a Gentleman* (OGH)
Film Clip 11. *Crimes and Misdemeanors* (CMN)
Film Clip 12. *Love Story* (LSS)
Film Clip 13. *Presidents Men* (PM2N)
Film Clip 14. *Invitation to the Wedding* (LFH)
Film Clip 15. *Hannah and her Sisters* (H2N)
Film Clip 16. *Steel Magnolias* (SMS)
Film Clip 17. *Endless Love* (END2N)
Film Clip 18. *Pretty Woman* (PW2H)

GROUP D

Film Clip 18. *Pretty Woman* (PW2H)
Film Clip 17. *Endless Love* (END2N)
Film Clip 16. *Steel Magnolias* (SMS)
Film Clip 15. *Hannah and her Sisters* (H2N)
Film Clip 14. *Invitation to the Wedding* (LFH)
Film Clip 13. *Presidents Men* (PM2N)
Film Clip 12. *Love Story* (LSS)
Film Clip 11. *Crimes and Misdemeanors* (CMN)
Film Clip 10. *Officer and a Gentleman* (OGH)

APPENDIX 2:

Film Self Report Questionnaire.

Positive and Negative Affect Schedule (PANAS).

Life Orientation Test.

Informed Consent Form.

Debriefing Form.

PRACTICE FILM CLIP QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**PLEASANT**

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**A GREAT DEAL**
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

3. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes**

FILM CLIP 1
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

4. Had you seen the film before?
Please tick: **No** ___ **Yes** ___

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes** __

FILM CLIP 2
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

5. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 3
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

6. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 4
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										Amusement
Anger										Anger
Anxiety										Anxiety
Confusion										Confusion
Disgust										Disgust
Embarrassment										Embarrassment
Fear										Fear
Happiness										Happiness
Interest										Interest
Joy										Joy
Love										Love
Pride										Pride
Sadness										Sadness
Surprise										Surprise

7. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 5
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

8. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 6
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

9. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 7
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

10. Had you seen the film before?
Please tick: **No** ___ **Yes** ___

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes** ___

FILM CLIP 8
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

11. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

FILM CLIP 9
QUESTIONNAIRE.

Please answer the following questions about ***how you felt*** during the film clip.

1. Using the scale below please tick how UNPLEASANT or PLEASANT you felt during the film clip:

UNPLEASANT	0	1	2	3	4	5	6	7	8	PLEASANT

2. Using the scale below please tick the amount of EACH emotion ***you*** experienced during the film clip:

NONE AT ALL	0	1	2	3	4	5	6	7	8	A GREAT DEAL
Amusement										**Amusement**
Anger										**Anger**
Anxiety										**Anxiety**
Confusion										**Confusion**
Disgust										**Disgust**
Embarrassment										**Embarrassment**
Fear										**Fear**
Happiness										**Happiness**
Interest										**Interest**
Joy										**Joy**
Love										**Love**
Pride										**Pride**
Sadness										**Sadness**
Surprise										**Surprise**

12. Had you seen the film before?
Please tick: **No** ___ **Yes ___**

4. Did you close your eyes or look away during any part of the clip?
Please tick: **No** ___ **Yes ___**

GENERAL INFORMATION

Please answer these questions as accurately as possible by placing a tick in the most appropriate box.

AGE GROUP: 18-20☐ 21-23☐ 24-26☐ OTHER☐

GENDER: FEMALE ☐ MALE ☐

ETHNIC ORIGION:
ASIAN ☐ AFRICAN ☐ EUROPEAN ☐ OTHER ☐

ARE YOU CURRENTLY IN A LONG TERM RELATIONSHIP?
YES ☐ NO ☐

IF YES FOR HOW LONG:
LESS THAN A YEAR ☐ MORE THAN A YEAR ☐

ORIENTATION: STRAIGHT ☐ OTHER ☐

HOW OFTEN WOULD YOU WATCH A FEATURE FILM EITHER AT HOME OR IN THE CINEMA:
WEEKLY ☐
MONTHLY ☐
YEARLY ☐
NEVER ☐

IF YOU WATCH A FILM WHAT CLASSIFICATION OF FILM ARE YOU MOST LIKELY TO WATCH:
PG ☐
12 ☐
15 ☐
18 ☐

Positive and Negative Affect Schedule (PANAS).

Affect is another word for emotional or mood state. Research has shown that one of the primary dimensions of emotion is whether the emotion is positive or negative (its valence). PANAS was developed by Watson et al. (1988) as a brief measure of positive and negative affect.

