How do reproduction, parenting, and health cluster together? Exploring diverging destinies, life histories and weathering in two UK cohort studies

Keywords: Diverging Destinies; Life History Theory; The Weathering Hypothesis; reproduction; parenting; health; Born in Bradford; Millennium Cohort Study

ABSTRACT

Life history theory researchers often assume reproductive, parenting and health behaviours pattern across a fast-slow continuum, with 'fast' life histories (typified by short lifespans, early maturation and investing in quantity over quality of children) favoured in poor quality environments and/or when resources are scarce. Some researchers further reduce this down to a simplistic 'fast' versus 'slow' dichotomy. Some of these ideas, with different theoretical motivations, are echoed in the 'diverging destinies' and 'weathering' frameworks developed in the social sciences. Whether clustering of reproductive, parenting and health traits exists has rarely been empirically tested, however. Using latent class analysis on data on mothers from the UK's Millennium Cohort (MCS) and Born in Bradford (BiB) studies, we explored whether reproduction and parenting traits clustered into 'diverging destinies', whether 'weathering' effects tied together health and reproduction, and whether all three domains were combined into either 'fast' vs 'slow' life histories, or into three groups more indicative of a fast-slow continuum. We leveraged ethnic diversity in these samples to examine four groups of mothers separately: 1. MCS White British/Irish (n=15,423); 2. MCS Pakistani-origin (n=923); 3. BiB White British (n=3,937); 4. BiB Pakistani-origin (n=4,351), and explored whether faster ‘weathering’ was evident amongst Pakistani-origin mothers.

Both two and three class models emerged as potential descriptions of latent subgroups, potentially providing support for fast and slow life histories or a continuum of traits. However, response profiles provided only limited support for theoretical predictions of which trait should cluster together, with inconsistent and restricted clustering of traits both within and between the domains of reproduction, parenting, and health. In addition, trait clustering was more pronounced amongst White mothers and we found no clear evidence supporting faster ‘weathering’ amongst Pakistani-origin mothers; the observed trait clustering instead suggested that cultural constraints may influence linkages between traits. Our results therefore provide some limited support for models which suggest certain traits cluster together in predictable ways, but it is also clear that theoretical frameworks should not emphasise very rigid clustering of large numbers of traits and should allow for contextual influences on clustering.

INTRODUCTION

Several theoretical frameworks used in demography link together either parenting and reproduction or health and reproduction. There is a long-standing assumption, for example, that fertility and parental investment are correlated. The quality-quantity trade-off assumes that parents who have many children will invest relatively less in each child, compared to parents who have fewer and can invest relatively more in each (Becker and Tomes, 1976; Colodro-Conde et al., 2013).

The more recent ‘diverging destinies’ framework ties more traits across the domains of reproduction and parenting together, positing that the second demographic transition resulted in women following one of two ‘destinies’ - one characterised by higher levels of education, delayed childbearing and increased resources for children, and the other associated with less education, earlier childbearing, childbearing outside of marriage, union instability, and fewer resources for children (Goisis, 2013; Härkönen, 2017; Kalil et al., 2012; McLanahan, 2004; Musick and Michelmore, 2018). Feminism, new birth control technologies, changes in the labour market and welfare policies have been posited as drivers of this divergence (McLanahan, 2004). The proposed causal factors are somewhat controversial, given the likely underlying causes of particular patterns of reproduction and parenting – namely poverty, disadvantage, and inequality – but nevertheless, there is empirical evidence for clustering of some reproductive and parenting traits (including family structure) (Härkönen, 2017; Kalil et al., 2012; Musick and Michelmore, 2018).

The 'weathering hypothesis' links the timing of reproduction with health outcomes, with evidence that individuals whose health deteriorates rapidly in adulthood have early first births (Geronimus, 1996, 1992; Geronimus et al., 2006; Goisis and Sigle-Rushton, 2014). Under this model, the health status of disadvantaged groups deteriorates more rapidly in response to persistent social and environmental adversity. The effects of social inequalities compound with age, leading to growing health disparities throughout adulthood. Early births are therefore preferable to ensure that childrearing occurs while women are still relatively healthy. Borne out of US-based research focusing primarily on racial disparities between Black and White Americans, the weathering hypothesis suggests that, even apart from socioeconomic disadvantage, ethnic minorities suffer greater disadvantage because of structural racism which leads to faster weathering (Geronimus, 1996; Geronimus et al., 2016, 2006). This hypothesis provides a rare example of the successful integration of sociological and evolutionary theories but has been little used in the UK context (Sear, Lawson, Kaplan, & Shenk, 2016; but see Goisis & Sigle-Rushton, 2014).

The evolutionary framework of 'life history theory' also links reproduction and health. This body of work suggests that there is a fundamental trade-off between these domains: assuming limited resource access, reproduction and health cannot be simultaneously maximised (Bielby et al., 2007; Stearns, 1983). Further, it's assumed that environmental conditions will shift individuals towards either prioritising reproduction and thereby suffering a rapid decline in health, or balancing investment between maintaining health and reproduction (Coall et al., 2016). In the evolutionary social sciences, it is often assumed that certain behavioural traits – such as parenting behaviours – can be linked together with reproduction and health. Some work in this area, taking inspiration from cross-species research, suggests that multiple traits may be linked together into life history trajectories (Figure 1), typified either by short lifespans, early maturation and reproduction, having several offspring and investing relatively little in each (the trajectory which prioritises reproduction, or 'fast' life histories); or by slower growth and maturation, fewer children and greater parental investment in each (or 'slow' life histories) (Hill, 1993; Nettle and Frankenhuis, 2020; G. V. Pepper and Nettle, 2014; Wells et al., 2017). There is also a controversial but rapidly growing body of research – referred to as the psychometric approach to human life history or LHT-P (life history theory in psychology) – which assumes a very wide range of behaviours and psychological traits are rigidly linked together into 'fast' and 'slow' life history strategies, where 'fast' strategies involve those behaviours which are supposedly linked to the prioritisation of reproduction, and 'slow' strategies involve behaviours supposedly linked to balancing reproduction and health (Nettle and Frankenhuis, 2020, 2019). It should be noted that the theoretical underpinnings of this body of research, however, owe far more to the psychologist Rushton's 'differential-K' theory (a pseudoscientific[1] theory which aimed to rank order human 'races') than they do to life history theory in biology (Black et al., 2017, Sear 2020).

The 'fast-slow' approach to human life histories, particularly but not only the psychometric approach, has attracted considerable criticism recently, on both theoretical and methodological

[1] https://psychology.uwo.ca/people/faculty/remembrance/rushton.html

grounds (K Gruijters et al., 2018; Sear, 2020; Stearns and Rodrigues, 2020; Zietsch and Sidari, 2019). Of relevance to this paper, there has been very little empirical testing of whether large numbers of traits across different domains hang together in predicted 'life history strategies'. The little evidence that does exist typically finds that large numbers of traits do not cluster in exactly the same way across multiple populations (Međedović, 2020; Sheppard and Van Winkle, 2020; Wells et al., 2019). There is growing evidence that certain reproductive, parenting and/or health outcomes may be linked together, however, and associated with environmental conditions (an observation which contrasts with LHT-P's assumption that life history strategies are largely genetically determined (Black et al., 2017)). For example, markers of 'harsh', or high mortality, environments are associated with earlier reproduction and fewer health-prolonging behaviours, in what has been called the 'behavioural constellation of deprivation' (Pepper and Nettle, 2017). Such research emphasises that these behaviours are contextually-appropriate responses to the environment, rather than examples of individuals being unable or unwilling to engage in behaviours that those in privileged positions deem 'sensible' (Frankenhuis and Nettle, 2020). This research clearly links with Geronimus' work on 'weathering', and with her recent promotion of 'Jedi public health', which aims to improve public health by changing features of the environment which induce poor health, rather than features of individuals themselves (Geronimus et al., 2016).

All three of the theoretical frameworks discussed above are similar in their prediction that traits cluster together, but vary in which domains they focus on: diverging destinies focuses on reproductive and parenting behaviours and assumes women take one of two paths (Goisis, 2013; Härkönen, 2017; Kalil et al., 2012; McLanahan, 2004; Musick and Michelmore, 2018), the weathering hypothesis has typically focused on health and how this deteriorates in response to adversity for ethnic minority groups (with consequences for reproductive timing) (Geronimus, 1996, 1992; Geronimus et al., 2006; Goisis and Sigle-Rushton, 2014), whilst the trade-offs inherent in life history theory, as used in the evolutionary social sciences, tie together the three domains of reproduction, parenting and health (Hill, 1993; Nettle and Frankenhuis, 2020; G. Pepper and Nettle, 2014; Wells et al., 2017).

In this paper, we empirically test the extent of trait clustering across the behavioural domains of reproduction, parenting, and health in UK mothers. We look at populations at two different scales: with one dataset of mothers from across the UK and one dataset of mothers who live in Bradford, West Yorkshire, England.

There are likely ethnic differences in resource access that disadvantage minority groups. Such social disparities in resource access are central to lifecourse and social epidemiology (Glymour et al., 2014; Halfon et al., 2014) and are fundamental causes of health inequalities (Link and Phelan, 1995; Phelan and Link, 2005). It is particularly important to test for within-population variation in large, complex, ethnically diverse societies like the UK (Stulp et al., 2016). We look at clustering in the two largest ethnic groups in the two datasets separately to explore any inequalities and to provide a test of the weathering hypothesis.

To summarise: there is a lack of empirical evidence on the extent to which parenting, reproductive and health traits cluster together. Beyond Geronimus' work on White and Black Americans, there is also little research on ethnic/cultural variation in this clustering. Identifying 'at-risk' populations is important from a policy perspective (Caspi et al., 2016), as acknowledged in the diverging destinies framework (McLanahan, 2004). There is therefore a need to assess the extent to which reproductive, parenting and health traits are associated with one another and also whether clustering differs by ethnicity. In this paper we combine sociological and evolutionary perspectives to apply diverging destinies, life history theory and weathering concepts to analyses of mothers in two UK cohort datasets. We use an exploratory data-driven approach to ask to what extent, and for whom, do destinies really diverge? Is it just reproduction and parenting that cluster together into diverging destinies, or does the weathering effect of poor health also impact on reproduction? Does clustering occur across all three domains to form fast and slow life histories? Finally, is weathering more evident amongst ethnic minority groups?

METHODS

Samples

To answer these questions, we used the Millennium Cohort Study (MCS) and Born in Bradford (BiB) datasets as both contain rich data on reproduction, parenting, and health. The MCS is a nationally-representative ongoing longitudinal study following the lives of around 19,000 children born in the UK between 2000 and 2002 (for a more detailed cohort profile see Connelly and Platt, 2014; UCL Centre for Longitudinal Studies, 2015) whilst BiB follows the health and wellbeing of over 13,500 children born at the Bradford Royal Infirmary, West Yorkshire, England between March 2007 and December 2010 (for protocol and cohort profile see Raynor and Born in Bradford Collaborative Group, 2008; Wright et al., 2013). Our study focuses on the life histories of the cohort members' mothers.

Although over-sampled by design (Connelly and Platt, 2014), numbers of ethnic minority respondents in the MCS remain relatively low, making the investigation of ethnic differences difficult. To explore whether faster weathering was evident in ethnic minority groups, we therefore conducted separate analyses for the two largest ethnic groups available: White British/Irish[2] and Pakistani-origin mothers. Although Pakistani-origin mothers comprise only about 2% of the UK population (Office for National Statistics, 2012), they form the largest ethnic minority in both datasets. Bradford has the

[2] Ethnicity coding differed slightly between the two datasets due to different geographical focuses – as their labels suggest, the MCS White British/Irish group includes both White British and White Irish mothers whereas the BiB White British group only includes White British mothers. In this paper we sometimes use 'White' for brevity.

largest proportion of people of Pakistani-origin in England (20.3%) and BiB has a much larger Pakistani-origin sample than the MCS (City of Bradford Metropolitan District Council, 2018).

Both datasets have their advantages and disadvantages. The MCS is nationally representative, and has a larger sample of mothers overall, but has fewer Pakistani-origin mothers and lacks information on menarche (a key marker of reproductive timing). The BiB dataset is geographically restricted but has a bi-ethnic sample with good numbers of Pakistani-origin mothers and information on menarche. Not only does the use of both datasets help to circumvent these limitations to some extent, but by stratifying analyses by datasets and ethnic group, our paper provides its own replication study. Focusing on the four groups of mothers separately (1. MCS White British/Irish, 2. MCS Pakistani-origin, 3. BiB White British and 4. BiB Pakistani-origin) allows us to test the robustness of theoretical predictions. Consistent patterning across all four groups of mothers could lend more support for the diverging destinies and life history models, whereas different trait expression across ethnic groups may provide evidence of weathering (dependent on patterns observed).

Due to likely constraints on parenting behaviours, we restricted analyses to cases where the respondent was the natural mother and still living with the cohort child and excluded cases where mothers gave birth to twins or triplets[3]. These restrictions left us with maximum usable sample sizes of 15,423 (weighted n=13,261) White British/Irish mothers and 923 (weighted n=494) Pakistani-origin mothers in the MCS, and 3,937 White British mothers and 4,351 Pakistani-origin mothers in BiB. Trait information was collected at different timepoints. For the MCS samples, we combined information from Waves 1 and 2, when cohort children were 9months and 3years old, respectively. In general, we used information collected as close to the occurrence of the trait as possible. For the BiB samples, we drew on information collected at different timepoints, including pregnancy (baseline

[3] For example, non-natural mothers are less likely to breastfeed, mothers no longer living with their children are less able to provide direct childcare, and mothers with multiple births may find it harder to breastfeed or provide as much care for any one child in the twin/triplet set as their time and energy are split between more children.

questionnaire at 26-28weeks gestation), birth (maternity information system) and from 6months through to 4years (sub-cohort follow-up surveys: BiB1000, ALLIN [ALLergy and Infection] and MEDALL [MEchanism of the Development of ALLergy]). Further detail on how information from different questionnaires was combined for each trait is shown in Table S1. As the datasets cover timepoints around 10 years apart, we analyse them separately.

Reproductive, parenting and health indicators

We chose a range of variables that captured reproduction, parenting, and health comprehensively (Table 1). Where more than one candidate was available, we chose what we felt best captured the trait in question. For example, we chose self-rated general health in the MCS over longstanding illness/disability because it captures a broader spectrum of health. Within the parenting domain, we captured prenatal investment with birthweight and gestational length and postnatal investment with breastfeeding initiation and duration, as well as how often the mother took her child to activities (BiB only), whether she expressed affection towards her child regularly, and whether all routine vaccinations were given. These indicators were chosen to encompass parental investment of differing types. Values indicative of lower parental investment e.g. not breastfeeding and shorter durations of breastfeeding, not giving all vaccinations, and not reading to the child often were considered 'fast' behaviours.

Within the reproduction domain, we included ages at menarche (BiB only), cohabitation/marriage (MCS only), and first birth, along with parity and union stability. Earlier ages were considered 'faster' traits. Parity was split into 1, 2, 3 and 4+ children and union stability was indexed by whether the mother was living with the cohort member's father at the earliest productive survey (to proxy family structure at birth). This domain therefore captured reproductive timing, output, and partnership status.

We used a mix of health outcomes and behaviours within the health domain: general health in the MCS and mental health in BiB, and smoking[4], drinking alcohol[5] and BMI in both datasets. See Table S1 for further detail on variables and indicator coding.

Data analysis

We tested how reproduction, parenting and health traits clustered together in our four groups of mothers using the analytical steps detailed below. Analyses were stratified by dataset and ethnic group due to the MCS and BiB being ten years apart and clear ethnic differences in trait expression (see Table 1). Analyses were conducted in Stata 15.1 using the structural equation modelling framework's latent class expansion (StataCorp, n.d.) and accounted for sample-clustering at the ward level in both datasets and additionally for probability weights in the MCS.

Firstly, as a descriptive analysis we tested for bivariate correlations between traits, both within and between the domains of parenting, reproduction, and health. This was to provide an initial overview of the extent to which traits were associated with one another. To test predictions from each of the three theories we also looked at the extent of associations between reproduction and parenting traits (diverging destinies), between health and reproduction (weathering) and between reproduction, parenting, and health (life history theory). Stratified by dataset and ethnic group, we ran four separate sets of correlations and examined the extent, strength, and Bonferroni-adjusted significance of positive associations.

Secondly, we used latent class analysis (LCA) with maximum likelihood estimation to test the extent of trait clustering to see if the latent categorical classes represented two 'diverging destinies' where clusters were defined by reproduction and parenting, or a 'weathering' effect where clusters

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[4] Smoking was excluded from MCS Pakistani-origin analyses due to very low numbers reporting smoking.
[5] Alcohol was excluded from both MCS and BiB Pakistani-origin analyses due to very low numbers reporting drinking alcohol.

were defined by links between health and reproduction, or ‘life histories’ which were defined by clustering across all three domains. We analysed samples and ethnic groups separately to allow visual comparison across ethnic groups and to consider whether ethnic minority groups exhibited faster ‘weathering’. Models were estimated with 20 Expectation-Maximisation iterations and 200 draws of random starting values to ensure that a global rather than a local (sub-optimal) solution was found, parameters were freely estimated and we allowed for correlations between indicators in each class due to our theoretical predictions that indicator variables would be associated with one another (Ng, 2019). Example Stata `gsem` syntax is included in the Supplementary Material. Whilst indicators (i.e. trait variables) are allowed to have missing data, and this is assumed to be missing at random, any records missing data on groups, sampling-clusters or weights were excluded as this type of missingness is not permitted in latent class analysis (Lanza et al., 2015).

Latent class analysis uses a categorical latent variable to capture the possibility that different response profiles arise because there are underlying subgroups of individuals with distinct combinations of features (Hallquist and Wright, 2014). We assessed whether two classes (in line with ‘diverging destinies’ or a dichotomous view of ‘fast’ vs ‘slow’ life histories) or three classes (more in line with continuums in all three approaches) were appropriate categorisations by comparing models with one, two, three, four and five classes. We used a combination of model fit statistics and class separation measures to aid with model selection. We examined model fit with the AIC, BIC and the Lo-Mendell-Rubin Likelihood Ratio Test comparing k to k-1 classes (Lo et al., 2001; Ng, 2018), and compared neatness of classification with normalised entropy (Ng and Schechter, 2017; Silverwood et al., 2011), Average Posterior Probability and Odds of Correct Classification (Nagin, 2005). To further assist with model selection, the two, three, four and five-class solutions were additionally evaluated for substantive meaning; we reviewed the item response probabilities/means to discern which models showed the most pronounced differences in terms of having a clear ‘fast’ and ‘slow’ class.

This does not automatically mean the two class model was favoured, but rather that a three, four or five class model could also be selected if it displayed a clear 'fast' and 'slow' class. 'Fast' and 'slow' classes were defined by scoring the lowest or highest on most items, respectively. We compared the number of 'fast' and 'slow' traits in the 'fast' and 'slow' classes across models, and also looked at how many of these corresponding probabilities/means were significantly lower or higher than in the other classes in order to decide which models to take forward.

We then compared estimated probabilities (categorical variables) and means (continuous variables) across classes for the different traits for the selected models in more detail. In doing so, we assessed whether our four groups of mothers split into classes representing 'diverging destinies' (defined by reproductive and parenting traits clustering), 'weathering' (defined by health and reproductive traits clustering) or 'fast' and 'slow' life histories (defined by clustering across all three domains). To support diverging destinies predictions, we would expect to see one class with earlier reproductive timing and reduced parental investment and another with later reproduction and increased parental investment. To support weathering, we would instead expect one class to be defined by poor health and earlier reproduction. To support life history theory, we would expect two class models to have one class with 'faster' behaviour in all three domains (e.g. earlier reproduction, more children, reduced parental investment, poorer health) and the other with 'slower' behaviour in all three domains (e.g. later reproduction, fewer children, greater investment and better health). Note that diverging destinies, weathering, and life history frameworks are not mutually exclusive, so that clustering of all three domains would also provide support for diverging destinies and weathering. More nuanced interpretations of these frameworks also allow for a continuum to emerge: in which case, we may expect to see more than two classes with an additional 'middle' class/classes with intermediate trait values.

RESULTS

Correlations between traits

A visual summary of the correlation results is shown in Table 2. Full correlation analyses are presented in Supplementary Tables S2 and S3 and a detailed description of the results is provided in the supplementary text. In sum, while predicted positive correlations both within and between domains were observed, there was variation between datasets, ethnic groups, and domains in how consistently predictions were upheld, and most correlations both within and between trait domains were weak or very weak. Across all three domains, all four groups of mothers had a similar proportion of positive correlations (with 60-72% of all trait pairs patterning in the predicted direction). However, the White groups had more (Bonferroni-adjusted) significant positive correlations compared to Pakistani-origin mothers (55% versus 2% in MCS and 17% versus 11% in BiB), and associations were stronger. This suggests slightly more pronounced associations amongst White mothers, especially the White British/Irish mothers in the MCS. However, taking both the weakness of the positive correlations and the number of negative correlations into account, these bivariate analyses provided only relatively weak evidence for predicted associations overall.

