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Who Delays Childbearing? The Associations Between Time to First Birth, Personality Traits and Education

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Abstract Using data from a large-scale survey, the British Household Panel Survey, this paper assesses the influence of personality traits on the timing of first childbirth and investigates whether, and in what way, personality traits explain the differences in maternity timing across educational groups. We estimate a log-logistic model of the time to first childbirth and show that there is a statistically significant relationship between the Big Five personality traits and the timing of motherhood. The results also show that highly qualified women who are 'open-minded' have the lowest hazards of childbirth, lower than similar less educated counterparts.

Keywords Reproductive behaviour · Fertility determinants · Delayed childbearing · Personality · Big Five · Educational status

1 Introduction

Entry into motherhood is one of the most important transitions in an individual's life course. More than higher-order births, it brings about substantial lifestyle changes and is irreversible (Hobcraft and Kiernan 1995). Understanding the determinants of this transition is in itself important and also has obvious demographic implications. This paper analyses the timing of entry into motherhood in Britain. Issues of timing are particularly relevant in the context of sub-replacement fertility rates which had

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become widespread by the end of the twentieth century. The trend towards postponing childbearing started in the USA among cohorts born in the late 1930s. England and Wales and the Netherlands then followed, as eventually did other European countries (Frejka and Sardon 2006). Whereas the postponement process ceased in the USA, the age at first birth in England and Wales has been rising continuously since the 1970s, reaching 28.5 in 2014 (Office for National Statistics 2015).

Delaying motherhood has two potentially adverse effects on fertility. First, it may result in involuntary childlessness given that the probability of a successful pregnancy decreases after the age of thirty (Leridon 2004). This might be one of the reasons for the sharp increase in childlessness in England and Wales (Billari 2006; Office for National Statistics 2013). Although a growing number of individuals choose not to have children, childlessness is mostly involuntary in that it often results from successive postponements (Hobcraft and Kiernan 1995; Testa and Toulemont 2006; Tanturri and Mencarini 2008). Second, it is associated with downward revision of childbearing intentions as other competing life objectives emerge (Morgan and Taylor 2006). The adverse effect of childbearing postponement on fertility is also hinted by recent evidence suggesting that the slowing down of childbearing postponement in some countries is indeed associated with a rise in the total fertility rate (Sobotka 2008). Postponement nonetheless remains a striking characteristic of birth rates in the developed world (Coleman 2007).

There is a large body of research on the determinants of fertility in both demography literature and that of other disciplines interested in the process of family formation (see Balbo et al. 2013 for a review). The determinants mentioned frequently refer to the context and, as such, are at least partly external to the individual. That is the case of socialisation (by family of origin, kin, peers) and partnership (partnership status and its quality, partner's fertility intentions) for example, not to mention economic and employment uncertainty or family policies. However, the fields of psychology and biodemography suggest that behaviour is guided by behavioural predispositions which, in turn, are explained by *both* sociological and biological/psychological determinants (Udry 1996).

Using Danish twin data, Rodgers et al. (2001) provide evidence of genetic influences on fertility outcomes such as completed fertility, and they seem to operate through fertility motivation. Hobcraft (2003) points out that genetically mediated pathways other than those related with genes responsible for fertility itself affect fertility behaviour. Personality is one of these genetically mediated pathways. On the one hand, the genetic contribution to individual differences in personality has been shown to be quite substantial (Jang et al. 1998; Plomin and Caspi 1999; Loehlin 2005). On the other hand, there is some, albeit scarce, evidence of an association between personality and fertility behaviour (e.g. Miller 1992 and Jokela et al. 2011).

This paper contributes to the literature by specifically studying the timing of first childbearing and by using an encompassing measure of personality rather than specific or ad-hoc personality traits. We conceptualise the heterogeneity in the time to first birth to be associated with individual differences, which we measure with the Big Five personality traits: extraversion, agreeableness, conscientiousness,

neuroticism and openness. These are the five main personality dimensions that are now consensually accepted as a general taxonomy of personality traits (John et al. 2008). The closest study to ours is that of Jokela et al. (2011), who use data from the USA to analyse the relationship between the Big Five and several reproductive outcomes but focus on the number of children and probability of entry into parenthood. Their study examines time at first childbearing among married couples only. This may introduce some bias given that some of the personality traits may be relevant to both childbearing and getting married.