It can be used to measure either trait dimensions (general mood) or state dimensions (current mood) according to the instructions given. In the class experiment, the trait instructions were used – thus PANAS was used to measure a person's general mood. PANAS is the second questionnaire in the booklet.

The PANAS schedule consists of 10 adjectives describing negative moods (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery and afraid), and 10 adjectives describing positive moods (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive and active). Subjects rate the extent to which they feel these feelings, on a 5 point scale.

The test is scored by adding up all the ratings for positive (panasP) and negative (panasN) adjectives separately.

Interestingly, the Panas P scale is not the opposite of the Panas N scale; rather, they measure different things. Thus P and N are independent of one another.

Reference:

Watson, D., Clark, L.A. & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of Personality and Social Psychology, 54, 1063-1070.

AFFECT SCALE.

This table consists of a number of words that describe different emotions and a rate of frequency scale. *There are no 'correct' or 'incorrect' answers*.

Please read each word carefully and then tick the appropriate box that best describes to what extent **you generally** have these emotions.

	1. Not at all	**2. A little**	**3. Moderately**	**4. Quite a bit**	**5. Extremely**
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					
Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
afraid					

LIFE ORIENTATATION SCALE

Using the scale below, write the appropriate letter in the box beside each statement, please answer as honestly and accurately as possible. Try not to let your response to one statement influence your responses to other statements. *There are no 'correct' or 'incorrect' answers.* Answer according to your **own feelings**, rather that how you think 'most people' would answer.

A	B	C	D	E
I agree a lot.	**I agree a little.**	**I neither agree or disagree.**	**I disagree a little.**	**I disagree a lot.**

1. In uncertain times, I usually expect the best. [__]
2. It's easy for me to relax. [__]
3. If something **can** go wrong for me, it **will**. [__]
4. I always look on the bright side. [__]
5. I'm always optimistic about my future. [__]
6. I enjoy my friends a lot. [__]
7. It's important for me to keep busy. [__]
8. I hardly ever expect things to go my way. [__]
9. Things never work out the way I want them to. [__]
10. I don't get upset easily. [__]
11. I'm a believer in the idea that 'every cloud has a silver lining' [__]
12. I rarely count on good things happening to me. [__]

INFORMED CONSENT SHEET

The Appraisal of Emotional Feelings to Commercial Film Clips.

The department of Human Sciences at Brunel University requires that all persons who participate in psychological studies give their written consent to do so. Please read the following and sign it if you agree with what it says.

I freely and voluntarily consent to be a participant in the research project entitled "The Appraisal of Emotional Feelings to Commercial Film Clips" to be conducted at Brunel University with Kathy Macaulay as principle investigator. The broad goal of this research program is to explore emotional feelings and neural activity in social interaction situations together with gender and affect style, in order to further understanding how feelings influence brain processes and structures. Specifically, I have been told that I will be asked to view and appraise various film clips taken from commercially available feature films. The session should take no longer than 50 minutes to complete.

I have been told that my responses will be kept strictly confidential. I also understand that if at any time during the session I feel unable or unwilling to continue, I am free to leave without negative consequences. That is, my participation of this study is completely voluntary, and I may withdraw from this study at any time. My withdrawal would not result in any penalty, academic or otherwise. My name and student identification number will not be linked with the research materials, as the researchers are interested in which feelings are associated with individual regions of the brain in general – not any particular individual's responses in particular.

I have been given the opportunity to ask questions regarding the procedure, and my questions have answered to my satisfaction. I been informed that if I have any questions about this project I should feel free to contact Kathy Macaulay on 07910 388524 or email kathy_macaulay@hotmail.co.uk. If I have any comments or concerns about the study or the informed consent procedures, I can contact Michael Wright at Michael.Wright@brunel.ac.uk.

I have read and understood the above and consent to participate in this study. My signature is not a waiver of any legal rights. Furthermore, I understand that I will be able to keep a copy of the informed consent sheet for my records.

Participant's Signature ______________________ Date ______________________

I have explained and defined in detail the research procedure in which the person has consented to participate. Furthermore, I will retain one copy of the informed consent form for my records.

Principal Investigator Signature ______________________ Date ______________________

DEBRIEFING FORM

The Appraisal of Emotional Feelings to Commercial Film Clips.

Positive and negative emotional feelings are viewed as implemented in partially separate regions of the brain and are viewed as the product of both decreases and increases in neural activity, potentially related to affect style and gender. Other factors that seem to affect neural activity are sociality (the presence of human forms) and appraisal and reappraisal of emotional situations. This investigation is looking into the impact the rating of positive and negative emotional feelings will have on the quality, or magnitude, of neural responses to social interaction situations and do these autonomic changes vary dependent upon gender or affect style. As this may further our understanding of how feelings influence mental state and behavior and could have implications for individuals with emotional and social deficits.