Relating findings back to our three theories, in terms of diverging destinies, we found that reproductive and parenting traits were not strongly associated in the Pakistani groups, with neither group having any significant positive correlations between these domains. In contrast, MCS White mothers showed high levels of associations between reproductive and parenting traits, with 71% of correlations between these domains being positive and significant, whilst BiB White mothers showed a low level of associations (22%). In terms of support for the weathering hypothesis, BiB Pakistani-origin mothers had more significant positive correlations between health and reproduction (42%) than their White counterparts (31%), but MCS Pakistani-origin mothers showed no associations between these domains whilst MCS White mothers had a moderate level (50%). In terms of supporting life history theory, associations were very low between reproduction, parenting, and health for all groups of mothers, except the MCS White mothers who had a moderate amount of associations (53%) between these three domains.

Comparing latent class analysis models

Model fit indices and class separation measures identified models with two to four classes as candidate solutions (see Table S4 in the Supplementary Material). Our review of the response profiles suggested that two and three class models had the clearest separation between 'fast' and 'slow' classes. We decided to focus on two and three class models for simplicity and comparability across samples whilst still allowing for the exploration of both a simple fast/slow dichotomy and a more complex continuum. We present the two class model results (available for all four groups) in the main text and the three class models (available for three of the four groups) in the Supplementary Material. Of note, only models with up to three and two classes would converge for the MCS White British/Irish and Pakistani-origin mothers, respectively.

We now turn to comparing response profiles for two (and three) class models for each of the four groups of mothers to determine the extent to which two classes successfully capture diverging destinies (i.e. defined by reproduction and parenting trait clustering) or 'fast' and 'slow' life histories (where health traits also cluster), and three classes the addition of an in-between 'middle' life history speed. We also check whether worse health patterns with earlier reproductive timing, and whether this is more evident in Pakistani groups, in line with the weathering hypothesis.

Comparing response profiles across classes

Millennium Cohort Study

1. White British/Irish mothers

In the two class model, 37% of BiB White British mothers were predicted to be in Class 1 and 63% in Class 2. Thirteen of the fifteen traits showed significant differences in indicator probability/means across the two classes in the predicted direction, with Class 1 and Class 2 diverging and demonstrating predominantly 'fast' and 'slow' traits, respectively (Table 3). Drinking alcohol was the only trait to pattern in the opposite direction with Class 1 mothers being significantly *more* likely to not drink. Smoking was the only trait that did not differ across the two classes. These response profiles therefore lend support to all three theoretical models.

In the three class model, 34% of MCS White British/Irish mothers were predicted to be in Class 1, 15% in Class 2 and 51% in Class 3. All traits except for smoking showed significant differences across classes (Supplementary Table S5). Class 1 MCS White mothers who formed partnerships earlier, who started childbearing earlier and who were least likely to be in a stable union, were also the least likely to breastfeed and read to their children often, lending some support to the clustering between reproduction and parenting predicted by the diverging destinies theory, as well as fitting with the idea of 'fast' life histories. Class 3 mothers who had stable relationships, later childbearing, lower parity, higher breastfeeding and vaccination rates, and a greater probability of having an affectionate relationship with their children, also had the longest gestations and heaviest birthweights, fitting the idea of 'slow' life histories. Class 2 which was 'middling' on several of the reproduction and parenting traits suggests that there may be more than two diverging destinies or life history classes.

We find some support for weathering in this group of mothers, in that mothers in the 'slow' class (Class 3) also have significantly better health than mothers in the other classes, although they are also more likely to drink alcohol. In addition, although not significantly different from the 'fast' class (Class 1) in terms of health, the 'middle' class (Class 2) does have the worst health outcomes (again excluding drinking alcohol), which in combination with having the shortest gestations and lowest birthweights does suggest some weathering effects.

The three class model lends some support to the idea of a continuum rather than a dichotomy of classes. However, whilst we can on balance assign a 'fast' (Class 1), 'middle' (Class 2) and 'slow' class (Class 3) to MCS White mothers in terms of reproductive and parenting traits, traits do not consistently cluster across all three domains, with health traits not defining either the 'fast' or 'middle' class, lending limited support to predictions that tie reproduction, parenting and health together through life history trade-offs.

2. Pakistani-origin mothers

73% of MCS Pakistani-origin mothers were predicted to be in Class 1 and 27% in Class 2. Only ages at cohabitation/marriage and first birth and gestational age showed significant differences and differentiated the two classes (Table 3). We find no support for the diverging destinies model amongst this group, as none of the parenting traits clustered together with the reproductive traits in either of the two latent classes; reproductive timing and prenatal parental investment drove class separation, but in opposite directions to that predicted by diverging destinies: Class 1 mothers had earlier reproductive timing (also characteristic of 'fast' life histories) but *longer* gestations (a 'slow' trait). We also find no support for the weathering hypothesis as neither class was defined by any health traits, suggesting that health does not cluster with reproduction in this group. Consequently, the results also don't support life history theory predictions that reproduction, parenting, and health traits will cluster together. Given this lack of clustering amongst MCS Pakistani-origin mothers, we also have no evidence that weathering is occurring faster than amongst MCS White British/Irish mothers. We do note however that the relatively small sample size may have prevented further significant differences between classes emerging.

Born in Bradford

3. White British mothers

In the two class model, 54% of BiB White British mothers were predicted to be in Class 1 and 46% in Class 2 (Table 4). Nine of the sixteen traits showed significant differences in indicator probability/means across the two classes, with all but two of these going in the predicted direction. In terms of parenting, Class 2 mothers had significantly higher probabilities of initiating breastfeeding and longer average breastfeeding durations. They were also more likely to take their child to activities at least once a week. However, mothers in this group also had shorter gestations. In terms of reproduction, Class 2 had significantly later average ages at first birth and were more likely to be living with the cohort member's father. In terms of health, Class 2 were significantly more likely to have good mental health and to have never regularly smoked but significantly less likely to not drink alcohol.

Overall, the two class model did split BiB White British mothers into divergent 'fast' (Class 1) and 'slow' (Class 2) classes quite well, with just a handful of traits breaking this pattern and only gestational length and alcohol differing significantly in the opposite direction. The response profiles therefore lend support to all three theoretical models.

For the three class model, 54% of BiB White British mothers were predicted to be in Class 1, 36% in Class 2 and 10% in Class 3. Ten traits showed significant differences across classes. There was some clustering between reproductive and parenting traits, lending some support to diverging destinies predictions, but prenatal and postnatal parental investment indicators did not hang together. Health and reproduction did not consistently cluster together as predicted by the weathering hypothesis, except that ‘slow’ mothers (Class 1) who had the latest ages at first birth and were the most likely to have two children and to be in a stable union, were also the most likely to never have regularly smoked. The overall patterning in this group may be indicative of a continuum of behaviour rather than two diverging destinies, or ‘fast’ vs ‘slow’ histories. Yet, with several non-significant differences across the three classes and some aspects of parental investment patterning differently, this limited clustering across all three domains lends very little support to the existence of life history trade-offs.

4. Pakistani-origin mothers

In the two class model, 7% of BiB Pakistani-origin mothers were predicted to be in (‘fast’) Class 1 and 93% in (‘slow’) Class 2. Most indicator probabilities and means did not differ significantly across the two classes, however there were four traits that showed significant differences and differentiated the two classes. BiB Pakistani-origin mothers did not demonstrate two clear diverging destinies as reproductive traits did not cluster well with parenting traits. Furthermore, birthweights patterned along with gestation lengths in the opposite direction to reproductive traits (i.e. greater parental investment was associated with earlier menarche). We did not find any evidence of weathering as classes did not differ on any of the health traits. As a result, this means life history trade-offs are also not well-supported in this group of mothers and we have no evidence for faster weathering compared to BiB White mothers.

For the three class model, 41%, 7% and 52% of mothers were predicted to be in Classes 1, 2 and 3, respectively. Seven of the fifteen traits showed significant differences across the classes. Parenting and reproductive traits did not cluster as theoretically predicted, with for example Class 3 (‘fast’?) mothers having the highest parities but also the latest ages at first birth and the heaviest birthweights. BMI did however significantly differ across the classes and clustered together with parity providing some limited evidence for the weathering hypothesis. That said, the lack of consistent patterning of traits across the three domains provides very little support to the existence of life history trade-offs.

DISCUSSION

Our study tested theoretical assumptions that traits across reproductive, parenting and health domains cluster together. As Table 5 and Supplementary Table 7 summarise, the extent and patterning of trait clustering varied by dataset and ethnic group, and though we did find limited evidence that some traits cluster together in predicted ways, we did not find overwhelming support for diverging destinies, weathering effects or life history theory, at least in their simplest form, across all four samples. Not all variables hung together as these theoretical conceptualisations would predict, and variation prevailed. Our results therefore point towards a more complex categorisation of behaviour in line with recent empirical studies (Sheppard and Van Winkle, 2020) and theoretical assertions (Stearns and Rodrigues, 2020); they certainly did not find support for the existence of a single 'fast-slow' continuum.

Amongst the four different groups of UK mothers we examined, we found limited clustering of traits both *within* and *between* domains. Response profiles could on balance be categorised into 'fast' and 'slow' classes in two class models with an additional intermediate 'middle' class in three class models. These classes could be interpreted as providing some limited evidence for the fast-slow continuum. However, it's clear that not all traits we included cluster together as predicted, with mothers displaying a mix of fast and slow traits rather than definitively 'fast' or 'slow' behaviour. In addition, BiB mothers could just as well have been described by four class models; but whilst these models also suggested a 'fast' and 'slow' class, the remaining two classes did not neatly pattern in the middle, and all classes displayed a mix of fast and slow traits, hinting at more behavioural complexity. The extent to which the two or three classes differed in trait expression varied, with

White mothers showing more significant differences between classes than their Pakistani counterparts whose estimated trait probabilities and means differed little between the two classes.

Clustering was most pronounced between reproductive and parenting traits, and particularly for White mothers. This suggests some support for the diverging destinies model, but the emergence of three classes suggests that destinies diverge into more than two paths. Yet three classes did not neatly describe a life history continuum from 'fast' to 'slow' either. In addition, the lack of a link between health and reproduction, and particularly so in our Pakistani groups, contradicts the prediction of faster weathering amongst ethnic minorities. Results instead suggest that cultural factors might be more important in shaping women's life histories. Theoretical models derived from life history theory, particularly those focusing on specific trade-offs rather than fixed 'life history strategies', as well as those derived from the weathering and diverging destinies frameworks, are still likely to prove fruitful in understanding the human life course, as long as they are applied in suitably nuanced ways (Bolund, 2020; Sear, 2020). We now turn to discuss some of our findings in more detail.

Clustering within and between trait domains

In none of our four groups of mothers did all indicators pattern in the same direction to be faster in one class than another. This suggests that whilst some traits cluster together, it may be too simplistic to assume that women 'fast' on one trait are going to be 'fast' on another. A US study illustrates this point nicely; mothers who had longer breastfeeding durations had *more* children than those who didn't breastfeed or who breastfed for shorter durations, and their interbirth intervals were also shorter (Maralani and Stabler, 2018). Whilst breastfeeding is closely linked to interbirth intervals through two-way physiological regulation, and is the main method of fertility regulation in traditional societies (Bongaarts, 1978; Colodro-Conde et al., 2013), widespread contraceptive use may be disengaging breastfeeding and interbirth intervals in high-income contexts such as the US and the UK (Howie and Mcneilly, 1982; Milne and Judge, 2012). Breastfeeding chances did not significantly differ across classes in our Pakistani samples. Furthermore, in contrast to what we would expect according to life history theory and economic models of quantity/quality trade-offs in parental investment (Becker and Tomes, 1976), White mothers with the greatest breastfeeding chances were the most likely to have two children but the *least* likely to have just one child. This resonates with Maralani and Staler's findings and with the public health literature that suggests that breastfeeding is a learned skill that becomes easier with subsequent children (Hackman et al., 2015).

Measures such as menarche, age at first birth and parity are akin to those used in assessing the life histories of other animals. Of these, age at first birth is most often used to differentiate between women's trajectories in the diverging destinies (McLanahan, 2004), weathering (Geronimus, 1996; Goisis and Sigle-Rushton, 2014) and life history frameworks (Low et al., 2008; Uggla and Mace, 2015). With limited and inconsistent clustering, our results lend limited support to the use of such reproductive indicators in indexing life histories. Our findings instead suggest that gestational age and birthweight, key physiological indicators of prenatal parental investment, are important in distinguishing classes but also that they don't appear to cluster well with other traits. Breastfeeding, a key aspect of postnatal parental investment, was only important for differentiating classes for White mothers. The other postnatal parental investment indicators showed inconsistent differences across White classes and no differences across Pakistani classes. Given that child socio-emotional development and related parenting practices are culturally-specific, there are both practical and ethical reasons for not relying on these more ethnocentric metrics of parental investment (Fearon and Roisman, 2017; Hays, 1998; Kalil et al., 2012; Keller, 2018).

Whilst evolutionary models suggest that the domains of reproduction and parenting are linked with the domain of health through trade-offs between investing in oneself versus having children, this isn't clearly reflected in our data. Except for BMI and parity in BiB three class models, health traits did not cluster with reproduction and parenting traits in the Pakistani samples. There were more health differences between classes for White mothers, although the 'slow' groups were also more likely to drink alcohol. This may be driven by women of higher socioeconomic position drinking more, since this is one of the few 'unhealthy' behaviours which tends to be more common in advantaged groups (Collins, 2016). Nevertheless, it would have been preferable to capture amount, duration and frequency of drinking and smoking rather than just using binary indicators (as in Mell et al., 2018) to counter the limited variation in these variables; Pakistani women barely drank alcohol at all and had very low levels of smoking, but 59% (MCS) and 91% (BiB) of White mothers drank alcohol and 19% (MCS) and 69% (BiB) smoked.

Unlike menarche, age at first birth and parity, smoking and drinking alcohol are not life history outcomes, but behaviours that people may adopt at different times in their lives. Likewise, the mental and general health indicators refer to a particular point in time and may therefore not accurately reflect health at other points in the lifecourse. Our analysis therefore may not provide a very strong test of the weathering hypothesis. Further, when looking across all three domains, given the lack of cohesive clustering found when life history traits and behavioural outcomes were used, we advise particular caution when extrapolating life histories based on purely psychometric and hypothetical behaviour indicators (i.e. using "What would you do if…?" questions and focussing on desires rather than actual completed behaviours). The 'classic' version of life history theory developed in evolutionary biology does not typically include behaviours, instead focusing on physiological and demographic traits, and this analysis lends further critique of approaches (as in 'LHT-P') which assume that life history and behavioural outcomes are very rigidly clustered together into a fast-slow classification.

Ethnic differences

We found less pronounced clustering amongst Pakistani-origin mothers than amongst White British/UK-born mothers. In addition, in two class models, 73% and 93% of MCS and BiB Pakistani-origin mothers were in one class, respectively, further suggesting limited clustering. Although we didn't test statistically for differences across ethnic groups, the response profiles showed that the Pakistani 'fast' classes were in some respects not as 'fast' as, or at least not that much 'faster' than the White 'fast' classes. For example, 'fast' Pakistani mothers had later ages at first birth than their White counterparts and ages at cohabitation/marriage were similar. Relating our findings back to the weathering hypothesis, this might suggest that social discrimination is not resulting in additional behavioural modification. In addition, Pakistani mothers had lower probabilities of unhealthy behaviours. Migration history will affect the physical and social environments women are exposed to and may explain why UK Pakistani women may demonstrate fewer weathering effects than African American women. The majority of the former are born outside the UK (Office for National Statistics, 2006) and the majority of the latter are born in the US (Perez and Hirschman, 2009) and their time spent as ethnic minorities and consequent exposure to racism are therefore likely to vary. We are not suggesting that recent immigrants don't experience racism or that racism isn't harmful for them, just that their duration of exposure to racism may be less. From this perspective, the US Hispanic population with its higher proportion of recent immigrants (Migration Policy Institute, 2018) may be a better comparator. Rare studies that have looked at weathering or trait clustering in this population found that foreign-born Hispanic mothers had lower odds of having a low birthweight baby than US-born Hispanic mothers (Acevedo-Garcia et al., 2005) and foreign-born Mexicans had lower allostatic loads than US-born Mexicans, Non-Hispanic Blacks and Non-Hispanic Whites (Kristen Peek et al., 2010). These examples suggest that both immigration and ethnic minority status are important determinants of reproductive, parenting and health behaviours, but the balance of factors may differ slightly in different populations.

Cultural factors are also important, with Pakistani norms favouring breastfeeding and stable unions, 'slow' life history traits, but also high parity, a 'fast' life history trait (Coleman and Dubuc, 2010; Kulu and Hannemann, 2016). The observed high breastfeeding rates are in line with Islamic teachings which highlight that breastfeeding has an important nurturing role (Williamson and Sacranie, 2012; Zaidi, 2014) and is a deeply spiritual act through which the mother's attributes as a 'good Muslim' are passed on to her child (Williamson and Sacranie, 2012). South Asian cultural teachings also emphasise the psychological benefits of breastfeeding (Choudhry and Wallace, 2012). However, we found that Pakistani mothers' greater chances of breastfeeding did not translate into the presentation of other 'slow' parenting traits, likely due to their ethnocentric nature. Whilst some Pakistani mothers were born in the UK, many more had migrated from Pakistan as adults or children (61.7% in the MCS and 97.5% in BiB). Future analyses could explore how migration and acculturation shape life histories. Previous MCS analyses have for example shown that whilst South Asian infants had similar odds of being breastfed as White babies, immigrant mothers were less likely to initiate breastfeeding the longer they lived in the UK (Brown and Sear, 2017: Supplementary Material; Hawkins et al., 2008).

Sociocultural factors may also exert constraints on reproductive and health traits in this group. As well as almost universal marriage, British Pakistani mothers have a high mean ideal family size, low levels of childlessness, and higher progression to third and higher order births (Hampshire et al., 2012). Whilst marriage stability indicates 'slow' behaviour, high fertility represents 'fast' behaviour. The total fertility rate (TFR)[6] of Pakistani women is around 4.1 in Pakistan but 2.8 in the

[6] TFR is the average number of children that would be born (per woman) among women progressing from age 15 to age 50 subject to the birth rates at each age in the population in question

UK (Coleman and Dubuc, 2010). This is in contrast to White UK-born mothers whose TFR is just 1.7 (Coleman and Dubuc, 2010). Fertility trends amongst British Pakistani mothers also hint at a role for acculturation, with for example, first-generation migrants having a TFR of 3.5 but second-generation migrants having a TFR of 2.5 (Coleman and Dubuc, 2010). In addition, women of colour often have less accessibility to healthcare and other resources that may also influence parity (Griffiths et al., 2008; Szczepura, 2005). In our study, Pakistani mothers had higher chances of breastfeeding, union stability and high parity than White mothers, and these traits did not distinguish classes well, reaffirming the importance of such cultural constraints. Furthermore, drinking and smoking appear to be less culturally acceptable for Pakistani women (Bush et al., 2003; Hurcombe et al., 2010). Such culturally-enforced traits may be relatively resilient to novel environmental conditions.

Limitations and future research

This was an exploratory, data-driven approach to testing whether reproductive, parenting and health traits cluster together. Our choice of indicators was restricted by what was available in our two datasets, meaning that they were not necessarily ideal to test our three models. For example, indicators relating to nutrition/weight are difficult to interpret. In particular, BMI has different meanings for different ethnic groups (Davis et al., 2013) and an unclear association with health (Nuttall, 2015). Furthermore, infants with heavier birthweights may not necessarily be the healthiest (Vangen et al., 2002). Future work could include age at first sex, relationship trajectories, age at menopause, number of grandchildren and age at death to provide a stronger and more comprehensive account of life histories.

As our samples comprised mothers of cohort children, they were necessarily restricted to parous women. It is therefore not clear how our findings would translate to nulliparous women; while nulliparous women are not expending any reproductive effort, it would still be useful to investigate certain types of trait clustering in women without children. Our analyses focussed on women rather than men, a focus justified by women's greater trade-off between physical growth and reproduction, and greater levels of parental investment (Kaplan and Lancaster, 2003). Similar analyses with male samples would however still be interesting to explore in future research.

We focus on their mothers here, but the MCS and BiB cohort children are now growing up and future research looking at their life histories would provide further insight into the extent of trait clustering[7]. The socioeconomic and environmental conditions of their parents could be used alongside indicators of their own adult conditions to explore how social mobility and changes in environmental quality alter behavioural responses. Given the likelihood that individual and environmental circumstances will change over the lifecourse (for some individuals at least), a longitudinal perspective will reveal the extent to which behaviours related to reproduction, parenting, and health cluster together to form distinct and consistent trajectories.

Conclusion

Our exploratory analyses found only limited trait clustering across the three behavioural domains of parenting, reproduction, and health. We have used a very data-driven approach to explore whether large numbers of traits cluster together and did not find clear-cut evidence that all mothers could be simplistically divided into 'fast' versus 'slow' life histories. We did however find some evidence that certain traits, particularly in the reproductive and parenting domains, clustered together as predicted, at least for White women, which also lends support to the diverging destinies model. Whilst life history theory is a very useful tool for exploring human behaviour, along with a growing consensus in the literature (Nettle and Frankenhuis, 2020; Sheppard and Van Winkle, 2020;

[7] Wave 6 of the MCS (collected when children were aged 14) includes pubertal indicators and these could be used alongside data from future surveys to explore life histories in this cohort

Stearns and Rodrigues, 2020), we caution against its oversimplification and restriction to a fast versus slow strategy approach which involves a large number of traits, including behavioural traits, clustering together. Instead, we favour a return to the investigation of individual life history trade-offs, with only cautious use of the fast-slow continuum as a heuristic to guide research. The ethnic variation in trait clustering warns further against a simplistic approach to describing women's life histories and cautions against assuming faster weathering in all ethnic minorities, although our data may not have been ideal to test the weathering hypothesis. In order to develop a more detailed and culturally-sensitive understanding of how reproduction, parenting and health traits cluster together, future research should continue examining within-population heterogeneity using longitudinal data and focussing on a range of different contexts, as well as draw on similar theoretical frameworks which have been developed in other disciplines.