Two reasons underpin the decision to focus specifically on the *first* childbirth. First, it is precisely because entry into motherhood is a special transition that the factors affecting the decision to become a parent are likely to be different from those affecting progression to higher parities. Second, fertility intentions change over time largely due to external factors, namely people's circumstances change or they acquire new information (Iacovou and Tavares 2011). Given the aim of studying the relationship between timing of childbearing and personality traits, a more 'internal type' of factor, we expect this relationship to be more relevant to the first childbirth.

In addition to studying the relationship between personality and time to first childbirth, we also explore the interplay between personality traits and education. Extending the analysis to why and how personality affects fertility is the paper's main contribution. Education plays a key role in determining fertility behaviour in developed societies, and the link between personality and education is therefore of particular interest. Education has been seen across the social sciences as one of the main 'culprits' of delayed motherhood for a number of reasons. First and foremost, there is a mechanical effect insofar as studying is seen as incompatible with childrearing and therefore individuals postpone childbearing at least until after having finished their studies (Bhrolcháin and Beaujouan 2012). This normative sequencing is well known and studied in research on life-course transitions (Blossfeld and Huinink 1991). However, this argument alone does not explain why some women postpone childbearing until well after they complete their education, nor does it explain higher ages at first birth among some less educated women.

Other arguments for the association between education and age at first birth are centred around the trade-off between the working career and motherhood (Rindfuss et al. 1996, Gustafsson and Kalwij 2006). In the economics literature, human capital plays a key role in arguments relating to the postponement of childbearing (Gustafsson 2001). It is argued that since caring for and raising children demand a substantial investment of time, the transition to motherhood entails two important opportunity costs: the current opportunity cost of the forgone wage during the period spent out of work, and the expected future cost associated with the forgone human capital accumulation due to the career interruption—the steeper the lifetime earnings profile and the earlier the work interruption occurs, the greater the cost (Cigno and Ermisch 1989). Indeed, several studies provide empirical evidence of the maternity penalty (Ellwood et al. 2004; Amuedo-Dorantes and Kimmel 2006; Correll et al. 2007; Miller 2010; Van Bavel 2010). More educated women are expected to have steeper earning profiles and therefore face higher opportunity costs. These higher perceived costs translate into lower childbearing motivation, and into childbirth postponement (Liefbroer 2005).

Thus, the aim of this paper is twofold: to contribute to the still limited literature on the relationship between personality and fertility behaviour, and to extend our understanding of that relationship by examining the potentially mediating and moderating role of education.

2 The Link Between Time to First Birth and Personality Traits

With the advent of the birth control pill, contraception became widespread and women gained much more effective control over their fertility. Consequently, the mismatch between childbearing intention and behaviour decreased. In conjunction with the shift in values of the 1960s, namely each individual's right to self-realisation (Van de Kaa 2004), this resulted in the attitude towards childbearing taking a more prominent role in the childbearing decision process. A similar argument is put forward by Hakim in her Preference theory: "in prosperous modern societies, preferences become a much more important determinant, maybe even the primary determinant, of women's behaviour'' (Hakim 2003 p. 361). To the extent that personality traits can be seen as antecedents of preferences and childbearing motivation, by looking at personality traits, we study the roots of the determinants of childbearing behaviour as suggested by Hobcraft (2006).

Personality traits differ from attitudes—a more familiar concept for demographers—in two important aspects. First, traits are antecedents of attitudes. McCrae and Costa (2008) define attitudes as manifestations of a combination of basic traits and external influences. According to their Five-Factor Theory, the Big Five personality traits capture basic tendencies which are regarded as biologically based dispositions. Whereas attitudes often change as events unfold, personality is more stable (Ajzen 2005). The genetic influence on personality is one of the main mechanisms of continuity over the life course. The empirical evidence of continuity throughout adulthood shows that personality is fairly stable. That is not to say that personality stops changing in adulthood, but that changes are small in magnitude (Caspi and Roberts 2001; Srivastava et al. 2003).