It is predicted that rating positive or negative social emotions will modify the quality or magnitude of neural responses and that positive social emotions will decrease activation in the right prefrontal cortex and the amygdala region. Further, it is also predicted that female rating of social emotions will be at variance with the neural responses activated by male social emotions. Finally, it is predicted that the quality or magnitude of neural responses will be mediated by individual pre-existing affect style.

The following studies might be of interest to you:

Ochsner K.N. Ray R.K. Cooper J.C. Robertson E.R Chopra S. Gavrieli J.D.E. and Gross. J.J. (2004) For better or for worse: neural systems supporting the cognitive down- and up-regulation of negative emotion. NeuroImage. Vol.23:483-499.

Britton J.C. Phan K.L. Taylor S.F. Welsh R.C. Berridge K.C. and Liberzon I. (2005). Neural correlates of social and nonsocial emotions : An fMRI study. NeuroImage. Article in press, available online.

Once again, we thank you for taking part in the present study.

Please feel free to contact Kathy Macaulay by email kathy_macaulay@hotmail.co.uk or telephone 07986 542707 if you have any questions or comments regarding this study.

APPENDIX 3.

Extended Positive and Negative Affect Schedule (PANAS X).

The Cognitive Failures Questionnaire.

AFFECT SCALE.

This table consists of a number of words that describe different emotions and a rate of frequency scale. *There are no 'correct' or 'incorrect' answers*.

Please read each word carefully and then tick the appropriate box that best describes to what extent **you generally** have these emotions.

	1. Not at all	**2. A little**	**3. Moderately**	**4. Quite a bit**	**5. Extremely**
Cheerful					
Disgusted					
Attentive					
Bashful					
Sluggish					
Daring					
Surprised					
Strong					
Scornful					
Relaxed					
Irritable					
Delighted					
Inspired					
Fearless					
Disgusted with self					
Sad					
Calm					
Afraid					
Tired					
Amazed					
Shaky					
Happy					
Timid					
Alone					

	1. Not at all	2. A little	3. Moderately	4. Quite a bit	5. Extremely
Alert					
Upset					
Angry					
Bold					
Blue					
Shy					
Active					
Guilty					
Joyful					
Nervous					
Lonely					
Sleepy					
Excited					
Hostile					
Proud					
Jittery					
Lively					
Ashamed					
At ease					
Scared					
Drowsy					
Angry at Self					
Enthusiastic					
Downhearted					
Sheepish					
Distressed					
Blameworthy					
Determined					
Frightened					
Astonished					
Interested					
Loathing					
Confident					
Energetic					
Concentrating					
Dissatisfied with self					

The Cognitive Questionnaire.

Using the scale below, write the appropriate letter in the box beside each statement please answer as honestly and accurately as possible. Try not to let your responses to one statement influence your responses to another statement. There are no "correct" or "incorrect" answers. Answer according to your **own feelings,** rather than how you think "most people" would answer.

A	B	C	D	E
I agree a lot.	**I agree a little.**	**I neither agree or disagree.**	**I disagree a little.**	**I disagree a lot.**

Do you consider yourself as forgetful? _____

Do you experience word finding problems? _______

Do you ever forget names of family members or friends? ______

Do people tell you that you tell stories twice? ________

Do you ever forget occurrences of the past one or two days? ______

Do you worry about forgetfulness? ________

Do you ever misplace items at odd locations, leave the stove burning, or forget how to use everyday appliances? ______

Do you ever forget appointments? _______

Do you ever lose your way in your neighbourhood or not recognize a person with whom you are well acquainted? _______

Have you experienced problems with planning of activities? _______

Do you have concentration problems? ________

APPENDIX 4:

Ethical Approval Form of the Research Ethics Committee of the Brunel University School of Social Sciences

EXPEDITED REVIEW CHECKLIST, School Of Social Sciences, Brunel University
Effective 1 October 2007

This checklist, based on the Research Ethics Review Checklist from the ESRC Research Ethics Framework, was designed to help determine the level of risk of harm to participants' welfare entailed in a proposed study within the School of Social Sciences at Brunel University.

This checklist should be completed for every empirical research project in the School by students and staff (see note below regarding staff funding applications), that involves human participants. It is used to identify whether a full application for ethics approval needs to be submitted. If a full application is required, then the University Research Ethics Committee's full Application Form for Research Ethics Approval must be used. A Word version of the full Application Form for Research Ethics Approval can be downloaded from: http://intranet.brunel.ac.uk/registry/minutes/researchethics/home.shtml.