Tables

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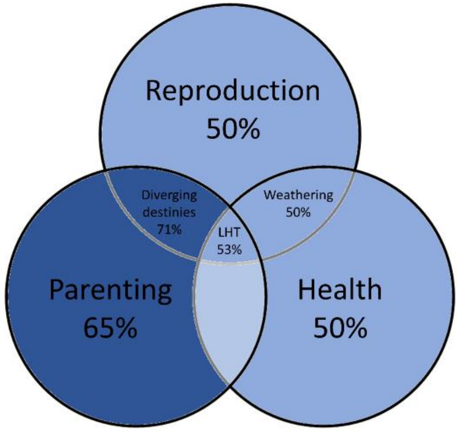
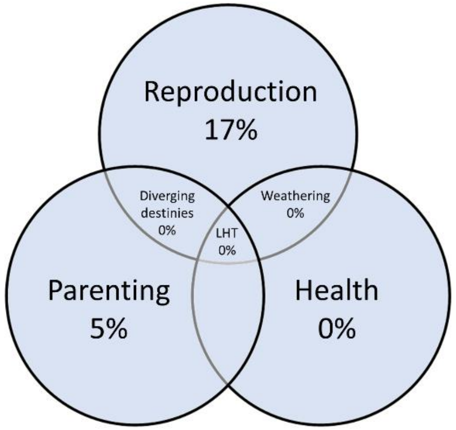
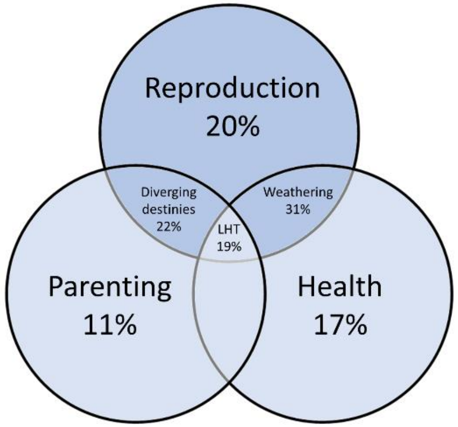
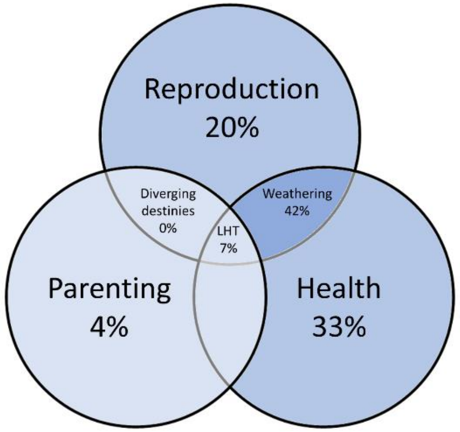
Table 1: Descriptive statistics by dataset and ethnic group

		Millennium Cohort Study (MCS)						Born in Bradford Study (BiB)				
		1. White British/Irish mothers (n=15,423)		2. Pakistani-origin mothers (n=923)				3. White British mothers (n=3,937)		4. Pakistani-origin mothers (n=4,351)		
Trait	**Data source (timepoint)**	**n**	**Mean (SD) / %**	**n**	**Mean (SD) / %**		**Data source (timepoint)**	**n**	**Mean (SD) / %**	**n**	**Mean (SD) / %**	
Reproduction												
Age at menarche (years)	-	-	-	-	-		Baseline Q (26-28weeks gestation)	3,749	13.04 (1.61)	4,018	13.44 (1.63)	*p < 0.001*
Age at cohabitation /marriage (years)	Parental Qs (9m, 3yrs)	13,277	24.16 (4.80)	838	21.17 (3.88)	*p < 0.001*	-	-	-	-	-	-
Age at first birth (years)	Parental Qs (9m, 3yrs)					*p < 0.001*	Maternity system (birth)	1,993	24.79 (5.90)	1,497	24.74 (4.19)	*p = 0.795*
Under 20		1,241	18.67%	46	15.23%							
20-24		1,444	21.73%	165	54.64%							
25-29		1,822	27.41%	60	19.87%							
30-34		1,523	22.92%	26	8.61%							
35+		616	9.27%	5	1.66%							
Parity	Parental Qs (9m, 3yrs)					*p < 0.001*	Maternity system (birth)					*p < 0.001*
4+		1,378	8.93%	234	25.35%			259	6.82%	843	20.35%	
3		2,717	17.62%	229	24.81%			461	12.15%	815	19.67%	
2		6,770	43.90%	292	31.64%			1,082	28.51%	988	23.85%	
1		4,558	29.55%	168	18.20%			1,993	52.52%	1,497	36.13%	
Family structure	Parental Qs (9m, 3yrs)					*p < 0.001*	Baseline Q (26-28weeks gestation); BiB1000 (6m, 1yr); ALLIN (1yr, 2yrs); MeDALL (4yrs)					*p < 0.001*
Not living with baby's father		2,800	18.15%	83	8.99%			1,158	29.44%	297	6.83%	
Living with baby's father		12,623	81.85%	840	91.01%			2,776	70.56%	4,050	93.17%	
Parenting												
Birthweight (kgs)	Parental Qs (9m, 3yrs)	15,412	3.39 (0.57)	918	3.11 (0.59)	*p < 0.001*	Maternity system (birth)	3,928	3.36 (0.56)	4,337	3.13 (0.53)	*p < 0.001*
Gestational length (weeks)	Parental Q (9m)	14,924	39.47 (1.93)	849	39.24 (2.00)	*p < 0.001*	Maternity system (birth)	3,929	39.29 (1.84)	4,337	39.09 (1.75)	*p < 0.001*
Breastfeeding initiation	Parental Qs (9m, 3yrs)					*p < 0.001*	Child health records (first few weeks after birth); BiB1000 (6m, 1yr, 2yrs, 3yrs); ALLIN (1yr, 2yrs); MeDALL (4yrs)					*p < 0.001*
No		5,511	35.76%	217	23.59%			2,261	58.61%	1,863	43.16%	
Yes		9,902	64.24%	703	76.41%			1,597	41.39%	2,453	56.84%	
Breastfeeding duration (months)	Parental Qs (9m, 3yrs)	9,902	3.61 (3.62)	703	3.68 (3.93)	*p = 0.594*	BiB1000 (6m, 1yr, 2yrs); ALLIN (1yr, 2yrs); MeDALL (4yrs)	858	5.13 (6.45)	1,390	7.47 (8.11)	*p < 0.001*
All route vaccinations given	Parental Qs (9m, 3yrs)					*p = 0.008*	ALLIN (1yr, 2yrs)					*p = 0.091*
No		1,227	8.00%	95	10.46%			489	62.77%	587	58.82%	
Yes		14,117	92.00%	813	89.54%			290	37.23%	411	41.18%	
Reading with child	Parental Q (3yrs)					*p < 0.001*	BiB1000 (2yrs, 3yrs)					*p < 0.001*
Once or twice a week (MCS) / Not every day (BiB)		2,567	20.37%	327				16	3.64%	122	21.71%	
Several times a week		2,356	18.69%	135								
Everyday		7,680	60.94%	243				424	96.36%	440	78.29%	
Took child to activities	-	-	-	-	-	-	ALLIN (1yr, 2yrs)					*p < 0.001*
Rarely								269	34.40%	518	51.54%	
At least once a month								198	25.32%	325	32.34%	
At least once a week								315	40.28%	162	16.12%	

Affectionate relationship with child	Parental Q (3yrs)					*p < 0.001*	BiB1000 (6m, 2yrs)					*p = 0.008*
No		590	4.91%	56	15.05%			150	30.00%	244	37.48%	
Yes		11,437	95.09%	316	84.95%			350	70.00%	407	62.52%	
Health												
General health	Parental Qs (9m, 3yrs)					*p < 0.001*	-	-	-	-	-	-
Poor		661	4.29%	67	7.26%							
Fair		3,071	19.91%	270	29.25%							
Good		8,530	55.31%	472	51.14%							
Excellent		3,160	20.49%	114	12.35%							
Mental health	-	-	-	-	-	-	Baseline Q (26-28weeks					*p < 0.001*
Poor (≥75th percentile)							gestation)	894	26.70%	1,073	30.74%	
Ok (<75th percentile)								2,454	73.30%	2,418	69.26%	
Healthy BMI	Parental Qs (9m, 3yrs)					*p < 0.001*	Baseline Q (26-28weeks					*p = 0.130*
Yes		8,414	54.55%	619	67.06%		gestation)	2,317	58.84%	2,489	57.19%	
No		7,009	45.45%	304	32.94%			1,621	41.16%	1,863	42.81%	
Ever regularly smoked	Parental Qs (9m, 3yrs)					*p < 0.001*	Baseline Q (26-28weeks					*p < 0.001*
Yes		1,707	19.38%	17	1.96%		gestation)	2,312	58.75%	364	8.39%	
No		7,099	80.62%	851	98.04%			1,623	41.25%	3,977	91.61%	
Drinks alcohol	Parental Qs (9m, 3yrs)					*p < 0.001*	Baseline Q (26-28weeks					*p < 0.001*
Yes		14,066	91.21%	22	2.38%		gestation)	2,708	68.87%	24	0.55%	
No		1,356	8.79%	901	97.62%			1,224	31.13%	4,316	99.45%	

MCS: Millennium Cohort Study; BiB: Born in Bradford study. Q: Questionnaire. P-values correspond to t-tests or chi-squared tests comparing White British and Pakistani-origin mothers for continuous and categorical variables, respectively. Ns are unweighted. Time points refer to age of cohort member, not mother. BiB had three subsequent follow-up sub-cohorts: BiB1000, ALLIN (ALLergy and Infection) and MeDALL (MEchanism of the Development of ALLergy). Variables coded so that lower values are indicative of "faster" behaviour. More detail on how variables were derived is provided in the Table S1 in the Supplementary Material.

Table 2: Summary of correlation results

Millennium Cohort Study (MCS)		Born in Bradford (BiB)	
1. White British/Irish mothers	**2. Pakistani-origin mothers**	**3. White British mothers**	**4. Pakistani-origin mothers**
Overall, **moderate** level of trait clustering across domains (55%):	Overall, **very low** level of trait clustering across domains (2%):	Overall, **very low** level of trait clustering across domains (17%):	Overall, **very low** level of trait clustering across domains (11%):
			

Key	
Very high	80-100%
High	60-80%
Moderate	40-60%
Low	20-40%
Very low	0-20%

The Venn diagrams show proportions of correlations that were significant (after Bonferroni adjustment) and in the predicted direction – both within each of the three domains and between domains in accordance with the three theories, with darker shading indicating more linkages between traits (as shown in the key to left). LHT: Life history theory.

Table 3: Response profiles for two class models (Millennium Cohort Study)

	1. White British/Irish mothers (n=15,423)		2. Pakistani-origin mothers (n=923)	
	Class 1 (37%) 'Fast'?	Class 2 (63%) 'Slow'?	Class 1 (73%) 'Fast'?	Class 2 (27%) 'Slow'?
Parenting	**Est. (95% CI)**	**Est. (95% CI)**	**Est. (95% CI)**	**Est. (95% CI)**
Breastfeeding initiation	**51.7% (48.9 - 54.4%)**	*81.3% (78.8 - 83.5%)*	*75.9% (69.4 - 81.4%)*	**84.3% (75.0 - 90.5%)**
Breastfeeding duration (months)	**2.7 (2.2 - 3.2)**	*6.6 (6.1 - 7.0)*	*7.2 (4.9 - 9.6)*	**5.5 (3.0 - 8.0)**
All routine vaccinations given to child	**89.4% (88.3 - 90.5%)**	*94.4% (93.6 - 95.1%)*	*90.7% (85.7 - 94.1%)*	**85.4% (74.7 - 92.0%)**
Reads with child				
Once or twice a week or less	**31.8% (29.3 - 34.4%)**	*10.3% (8.9 - 11.9%)*	**45.1% (40.1 - 50.1%)**	*38.9% (29.2 - 49.5%)*
Several times a week	*20.2% (18.7 - 21.9%)*	**17.5% (16.2 - 19.0%)**	**19.9% (16.3 - 24.0%)**	*21.7% (12.8 - 34.3%)*
Everyday	**47.9% (45.3 - 50.6%)**	*72.2% (69.7 - 74.5%)*	**35.0% (30.6 - 39.7%)**	*39.5% (29.4 - 50.5%)*
Affectionate relationship with child	**91.6% (90.4 - 92.6%)**	*97.7% (97.1 - 98.1%)*	**83.4% (77.1 - 88.2%)**	*93.2% (79.7 - 97.9%)*
Gestational length (weeks)	**39.7 (39.5 - 39.8)**	*39.8 (39.7 - 39.9)*	*39.5 (39.3 - 39.7)*	**38.5 (37.8 - 39.1)**
Birthweight (kgs)	**3.4 (3.4 - 3.4)**	*3.5 (3.5 - 3.5)*	*3.2 (3.1 - 3.2)*	**3.0 (2.8 - 3.1)**
Reproduction				
Age at cohabitation/marriage (years)	**21.0 (20.6 - 21.4)**	*26.0 (25.7 - 26.3)*	**19.7 (19.2 - 20.3)**	*25.9 (24.5 - 27.3)*
Age at first birth				
Under 20 years	**37.8% (34.0 - 41.7%)**	*0.0% (0.0 - 0.0%)*	**16.4% (9.8 - 26.1%)**	*3.6% (1.0 - 11.7%)*
20-24 years	**39.4% (36.0 - 42.8%)**	*4.0% (2.1 - 7.7%)*	**76.2% (64.3 - 85.0%)**	*7.9% (2.3 - 23.3%)*
25-29 years	**15.7% (12.6 - 19.4%)**	*38.1% (35.0 - 41.4%)*	**6.7% (1.8 - 22.2%)**	*49.1% (33.1 - 65.3%)*
30-34 years	**5.6% (4.0 - 7.8%)**	*40.7% (37.5 - 44.1%)*	**0.7% (0.1 - 4.5%)**	*32.8% (19.3 - 50.0%)*
35+ years	**1.6% (0.9 - 2.8%)**	*17.1% (15.1 - 19.3%)*	**0.0% (0.0 - 0.0%)**	*6.6% (2.5 - 16.2%)*
Parity				
4+	**9.8% (8.7 - 11.1%)**	*6.6% (5.9 - 7.4%)*	**26.3% (21.5 - 31.7%)**	*13.2% (7.0 - 23.5%)*
3	*16.6% (15.3 - 18.1%)*	**17.7% (16.6 - 18.8%)**	*26.0% (22.5 - 29.9%)*	**26.8% (18.1 - 37.8%)**
2	**36.7% (35.0 - 38.3%)**	*52.3% (50.6 - 54.0%)*	**29.5% (24.9 - 34.6%)**	*36.5% (27.8 - 46.3%)*
1	*36.9% (35.0 - 38.8%)*	**23.4% (22.1 - 24.8%)**	**18.2% (15.2 - 21.6%)**	*23.4% (15.8 - 33.2%)*
Living with child's father	**67.8% (65.1 - 70.4%)**	*95.5% (94.4 - 96.3%)*	*92.8% (90.0 - 94.9%)*	**91.1% (82.9 - 95.6%)**
Health				
General health				
Poor	**6.6% (5.7 - 7.6%)**	*2.6% (2.1 - 3.1%)*	*6.5% (4.4 - 9.6%)*	**9.9% (5.4 - 17.7%)**
Fair	**26.5% (24.9 - 28.1%)**	14.4% (13.1 - 15.7%)	**31.7% (26.5 - 37.4%)**	*25.9% (18.6 - 35.0%)*
Good	***53.5% (51.7 - 55.2%)***	*56.6% (55.1 - 58.1%)*	*50.7% (44.3 - 57.0%)*	**49.2% (40.3 - 58.2%)**
Excellent	**13.5% (12.1 - 15.0%)**	*26.4% (24.9 - 28.1%)*	**11.1% (8.2 - 14.8%)**	*14.9% (8.2 - 25.6%)*
Healthy BMI	**39.0% (37.2 - 40.8%)**	*52.0% (49.7 - 54.2%)*	*33.3% (28.5 - 38.5%)*	**32.2% (23.3 - 42.5%)**
Never regularly smoked [a]	*80.3% (77.5 - 82.8%)*	**78.6% (77.0 - 80.1%)**		
Doesn't drink alcohol [a]	*11.7% (10.6 - 13.0%)*	**5.5% (4.8 - 6.4%)**		

Diverging destinies | Weathering | Life history theory

Est: Estimated probabilities (%) for categorical indicators and estimated means for continuous indicators; continuous indicators are those with units in brackets. 'Fastest' and 'slowest' values for each trait highlighted in bold and italicised for each sample, respectively. Estimates underlined where confidence intervals don't overlap with other classes in the same sample, indicating estimates are significantly different from one another. [a] Alcohol and smoking excluded form Pakistani-origin models due to small cell sizes.

Table 4: Response profiles for two class models (Born in Bradford)

				3. White British mothers (n=3,937)		4. Pakistani-origin mothers (n=4,351)	
				Class 1 (54%) 'Fast'? Est. (95% CI)	Class 2 (46%) 'Slow'? Est. (95% CI)	Class 1 (7%) 'Fast'? Est. (95% CI)	Class 2 (93%) 'Slow'? Est. (95% CI)
Parenting							
Breastfeeding initiation				**24.5% (20.4 - 29.1%)**	*61.0% (55.7 - 66.0%)*	**50.1% (42.0 - 58.3%)**	*57.3% (55.4 - 59.3%)*
Breastfeeding duration (months)				**4.0 (2.8 - 5.3)**	*7.9 (7.1 - 8.7)*	**7.8 (5.7 - 9.8)**	*8.8 (8.1 - 9.6)*
All routine vaccinations given to child				**34.3% (29.4 - 39.6%)**	*39.4% (35.8 - 43.2%)*	**33.9% (19.2 - 52.4%)**	*41.7% (38.1 - 45.4%)*
Reads with child everyday				**94.4% (89.7 - 97.1%)**	*98.1% (94.0 - 99.4%)*	*81.5% (68.3 - 89.9%)*	**78.1% (74.4 - 81.3%)**
Takes child to activities							
Rarely				**54.3% (47.9 - 60.5%)**	*19.1% (15.2 - 23.6%)*	*45.4% (32.6 - 58.8%)*	**52.0% (49.6 - 54.3%)**
At least once a month				**23.5% (19.2 - 28.5%)**	*26.7% (22.6 - 31.4%)*	*32.9% (22.3 - 45.6%)*	**32.3% (30.2 - 34.4%)**
At least once a week				**22.2% (17.6 - 27.8%)**	*54.2% (48.9 - 59.4%)*	*21.7% (11.6 - 37.0%)*	**15.7% (12.8 - 19.2%)**
Affectionate relationship with child				**62.1% (53.2 - 70.2%)**	*77.1% (69.0 - 83.5%)*	*69.1% (54.7 - 80.5%)*	**62.0% (57.5 - 66.3%)**
Gestational length (weeks)	Diverging destinies			*39.8 (39.7 - 39.8)*	**38.7 (38.5 - 38.9)**	**35.7 (34.9 - 36.5)**	*39.4 (39.3 - 39.4)*
Birthweight (kgs)				*3.4 (3.4 - 3.4)*	**3.3 (3.2 - 3.4)**	**2.3 (2.2 - 2.5)**	*3.2 (3.2 - 3.2)*
Reproduction			Life history theory				
Age at menarche (years)				*13.0 (12.9 - 13.1)*	**13.0 (12.9 - 13.1)**	*14.5 (14.0 - 15.0)*	**13.4 (13.3 - 13.4)**
Age at first birth (years)				**20.7 (20.2 - 21.1)**	*28.9 (28.4 - 29.4)*	**24.7 (21.2 - 28.2)**	*24.8 (24.4 - 25.2)*
Parity							
4+				**7.8% (6.6 - 9.3%)**	*5.7% (3.9 - 8.1%)*	*16.8% (13.2 - 21.0%)*	**20.6% (18.9 - 22.5%)**
3				**14.2% (11.5 - 17.5%)**	*9.8% (6.8 - 13.8%)*	*14.5% (10.8 - 19.1%)*	**20.1% (18.8 - 21.5%)**
2		Weathering		**28.5% (24.9 - 32.3%)**	*28.5% (24.5 - 32.8%)*	**18.3% (12.3 - 26.3%)**	*24.3% (22.8 - 25.9%)*
1				**49.4% (44.2 - 54.6%)**	*56.1% (49.0 - 62.9%)*	*50.5% (40.7 - 60.2%)*	**35.0% (31.9 - 38.1%)**
Living with child's father				**54.9% (48.4 - 61.3%)**	*88.6% (86.0 - 90.7%)*	**89.0% (80.2 - 94.2%)**	*93.5% (92.7 - 94.2%)*
Health							
Good mental health				**70.6% (68.2 - 72.8%)**	*76.4% (73.9 - 78.8%)*	**64.8% (56.7 - 72.2%)**	*69.6% (67.5 - 71.6%)*
Healthy BMI				*44.0% (40.6 - 47.5%)*	**37.8% (33.3 - 42.6%)**	*43.9% (34.1 - 54.2%)*	**42.7% (40.9 - 44.5%)**
Never regularly smoked				**31.7% (28.2 - 35.3%)**	*52.3% (48.8 - 55.8%)*	**88.0% (79.9 - 93.1%)**	*91.9% (90.3 - 93.2%)*
Doesn't drink alcohol [a]				*35.6% (31.9 - 39.5%)*	**26.0% (22.7 - 29.6%)**		

Est: Estimated probabilities (%) for categorical indicators and estimated means for continuous indicators; continuous indicators are those with units in brackets. 'Fastest' and 'slowest' values for each trait highlighted in bold and italicised for each sample, respectively. Estimates underlined where confidence intervals don't overlap with other classes in the same sample, indicating estimates are significantly different from one another. [a] Alcohol excluded form Pakistani-origin models due to small cell sizes.

Table 5: Summary of two class models

	1. MCS White British/Irish mothers			2. MCS Pakistani-origin mothers			3. BiB White British mothers			4. BiB Pakistani-origin mothers		
	Class 1 = 'Fast'?			**Class 1 = 'Fast'?**			**Class 1 = 'Fast'?**			**Class 1 = 'Fast'?**		
	Diverging Destinies	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**
Reproduction	✓ Earlier ages at cohabitation/marriage ✓ More likely to have first birth at ≤24yrs and less likely to have first birth at ≥25yrs ✓ More likely to have 4+ children and less likely to have 2 children ✓ Less likely to be in a stable union ✗ More likely to have just one child			✓ Earlier ages at cohabitation/marriage ✓ More likely to have first birth at 20-24yrs and less likely to have first birth at ≥25yrs			✓ Earlier ages at first birth ✓ Less likely to be in a stable union			✗ Later ages at menarche ✗ More likely to have just one child		
Parenting	✓ Less likely to initiate breastfeeding ✓ Shorter breastfeeding durations ✓ Less likely to have fully vaccinated their child ✓ More likely to read with child once or twice a week or less and less likely to read with child everyday ✓ Lower birthweights			✗ Longer gestations			✓ Less likely to initiate breastfeeding ✓ Shorter breastfeeding durations ✓ Less likely to take child to activities at least once a week ✗ Longer gestations			✓ Shorter gestations ✓ Lower birthweights		
Health		✓ More likely to have poor or fair health and less likely to have excellent health ✓ Less likely to have a healthy BMI ✗ More likely not to drink alcohol			✗ No defining traits			✓ Less likely to have good mental health ✓ Less likely to have never regularly smoked ✗ More likely not to drink alcohol		✗ No defining traits		
	Class 2 = 'Slow'?			**Class 2 = 'Slow'?**			**Class 2 = 'Slow'?**			**Class 2 = 'Slow'?**		
	Diverging Destinies	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**
Reproduction	✓ Later ages at cohabitation/marriage ✓ Less likely to have first birth at ≤24yrs and more likely to have first birth at ≥25yrs ✓ Less likely to have 4+ children and more likely to have 2 children ✓ More likely to be in a stable union ✗ Less likely to have just one child			✓ Later ages at cohabitation/marriage ✓ Less likely to have first birth at 20-24yrs and more likely to have first birth at ≥25yrs			✓ Later ages at first birth ✓ More likely to be in a stable union			✗ Earlier ages at menarche ✗ Less likely to have just one child		
Parenting	✓ More likely to initiate breastfeeding ✓ Longer breastfeeding durations ✓ More likely to have fully vaccinated their child ✓ Less likely to read with child once or twice a week or less and more likely to read with child everyday ✓ Higher birthweights			✗ Shorter gestations			✓ More likely to initiate breastfeeding ✓ Longer breastfeeding durations ✓ More likely to take child to activities at least once a week ✗ Shorter gestations			✓ Longer gestations ✓ Higher birthweights		
Health		✓ Less likely to have poor or fair health and more likely to have excellent health ✓ More likely to have a healthy BMI ✗ Less likely not to drink alcohol			✗ No defining traits			✓ More likely to have good mental health ✓ More likely to have never regularly smoked ✗ Less likely not to drink alcohol		✗ No defining traits		

Figures

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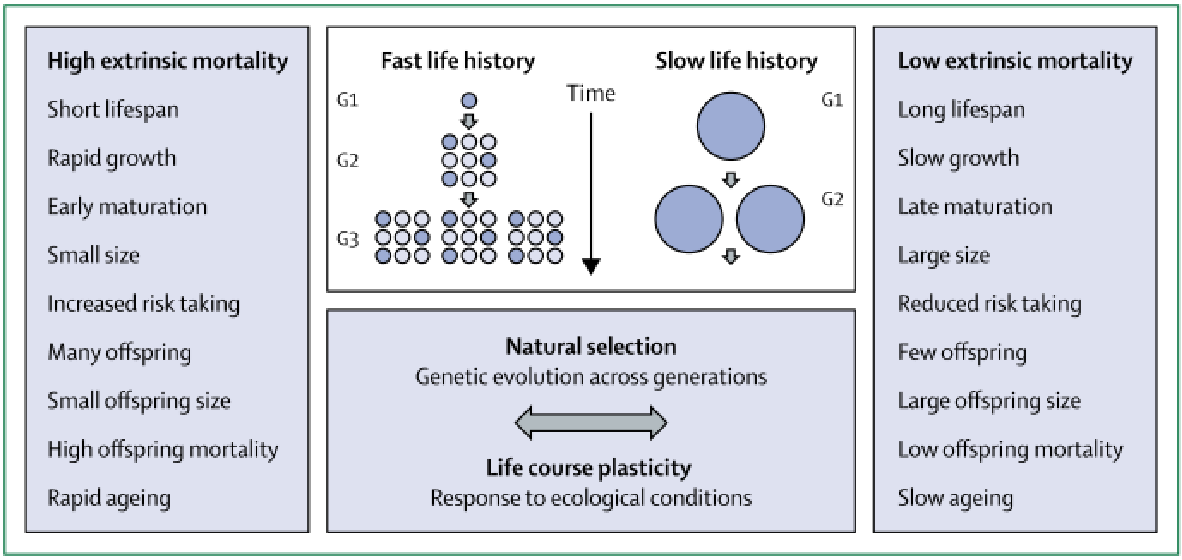
Figure 1: Life histories



Fast life histories are favoured in environments with high mortality risk, whereas slow life histories can evolve when mortality risk reduces. These trajectories might evolve under natural selection, but physiology can also respond to cues during the life course through plasticity. The size of the circles is proportional to adult body size, and filled circles indicate individuals that survive to reproduce. G1=first generation. G2=second generation. G3=third generation. Reprinted from The Lancet, Vol. 390, Wells et al., Evolutionary public health: introducing the concept, Pages 500-509, Copyright (2017), with permission from Elsevier.

References

Acevedo-Garcia, D., Soobader, M.-J., Berkman, L.F., 2005. The Differential Effect of Foreign-Born Status on Low Birth Weight by Race/Ethnicity and Education. Pediatrics 115, e20–e30. https://doi.org/10.1542/peds.2004-1306

Becker, G.S., Tomes, N., 1976. Child endowments, and the quantity and quality of children. NBER Work. Pap. Ser.

Bielby, J., Mace, G.M., Bininda-Emonds, O.R.P., Cardillo, M., Gittleman, J.L., Jones, K.E., Orme, C.D.L., Purvis, a, 2007. The fast-slow continuum in mammalian life history: an empirical reevaluation. Am. Nat. 169, 748–757. https://doi.org/10.1086/516847

Black, C.J., José Figueredo, A., Jacobs, W.J., Figueredo, A.J., Jacobs, W.J., 2017. Substance, history, and politics: An examination of the conceptual underpinnings of alternative approaches to the life history narrative. Evol. Psychol. 15, 147470491667040. https://doi.org/10.1177/1474704916670402

Bolund, E., 2020. The challenge of measuring trade-offs in human life history research. Evol. Hum. Behav. 41, 502–512. https://doi.org/10.1016/j.evolhumbehav.2020.09.003

Bongaarts, J., 1978. A Framework for Analyzing the Proximate Determinants of Fertility. Popul. Dev. Rev. 4, 105–132.

Brown, L.J., Sear, R., 2017. Local environmental quality positively predicts breastfeeding in the UK's Millennium Cohort Study. Evol. Med. Public Heal. 2017, 120–135. https://doi.org/10.1093/emph/eox011

Bush, J., White, M., Kai, J., Rankin, J., Bhopal, R., 2003. Understanding influences on smoking in Bangladeshi and Pakistani adults: Community based, qualitative study. Br. Med. J. 326, 962–965.

Caspi, A., Houts, R.M., Belsky, D.W., Harrington, H., Hogan, S., Ramrakha, S., Poulton, R., Moffitt, T.E., 2016. Childhood forecasting of a small segment of the population with large economic burden. Nat. Hum. Behav. 1, 1–10. https://doi.org/10.1038/s41562-016-0005

Choudhry, K., Wallace, L.M.L., 2012. "Breast is not always best": South Asian women's experiences of infant feeding in the UK within an acculturation framework. Matern. Child Nutr. 8, 72–87. https://doi.org/10.1111/j.1740-8709.2010.00253.x

City of Bradford Metropolitan District Council, 2018. Population [WWW Document]. Our datasets. URL https://www.bradford.gov.uk/open-data/our-datasets/population (accessed 11.11.18).

Coall, D.A., Tickner, M., McAllister, L.S., Sheppard, P., 2016. Developmental influences on fertility decisions by women: An evolutionary perspective. Philos. Trans. R. Soc. B Biol. Sci. 371. https://doi.org/10.1098/rstb.2015.0146

Coleman, D.A., Dubuc, S., 2010. The fertility of ethnic minorities in the UK, 1960s-2006. Popul. Stud. (NY). 64, 19–41. https://doi.org/10.1080/00324720903391201

Collins, S.E., 2016. Associations between socioeconomic factors and alcohol outcomes. Alcohol Res. Curr. Rev. 38, 83–94.

Colodro-Conde, L., Rijsdijk, F., Ordoñana, J.R., 2013. The Genetic and Environmental Structure of Reproduction-Related Variables: The Case of Fertility and Breastfeeding. Twin Res. Hum. Genet. 16, 1096–1102. https://doi.org/10.1017/thg.2013.64

Connelly, R., Platt, L., 2014. Cohort profile: UK Millennium Cohort Study (MCS). Int. J. Epidemiol. 43, 1719–1725. https://doi.org/10.1093/ije/dyu001

Davis, J., Juarez, D., Hodges, K., 2013. Relationship of ethnicity and body mass index with the development of hypertension and hyperlipidemia. Ethn. Dis. 23, 65–70.

Fearon, R.M.P., Roisman, G.I., 2017. Attachment theory: progress and future directions. Curr. Opin. Psychol. 15, 131–136. https://doi.org/10.1016/j.copsyc.2017.03.002

Frankenhuis, W.E., Nettle, D., 2020. The Strengths of People in Poverty. Curr. Dir. Psychol. Sci. 29, 16–21. https://doi.org/10.1177/0963721419881154

Geronimus, A.T., 1996. Black/white differences in the relationship of maternal age to birthweight: A population-based test of the weathering hypothesis. Soc. Sci. Med. 42, 589–597. https://doi.org/10.1016/0277-9536(95)00159-X

Geronimus, A.T., 1992. The weathering hypothesis and the health of African-American women and infants: evidence and speculations. Ethn. Dis. 2, 207–221.

Geronimus, A.T., Hicken, M., Keene, D., Bound, J., 2006. Weathering and Age Patterns of Allostatic Load Scores Among Blacks and Whites in the United States. Am. J. Public Health 96, 826–833. https://doi.org/10.2105/AJPH.2004.060749

Geronimus, A.T., James, S.A., Destin, M., Graham, L.F., Hatzenbuehler, M.L., Murphy, M.C., Pearson, J.A., Omari, A., Thompson, J.P., 2016. Jedi public health: Co-creating an identity-safe culture to promote health equity. SSM - Popul. Heal. https://doi.org/10.1016/j.ssmph.2016.02.008

Glymour, M.M., Avendano, M., Kawachi, I., 2014. Socioeconomic status and health, in: Berkman, L.F., Kawachi, I., Glymour, M.M. (Eds.), Social Epidemiology. Oxford University Press, Oxford, pp. 17–62.

Goisis, A., 2013. Childbearing postponement and child wellbeing in the U.K. Reconciling and integrating different perspectives. LSE.

Goisis, A., Sigle-Rushton, W., 2014. Childbearing Postponement and Child Well-being: A Complex and Varied Relationship? Demography 51, 1821–1841. https://doi.org/10.1007/s13524-014-0335-4

Griffiths, C., Prost, A., Hart, G., 2008. Sexual and reproductive health of South Asians in the UK: An overview. J. Fam. Plan. Reprod. Heal. Care 34, 251–260. https://doi.org/10.1783/147118908786000352

Hackman, N.M., Schaefer, E.W., Beiler, J.S., Rose, C.M., Paul, I.M., 2015. Breastfeeding outcome comparison by parity. Breastfeed. Med. 10, 156–162. https://doi.org/10.1089/bfm.2014.0119

Halfon, N., Larson, K., Lu, M., Tullis, E., Russ, S., 2014. Lifecourse health development: Past, present and future. Matern. Child Health J. 18, 344–365. https://doi.org/10.1007/s10995-013-1346-2

Hallquist, M.N., Wright, A.G.C., 2014. Mixture Modeling Methods for the Assessment of Normal and Abnormal Personality, Part I: Cross-Sectional Models. J. Pers. Assess. 96, 256–268. https://doi.org/10.1080/00223891.2013.845201

Hampshire, K., Blell, M., Simpson, B., 2012. Navigating New Socio-Demographic Landscapes: Using Anthropological Demography to Understand the 'Persistence' of High and Early Fertility Among British Pakistanis. Eur. J. Popul. / Rev. Eur. Démographie 28, 39–63. https://doi.org/10.1007/s10680-011-9252-z

Härkönen, J., 2017. LIS Working Paper Series Diverging destinies in international perspective: Education, single motherhood, and child poverty Diverging destinies in international perspective: Education, single motherhood, and child poverty.

Hawkins, S.S., Lamb, K., Cole, T.J., Law, C., 2008. Influence of moving to the UK on maternal health behaviours: prospective cohort study. BMJ 336, 1052–5. https://doi.org/10.1136/bmj.39532.688877.25

Hays, S., 1998. The Fallacious Assumptions and Unrealistic Prescriptions of Attachment Theory: A Comment on "Parents'' Socioemotional Investment in Children"." J. Marriage Fam. 60, 782. https://doi.org/10.2307/353546

Hill, K., 1993. Life history theory and evolutionary anthropology. Evol. Anthropol. Issues, News, Rev. 78–88. https://doi.org/10.1002/evan.1360020303

Howie, P.W., Mcneilly, A.S., 1982. Effect of breast-feeding patterns on human birth intervals. J. Reprod. Fertil. 65, 545–557.

Hurcombe, R., Bayley, M., Goodman, A., 2010. Ethnicity and alcohol: A review of the UK literature, Joseph Rowntree Foundation. York.

K Gruijters, S.L., I Fleuren, B.P., K Gruijters StefanGruijters, S.L., Gruijters, S.L.K., Fleuren, B.P.I., 2018. Measuring the Unmeasurable The Psychometrics of Life History Strategy. Hum. Nat. 29, 33–44. https://doi.org/10.1007/s12110-017-9307-x

Kalil, A., Ryan, R., Corey, M., 2012. Diverging Destinies: Maternal Education and the Developmental Gradient in Time with Children *. Demography 49, 1361–1383. https://doi.org/10.1007/s13524-012-0129-5

Kaplan, H.S., Lancaster, J.B., 2003. An Evolutionary and Ecological Analysis of Human Fertility, Mating Patterns, and Parental Investment, in: Wachter, K.W., Bulatao, R.A. (Eds.), Offspring: Human Fertility Behavior in Biodemographic Perspective. The National Academic Press, Washington, DC, pp. 170–223.

Keller, H., 2018. Universality claim of attachment theory: Children's socioemotional development across cultures. Proc. Natl. Acad. Sci. 115, 11414–11419. https://doi.org/10.1073/PNAS.1720325115

Kristen Peek, M., Cutchin, M.P., Salinas, J.J., Sheffield, K.M., Eschbach, K., Stowe, R.P., Goodwin, J.S., 2010. Allostatic load among non-hispanic whites, non-hispanic blacks, and people of mexican origin: Effects of ethnicity, nativity, and acculturation. Am. J. Public Health 100, 940–946. https://doi.org/10.2105/AJPH.2007.129312

Kulu, H., Hannemann, T., 2016. Why does fertility remain high among certain UK-born ethnic minority women? Demogr. Res. 35, 1441–1488. https://doi.org/10.4054/DemRes.2016.35.49

Lanza, S.T., Dziak, J.J., Huang, L., Wagner, A.T., Collins, L.M., 2015. LCA Stata plugin users' guide (Version 1.2). The Pennsylvania State Univeristy, Penn State.

Link, B.G., Phelan, J., 1995. Social Conditions as Fundamental Causes of Disease. J. Heal. Soc. Behav. 35, 80–94.

Lo, Y., Mendell, N.R., Rubin, D.R., 2001. Testing the number of components in a normal mixture. Biometrika 88, 767–778. https://doi.org/10.1093/biomet/88.3.767

Low, B.S., Hazel, A., Parker, N., Welch, K.B., 2008. Influences on women's reproductive lives: Unexpected ecological underpinnings. Cross-Cultural Res. 42, 201–219. https://doi.org/10.1177/1069397108317669

Maralani, V., Stabler, S., 2018. Intensive Parenting: Fertility and Breastfeeding Duration in the United States. Demography 55, 1681–1704. https://doi.org/10.1007/s13524-018-0710-7

McLanahan, S., 2004. Diverging Destinies: How Children Are Faring Under the Second Demographic Transition. Demography 41, 607–627. https://doi.org/10.1353/dem.2004.0033

Međedović, J., 2020. On the incongruence between psychometric and psychosocial-biodemographic measures of life history. Hum. Nat.

Mell, H., Safra, L., Algan, Y., Baumard, N., Chevallier, C., 2018. Childhood environmental harshness predicts coordinated health and reproductive strategies: A cross-sectional study of a nationally representative sample from France. Evol. Hum. Behav. 39, 1–8. https://doi.org/10.1016/j.evolhumbehav.2017.08.006

Migration Policy Institute, 2018. Legal Immigrants by Country of Origin, 1999-2016.

Milne, F.H., Judge, D.S., 2012. A Novel Quantitative Approach to Women's Reproductive Strategies. PLoS One 7. https://doi.org/10.1371/journal.pone.0046760

Musick, K., Michelmore, K., 2018. Cross-National Comparisons of Union Stability in Cohabiting and Married Families With Children. Demography 55, 1389–1421. https://doi.org/10.1007/s13524-018-0683-6

Nagin, D.S., 2005. Group-Based Modeling of Development. Harvard University Press, Cambridge, Massachusetts; London, England.

Nettle, D., Frankenhuis, W.E., 2020. Life-history theory in psychology and evolutionary biology: One research programme or two? Philos. Trans. R. Soc. B Biol. Sci. 375. https://doi.org/10.1098/rstb.2019.0490

Nettle, D., Frankenhuis, W.E., 2019. The evolution of life-history theory: a bibliometric analysis of an interdisciplinary research area. Proc. R. Soc. B Biol. Sci. 286, 20190040. https://doi.org/10.1098/rspb.2019.0040

Ng, W., 2019. Predictors of Class Membership with Latent Class Analysis [WWW Document]. Statalist - Stata Forum. URL https://www.statalist.org/forums/forum/general-stata-discussion/general/1490812-predictors-of-class-membership-with-latent-class-analysis (accessed 2.7.21).

Ng, W., 2018. Lo–Mendell–Rubin Adjusted Likelihood Ratio Test and wald test [WWW Document]. Statalist - Stata Forum. URL https://www.statalist.org/forums/forum/general-stata-discussion/general/1438666-lo–mendell–rubin-adjusted-likelihood-ratio-test-and-wald-test/page2 (accessed 7.8.20).

Ng, W., Schechter, C., 2017. Calculating entropy for LCA (latent class analysis) in STATA 15 - Statalist [WWW Document]. Statalist - Stata Forum. URL https://www.statalist.org/forums/forum/general-stata-discussion/general/1412686-calculating-entropy-for-lca-latent-class-analysis-in-stata-15 (accessed 9.25.18).

Nuttall, F.Q., 2015. Body Mass Index. Nutr. Today 50, 117–128. https://doi.org/10.1097/NT.0000000000000092

Office for National Statistics, 2012. Ethnicity and National Identity in England and Wales - Office for National Statistics [WWW Document]. People, Popul. community. URL https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/articles/ethnicityandnationalidentityinenglandandwales/2012-12-11 (accessed 11.8.18).

Office for National Statistics, 2006. Focus on Ethnicity and Religion, 2006th ed. Palgrave Macmillan, Basingstoke.