Before completing this form, please refer to the university General Ethical Guidelines and Procedures, as well as the Code of Research Ethics (both documents can be downloaded from http://intranet.brunel.ac.uk/registry/minutes/researchethics/home.shtml). The principal investigator at Brunel University (and, when the student is the principal investigator, the student's immediate supervisor at Brunel University) is responsible for exercising appropriate professional judgement in this review.

This checklist must be completed and approved before potential participants are approached to take part in any research.

Having completed this form, it is possible that we may need further information from you, and in some instances you may be required to submit your plans for addressing the ethical issues raised by your proposal using the University Research Ethics Committee's full Application Form. This does not mean that you cannot do the research, only that your proposal may need to be considered further and approved by the School Research Ethics Committee. Please note that answering 'Yes' or 'No' to any of questions does not in itself give rise to the possibility of having to provide a fuller description.

If you answered 'Yes' to question 11, and the research falls outside of NHS audit procedures, then you will have to submit an application to the appropriate external health authority ethics committee after you have received provisional approval from the School Research Ethics committee (please see instructions on School Ethics webpage).

It is your responsibility to follow the Code of Research Ethics, developed by the University Research Ethics Committee, as well as any relevant academic or professional guidelines in the conduct of your study. This includes providing appropriate documentation, and ensuring confidentiality in the storage and use of data. Any significant change in the question, design or conduct over the course of the research should be notified to the School Research Ethics Officer and may require a new application for ethics approval.

Assessed work requiring research ethics approval
Undergraduate and Masters students must retain a copy of the approved form and submit it with their research report or dissertation (bound in the Appendix); MPhil/PhD students must retain a copy of the form and submit it to the Research Degrees Board with their application for Registration. For class exercises, lecturers who have set research projects on behalf of the students will be responsible for obtaining ethics approval; in such instances, students must enclose a copy of their lecturers' approved ethics forms with their work. All undergraduate and postgraduate work that is submitted without an approved ethics form may be subject to penalties; students must consult the appropriate module convenors for penalties regarding failure to submit approved ethics forms as part of research-based work in specific modules.

Staff research
Please note that all members of staff who are the primary researchers at Brunel University, whether collecting data with or without the aid of students, must submit ethics forms to the School Research Ethics Committee. If the ethics submission relates to staff research for which an application to an external funding agency will be/has been made, then please complete and submit the full University ethics submission form (see notes on School Ethics Webpage).

Submission instructions
Please submit **two copies** of this form completed and signed, to Devinder Saggi via the drop box outside MJ157 for review.

SCHOOL OF SOCIAL SCIENCE RESEARCH ETHICS CHECKLIST (Effective 1 Oct 2007)

If the ethics submission relates to staff research for which an application to an external funding agency will be/has been made, then please complete and submit the full University ethics submission form.

Section I: Project Details

1. Project title:

Section II: Applicant Details

2. Name of researcher (applicant):
3. Status (please circle): Undergrad Student/Postgrad Student/Staff
4. Discipline (please circle): Eco & Fin/His & Pol/Psy/SAnth/Soc & Com
5. Email address:
6. Telephone number

Section III: For Students Only

7. Module name and number:
8. Brunel supervisor's or module leader's name:
9. Brunel supervisor's email address:

Supervisor: Please tick the appropriate boxes. The study should not begin until all boxes are ticked:

☐ The student states that he or she has read the Brunel University Code of Research Ethics.

☐ The topic merits further research.

☐ The student will possess the skills to carry out the research by the time that he or she starts any work which could affect the well-being of other people. He or she will be deemed to have acquired such skills on passing the relevant research skills module.

☐ The participant information sheet or leaflet is appropriate.

☐ The procedures for recruitment and obtaining informed consent are appropriate.

Please confirm the professional research ethics code that will guide the research (please circle)

ASA/BPS/BSA/Other (please state) ________________

______________________________ ______________________

Supervisor's signature Date

Section IV: Research Checklist

Please answer each question by ticking the appropriate box:

		YES	NO
1.	Does the study involve participants who may be particularly vulnerable and/or unable to give informed consent, thus requiring the consent of parents or guardians? (e.g. children under the age of 16; people with certain learning disabilities)	☐	☐
2a.	Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited?	☐	☐
2b.	If the answer to Question 2a is Yes, then will the study involve people who could be deemed in any way to be vulnerable by virtue of their status within particular institutional settings? (e.g. students at school; disabled people; members of a self-help group; residents of a nursing home, prison, or any other institution where individuals cannot come and go freely)	☐	☐
3.	Does the research involve observational/ethnographic methods?	☐	☐
4.	Will the study involve discussion by or with respondents or interviewees of their own involvement in activities such as sexual behaviour or drug use, where they have not given prior consent to such discussion?	☐	☐
5.	Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	☐	☐
6.	Will blood or tissue samples be obtained from participants?	☐	☐
7.	Is pain or more than mild discomfort likely to result from the study?	☐	☐
8.	Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?	☐	☐
9.	Will the study involve prolonged or repetitive testing?	☐	☐
10.	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	☐	☐
11.	Will the study involve recruitment of patients or staff through the NHS?	☐	☐
12a.	Have you undertaken this study as part of your work placement?	☐	☐
12b.	If your answer to Question 12a is Yes, then have the employers at your work placement conducted their own research ethics review?	☐	☐
13.	Does the research involve MRI, MEG, or EEG methods?	☐	☐

APPENDIX 5:

fMRI Information Form.

Informed Consent Sheet.

fMRI Consent Form.

Initial Screening Form.

Second Screening Form.

Debriefing Form.

Brunel University

February 2010.

Ref: The Rating of Positive and Negative Emotional Feelings and Neural Responses to Happy and Sad Films.

Thank you for providing a postal address and interest in participating in my study.

Please find enclosed an information sheet giving details about the fMRI study you are invited to take part. It is VERY important you read through this information sheet and if you have any particular concerns or questions please do no hesitate to email me.

Also enclosed is an initial screening form and consent form relating to my particular study again if you could complete and sign both these forms if you have any concerns, or would like further information about the study, please email me.

As part of the study I am collecting information about participants and affect so please could you also fill in the AFFECT SCALE enclosed. There are no 'correct' or 'incorrect' answers just to what extent participants generally have these emotions.

Please keep the information sheet for future reference but to summarise if you could return in the stamped addressed envelope provided

a. The initial screening form,
b. The study consent form ,
c. The Affect Scale,

Thank you again for your interest.

Regards,

Kathy Macaulay.

INFORMATION FORM

These notes give some information about an fMRI study in which you are invited to take part.

FMRI is a method for producing images of the activity in the brain as people carry out various mental tasks. It involves placing the participant inside a large, powerful magnet which forms part of the brain scanner. When particular regions of the brain are active, they require more oxygen, which comes from red corpuscles in the blood. As a result, the flow of blood increases. This can be detected as changes in the echoes from brief pulses of radio waves. These changes can then be converted by a computer into 3D images. This enables us to determine which parts of the brain are active during different tasks.

As far as we know, this procedure poses no direct health risks. However, the Department of Health advises that certain people should NOT be scanned. Because the scanner magnet is very powerful, it can interfere with heart pacemakers and clips or other metal items which have been implanted into the body by a surgeon, or with body-piercing items. If you have had surgery which may have involved the use of metal items you should NOT take part. Note that only ferro-magnetic materials (e.g. steel) are likely to cause significant problems. Thus normal dental amalgam fillings do not prohibit you from being scanned, though a dental plate which contained metal would do so, and you would be asked to remove it. You will be asked to remove metal from your pockets (coins, keys), remove articles of clothing which have metal fasteners (belts, bras, etc), as well as most jewellery. Alternative clothing will be provided as necessary. Watches and credit cards should not be taken into the scanner since it can interfere with their operation. You will be asked to complete a questionnaire (the Initial Screening Form) which asks about these and other matters to determine whether it is safe for you to be scanned. In addition, you are asked to give the name and address of your Family Doctor. This is because there is a very small chance that the scan could reveal something which required investigation by a doctor. If that happened, we would contact your doctor directly. By signing the consent form, you authorise us to do this. You will also be asked to complete a second, shorter, screening form immediately before the scan.

To be scanned, you would lie on your back on a narrow bed on runners, on which you would be moved until your head was inside the magnet. This is rather like having your head put inside the drum of a very large front-loading washing machine. The scanning process itself creates intermittent loud noises, and you would wear ear-plugs or sound-attenuating headphones. We would be able to talk to you while you are in the scanner through an intercom. If you are likely to become very uneasy in this relatively confined space (suffer from claustrophobia), you should NOT take part in the study. If you do take part and this happens, you will be able to alert the experimenters by activating an alarm and will then be removed from the scanner quickly. It is important that you keep your head as still as possible during the scan, and to help you with this, your head will be partially restrained with padded headrests. We shall ask you to relax your head and keep it still for a period that depends on the experiment but may be more than one hour, which may require some effort on your part. If this becomes unacceptably difficult or uncomfortable, you may demand to be removed from the scanner.