Pepper, G., Nettle, D., 2014. Socioeconomic Disparities in Health Behaviour: An Evolutionary Perspective, in: Gibson, M.A., Lawson, D.W. (Eds.), Applied Evolutionary Anthropology: Darwinian Approaches to Contemporary World Issues. Springer, pp. 225–243. https://doi.org/10.1007/978-1-4939-0280-4

Pepper, G. V., Nettle, D., 2017. The behavioural constellation of deprivation: causes and consequences. Behav. Brain Sci. 1–72. https://doi.org/10.1017/S0140525X1600234X

Pepper, G. V., Nettle, D., 2014. Perceived Extrinsic Mortality Risk and Reported Effort in Looking after Health. Hum. Nat. 378–392. https://doi.org/10.1007/s12110-014-9204-5

Perez, A.D., Hirschman, C., 2009. The Changing Racial and Ethnic Composition of the US Population: Emerging American Identities. Popul. Dev. Rev. 35, 1–51. https://doi.org/10.1111/j.1728-4457.2009.00260.x.The

Phelan, J.C., Link, B.G., 2005. Controlling Disease and Creating Disparities: A Fundamental Cause Perspective. Journals Gerontol. Ser. B 60, S27–S33. https://doi.org/10.1093/geronb/60.Special_Issue_2.S27

Raynor, P., Born in Bradford Collaborative Group, 2008. Born in Bradford, a cohort study of babies born in Bradford, and their parents: Protocol for the recruitment phase. BMC Public Health 8, 1–13. https://doi.org/10.1186/1471-2458-8-327

Sear, R., 2020. Do human 'life history strategies' exist? Evol. Hum. Behav. 41, 513–526. https://doi.org/10.1016/j.evolhumbehav.2020.09.004

Sear, R., Lawson, D.W., Kaplan, H., Shenk, M.K., 2016. Understanding variation in human fertility: What can we learn from evolutionary demography? Philos. Trans. R. Soc. B Biol. Sci. 371. https://doi.org/10.1098/rstb.2015.0144

Sheppard, P., Van Winkle, Z., 2020. Using sequence analysis to test if human life histories are coherent strategies. Evol. Hum. Sci. 2, e39. https://doi.org/10.1017/ehs.2020.38

Silverwood, R.J., Nitsch, D., Pierce, M., Kuh, D., Mishra, G.D., 2011. Characterizing longitudinal patterns of physical activity in mid-adulthood using latent class analysis: Results from a prospective cohort study. Am. J. Epidemiol. 174, 1406–1415. https://doi.org/10.1093/aje/kwr266

StataCorp, n.d. Latent Class Analysis (LCA) [WWW Document]. New Stata release 15. URL https://www.stata.com/new-in-stata/latent-class-analysis/ (accessed 9.5.18).

Stearns, S.C., 1983. The influence of size and phylogeny on patterns of cavariation among life-history traits in ammals. Oikos 41, 173–187.

Stearns, S.C., Rodrigues, A.M.M., 2020. On the use of "life history theory" in evolutionary psychology. Evol. Hum. Behav. https://doi.org/10.1016/j.evolhumbehav.2020.02.001

Stulp, G., Sear, R., Barrett, L., 2016. The Reproductive Ecology of Industrial Societies, Part I: Why Measuring Fertility Matters. Hum. Nat. 27, 422–444. https://doi.org/10.1007/s12110-016-9272-9

Szczepura, A., 2005. Access to health care for ethnic minority populations. Postgrad. Med. J. 81, 141–147. https://doi.org/10.1136/pgmj.2004.026237

UCL Centre for Longitudinal Studies, 2015. Welcome to the Millennium Cohort Study [WWW Document]. Cent. Longitud. Stud. URL http://www.cls.ioe.ac.uk/page.aspx?&sitesectionid=851&sitesectiontitle=Welcome+to+the+Millennium+Cohort+Study (accessed 12.17.15).

Uggla, C., Mace, R., 2015. Local ecology influences reproductive timing in Northern Ireland independently of individual wealth. Behav. Ecol. 27, 158–165. https://doi.org/10.1093/beheco/arv133

Vangen, S., Stoltenberg, C., Skjaerven, R., Magnus, P., Harris, J.R., Stray-Pedersen, B., 2002. The heavier the better? Birthweight and perinatal mortality in different ethnic groups. Int. J. Epidemiol. 31, 654–660. https://doi.org/10.1093/ije/31.3.654

Wells, J.C.K., Cole, T.J., Cortina-Borja, M., Sear, R., Leon, D.A., Marphatia, A.A., Murray, J., Wehrmeister, F.C., Oliveira, P.D., Gonçalves, H., Oliveira, I.O., Menezes, A.M.B., 2019. Low Maternal Capital Predicts Life History Trade-Offs in Daughters: Why Adverse Outcomes Cluster in Individuals. Front. Public Heal. 7. https://doi.org/10.3389/fpubh.2019.00206

Wells, J.C.K., Nesse, R.M., Sear, R., Johnstone, R.A., Stearns, S.C., 2017. Evolutionary public health: introducing the concept. Lancet 390, 500–509. https://doi.org/10.1016/S0140-6736(17)30572-X

Williamson, I.R., Sacranie, S.M., 2012. Nourishing body and spirit: exploring British Muslim mothers' constructions and experiences of breastfeeding. Divers. Equal. Heal. Care 9, 113–23.

Wright, J., Small, N., Raynor, P., Tuffnell, D., Bhopal, R., Cameron, N., Fairley, L., A Lawlor, D., Parslow, R., Petherick, E.S., Pickett, K.E., Waiblinger, D., West, J., 2013. Cohort profile: The born in bradford multi-ethnic family cohort study. Int. J. Epidemiol. 42, 978–991. https://doi.org/10.1093/ije/dys112

Zaidi, F., 2014. Challenges and practices in infant feeding in Islam. Br. J. Midwifery 22, 167–172.

Zietsch, B.P., Sidari, M.J., 2019. A critique of life history approaches to human trait covariation. Evol. Hum. Behav. https://doi.org/10.1016/j.evolhumbehav.2019.05.007

Supplementary material

Correlations between traits

Tables S2 and S3 show correlations between traits for the four groups of mothers. Variables were coded from 'fast' to 'slow', with positive correlations (in blue) indicating associations in the predicted direction and negative correlations (in red) indicating associations in the opposite direction with intensity of shading corresponding to correlation strength (with the light shading highlighting that most correlations had only weak correlations).

Millennium Cohort Study

Table S2 shows the MCS correlation results, with results for White British/Irish mothers and Pakistani-origin mothers below and below the diagonal, respectively.

1. White British/Irish mothers

For MCS White British/Irish mothers the Bonferroni-adjusted critical p-value was set to 0.0005 based on 104 correlations. 13 of the 20 pairs of parenting traits were significantly positively correlated. Correlations were however mostly weak, except for birthweight and gestational age which were moderately correlated (r=0.57, p<0.0001). Vaccinations and breastfeeding duration were very weakly negatively correlated, although not significantly so (r=-0.05, p=0.0073).

In the reproduction domain, five of the six trait pairs were significantly correlated, three positively and two negatively. Family structure was only weakly positively correlated with age at cohabitation/marriage (r=0.19, p<0.0001) but moderately positively correlated with age at first birth (r=0.56, p<0.0001). Ages at cohabitation/marriage and first birth were very strongly correlated (r=0.81, p<0.0001). Parity was only very weakly correlated with age at cohabitation/marriage (r=-0.03, p=0.0012), age at first birth (r=-0.12, p<0.0001) and family structure (r=-0.15, p<0.0001) but in the opposite to predicted direction, whereby later ages at cohabitation/marriage and first birth and living with the cohort member's father were each associated with higher rather than lower parities.

In the health domain, five of the six correlations were significant, but only three of these were positive and associations were weak. Mothers who ever regularly smoked were more likely to drink alcohol (r=0.13, p<0.0001) and to have worse general health (r=0.09, p<0.0001) and mothers with an unhealthy BMI were more likely to have poor general health (r=0.20, p<0.0001). In the opposite direction, mothers who drank alcohol were more likely to report better general health (r=-0.10, p<0.0001) and to have a healthy BMI (r=-0.10, p<0.0001).

Between domains, 47 out of 72 pairs of traits were correlated in the predicted direction, 38 significantly so, although the vast majority were only weakly correlated. Age at first birth and breastfeeding initiation were however moderately positively correlated (r=0.42, p<0.0001). 12 of the 23 negative correlations were significant, but these were all weak, with drinking alcohol and breastfeeding initiation showing the strongest correlation (r=-0.18, p<0.0001).

Overall then, 95%, 50% and 67% of correlations were in the predicted direction within the parenting, reproduction, and health domains, respectively (65%, 50%, and 50% significantly so at alpha=0.0005). Across all domains, 70% of all correlations were in the predicted direction, 55% significantly so.

In terms of support for diverging destinies, ages at cohabitation/marriage and first birth were positively associated with postnatal (rhos=0.08 to 0.42), but not prenatal parental investment (rhos=-0.02 to 0.02) amongst MCS White British mothers. Mothers with later ages at cohabitation/marriage and first birth were also more likely to be in stable unions (rhos=0.19 and 0.56). Being in a stable union was also positively associated with parental investment (rhos=0.03 to 0.35).

In terms of weathering, worse general health and having an unhealthy BMI were associated with earlier cohabitation/marriage (rhos=0.05 and 0.09) and first birth (rhos=0.16 and 0.09), but drinking alcohol (-0.11) was associated with later reproductive timing (rhos=-0.08 and 0.11).

In addition, we found that worse general health and having an unhealthy BMI were generally associated with reduced parental investment (rhos=0.02 to 0.24) although mothers with unhealthy BMIs had heavier babies (-0.06). Drinking alcohol (-0.05 to -0.18) was associated with increased parental investment and smoking similarly correlated with increased investment, but not significantly (-0.06 to 0.02). Taken together with the links between reproduction and health described above, this lends mixed support to the life history theory prediction that reproduction, parenting, and health traits are associated with one another. Furthermore, correlations between domains were mostly weak, and moderate at best (highest rho=0.42 for age at first birth and breastfeeding initiation, p<0.0001).

In sum, in terms of support for diverging destinies predictions, we find that 82% of correlations between reproductive and parenting traits were positive, 71% significantly so (alpha=0.0005). In terms of weathering, we found that 56% of correlations between health and reproduction were positive, 50% significantly so. In terms of life history theory, 65% of correlations between all three domains were positive, 53% significantly so.

2. Pakistani-origin mothers

For MCS Pakistani-origin mothers the Bonferroni-adjusted critical p-value was set to 0.0006 based on 90 correlations. 16 out of 20 pairs of parenting traits were positively correlated, but only gestational age and birthweight were significantly associated and only moderately so (r=0. 51, p<0.0001). There were no significant negative correlations.

In the reproduction domain, five of the six correlations were positive but only ages at cohabitation/marriage and first birth were significantly correlated (r=0.71, p<0.0001).

In the health domain, there were no significant correlations, however the strongest association was between BMI and smoking, with mothers with healthy BMIs being more likely to have ever regularly smoked, although this correlation was only weak (r=-0.36, p=-0.0230).

Between domains, 40 out of 61 trait pairs were positively correlated, although none of these reached the adjusted threshold for significance. The strongest positive correlation across domains was between age at first birth and breastfeeding initiation (r=0.29, p=0.0164). Of the 18 negative correlations, only parity and birthweight were significantly correlated, and weakly so (r=-0.16, p=0.0001), with mothers with lower parities having lower birthweight babies.

Overall then, 80%, 83% and 33% of correlations were in the predicted direction within the parenting, reproduction, and health domains, respectively, but only 5%, 17%, and 0% were significant at alpha=0.0006. Across all domains, 69% of all correlations were in the predicted direction but only 2% significantly so.

In terms of support for the three theories, we find even weaker correlations between reproductive timing and parental investment amongst MCS Pakistani-origin mothers (rhos=-0.03 to 0.29), and neither measure of reproductive timing was associated with union stability (0.01 and 0.02), contrary to diverging destinies predictions. But more in line with predictions, Pakistani mothers in stable unions tended to exhibit greater parental investment (0.05 to 0.21) than those in unstable unions, although not in terms of breastfeeding duration (0.00) or reading (-0.05). However, none of these associations came anywhere close to the Bonferroni-adjusted level of significance (i.e. 0.0005). In general, health was not associated with reproductive timing, although mothers who smoked began childrearing earlier, although this weak negative association (rho=-0.31) was also non-significant. We therefore find no evidence suggestive of weathering in this group of mothers.

Correlations between health traits and parenting traits were also mixed. For example, Pakistani mothers who didn't smoke were more likely to be affectionate with their children (rho=0.31) but also less likely to breastfeed (rho=-0.37). There were just as many negative as positive correlations between these two domains. Taken together with the mixed correlations between health and reproduction, the lack of consistent interdomain correlations goes against life history theory predictions. In addition, positive correlations between domains were all weak (max rho=0.31 for smoking and affection, p=0.1868).

In sum, in terms of support for diverging destinies predictions, we find that 82% of correlations between reproductive and parenting traits were positive. In terms of weathering, we found that 50% of correlations between health and reproduction were positive. In terms of life history theory, 66% of correlations between all three domains were positive. However, none of these between domain correlations were significant at the Bonferroni-adjusted alpha of 0.0006.

Looking across the correlations for both MCS ethnic groups then, we do not find evidence to suggest that Pakistani-origin mothers exhibited greater weathering. This may be due to the small sample size and so we turn now to BiB to explore this further.

Born in Bradford

Table S3 shows the BiB correlation results, with results for White British mothers and Pakistani-origin mothers below and above the diagonal, respectively.

3. *White British mothers*

For BiB White British mothers the Bonferroni-adjusted critical p-value was set to 0.0004 based on 118 correlations. 19 out of 27 pairs of parenting traits were positively correlated, three significantly so. Breastfeeding initiation (r=0.31, p<0.0001) and duration (r=0.30, p<0.0001) were each weakly correlated with activities. Birthweight was moderately correlated with gestational age (r=0.59, p<0.0001). None of the negative correlations were significant.

In the reproduction domain, two of the five trait pairs were significantly correlated. Age at first birth (p<0.0001) and parity (p<0.0001) were both associated with family structure, the former moderately positively (r=0.54) and the latter only weakly negatively (r=-0.15).

In the health domain, five of the six correlations were positive, but only one was significant and associations were weak. Mothers who ever regularly smoked were more likely to have worse mental health (r=0.15, p<0.0001).

Between domains, 54 out of 80 trait pairs were positively correlated, although all only weakly and only 15 significantly so. The strongest associations were between age at first birth and breastfeeding initiation (r=0.39, p<0.0001) and breastfeeding initiation and family structure (r=0.37, p<0.0001), whereby mothers with later ages at first birth or who were living with the cohort member's father, were more likely to initiate breastfeeding. Only seven of the 22 negative correlations were significant, and associations were all very weak. Lower parity mothers (r=-0.15, p<0.0001) were more likely to drink alcohol as were older mothers (r=-0.16, p<0.0001) who were also less likely to have a healthy BMI (r=-0.15, p<0.0001).

Overall then, 70%, 40% and 83% of correlations were in the predicted direction within the parenting, reproduction, and health domains, respectively (11%, 20%, and 17% significantly so). Across all domains, 68% of all correlations were in the predicted direction, 17% significantly so.

We find only limited support for the diverging destinies hypothesis amongst BiB White British mothers. Mothers with later ages at first birth were more likely to breastfeed (initiation rho=0.39, duration rho=0.23) and take their child to activities regularly (0.26) but age at first birth was not

associated with vaccinations, affection, reading or prenatal parental investment. Mothers with later childbearing were however more likely to be in stable unions (rho=0.54). Being in a stable union was also positively associated with breastfeeding initiation (0.37), activities (0.25) and birthweight (0.10). Menarche was neither significantly associated with any parenting traits nor with union stability.
In terms of weathering, we found mothers with unhealthy BMIs had earlier ages at menarche (0.15) and that smoking was associated with later age at first birth (rho=0.21). Contrary to predictions, mothers with unhealthy BMIs (-0.15) and who drank alcohol (-0.16) had earlier first births.

Contrary to the life history prediction that parenting and health traits will also correlate, we found that mothers who drank alcohol were more likely to breastfeed (rho=-0.11) and mothers with unhealthy BMIs had higher birthweight babies (-0.14). Mothers who smoked did however have lower birthweight babies (rho=0.12) and were both less likely to breastfeed (0.19) and to take their child to activities regularly (0.27). Taken together with the mixed links between reproduction and health described above, this lends mixed support to the life history theory prediction that reproduction, parenting and health traits hang together. Furthermore, correlations between domains were all weak (highest rho=0.39 for age at first birth and breastfeeding initiation, p<0.0001).

In sum, in terms of support for diverging destinies predictions, we find that 40% of correlations between reproductive and parenting traits were positive, 20% significantly so (alpha=0.0004). In terms of weathering, we found that 63% of correlations between health and reproduction were positive, 31% significantly so. In terms of life history theory, 68% of correlations between all three domains were positive, 19% significantly so.

4. Pakistani-origin mothers

For BiB Pakistani-origin mothers the Bonferroni-adjusted critical p-value was set to 0.0005 based on 103 correlations. Concentrating first within behavioural domains, only 15 out of 27 pairs of parenting traits were positively correlated, and only birthweight and gestational age were significantly associated and were moderately correlated (r=0.58, p<0.0001). None of the negative correlations were significant.

In the reproduction domain, only two of the five estimable correlations were significant. Family structure was weakly positively correlated with age at first birth (r=0.24, p<0.0001), and weakly negatively correlated with parity (r=-0.27, p<0.0001). The coding of the variables (parity from high to low and family structure 0 = not living with baby's father, 1 = living with baby's father) means that older ages at first birth and increasing parity were associated with increased chances of living with the cohort member's father.

In the health domain, mental health and smoking were weakly correlated with mothers with worse mental health being more likely to have ever regularly smoked (r=0.14, p=0.0002).

Between domains, 41 out of 68 correlations were positively correlated, 5 significantly so, although associations were all weak. The strongest positive association was between family structure and smoking (r=0.28, p<0.0001), whereby mothers not living with the cohort member's father were more likely to have ever regularly smoked. Mothers with higher parities were less likely to have healthy BMIs (r=0.26, p<0.0001). The strongest negative correlation was between affection and smoking, whereby mothers who never regularly smoked were less likely to have had affectionate relationships with their children, although this was weak and did not reach the adjusted level of significance (r=-0.22, p=0.0231). Parity and healthy BMI were each significantly negatively associated with birthweight, but relationships were again weak (r=-0.17, p<0.0001; r=-0.13, p<0.0001).

Overall then, 56%, 60%, and 67% of correlations were in the predicted direction within the parenting, reproduction and health domains, respectively (4%, 20%, and 33% significantly so).

Between domains, 60% of correlations were in the predicted direction (7% significantly so). Across all domains, 59% of all correlations were in the predicted direction but only 11% significantly so.

In terms of the three theories, for BiB Pakistani-origin mothers, mothers with earlier first births were less likely to be in stable unions (rho=0.24) but neither menarche or age at first birth were significantly associated with any of the parenting traits, nor was union stability. This provides very little support for the diverging destinies theory in this group of mothers.

Mothers with unhealthy BMIs had earlier menarche (rho=0.08) but other health traits did not correlate with menarche or age at first birth, offering very limited support to the weathering hypothesis.

Across health and parenting traits, only BMI and birthweight were significantly associated, and not in the direction life history theory would predict. Mothers with unhealthy BMIs had higher birthweight children (rho=-0.13).

In sum, in terms of support for diverging destinies predictions, we find that 55% of correlations between reproductive and parenting traits were positive, but none significantly so (alpha=0.0005). In terms of weathering, we found that 58% of correlations between health and reproduction were positive, 42% significantly so. In terms of life history theory, 60% of correlations between all three domains were positive, 7% significantly so.

White British mothers had more positive correlations between health and reproduction but Pakistani-origin mothers had more significant positive correlations, suggesting that the link between these domains may be more pronounced in the latter group. However, correlations were generally weaker for Pakistani-origin mothers, and there were fewer significant associations. We therefore only have weak evidence of faster weathering in this group compared to their White counterparts.

Comparing latent class analysis models

Methods

We used Stata's gsem command for the latent class analysis models. Below is example syntax for the BiB White British mothers two class model:

```
gsem ///
(everbf <-, logit) ///
(bfd <-, family(weibull, failure(stopbf))) ///
(vaxbin readbin <-, logit) ///
(activ <-, ologit) ///
(affectbin <-, logit) ///
(bwtkg gestwks <- ) ///
(menarche afb <- ) ///
(parcat <-, ologit) ///
(livdad ghq_75 healthybmi regsmk alco <-, logit) ///
if ethgrp==1, ///
lclass (C 2) startvalues(randompr, draws(200) seed(10)) ///
vce(cluster  ward11_name) ///
covstructure(e._OEn, unstructured) ///
lcinvariant(none) nodvheader
```

The `startvalues(randompr, draws(200) seed(10))` specifies 200 random starting values for class probabilities should be tried and that the one with the best log likelihood after the expectation–maximization (EM) iterations should be used as starting values. For one class models, we used parameters from two class by additionally using the `from(b)` option (StataCorp LLC, 2019). We did not specify any parameters as constrained to be equal across the classes. Specifically, by using the `lcinvariant(none)` option we allowed for different error variances across all classes and by using the `covstructure(e._0En, unstructured)` option we allowed for correlations between indicators in each class (Ng, 2019). Both means and variances were calculated for continuous variables, although for simplicity's sake, our analysis focusses just on the former.

Supplementary Tables

List of Supplementary Tables

Table S1: Derivation and coding of variables

Domain	Indicator	Millennium Cohort Study coding	Born in Bradford coding
Ethnicity	**Ethnic group**	One new binary variable with two main ethnic groups derived from Wave 1 respondent ethnic group information in the first instance and Wave 2 respondent ethnic group information in Wave 2 where this wasn't available. Wave 1 cohort member ethnic group was used as a proxy if respondent ethnic group information wasn't available for either wave and Wave 2 cohort member ethnic group was used if Wave 1 cohort member ethnic group information wasn't available. No other ethnicities coded into the new variable as they are excluded from analyses. **Original variables:** Wave 1 (when cohort member ~9months old) Respondent ethnic group for England (AMDEEA00). Nominal, scored 1-15, 95 (-9 = "Refusal", -8 = "Don't Know", -1 = "Not applicable"), 1 = "White - British", 2 = "White - Irish", 9 = "Asian/Asian British – Pakistani". Respondent ethnic group for Wales (AMDEWA00). Nominal, scored 1-16, 96 (-8 = "Don't Know", -1 = "Not applicable"), 1 = "White – Welsh", 2 = "White – other British", 3 = "White – Irish", 10 = "Asian/Asian British – Pakistani". Respondent ethnic group for Scotland (AMDESA00). Nominal, scored 1-13, 95 (-8 = "Don't Know", -1 = "Not applicable"), 1 = "White – Scottish", 2 = "White – other British", 3 = "White – Irish", 7 = "Asian/Asian Scottish – Pakistani". Respondent ethnic group for Northern Ireland (AMDENA00). Nominal, scored 1-10, 95 (-1 = "Not applicable), 1 = "White", 5 = "Pakistani". Cohort member ethic group for England (ADCEEAA0). Nominal, scored the same as AMDEEA00. Cohort member ethnic group for Wales (ADCEWAA0). Nominal, scored the same as AMDEWA00. Cohort member ethnic group for Scotland (ADCESAA0). Nominal, scored the same as AMDESA00. Cohort member ethnic group for Northern Ireland (ADCENAA0). Nominal, scored the same as AMDENA00. Wave 2 (when cohort member ~3years old) Respondent ethnic group for England (BMDEEA00), Wales (BMDEWA00), Scotland (BMDESA00) and Northern Ireland (BMDENA00). Nominal, scored the same as Wave 1 equivalents (AMDEEA00, AMDEWA00, AMDESA00, AMDENA00). Cohort member ethic group variables for England (BDCEEAA0), Wales (BDCEWAA0), Scotland (BDCESAA0) and Northern Ireland (BDCENAA0). Nominal, scored the same as Wave 1 equivalents (ADCEEAA0, ADCEWAA0, ADCESAA0, ADCENAA0). **New variable:** Ethgrp (Ethnic group). Binary, coded 1 "White British/Irish mothers" if the above respondent/cohort member ethnic group variables were coded as "White – British", "White – Irish", "White – Welsh", "White – other British" or "White Scottish", and 2 "Pakistani-origin mothers" if the above respondent/cohort member ethnic group variables were coded as "Asian/Asian British – Pakistani", "Asian/Asian Scottish – Pakistani", or "Pakistani". All other ethnicities, missing, "Don't Know", "Refusal"and "Not applicable" coded as missing.	One new binary variable with two main ethnic groups derived from ethnic group classification available in mother's baseline questionnaire (at 26-28weeks gestation). No other ethnicities coded into the new variable as they are excluded from analyses. Baseline survey (26-28 weeks gestation of cohort member) **Original variable:** *eth0eth3gp* (Mother's ethnic group – 3 categories). Nominal, scored 1-3, 1 = "White British", 2 = "Pakistani", 3 = "Other". **New variable:** Ethgrp (Ethnic group). Binary, coded 1 "White British mothers" if eth0eth3gp was 1 and coded 2 "Pakistani-origin mothers" if eth0eth3gp was 2. 3 "Other" was recoded as missing.
Parenting	Birthweight	Weight information was available for both waves (Wave 1 at ~9months: ambiwta0, amwtkga0, amwtoua0, amwtlba0; Wave 2 at ~3years: bnwtkga0, bnwtlba0, bnwtoua0). Weight in kilograms derived by converting from pounds, ounces and grams where necessary. Wave 1 information used for Wave 1 entrants and Wave 2 information used for Wave 2 entrants and for Wave 1 entrants with missing Wave 1 information. Continuous and normally distributed variable (bwtkg) going from "fast" to "slow" life history. Extreme values, i.e. over 6kgs were recoded as missing.	Maternity system variable eclbirthwt "Birth weight (g)" converted from grams to kilograms. Continuous and normally distributed variable (bwtkg) going from "fast" to "slow" life history.
Parenting	Gestational length	Continuous variable (gestwks) coded from "fast" to "slow" life history based on gestational age question (ADGESTA0), asked in Wave 1 when cohort members were ~9months old (question not asked in Wave 2). Answer divided by 7 to convert from days to weeks.	Continuous variable (gestwks) coded from "fast" to "slow" life history based on gestational age information in the eClipse maternity system information (eclgestwks).
Parenting	Breastfeeding initiation	One new binary variable, everbf, derived from Wave 1 breastfeeding questions (when cohort members were ~9months old) "Ever tried to breastfeed C1" (ambfeva0); "Age when last had breast milk C1" (ambfeda0, in days; ambfewa0, in weeks; ambfema0, in months) and Wave 2 questions (when cohort	One new binary variable, everbf, based on "Whether Read code recording as have been breastfed" (BreastFed) in child health records. Answers given in subsequent surveys used to replace missing information and derived variable coded as 1 "Yes" if at least one affirmative answer given, otherwise

		members were ~3years old) “Age when last had breast milk C1” (bmbfeaa0, in months), “Age child last had breast milk C1” (bmbfmta0, text; bmbfmta0, months; bmbfmtb0, years). Coded from “fast” to “slow” life history, assigned 0 “No” if all answered questions indicated no breastfeeding, and assigned 1 “Yes” if at least one affirmative answer given. Those with N/A, Don’t Know, refusal or missing in all answers were coded as missing. “Yes”, “Still breastfeeding”, “Stopped breastfeeding”, and reported durations → 1 “Yes”; “No”, “Never took breastmilk” → 0 “No”; -1 “Not applicable”, -8 “Don’t know”, -9 “Refusal” → .	coded 0 “No”. Breastfeeding questions asked in the different sub-cohorts: at 6 months in BiB1000 - bib6c1 “Was child ever breastfed”, bib6c2 “Is child still breastfed”; at 12 months in ALLIN - all12c1 “Child ever breastfed”, all12c2 “Child still breastfed”, all12c3 “How old when child stopped breastfeeding”, and in BiB1000 - bib12e1 “Was child ever breastfed”, bib12e2 “Is child still being breastfed”; at 24 months in ALLIN - all24c1 “Child currently breastfed”, all24c2 “If not currently breastfed”, and in BiB1000 - bib24f1 “Was child ever breastfed”, bib24f2 “Is child still being breastfed”; at 36 months in BiB1000 - bib36c1 “Was child ever breastfed”, bib36c2 “Is child still being breastfed”; at 4 years in MeDALL - mede8 “Child ever breastfed”. Those with N/A and Don’t Know in all answers were coded as missing. Binary variable going from “fast” to “slow” life history. “Yes”, “Still having breastmilk”, “Stopped having breastmilk”,“Has stopped breastfeeding”, and reported durations → 1 “Yes”; “No”, “Never had breastmilk” → 0 “No”; “Don’t know”, . → .
Parenting	Breastfeeding duration (months)	One new variable, bfd, based on variables from both Wave 1 and 2 (when CM was ~9months and ~3years old, respectively). Calculated in months using Wave 1“Age when last had breast milk C1” (ambfema0) and Wave 2“Age child last had breast milk (months) C1” (bmbfmta0) answers as a starting point. Answers given in weeks in Wave 1 “Age when last had breast milk C1” (ambfewa0) divided by 4.34524 to convert to months; and answers given in days in Wave 1 “Age when last had breast milk C1” (ambfeda0) divided by 30.4167 to convert to months. Duration assigned as 0.01642744 months (half a day) when child was “Less than one day” old when last had breastmilk, 0.5 months if child was “0” months old when last had breastmilk, 0.033 months (i.e. 1 day) if “Never took breastmilk” but reported initiating breastfeeding (as still reflects attempted breastfeeding). Interview date and baby’s birth date used to determine duration for those who responded “Still breastfeeding” (likely underestimating durations for these women). The highest recorded/calculated duration across both waves was used. Mothers with all answers recorded as “Don’t know”, “Not applicable” or missing, and those who didn’t initiate breastfeeding coded as “Missing” (.).Continuous variable going from “fast” to “slow” life history.	One new variable, bfd, based on breastfeeding duration questions asked in the different sub-cohorts: in MeDALL when cohort members were ~4years old - “Breastfeeding duration in weeks” (mede8wk), “Breastfeeding duration in days” (mede8dy); In ALLIN when cohort members were ~24months old - “Breastfeeding duration in weeks” (all24c2wk), “Breastfeeding duration in days” (all24c2dy), ~12months old - “Breastfeeding duration in weeks” (all12c3wk); in BiB1000 when cohort members were ~ 24months old - “Age stopped breastfeeding (days)” (bib24bfdays), ~ 12months old “Age stopped breastfeeding (days)” (bib12bfdays), ~6months old - “Breastfeeding duration in days” (bib6bfdays) “Age stopped breastfeeding (days)(derived)”. Answers given in days divided by 30.4167 and answers given in weeks divided by 4.34524 to convert to months. Duration assigned as 0.01642744 months (half a day) when initiation was recorded but duration was listed as 0 months. For mothers still breastfeeding at the time of the last survey, cohort member age in months was used to determine duration for MeDALL mothers (medchldage), and as cohort member age was not available in months for the other sub-cohorts, timing of last productive survey (i.e. 6, 12, 18, 24 or 36 months) was used as a proxy (likely underestimating duration for these women). Where mothers stopped breastfeeding between surveys, duration was coded as the age of the child in the last survey where breastfeeding was recorded as still happening (also likely underestimating duration for these women). The highest recorded/calculated duration across all surveys was used. Duration assigned as missing for mothers with “Don’t know” and/or missing responses for all breastfeeding questions. Continuous variable going from “fast” to “slow” life history, lognormal distribution.
Parenting	All routine vaccinations given	New binary variable, vaxbin. Mothers who were only productive in Wave 1 (when cohort members were ~9months old) were coded as 0 “No” if they responded “No” or “Yes” to “Had any immunisations C1” (amimana0) but “No” to “Has all immunisations C1” (amimmua0) and coded as 1 “Yes” if they responded “Yes” to “Has all immunisations C1” (amimmua0). Mothers who were only productive in Wave 2 (when cohort members were ~3years old) were coded as 0 “No” if they answered “0”, “1”, or “2” to any of the individual vaccination questions asking how many doses where given (polio, bmpobma0; diphtheria, bmdipha0; tetanus, bmtetaa0; whooping cough, bmwhcoa0c) and coded as 1 “Yes” if they answered “3” or “Has had all vaccinations should have all doses”. Mothers who were productive in both waves were coded as 0 “No” if only Wave 1 or Wave 2 information indicated all vaccinations, and 1 “Yes” if both Wave 1 and Wave 2 information indicated all vaccinations (as per the above criteria). Mothers with “dk can’t remember”, “Not applicable”, “Don’t Know” or missing in all variables were coded as missing. Binary variable going from “fast” (0 “No”) to “slow” (1 “Yes) life history.	New binary variable, vaxbin. Vaccination information only available for mothers in the ALLIN sub-cohort. Answers based on 12 months (MMR - all12n1mmr13; PCV - all12n1pcv2, all12n1pcv4, all12n1pcv13; meningitis, all12n1men3, all12n1menc4, all12n1men12; diphtheria - all12n1dtp2, all12n1dtp3, all12n1dtp4) and 24 months surveys (MMR - all24m1mm2; PCV - all24m1pcv; meningitis - all24m1men). Mothers coded as 0 “No” if answered “No” to at least one routine immunisation question and coded 1 “Yes” if answered “Yes” to all of them. Mothers were coded as missing if all answers were “don’t know” or missing. Binary variable going from “fast” (0 “No”) to “slow” (1 “Yes) life history.
Parenting	Reading with child	New ordinal variable, read, based on Wave 2 question “How often do you read to the child?” (bmofrea0) asked when cohort members were ~3years old. Some categories collapsed due to small cell sizes. Coded from “fast” to “slow” life history. 3 “Once or twice a week”, 4 “Once or twice a month”, 5 “Less often”, 6 “Not all” → 1 “Once or twice a week or less” 2 “Several times a week” 1 “Everyday” → 3 “Everyday” -1 “Not Applicable” and missing → .	Reading information only available for BiB1000 sub-cohort. New binary variable, readbin, derived from “How often spent reading/being read to” questions asked when cohort members were 24 months (bib24l1fhowoften) and 36 months old (bib36i1fhowoften). The more frequent of the two answers was used so that this variable reflects whether mothers read to their child everyday when they were 24 months old and/or 36 months old. Converted into a binary variable, readbin, due to small cell sizes. Code from “fast” to “slow” life history. 0 “Not at all”, 8 “<once per week”, 1 “1 day per week”, 2 “2 days per week”, 3 “3 days per week”, 4 “4 days per week”, 5 “5 days per week”, 6 “6 days per week” → 0 “No” 7 “7 days per week” → 1 “Yes”

Parenting	Took child to activities		Activities information only available for mothers in ALLIN sub-cohort. Relevant questions were asked when cohort members were: ~12months old - "Baby activities first 6 mo" (all12h1) and "Baby activities 6 mo onwards" (all12h2); and ~24 months old "Child activities from 12mo" (all24h1). These variables were coded as 1 "Rarely", 2 "At least once a month", 3 "Usually once a week", 4 "More than once a week". Average response across these three questions was used to reflect mother's average frequency of taking child to activities from their first 6 months through to them being 24 months old. We summed across and divided by the number of answers given for each woman to give an average activities score which was then used to allocate her average frequency. Original categories were collapsed due to small cell sizes. New ordinal variable, activ, coded from "fast" to "slow" life history. < 1.5 → 1 "Rarely" >=1.5 & <2.5 → 2 "At least once a month" >=2.5 → "At least once a week"
Parenting	Affection	Based on Wave 2 variable "Warm, affectionate relationship with child C1." (bmpiawa0) asked when cohort members were ~3years old. Collapsed into new binary variable (affectbin) due to small cell sizes. Coded from "fast" to "slow" life history. 1 "Definitely does not apply", 2 "Not really" 3 "Neutral, not sure", 4 "Applies sometimes", 6 "Can't say" → 0 "No" 5 "Definitely applies" → 1 "Yes"	Affection variables only available in BiB1000 sub-cohort, when cohort members were: ~6months old - "How often do you express affection by hugging etc. child" (bib6p6), "How often do you have warm/close times with child" (bib6p9), "How often do you hug child for no particular reason" (bib6p7), "How often do you tell child how happy he makes you" (bib6p8); ~24 months old - "How often express affection for child" (bib24o6); "How often have warm times with child" (bib24o9), "How often hug or hold child" (bib24o7), "How often tell child he makes you happy" (bib24o8). These original variables were coded as 1 "Never", 2 "Rarely", 3 "Sometimes", 4 "Often", 5 "Always/almost always". We summed across and divided by the number of answers given for each woman to give an average affection score. This was then simplified into a binary variable (affectbin) due to small cell sizes, "Always/almost always affectionate with child", coded 0 "No" if affection score was less than 4.5 and 1 "Yes" if affection score was 4.5 or higher. Binary variable going from "fast" to "slow" life history.
Reproduction	Age at menarche (years)		Used rep0firper "Age at first period" in years, asked in baseline questionnaire at 26-28 weeks gestation. Approximately normally distributed continuous variable (menarche) going from "fast" to "slow" life history. Recoded extreme values i.e. those that were below the 5th percentile (0 years, 1 year) and above the 95th percentile (27 years, 30 years).
Reproduction	Age at cohabitation or marriage (years)	Age at marriage and age at cohabitation both derived from date of birth (ampdby00/ bmpdby00, ampdbm00/ bmpdbm00) and month and year of event (ammayr00/ bmmayr00 "Year got married"; ammamt00/ bmmamt00 "Month got married; amliyr00/ bmliyr00 "Year started living together"; amlimt00/ bmlimt00 "Month started living together") and the younger age of the two used to create continuous "Age at cohabitation or marriage" variable. Wave 1 information (when CM was ~9months old) used for Wave 1 entrants and Wave 2 information (when CM was ~3years old) used for Wave 2 entrants and Wave 1 entrant with missing Wave 1 information. NB: refers to marriage or cohabitation with baby's father, but may not be the age at which women first married or cohabited. Extreme improbable young ages i.e. less than 13 years were recoded as missing. New continuous variable (acm) approximately normally distributed, going from "fast" to "slow" life history.	
Reproduction	Age at first birth (years)	Only deducible for mothers for whom the cohort members were first birth. Used reported age at cohort member birth from Wave 1 (AMDAGB00 when cohort members were ~9months old) and from Wave 2 (BMDAGB00, ~3years old) when Wave 1 information was missing. All mothers who reported at least one sibling of cohort member in the household were coded as missing. "Not known" and "Not applicable" also coded as missing. As the distribution of age at first birth was bimodal (with peaks around 19 and 29 years), we created a categorical variable, afbcat, coded from "fast" to "slow" life history. 1 "Under 20" 2 "20-24" 3 "25-29" 4 "30-34" 5 "35+"	Only deducible for mothers for whom the cohort members were first birth. Used admincdobagemy "Mother age at child date of birth (years)" from eClipse maternity information. New afb variable coded as missing for mothers for whom CM is not first child. Approximately normally distributed continuous variable, going from "fast" to "slow" life history.
Reproduction	Parity	New ordinal variable, parcat, derived by adding 1 to "Number of siblings of cohort member in household" variable from most recent productive survey (Wave 2 (BDOTHS00) when cohort members were ~3years old and if unproductive, Wave 1 (BDOTHS00) when cohort members were ~9months old). Reverse coded to go from "fast" to "slow" life history, with larger parities collapsed due to small cell sizes.	New ordinal variable, parcat, derived by adding 1 to "Registerable parity" recorded in maternity system at time of cohort member's birth (eclregpart). Reverse coded to go from "fast" to "slow" life history, with larger parities collapsed due to small cell sizes. 3, 4, 5, 6, 7, 8, 9, 10 → 1 "4+" 2 → 2 "3"