You may be asked to look at a screen through a small mirror (or other optical device) placed just above your eyes and/or be asked to listen to sounds through headphones. You may be asked to make judgements about what you see or asked to perform some other kind of mental task. Details of the specific experiment in which you are invited to participate will either be appended to this sheet or else given to you verbally by the experimenter. Detailed instructions will be given just before the scan, and from time to time during it.

The whole procedure will typically take about 1 hour, plus another 15 minutes to discuss with you the purposes of the study and answer any questions about it which you may raise. You will be able to say that you wish to stop the testing and leave at any time, without giving a reason. This would not affect your relationship with the experimenters in any way. The study will not benefit you directly, and does not form part of any medical diagnosis or treatment. If you agree to participate you will be asked to sign the initial screening form that accompanies this information sheet, in the presence of the experimenter (or other witness, who should countersign the form giving their name and address, if this is not practical). It is perfectly in order for you to take time to consider whether to participate, or discuss the study with other people, before signing. After signing, you will still have the right to withdraw at any time before or during the experiment, without giving a reason.

The images of your brain will be held securely and you will not be identified by name in any publications that might arise from the study. The information in the two screening forms will also be treated as strictly confidential and the forms will be held securely until eventually destroyed.

Further information about the specific study in which you are invited to participate may have been appended overleaf, if the experimenter has felt that this would be helpful. Otherwise, he/she will already have told you about the study and will give full instructions prior to the scan. Please feel free to ask any questions about any aspect of the study or the scanning procedure before completing the initial screening form.

Rev. 2009

ROYAL HOLLOWAY, UNIVERSITY OF LONDON

MAGNETIC RESONANCE IMAGING UNIT

CONSENT FORM

NAME OF PARTICIPANT...

Please read the following statement carefully and then add your signature. If you have any questions, please ask the person who gave you this form. You are under no pressure to give your consent and you are free to withdraw from the MRI examination at any time.

I agree to participate in an MRI examination conducted for research purposes by

.... (name of operator) on ....

.... (name of project).

I understand that the examination is not part of any medical treatment. I have completed two screening forms and I have been given an opportunity to discuss any issues arising from it. The nature of the examination has been explained to me and I have had an opportunity to ask questions about it. I consent to my general practitioner being contacted in the unlikely event that the scan reveals any suspected abnormality. I understand that the scans will be done solely for research purposes, and that the Investigators are not experts in MRI diagnosis and cannot provide a 'clean bill of health'.

Signature .... Date.............................

FOR STAFF USE:

Statement by a witness, who must be either an authorised person or a scientific collaborator who is familiar with the experimental procedure and is able to answer questions about it.

I certify that the above participant signed this form in my presence. I am satisfied that the participant fully understands the statement made and I certify that he/she had adequate opportunity to ask questions about the procedure before signing.

Signature.. Date.............................

Name ....

Address of witness (if not an Authorised Person):

ROYAL HOLLOWAY, UNIVERSITY OF LONDON - MAGNETIC RESONANCE IMAGING UNIT

INITIAL SCREENING FORM

NAME OF PARTICIPANT .... Sex: M / F

Date of birth........................... Approximate weight in kg............ (one stone is about 6.3 kg)

Please read the following questions CAREFULLY and provide answers. For a very small number of individuals, being scanned can endanger comfort, health or even life. The purpose of these questions is to make sure that you are not such a person.

You have the right to withdraw from the screening and subsequent scanning if you find the questions unacceptably intrusive. The information you provide will be treated as strictly confidential and will be held in secure conditions.

	Delete as appropriate
1. Have you been fitted with a pacemaker or artificial heart valve?	YES/NO
2. Have you any aneurysm clips, shunts or stents in your body or a cochlear implant?	YES/NO
3. Have you ever had any metal fragments in your eyes?	YES/NO
4. Have you ever had any metal fragments, e.g. shrapnel in any other part of your body?	YES/NO
5. Have you any surgically implanted metal in any part of your body, other than dental fillings and crowns (e.g. joint replacement or bone reconstruction)	YES/NO
6. Have you ever had any surgery that might have involved metal implants of which you are not aware?	YES/NO
7. Do you wear a denture plate or brace with metal in it?	YES/NO
8. Do you wear a hearing aid?	YES/NO
9. Have you ever suffered from any of: epilepsy, diabetes or thermoregulatory problems?	YES/NO
10. Have you ever suffered from any heart disease?	YES/NO
11. Is there any possibility that you might be pregnant?	YES/NO
12. Have you been sterilised using clips?	YES/NO
13. Do you have a contraceptive coil (IUD) installed?	YES/NO
14. Are you currently breast-feeding an infant?	YES/NO

I have read and understood the questions above and have answered them correctly.