		3, 4, 5, 6, 7, 8, 9, 10, 12 → 1 "4+" 2 → 2 "3" 1 → 3 "2" 0 → 4 "1"	1 → 3 "2" 0 → 4 "1"
Reproduction	Family structure	New binary variable, livdad, derived from "Parent/Carers in Household" variable in Wave 1 (ADHTYP00, when cohort members were ~9months old) and where this information was unavailable, information from Wave 2 (BDHTYP00, ~3years old) was used instead, to try to get an indication of family structure at the time of birth. Mothers were assigned 0 "Not living with baby's father" if coded as "Natural mother and step-parent", "Natural mother and partner", "Natural mother only", "Natural mother and other parent/carer", "Natural mother and adoptive parent", "Natural mother only" and assigned 1 "Living with baby's father" if coded as "Both natural parents". Coded as missing if no information available or marked as "Not applicable" in both waves. Coded to go from "fast" to "slow" life history, with categories collapsed due to small cell sizes.	New binary variable, livdad, derived from cohabitation status and living arrangements questions, with information from earliest available time point chosen to proxy family structure at birth. Baseline questionnaire information (26-28 weeks gestation, hhd0cohab "Cohabitation status") used where available and if not, 6 months survey information used (bib6e02 "Living arrangements"), then 12 months survey information used (all12d2 "Cohabitation status"; bib12b02 "Living arrangements"), then 24 months (all24d2 "Cohabitation status"), then 4 years (medg3 "Cohabitation status"). Coded from "fast" to "slow" life history, assigned 0 "Not living with baby's father" " if mother answered "Living with another partner", "Not living with a partner", "Not living with partner but in relationship", or "Not living with a partner and not in relationship" in earliest productive survey, and assigned 1 "Living with baby's father" if mother answered "Living with baby's father" or "Living with child's other parent" in earliest productive survey. Coded as missing if no information available in any of the six variables. Coded to go from "fast" to "slow" life history, with categories collapsed due to small cell sizes.
Health	Health status	New categorical variable, health, derived from general health status questions asked at both waves (Wave 1, when cohort members were ~9months old, amgehe00; and Wave 2 ~3years old, bmgehe00). When data was available at both waves, the worst of the two statuses was chosen. Variable reverse coded to go from "fast" to "slow" life history. 4 → 1 "Poor" 3 → 2 "Fair" 2 → 3 "Good" 1 → 4 "Excellent"	28 General Health Questionnaire items (ghq0ques01 - ghq0ques028) from baseline survey (26-28 weeks gestation) were used to calculate ethno-language group specific 75th centiles (as per Prady et al., 2015) to minimise variation caused by potential measurement inconsistencies. Where language was missing we assumed English. This left just three mothers not assigned to an ethno-language category. New binary variable, ghq_75, coded from "fast" to "slow" life history, assigned 1 if <75th centile and 0 if ≥75th centile. Being in 75th centile or above is indicative of caseness and therefore poorer mental health.
Health	Healthy BMI	New binary variable, healthybmi, capturing whether mothers were ever in an unhealthy BMI range during the study period, based on BMI information available at different timepoints i.e. prior to the birth of cohort child (ADMBMB00, AMDBMIA0), when cohort child was ~9months old (ADMBMI00, AMDBMIB0) and around ~3years old (BDMBMI00, BMDBMI00). Extremely low BMIs (<14) were recoded as missing and then the highest and lowest recorded BMIs were used to indicate whether mothers had ever had a BMI outside the healthy range. Coded from "fast" to "slow" life history, with mothers whose BMI was either below 18.5 or above 24.9 coded as 0 "Unhealthy BMI" and those within this range coded as 1 "Healthy BMI".	New binary variable, healthybmi, derived from mother's booking BMI (mms0mbkbmi) included in the baseline questionnaire data (26-28 weeks gestation). Coded from "fast" to "slow" life history, with mothers whose BMI was either below 18.5 or above 24.9 coded as 0 "Unhealthy BMI" and those within this range coded as 1 "Healthy BMI". Extremely low BMIs (<14) were recoded as missing.
Health	Ever regularly smoked	New binary variable, regsmk, derived from Wave 1 "Ever smoked" question (amsmev00, when cohort members were ~9months old) and Wave 2 "Ever regularly smoked tobacco products" question (bmsmev00, ~3years old). Coded from "fast" to "slow" life history with mothers who answered "Yes" in either survey coded as 0 "Yes" and mothers who answered "No" in both surveys coded as 1 "No". Mothers with missing data or "Not applicable" recorded in both waves were coded as missing.	New binary variable, regsmk, derived from "Mother ever regularly smoked" smk0regsmk item in baseline questionnaire (administered at 26-28 weeks gestation). Coded from "fast" to "slow" life history, assigned 0 "Yes" if answered "Yes, more than 1 year", "Yes, less than 1 year" or "Yes, not specified", and assigned 1 "No" if answered "No".
Health	Drinks alcohol	New binary variable, alco, derived from Wave 1 variables amaldr00 "Frequency of current alcohol consumption" and amdrof00 "Frequency of alcohol consumption before preg" (when cohort members were ~9months old) and Wave 2 variable bmaldr00 "How often usually drink alcohol" (~3years old). Coded from "fast" to "slow" life history, assigned 1 "No" if answered "Never" to all productive questions, coded missing if all answers marked "Refusal" or "Don't know" or "Not applicable", all other frequencies coded 0 "Yes".	New binary variable, alco, derived from baseline questionnaire (26-28 weeks gestation) items alc0drpreg "Mother drank alcohol during pregnancy or 3 months before", alc0dr3mb4 "Mother drank alcohol 3 months before pregnancy", alc0dr4thm "Mother drank alcohol since 4th month of pregnancy", and alc0drfr3m "Mother drank alcohol in the first 3 months of pregnancy". Coded from "fast" to "slow" life history, assigned 0 "Yes" if recorded as "Yes, once a week", "Yes, occasionally", or "Yes, not specified" to any of the four alcohol variables and assigned 1 "No" if recorded as "No" in all for which an answer was recorded. Coded missing if marked as "Don't remember" or answer missing for all four variables.

Table S2: Correlations between traits (Millennium Cohort Study)

	Breastfeeding initiation [b]	Breastfeeding duration [c]	Vaccinations [b]	Reading [b]	Affection [b]	Birth-weight [c]	Gestational length [c]	Age at cohabitation/ marriage [c]	Parity [o]	Age at first birth [o]	Family structure [b]	General health [o]	Healthy BMI [b]	Smoking [b]
Breastfeeding initiation [b]		*703*	0.08 0.4128 *906*	0.06 0.4717 *703*	-0.02 0.9109 *371*	0.03 0.5861 *915*	0.06 0.3299 *848*	0.05 0.3731 *837*	0.11 0.0807 *920*	0.29 0.0164 *301*	0.19 0.0751 *920*	-0.09 0.1494 *920*	0.02 0.7983 *920*	-0.37 0.0926 *865*
Breastfeeding duration [c]	*9,902*		0.11 0.1931 *693*	0.05 0.4044 *544*	-0.07 0.5209 *301*	0.04 0.3860 *544*	0.06 0.2450 *489*	0.04 0.4630 *485*	0.01 0.8392 *703*	0.16 0.0641 *245*	0.00 0.9906 *703*	0.09 0.0706 *703*	0.05 0.4414 *703*	-0.05 0.7133 *657*
Vaccinations [b]	0.09 **<0.0001** *15,337*	-0.05 0.0073 *9,853*		0.04 0.6672 *690*	-0.04 0.8341 *367*	0.06 0.3541 *903*	0.11 0.1154 *837*	-0.03 0.6497 *825*	0.08 0.2834 *908*	0.06 0.6560 *297*	0.21 0.0838 *908*	0.18 0.0171 *908*	0.18 0.0660 *908*	0.09 0.6721 *854*
Reading [b]	0.31 **<0.0001** *12,594*	0.21 **<0.0001** *8,479*	0.10 **<0.0001** *12,525*		0.01 0.9377 *372*	0.03 0.4974 *702*	-0.02 0.7681 *639*	0.06 0.2608 *635*	0.12 0.0508 *705*	0.13 0.2220 *219*	-0.05 0.6219 *705*	0.08 0.1715 *705*	0.02 0.8218 *705*	-0.21 0.2288 *659*
Affection [b]	0.21 **<0.0001** *12,018*	0.17 **<0.0001** *8,150*	0.11 0.0008 *11,956*	0.22 **<0.0001** *12,027*		0.14 0.1078 *371*	0.12 0.2271 *340*	0.16 0.1586 *336*	0.11 0.2931 *372*	0.20 0.2561 *131*	0.15 0.3679 *372*	-0.05 0.6152 *372*	0.15 0.2645 *372*	0.31 0.1868 *335*
Birthweight [c]	0.07 **<0.0001** *15,404*	0.09 **<0.0001** *8,507*	0.04 0.0026 *15,334*	0.03 0.0037 *12,594*	0.08 **0.0001** *12,018*		0.51 **<0.0001** *639*	0.03 0.4250 *635*	-0.16 **0.0001** *918*	0.11 0.1121 *300*	0.05 0.5298 *918*	-0.03 0.5554 *918*	-0.10 0.0594 *918*	-0.01 0.9282 *863*
Gestational length [c]	0.03 0.0090 *14,924*	0.06 **<0.0001** *8,096*	0.04 0.0046 *14,858*	0.02 0.0304 *12,140*	0.09 **<0.0001** *11,602*	0.57 **<0.0001** *12,189*		0.05 0.1020 *618*	-0.07 0.1609 *849*	0.02 0.7470 *286*	0.06 0.4950 *849*	0.00 0.9834 *849*	-0.06 0.2997 *849*	0.10 0.4055 *799*
Age at cohabitation/ marriage [c]	0.22 **<0.0001** *13,275*	0.12 **<0.0001** *7,623*	0.08 **<0.0001** *13,220*	0.14 **<0.0001** *11,045*	0.14 **<0.0001** *10,589*	0.00 0.7190 *11,081*	-0.02 0.0870 *11,026*		0.07 0.1327 *838*	0.71 **<0.0001** *279*	0.01 0.9197 *838*	0.03 0.5316 *838*	0.01 0.9083 *838*	-0.02 0.8383 *794*
Parity [o]	0.08 **<0.0001** *15,413*	-0.16 **<0.0001** *9,902*	0.11 **<0.0001** *15,344*	0.22 **<0.0001** *12,603*	0.07 **0.0004** *12,027*	-0.11 **<0.0001** *15,412*	0.01 0.2779 *14,924*	-0.03 0.0012 *13,277*		0.04 0.6881 *302*	-0.14 0.0982 *923*	0.12 0.0195 *923*	0.04 0.5023 *923*	-0.16 0.2341 *868*
Age at first birth [o]	0.42 **<0.0001** *6,644*	0.27 **<0.0001** *4,589*	0.10 **<0.0001** *6,628*	0.27 **<0.0001** *5,341*	0.28 **<0.0001** *5,103*	0.02 0.0591 *6,644*	0.00 0.8033 *6,504*	0.81 **<0.0001** *5,553*	-0.12 **<0.0001** *6,646*		0.02 0.9104 *302*	0.03 0.7124 *302*	0.00 0.9829 *302*	-0.31 0.1128 *280*
Family structure [b]	0.35 **<0.0001** *15,413*	0.22 **<0.0001** *9,902*	0.17 **<0.0001** *15,344*	0.23 **<0.0001** *12,603*	0.18 **<0.0001** *12,027*	0.13 **<0.0001** *15,412*	0.03 0.0411 *14,924*	0.19 **<0.0001** *13,277*	-0.15 **<0.0001** *15,423*	0.56 **<0.0001** *6,646*		0.11 0.2018 *923*	-0.04 0.7154 *923*	-0.10 0.7066 *868*
General health [o]	0.12 **<0.0001** *15,412*	0.15 **<0.0001** *9,902*	0.10 **<0.0001** *15,343*	0.20 **<0.0001** *12,603*	0.24 **<0.0001** *12,027*	0.08 **<0.0001** *15,411*	0.08 **<0.0001** *14,923*	0.05 **<0.0001** *13,276*	0.06 **<0.0001** *15,422*	0.16 **<0.0001** *6,645*	0.17 **<0.0001** *15,422*		0.11 0.0585 *923*	-0.09 0.5095 *868*
Healthy BMI [b]	0.11 **<0.0001** *15,413*	0.14 **<0.0001** *9,902*	0.02 0.3124 *15,344*	0.10 **<0.0001** *12,603*	0.06 0.0199 *12,027*	-0.06 **<0.0001** *15,412*	0.02 0.0972 *14,924*	0.09 **<0.0001** *13,277*	0.03 0.0023 *15,423*	0.09 **<0.0001** *6,646*	0.08 **<0.0001** *15,423*	0.20 **<0.0001** *15,422*		-0.36 0.0230 *868*
Smoking [b]	-0.06 0.0013 *8,803*	-0.04 0.0137 *6,331*	0.03 0.2438 *8,769*	-0.01 0.6255 *7,436*	-0.01 0.7855 *7,123*	-0.02 0.2725 *8,800*	0.02 0.1093 *8,548*	-0.03 0.0319 *8,069*	0.10 **<0.0001** *8,806*	-0.06 0.0080 *3,707*	-0.03 0.2942 *8,806*	0.09 **<0.0001** *8,806*	0.02 0.3656 *8,806*	
Alcohol [b]	-0.18 **<0.0001** *15,412*	-0.05 0.0075 *9,902*	-0.12 **<0.0001** *15,343*	-0.09 **<0.0001** *12,603*	-0.14 **0.0001** *12,027*	-0.09 **<0.0001** *15,411*	-0.05 0.0015 *14,923*	-0.08 **<0.0001** *13,276*	-0.12 **<0.0001** *15,422*	-0.11 **<0.0001** *6,645*	-0.14 **<0.0001** *15,422*	-0.10 **<0.0001** *15,422*	-0.10 **<0.0001** *15,422*	0.13 **<0.0001** *8,806*

← Strong correlation against predicted direction — *No correlation* — *Strong correlation in predicted direction →*

Table S3: Correlations between traits (Born in Bradford)

	Breastfeeding initiation [b]	Breastfeeding duration [c]	Vaccinations [b]	Reading [b]	Activities [o]	Affection [b]	Birth-weight [c]	Gestational length [c]	Age at menarche [c]	Age at first birth [c]	Parity [o]	Family structure [b]	Mental health [b]	Healthy BMI [b]	Smoking [b]
Breastfeeding initiation [b]		 *1,390*	-0.01 0.8738 *998*	0.05 0.5966 *562*	0.08 0.1385 *1,005*	-0.15 0.0442 *651*	0.06 0.0020 *4,301*	0.04 0.0632 *4,301*	0.00 0.8109 *3,988*	0.07 0.0808 *1,483*	-0.01 0.5258 *4,108*	0.02 0.5122 *4,311*	-0.05 0.0969 *3,462*	0.05 0.0507 *4,316*	0.08 0.0279 *4,305*
Breastfeeding duration [c]	 *858*		0.04 0.3130 *844*	0.12 0.0551 *466*	0.06 0.1242 *849*	-0.05 0.3792 *544*	0.04 0.1320 *1,379*	0.00 0.8759 *1,379*	0.01 0.6906 *1,305*	0.14 0.0030 *475*	-0.06 0.0218 *1,357*	-0.02 0.6162 *1,390*	-0.04 0.2140 *1,337*	0.05 0.0955 *1,390*	0.10 0.0499 *1,388*
Vaccinations [b]	0.00 0.9535 *779*	-0.10 0.1204 *545*		0.09 0.5491 *178*	-0.04 0.3829 *998*	0.05 0.7197 *194*	-0.05 0.2739 *993*	-0.02 0.6111 *993*	0.01 0.7426 *939*	0.14 0.0619 *322*	0.09 0.0391 *973*	-0.12 0.1287 *998*	0.02 0.6536 *945*	-0.03 0.5415 *998*	0.15 0.0560 *998*
Reading [b]	0.06 0.6525 *440*	0.16 0.3647 *294*	0.94 0.2449 *131*		0.19 0.1184 *182*	0.26 0.0006 *554*	0.04 0.5332 *558*	-0.07 0.3114 *558*	0.03 0.6049 *533*	0.08 0.5204 *181*	-0.01 0.8584 *552*	-0.04 0.7406 *562*	0.04 0.6443 *561*	0.05 0.4692 *562*	0.07 0.5443 *562*
Activities [o]	0.31 **<0.0001** *782*	0.30 **<0.0001** *547*	0.14 0.0085 *779*	0.04 0.8627 *133*		0.04 0.6912 *199*	-0.03 0.4134 *1,000*	-0.01 0.8498 *1,000*	0.03 0.4086 *946*	0.11 0.1185 *324*	0.10 0.0088 *980*	-0.06 0.3775 *1,005*	0.01 0.8142 *952*	0.07 0.1554 *1,005*	-0.13 0.0644 *1,005*
Affection [b]	0.13 0.0820 *500*	0.01 0.9409 *333*	-0.05 0.7714 *143*	0.01 0.9280 *430*	0.37 0.0025 *144*		0.00 0.9925 *647*	-0.03 0.5508 *647*	-0.04 0.4779 *619*	0.10 0.3777 *216*	0.02 0.7537 *640*	0.05 0.6492 *651*	-0.01 0.8539 *650*	0.04 0.4835 *651*	-0.22 0.0231 *651*
Birthweight [c]	0.05 0.0209 *3,848*	0.10 0.0050 *852*	-0.02 0.6174 *774*	0.03 0.7866 *438*	0.09 0.0145 *777*	-0.03 0.6236 *498*		0.58 **<0.0001** *4,337*	-0.02 0.2166 *4,005*	0.00 0.9733 *1,497*	-0.17 **<0.0001** *4,143*	0.07 0.0184 *4,332*	-0.02 0.2990 *3,476*	-0.13 **<0.0001** *4,337*	0.06 0.0414 *4,326*
Gestational length [c]	-0.02 0.4137 *3,849*	0.06 0.0800 *852*	0.02 0.6744 *774*	-0.13 0.2891 *438*	0.02 0.6098 *777*	-0.04 0.5443 *498*	0.59 **<0.0001** *3,928*		-0.01 0.5579 *4,005*	-0.02 0.4643 *1,497*	0.01 0.5443 *4,143*	0.03 0.3804 *4,332*	0.06 0.0092 *3,476*	0.03 0.1387 *4,337*	0.06 0.0260 *4,326*
Age at menarche [c]	-0.01 0.6025 *3,678*	0.01 0.6997 *827*	0.02 0.6246 *742*	0.03 0.8281 *424*	0.05 0.2690 *745*	-0.02 0.7518 *482*	0.00 0.7993 *3,740*	0.02 0.1350 *3,741*		0.01 0.5986 *1,401*	-0.01 0.5173 *3,826*	0.06 0.0704 *4,014*	-0.01 0.5352 *3,252*	0.08 **0.0002** *4,018*	0.05 0.0787 *4,007*
Age at first birth [c]	0.39 **<0.0001** *1,956*	0.23 **<0.0001** *451*	-0.03 0.5153 *386*	-0.09 0.5661 *223*	0.26 **<0.0001** *387*	0.25 0.0009 *251*	0.05 0.0316 *1,992*	-0.03 0.2084 *1,993*	0.06 0.0076 *1,916*		. . *1,497*	0.24 **<0.0001** *1,495*	-0.03 0.5755 *1,243*	-0.08 0.0386 *1,497*	0.10 0.0764 *1,494*
Parity [o]	0.06 0.0081 *3,720*	-0.09 0.0504 *838*	0.23 **<0.0001** *758*	0.13 0.2886 *430*	0.13 0.0070 *761*	-0.04 0.5308 *490*	-0.09 **<0.0001** *3,794*	0.06 0.0013 *3,795*	-0.01 0.6806 *3,613*	 *1,993*		-0.27 **<0.0001** *4,138*	0.12 **<0.0001** *3,391*	0.26 **<0.0001** *4,143*	-0.09 0.0025 *4,132*
Family structure [b]	0.37 **<0.0001** *3,854*	0.16 0.0127 *858*	-0.10 0.1048 *779*	0.07 0.6413 *440*	0.25 **<0.0001** *782*	0.15 0.0563 *500*	0.10 **<0.0001** *3,924*	-0.02 0.3093 *3,925*	-0.01 0.7827 *3,745*	0.54 **<0.0001** *1,991*	-0.15 **<0.0001** *3,791*		0.192 **<0.0001** *3,488*	0.00 0.9139 *4,347*	0.28 **<0.0001** *4,336*
Mental health [b]	0.00 0.9703 *3,286*	0.04 0.4184 *852*	0.15 0.0130 *775*	-0.11 0.4766 *439*	0.08 0.1642 *778*	-0.03 0.7270 *499*	0.02 0.3803 *3,338*	0.01 0.7440 *3,339*	0.07 0.0029 *3,175*	0.07 0.0115 *1,704*	0.03 0.2619 *3,269*	0.13 **<0.0001** *3,348*		0.03 0.3578 *3,491*	0.14 **0.0002** *3,490*
Healthy BMI [b]	0.06 0.0143 *3,858*	0.05 0.2831 *858*	0.01 0.8249 *779*	0.04 0.7763 *440*	0.12 0.0160 *782*	-0.10 0.1727 *500*	-0.14 **<0.0001** *3,928*	-0.01 0.4912 *3,929*	0.15 **<0.0001** *3,749*	-0.15 **<0.0001** *1,993*	0.16 **<0.0001** *3,795*	-0.12 **<0.0001** *3,934*	0.09 0.0023 *3,348*		0.00 0.9119 *4,341*
Smoking [b]	0.19 **<0.0001** *3,855*	0.08 0.1188 *858*	0.01 0.8630 *779*	0.05 0.7450 *440*	0.27 **<0.0001** *782*	0.05 0.5048 *500*	0.12 **<0.0001** *3,925*	0.01 0.5349 *3,926*	0.04 0.0680 *3,746*	0.21 **<0.0001** *1,992*	0.06 0.0182 *3,792*	0.26 **<0.0001** *3,931*	0.15 **<0.0001** *3,346*	0.00 0.9747 *3,935*	
Alcohol [b]	-0.11 **0.0001** *3,852*	0.00 0.9319 *855*	0.12 0.0406 *777*	0.05 0.7291 *437*	0.04 0.4974 *780*	0.08 0.2863 *497*	0.01 0.7277 *3,922*	-0.01 0.7288 *3,923*	0.00 0.9689 *3,743*	-0.16 **<0.0001** *1,989*	-0.15 **<0.0001** *3,789*	-0.09 0.0016 *3,928*	0.05 0.1012 *3,344*	0.02 0.4446 *3,932*	0.08 0.0032 *3,930*

← Strong correlation against predicted direction	No correlation	Strong correlation in predicted direction →

Tables S2 and S3. *Correlations between traits in the Millennium Cohort Study (Table S2) and Born in Bradford (Table S3). For each pair of traits, correlation coefficients shown in first row, p-values in second row and ns in third row. Results for Pakistani-origin and White British/Irish mothers shown above and below the diagonals, respectively. Polychoric correlations calculated for combinations of binary (ᵇ) and/or ordinal (ᵒ) variables, polyserial correlations calculated for combinations of continuous (ᶜ) and binary/ordinal variables, Pearson's correlations calculated for combinations of continuous (ᶜ) variables. All variables coded so that higher values correspond to 'faster' traits. Correlation strength is indicated by intensity of colour, with blue and red signifying positive and negative correlation, respectively (the darker the blue, the stronger the positive association, and the darker the red, the stronger the negative association). Bonferroni-adjusted significant correlations are highlighted in bold (altered alpha = 0.0006 and 0.0005 for MCS Pakistani-origin and White British/Irish mothers, respectively, and 0.0005 and 0.0004 for BiB Pakistani-origin and White British mothers, respectively). Boxed-in areas indicate correlations between traits within the same domain (parenting, reproduction, health). All correlations were adjusted for sample-clustering at the ward level in both datasets, all MCS correlations were weighted and MCS Pearson's correlations also accounted for stratification in the survey design (fully adjusting for complex survey design is not possible for polychoric and polyserial correlations).*

Table S4: Goodness of fit and class separation statistics for models with 1-5 latent classes by dataset and ethnic group

							LMR LT (k vs k-1)		Class 1				Class 2				Class 3				Class 4			
K	Obs.	LL	df	AIC	BIC	E	Test stat.	P	n	AvePP	Prop.	OCC	n	AvePP	Prop.	OCC	n	AvePP	Prop.	OCC	n	AvePP	Prop.	OCC
1.	**MCS White British/Irish mothers (n=15,423)** [a]																							
1	15,423	-214,458	30	428,977	429,206				15,423	1.00	1.00	.												
2	15,423	-209,753	61	419,629	420,095	0.70	9,095.68	<0.001	6,314	0.87	0.37	11.91	9,109	**0.90**	0.63	5.16								
3	15,423	-207,370	92	**414,924**	**415,627**	**0.73**	4,607.83	<0.001	6,134	**0.88**	0.34	**13.54**	1,927	0.83	0.15	**27.24**	7,362	0.85	0.50	5.56				
4	.	.	.	.	.	.	.	.		.	.	.		.	.	.		.	.	.		.	.	.
5	.	.	.	.	.	.	.	.		.	.	.		.	.	.		.	.	.		.	.	.
2.	**MCS Pakistani-origin mothers (n=923)** [a, b]																							
1	923	-6,766	28	13,589	13,724				923	1.00	1.00	.												
2	923	-6,597	57	**13,307**	**13,583**	0.99	323.70	<0.001	714	0.93	0.73	4.75	209	0.88	0.27	21.32								
3	.	.	.	.	.	.	.	.		.	.	.		.	.	.		.	.	.				
4	.	.	.	.	.	.	.	.		.	.	.		.	.	.		.	.	.		.	.	.
5	.	.	.	.	.	.	.	.		.	.	.		.	.	.		.	.	.		.	.	.
3.	**BiB White British mothers (n=3,937)**																							
1	3,937	-46,524	30	93,107	93,296				3,937	1.00	1.00	.												
2	3,937	-45,510	44	91,107	91,384	0.85	1,949.51	<0.001	2,206	**0.85**	0.54	4.85	1,732	**0.86**	0.46	7.26								
3	3,937	-44,938	44	89,963	90,239	**0.88**	1,100.11	<0.001	2,286	0.84	0.54	4.65	1,360	0.84	0.36	9.65	292	0.85	0.10	**52.14**				
4	3,937	-44,756	44	89,600	89,876	0.86	348.92	<0.001	1,273	0.79	0.33	**7.62**	1,505	0.70	0.34	4.43	884	0.83	0.23	16.18	276	**0.85**	0.09	**55.38**
5	3,937	-44,674	44	**89,436**	**89,712**	0.86	158.15	<0.001	1,226	0.77	0.30	7.49	707	0.78	0.17	16.90	243	**0.86**	0.08	**65.59**	960	0.66	0.23	6.58
4.	**BiB Pakistani-origin mothers (n=4,351)** [c]																							
1	4,351	-45,240	29	90,538	90,723				4,351	1.00	1.00	.												
2	4,351	-44,330	31	88,721	88,919	**0.95**	1,751.25	<0.001	233	**0.89**	0.07	**97.08**	4,119	**0.97**	0.93	2.76								
3	4,351	-44,038	31	88,137	88,335	0.85	561.71	<0.001	1,754	0.79	0.41	5.37	233	0.87	0.07	**90.37**	2,365	**0.81**	0.52	4.03				
4	4,351	-43,973	30	88,007	88,198	0.84	123.64	<0.001	1,898	0.77	0.42	4.51	397	0.63	0.13	11.27	1,907	0.74	0.40	4.22	150	**0.85**	0.05	**118.70**
5	4,351	-43,858	31	**87,778**	**87,976**	0.84	221.88	<0.001	1,574	0.66	0.36	3.47	1,514	0.70	0.34	4.64	264	0.73	0.08	32.03	170	0.84	0.05	**105.56**

K: number of classes in latent class model. Obs: Observations. LL: Log likelihood. Df: Degrees of freedom. Lower Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values indicate better model fit; the lowest values for each sample highlighted in bold. Entropy (E) values approaching 1 indicate clear delineation of classes, entropy values less than 0.8 are highlighted in yellow, and highest entropy values highlighted in bold. Lo-Mendell-Rubin Likelihood Ratio Test (LMR LT) of k − 1 classes against k classes, where a significant result thereby indicates that the null hypothesis of k − 1 classes should be rejected in favour of at least k classes. Average Posterior Probability (AvePP) should be at least 0.7 for all classes and is highlighted in yellow where this is not the case, and highest AvePPs are highlighted in bold. Larger values of Odds of Correct Classification (OCC) indicate better assignment accuracy and an OCC greater than 5 for all classes is indicative that the model has high assignment accuracy; OCCs less than 5 are highlighted in yellow and highest OCCs shown in bold. Contender models highlighted in green. [a] MCS models not fully adjusted for complex survey design as survey setting does not permit goodness-of-fit statistics, ns are therefore unweighted. [b] Alcohol and smoking excluded due to small cell sizes. [c] Alcohol excluded due to small cell sizes.

Table S5: Response profile for three class model (Millennium Cohort Study White British/Irish mothers)

				1. White British/Irish mothers (n=15,423)		
				Class 1 (34%) 'Fast'?	**Class 2 (15%) 'Middle'?**	**Class 3 (51%) 'Slow'?**
Parenting				**Est. (95% CI)**	**Est. (95% CI)**	**Est. (95% CI)**
Breastfeeding initiation				**50.6% (47.4 - 53.7%)**	70.2% (63.6 - 76.0%)	*83.8% (80.5 - 86.6%)*
Breastfeeding duration (months)				**2.7 (2.2 - 3.2)**	4.6 (3.4 - 5.7)	*6.7 (6.3 - 7.1)*
All routine vaccinations given to child				**90.0% (88.8 - 91.0%)**	90.4% (88.2 - 92.2%)	*95.0% (94.1 - 95.7%)*
Reads with child						
Once or twice a week or less				**32.2% (29.5 - 35.0%)**	21.5% (16.6 - 27.4%)	*7.8% (6.1 - 10.0%)*
Several times a week				*20.8% (19.2 - 22.5%)*	18.6% (16.0 - 21.5%)	**17.1% (15.5 - 18.8%)**
Everyday				**47.0% (44.1 - 49.9%)**	59.9% (53.7 - 65.8%)	*75.1% (72.1 - 77.9%)*
Affectionate relationship with child				**92.4% (91.2 - 93.4%)**	93.6% (91.0 - 95.5%)	*98.1% (97.4 - 98.6%)*
Gestational length (weeks)				39.7 (39.5 - 39.8)	**37.4 (37.1 - 37.7)**	*39.9 (39.9 - 40.0)*
Birthweight (kgs)				3.4 (3.4 - 3.4)	**3.0 (2.9 - 3.1)**	*3.5 (3.5 - 3.6)*
Reproduction						
Age at cohabitation/marriage (years)	**Diverging destinies**			**20.2 (19.9 - 20.5)**	*28.7 (27.7 - 29.6)*	25.5 (24.9 - 26.1)
Age at first birth						
Under 20 years				**40.6% (36.0 - 45.3%)**	5.2% (2.8 - 9.5%)	*0.0% (0.0 - 0.0%)*
20-24 years				**48.4% (45.7 - 51.2%)**	4.6% (2.6 - 8.0%)	*0.5% (0.0 - 47.0%)*
25-29 years				**11.0% (6.9 - 17.0%)**	22.3% (16.6 - 29.3%)	*44.5% (38.8 - 50.5%)*
30-34 years			**Life history theory**	**0.0% (0.0 - 0.0%)**	32.3% (28.3 - 36.6%)	*44.1% (39.6 - 48.7%)*
35+ years				**0.0% (0.0 - 0.0%)**	*35.5% (26.8 - 45.3%)*	10.8% (7.0 - 16.4%)
Parity						
4+				9.6% (8.5 - 10.8%)	**11.9% (9.3 - 15.0%)**	*5.4% (4.6 - 6.3%)*
3				17.4% (16.1 - 18.8%)	**18.6% (16.1 - 21.3%)**	*16.8% (15.5 - 18.2%)*
2		**Weathering**		38.6% (36.7 - 40.5%)	**37.4% (33.2 - 41.8%)**	*54.7% (52.7 - 56.7%)*
1				*34.5% (32.6 - 36.3%)*	32.2% (28.7 - 35.9%)	**23.1% (21.4 - 24.8%)**
Living with child's father				**68.4% (65.0 - 71.7%)**	82.2% (77.5 - 86.2%)	*97.6% (96.4 - 98.4%)*
Health						
General health						
Poor				5.5% (4.7 - 6.5%)	**8.4% (6.3 - 11.2%)**	*1.7% (1.3 - 2.3%)*
Fair				25.3% (23.7 - 27.1%)	**27.5% (24.1 - 31.2%)**	*11.8% (10.4 - 13.3%)*
Good				54.7% (52.9 - 56.4%)	**49.8% (46.1 - 53.4%)**	*57.7% (56.0 - 59.4%)*
Excellent				14.5% (13.0 - 16.1%)	**14.3% (11.4 - 17.7%)**	*28.8% (27.0 - 30.6%)*
Healthy BMI				**39.2% (37.3 - 41.0%)**	42.5% (37.7 - 47.5%)	*54.1% (51.1 - 57.0%)*
Never regularly smoked				*80.6% (77.7 - 83.2%)*	**76.0% (71.8 - 79.8%)**	79.1% (77.2 - 80.8%)
Doesn't drink alcohol				11.0% (9.7 - 12.4%)	*11.1% (8.4 - 14.4%)*	**4.7% (3.8 - 5.8%)**

Est: Estimated probabilities (%) for categorical indicators and estimated means for continuous indicators; continuous indicators are those with units in brackets. "Fastest" and "slowest" values for each trait highlighted in bold and italicised for each sample, respectively. Estimates underlined where confidence intervals don't overlap with other classes in the same sample, indicating estimates are significantly different from one another.

Table S6: Response profiles for three class models (Born in Bradford mothers)

				3. White British mothers (n=3,937)			**4. Pakistani-origin mothers (n=4,351)**		
				Class 2 (36%) 'Fast'? Est. (95% CI)	**Class 3 (10%) 'Middle'? Est. (95% CI)**	**Class 1 (54%) 'Slow'? Est. (95% CI)**	**Class 3 (52%) 'Fast'? Est. (95% CI)**	**Class 2 (7%) 'Middle'? Est. (95% CI)**	**Class 1 (41%) 'Slow'? Est. (95% CI)**
Parenting	**Diverging destinies**		**Life history theory**						
Breastfeeding initiation				**19.3% (16.8 - 22.0%)**	38.0% (28.7 - 48.4%)	*56.8% (51.2 - 62.2%)*	*57.8% (55.4 - 60.3%)*	**50.2% (41.8 - 58.6%)**	56.6% (53.9 - 59.3%)
Breastfeeding duration (months)				**3.3 (2.0 - 4.6)**	5.3 (3.1 - 7.6)	*7.8 (6.8 - 8.8)*	*9.6 (8.9 - 10.4)*	8.1 (6.0 - 10.2)	**7.6 (6.7 - 8.6)**
All routine vaccinations given to child				*39.0% (33.0 - 45.3%)*	38.3% (29.4 - 48.0%)	**36.3% (32.1 - 40.7%)**	40.7% (35.7 - 45.9%)	**34.8% (22.0 - 50.1%)**	*43.0% (34.4 - 51.9%)*
Reads with child everyday				**95.0% (89.9 - 97.6%)**	*100.0% (100.0 - 100.0%)*	96.4% (93.6 - 98.0%)	79.4% (76.9 - 81.7%)	*80.0% (64.3 - 89.9%)*	**76.7% (68.6 - 83.2%)**
Takes child to activities									
Rarely				**58.5% (51.7 - 65.0%)**	33.7% (20.1 - 50.5%)	*23.7% (19.2 - 28.8%)*	**53.4% (51.0 - 55.8%)**	*47.3% (34.1 - 60.8%)*	49.5% (43.8 - 55.3%)
At least once a month				**21.6% (16.8 - 27.4%)**	*33.4% (21.2 - 48.3%)*	25.8% (22.4 - 29.5%)	*32.7% (29.2 - 36.4%)*	**31.3% (21.3 - 43.4%)**	32.0% (27.9 - 36.5%)
At least once a week				**19.9% (14.9 - 26.1%)**	33.0% (18.0 - 52.4%)	*50.6% (45.5 - 55.6%)*	**13.9% (11.1 - 17.3%)**	*21.4% (10.2 - 39.6%)*	18.5% (14.2 - 23.7%)
Affectionate relationship with child				**55.9% (46.4 - 65.1%)**	*81.5% (67.1 - 90.5%)*	74.9% (68.4 - 80.4%)	**61.7% (53.0 - 69.8%)**	*67.4% (52.7 - 79.3%)*	62.7% (54.5 - 70.2%)
Gestational length (weeks)				*39.8 (39.7 - 39.9)*	**36.1 (35.6 - 36.6)**	39.6 (39.5 - 39.6)	39.2 (39.2 - 39.3)	**35.5 (35.0 - 36.1)**	*39.5 (39.4 - 39.6)*
Birthweight (kgs)				3.3 (3.3 - 3.4)	**2.6 (2.5 - 2.7)**	*3.5 (3.5 - 3.5)*	*3.3 (3.3 - 3.3)*	**2.3 (2.2 - 2.4)**	3.1 (3.0 - 3.1)
Reproduction		**Weathering**							
Age at menarche (years)				13.0 (12.9 - 13.1)	*13.3 (13.0 - 13.7)*	**13.0 (12.9 - 13.1)**	**13.3 (13.2 - 13.5)**	*14.5 (14.1 - 14.9)*	13.4 (13.3 - 13.5)
Age at first birth (years)				**20.0 (19.8 - 20.2)**	25.6 (24.5 - 26.7)	*28.7 (27.9 - 29.5)*	*28.7 (27.7 - 29.7)*	25.1 (23.9 - 26.4)	**23.5 (23.2 - 23.9)**
Parity									
4+				6.8% (5.2 - 8.9%)	**9.1% (6.0 - 13.6%)**	*6.4% (4.5 - 9.0%)*	**35.4% (28.8 - 42.5%)**	17.0% (12.9 - 22.0%)	*2.2% (0.3 - 12.4%)*
3				11.1% (9.2 - 13.3%)	*10.1% (6.4 - 15.7%)*	**13.3% (11.2 - 15.7%)**	**26.3% (23.3 - 29.5%)**	15.0% (11.3 - 19.7%)	*12.2% (8.3 - 17.7%)*
2				21.9% (18.8 - 25.3%)	**21.5% (17.2 - 26.6%)**	*34.2% (31.8 - 36.7%)*	24.0% (20.8 - 27.4%)	**18.5% (13.2 - 25.2%)**	*24.6% (21.3 - 28.3%)*
1				*60.3% (56.3 - 64.1%)*	59.2% (51.6 - 66.4%)	**46.1% (42.7 - 49.5%)**	**14.4% (11.0 - 18.7%)**	49.5% (42.9 - 56.1%)	*61.0% (53.7 - 67.8%)*
Living with child's father				**38.4% (33.3 - 43.9%)**	65.4% (57.4 - 72.6%)	*93.0% (89.3 - 95.5%)*	*96.2% (94.0 - 97.7%)*	90.2% (83.5 - 94.4%)	**89.8% (88.0 - 91.3%)**
Health									
Good mental health				**68.9% (65.4 - 72.2%)**	70.7% (64.8 - 76.0%)	*76.7% (73.9 - 79.3%)*	65.7% (62.8 - 68.4%)	**65.4% (56.7 - 73.1%)**	*74.3% (70.0 - 78.2%)*
Healthy BMI				*48.7% (45.2 - 52.2%)*	43.4% (38.7 - 48.2%)	**35.7% (31.7 - 39.8%)**	**29.5% (24.5 - 35.2%)**	42.5% (35.2 - 50.2%)	*59.6% (55.9 - 63.2%)*
Never regularly smoked				**27.0% (23.5 - 30.7%)**	36.0% (28.2 - 44.6%)	*51.8% (48.0 - 55.5%)*	*93.5% (91.8 - 94.8%)*	**88.9% (83.8 - 92.5%)**	89.7% (87.0 - 91.9%)
Doesn't drink alcohol [a]				*35.8% (31.7 - 40.2%)*	32.4% (27.7 - 37.5%)	**27.7% (23.6 - 32.2%)**			

Est: Estimated probabilities (%) for categorical indicators and estimated means for continuous indicators; continuous indicators are those with units in brackets. "Fastest" and "slowest" values for each trait highlighted in bold and italicised for each sample, respectively. Estimates underlined where confidence intervals don't overlap with other classes in the same sample, indicating estimates are significantly different from one another. [a] Alcohol excluded form Pakistani-origin models due to small cell sizes.

Table S7: Summary of three class models

	1. MCS White British/Irish mothers			3. BiB White British mothers			4. BiB Pakistani-origin mothers		
	Class 1 = ‘Fast’?			**Class 2 = ‘Fast’?**			**Class 3 = ‘Fast’?**		
	Diverging Destinies	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**
Reproduction	✓ Earliest ages at cohabitation/marriage ✓ Most likely to have first birth at ≤24yrs and least likely to have first birth at ≥30yrs ✓ Least likely to be in a stable union			✓ Earliest ages at first birth ✓ Least likely to be in a stable union			✓ Most likely to have 3 or 4+ children and least likely to have just one child × Latest ages at first birth		
Parenting	✓ Least likely to initiate breastfeeding ✓ Shortest breastfeeding durations ✓ Most likely to read with child once or twice a week or less and least likely to read with child everyday × Middling gestations × Middling birthweights			✓ Least likely to initiate breastfeeding ✓ Most likely to take child to activities rarely and least likely to take child to activities at least once a week ✓ Least likely to have an affectionate relationship with child × Longest gestations × Middling birthweights			× Middling gestations × Heaviest birthweights		
Health		× No defining traits			× No defining traits		✓ Least likely to have a healthy BMI		
	Class 2 = ‘Middle’?			**Class 3 = ‘Middle’?**			**Class 2 = ‘Middle’?**		
	Diverging Destinies	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**
Reproduction	✓ Middling chances of having first birth at ≤24yrs and 30-34yrs ✓ Middling chances of being in a stable union × Most likely to have first birth at 35+yrs × Latest ages at cohabitation/marriage			✓ Middling ages at first birth ✓ Middling chances of being in a stable union			✓ Middling ages at first birth ✓ Middling chances of having 4+ children × Latest ages at menarche		
Parenting	✓ Middling chances of initiating breastfeeding ✓ Middling breastfeeding durations ✓ Middling chances of reading with child once or twice a week or less and everyday × Shortest gestations × Lowest birthweights			× Middling chances of initiating breastfeeding × Most likely to ready with child everyday × Shortest gestations × Lowest birthweights			× Shortest gestations × Lowest birthweights		
Health		× No defining traits			× No defining traits		× Middling chances of having a healthy BMI		
	Class 3 = ‘Slow’?			**Class 1 = ‘Slow’?**			**Class 1 = ‘Slow’?**		
	Diverging Destinies	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**	**Diverging Destinies**	**Life history theory**	**Weathering**
Reproduction	✓ Least likely to have first birth at ≤24yrs and most likely to have first birth at 30-34yrs ✓ Least likely to have 4+ children, most likely to have 2 children ✓ Most likely to be in a stable union × Least likely to have just one child × Middling ages at cohabitation/marriage × Middling chances of having first birth at 35+yrs × Middling chances of being in a stable union			✓ Latest ages at first birth ✓ Most likely to have 2 children ✓ Most likely to be in a stable union × Least likely to have just one child			✓ Least likely to have 4+ children × Earliest ages at first birth		
Parenting	✓ Most likely to initiate breastfeeding ✓ Longest breastfeeding durations ✓ Most likely to have fully vaccinated their child ✓ Least likely to read with child once or twice a week or less and most likely to read with child everyday			✓ Most likely to initiate breastfeeding ✓ Most likely to take child to activities at least once a week ✓ Highest birthweights ✓ Middling gestations			✓ Longest gestations × Middling birthweights		

	✓ Most likely to have affectionate relationship with child ✓ Longest gestations ✓ Highest birthweights							
Health		✗ Least likely to have poor or fair health and most likely to have excellent health ✗ Most likely to have a healthy BMI ✗ Least likely not to drink alcohol			✓ Most likely to have never regularly smoked		✓ Most likely to have a healthy BMI	

References for Supplementary material

Ng, W., 2019. Predictors of Class Membership with Latent Class Analysis [WWW Document]. Statalist - Stata Forum. URL https://www.statalist.org/forums/forum/general-stata-discussion/general/1490812-predictors-of-class-membership-with-latent-class-analysis (accessed 2.7.21).

Prady, S.L., Pickett, K.E., Croudace, T., Mason, D., Petherick, E.S., McEachan, R.R.C., Gilbody, S., Wright, J., 2015. Maternal psychological distress in primary care and association with child behavioural outcomes at age three. Eur. Child Adolesc. Psychiatry 25, 601–613. https://doi.org/10.1007/s00787-015-0777-2

StataCorp LLC, 2019. Stata Structural Equation Modeling Reference Manual, Version 16. ed. Stata Press, Texas.