SIGNED...................................... DATE.............................

In the presence of .... (name) ....(signature)

Address of witness, if not the experimenter:

Please enter below the name and address of your doctor (general practitioner).
(Not required for persons entering the controlled area but not being scanned.)

SECOND SCREENING FORM

This form should be completed and signed immediately before your scan, after removal of any jewellery or other metal objects and (if required by the operator) changing your clothes.

NAME OF PARTICIPANT ....

Date of birth.................................... Sex: M / F

Please read the following questions CAREFULLY and provide answers. For a very small number of individuals, being scanned can endanger comfort, health or even life. The purpose of these questions is to make sure that you are not such a person.

You have the right to withdraw from the screening and subsequent scanning if you find the questions unacceptably intrusive. The information you provide will be treated as strictly confidential and will he held in secure conditions.

BEFORE YOU ARE TAKEN THROUGH FOR YOUR SCAN IT IS ESSENTIAL THAT YOU REMOVE **ALL METAL OBJECTS** INCLUDING:-WATCHES, PENS, LOOSE CHANGE, KEYS, HAIR CLIPS, ALL JEWELLERY, BRASSIERES WITH METAL FASTNERS, METALLIC COSMETICS, CHEQUE/CASH POINT CARDS.

	Delete as appropriate
1. Are you wearing or carrying any metal items such as those listed above?	YES/NO
2. Have your answers to any of the questions in the initial screening form changed?	
(The initial screening form must be shown to you before you answer this question.)	YES/NO
Specifically, please confirm:	
3. Have you been fitted with a pacemaker, artificial heart valve or cochlear implant?	YES/NO
4. Is there any possibility that you might be pregnant?	YES/NO

I have read and understood the questions above and have answered them correctly.

SIGNATURE...................................... DATE.............................

FOR STAFF USE:

I certify that the initial screening form and the consent form have been completed by the person named above and I have attached them to this form. The volunteer has been given the standard information sheet about MRI experiments, together with any necessary study-specific information, and has been given an opportunity to ask questions. I am satisfied that the volunteer is adequately informed and understands the content of the consent form. I have taken adequate steps to ensure that the volunteer has no ferro-magnetic metal in or on his/her person and I am satisfied that the scan can proceed.

SIGNATURE...................................... NAME (print) ....

DEBRIEFING FORM

<u>The Appraisal of Emotional Feelings to Commercial Film Clips.</u>

Positive and negative emotional feelings are viewed as implemented in partially separate regions of the brain and are viewed as the product of both decreases and increases in neural activity, potentially related to affect style and gender. Other factors that seem to affect neural activity are sociality (the presence of human forms) and appraisal and reappraisal of emotional situations. This investigation is looking into the impact the rating of positive and negative emotional feelings will have on the quality, or magnitude, of neural responses to social interaction situations and do these autonomic changes vary dependent upon gender or affect style. As this may further our understanding of how feelings influence mental state and behavior and could have implications for individuals with emotional and social deficits.

It is predicted that rating positive or negative social emotions will modify the quality or magnitude of neural responses and that positive social emotions will decrease activation in the right prefrontal cortex and the amygdala region. Further, it is also predicted that female rating of social emotions will be at variance with the neural responses activated by male social emotions. Finally, it is predicted that the quality or magnitude of neural responses will be mediated by individual pre-existing affect style.

The following studies might be of interest to you:

Ochsner K.N. Ray R.K. Cooper J.C. Robertson E.R Chopra S. Gavrieli J.D.E. and Gross. J.J. (2004) For better or for worse: neural systems supporting the cognitive down- and up-regulation of negative emotion. NeuroImage. Vol.23:483-499.

Britton J.C. Phan K.L. Taylor S.F. Welsh R.C. Berridge K.C. and Liberzon I. (2005). Neural correlates of social and nonsocial emotions : An fMRI study. NeuroImage. Article in press, available online.

Once again, we thank you for taking part in the present study.

Please feel free to contact Kathy Macaulay by email <u>kathy_macaulay@hotmail.co.uk</u> or telephone 07986 542707 if you have any questions or comments regarding this study.

APPENDIX 6

Table 29: Bold Activation to Happy (versus control sticks) films comparison of European Participants (1) and Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Transverse Temporal Gyrus	41	4.30	81	-45	-28	10
Left Middle Temporal Gyrus	22	3.91		-51	-37	7
Left Putamen		3.36		-33	-13	1
Right Postcentral Gyrus	3	4.25	136	51	-16	49
Right Paracentral Lobule	5	3.90		6	-40	58
Right Precentral Gyrus	4	3.80		21	-25	67
Left Precentral Gyrus	4	4.17	56	-18	-25	64
Left Precentral Gyrus	4	3.76		-24	-28	58
Right Posterior Cingulate,	30	3.98	29	18	-58	16
Left Medial Frontal Gyrus	6	3.91	24	-3	-16	55
Left Postcentral Gyrus	4	3.88	25	-42	-19	49
Occipital Lobe/Precuneus	31	3.84	68	0	-70	25
Left Parietal Lobe/Precuneus	7	3.69		-12	-73	37
Right Parietal Lobe/Precuneus	7	3.58		9	-73	31
Left Inferior Parietal Lobule	40	3.81	31	-36	-61	37
Left Paracentral Lobule	5	3.70	21	-9	-37	55
Left Posterior Cingulate	30	3.63	10	-21	-58	13
Left Medial Frontal Gyrus	6	3.61	22	0	-13	67

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise $\boldsymbol{P} < 0.001$, uncorrected, $\boldsymbol{k} = 5$.

Table 30: Bold Activation to Sad (versus control sticks) films comparison of European Participants (1) and Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	z Value	Size (voxels)	x	y	Z
Left Superior Temporal Gyrus	42	4.31	28	-63	-37	22
Left Supramarginal Gyrus	40	3.52		-63	-46	34
Left Superior Frontal Gyrus	6	4.22	31	-9	-7	76
Left Medial Frontal Gyrus	6	3.82		0	-10	70

Left Paracentral Lobule	6	3.61		-9	-16	79
Left Precentral Gyrus	6	3.79	7	-33	-7	64
Right Precentral Gyrus	6	3.70	10	30	-16	70
Right Middle Temporal Gyrus	22	3.69	12	51	-40	4
Right Paracentral Lobule	5	3.69	27	3	-46	55
Right Paracentral Lobule	31	3.51	10	3	-19	46
Right Middle Temporal Gyrus	22	3.40	5	57	-52	16
Left Occipital Precuneus	31	3.37	8	-6	-76	22
Left Supramarginal Gyrus	40	3.26	5	-57	-55	25

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***P*** < 0.001, uncorrected***,*** ***k*** = 5.

Table 31: Bold Activation to Happy films (versus control sticks) comparison of Female European Participants (1) and Female Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	Size (voxels)	z value	x	y	z
Right Postcentral Gyrus	4	44	3.94	42	-19	52
Right Postcentral Gyrus	3		3.83	36	-22	46
Right Postcentral Gyrus	3		3.71	51	-16	46
Left Superior Temporal Gyrus	41	10	3.64	-48	-31	10
Left Medial Frontal Gyrus	6	5	3.48	-3	-16	55
Left Precentral Gyrus	6	5	3.28	-18	-25	64

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***P*** < 0.001, uncorrected***,*** ***k*** = 5.

Table 32: Bold Activation to Sad films (versus control sticks) comparison of Female European Participants (1) and Female Non-European Participants (-1) whilst viewing Design One (90 second clips).

Brain Region	Brodmann area	Size (voxels)	z value	x	Y	Z
Left Inferior Parietal Lobule	40	22	3.84	-63	-37	25
Left Supramarginal Gyrus	40		3.66	-63	-46	34
Left Superior Frontal Gyrus	6	12	3.79	-9	-7	76
Medial Frontal Gyrus	6		3.38	0	-10	70
Left Supramarginal Gyrus	40	6	3.15	-57	-55	22

Note: All coordinates reported in Talairach space. Activations shown are based on a voxelwise ***P*** < 0.001, uncorrected***,*** ***k*** = 5.

APPENDIX 7

Department of Health: Ethnic group - 16+1 codes

What is your ethnic group? *Choose ONE section from A to E, then tick the appropriate box to indicate your ethnic group.*

A : White

- British
- Irish
- Any other White background (please write in)

B : Mixed

- White and Black Caribbean
- White and Black African
- White and Asian
- Any other mixed background (please write in)

C : Asian or Asian British

- Indian
- Pakistani
- Bangladeshi
- Any other Asian background (please write in)

D : Black or Black British

- Caribbean
- African
- Any other Black background (please write in)

E : Chinese or other ethnic group

- Chinese
- Any other (please write in)

Not stated

- Not stated