If attitude towards a behaviour is defined as the individual's own evaluation of performing that behaviour (Ajzen 1991, 2005), the relationship between personality traits and time to first birth can be seen as the differences in personality being associated with the diverse ways individuals weight all the childbearing costs and benefits involved, which then translate into behaviour. Demographers have long been interested in identifying which costs and rewards are important (Liefbroer 2005). Liefbroer (2005) finds that *perceived* costs in terms of career opportunities and individual autonomy are associated with the postponement of first childbirth, whereas a *perceived* increase in the sense of security is associated with an earlier transition to motherhood (for women). Personality is one of the possible antecedents of those perceptions.

While it is true that childbearing in societies with widespread modern contraception is frequently the outcome of a rational decision-making process—individuals assess the costs and benefits of childbearing and then decide whether or not, and when, to have a (another) child—this is not always the case. A non-

negligible percentage of births are known to result from unplanned pregnancies, either unwanted or mistimed. Personality might also be associated with unplanned childbearing, namely teenage childbearing. Many studies show that early childbearing is associated with risky behaviour which in turn is influenced by personality (see Cooper et al. 2003 and Boislard and Poulin 2011).

2.1 The Big Five: A Measure of Personality Traits

Before turning to a more detailed discussion of why and how personality traits may relate to entry into motherhood, it is important to define these traits and clarify how our measure compares with other personality measures. We use the Big Five personality traits as defined by the Five-factor model developed in Personality Psychology. This is a hierarchical model in which five main domains of personality—extraversion, agreeableness, conscientiousness, neuroticism and openness—are extracted from a larger set of more specific personality characteristics. Extraversion is mainly characterised by sociability. Extraverts tend to be sociable, talkative and assertive as opposed to reserved and quiet. Agreeableness relates to the willingness to help others, to be caring, gentle, co-operative, kind and affectionate, and the behaviour towards others is prosocial rather than antagonistic. Conscientiousness refers to the tendency to follow rules, to be reliable, well-organised, self-disciplined. Low scorers in this trait tend to be undependable, disorganised, lazy and negligent. Neuroticism summarises traits related to emotional stability. High scorers tend to be anxious, depressed and insecure. Openness to experience—also called autonomy—is associated with unconventionality and intellect. High scorers in openness tend to question conventions, be imaginative, creative, curious about the world, complex and broad-minded.

Personality can be measured at different hierarchical levels. The name Big Five was chosen to stress that that each of five dimensions is extremely extensive, comprising numerous personality characteristics (John et al. 2008). Thus, they may be used to describe major personality differences within the population. Although it is a good starting point to incorporate personality traits in demographic studies, it should be acknowledged that the predictive power of the Big Five may be weakened by its generality and therefore it cannot be expected to explain a big share of variation in the timing of first childbirth.

3 Theoretical Model

The model in Fig. 1 depicts the relationships explored in this paper. In addition to examining the direct association between personality and time to first birth (*a* in Fig. 1), we also address two other aspects involving the interplay with education in which personality and time to childbearing may be linked. First, as women may self-select into education based on personality traits that also influence time to first birth, personality may impinge upon the relationship between education and time to first birth (*b* in Fig. 1). Second, education may moderate the relationship between personality traits and timing of first childbirth (*c* in Fig. 1). Whereas in the first case

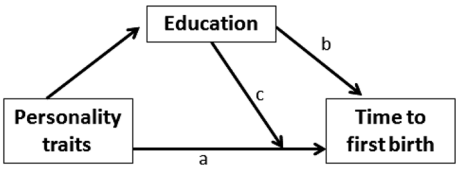

Fig. 1 The relationships between time to first birth, personality traits and education

personality would explain differences in the timing of first childbearing *across* educational groups, in the second it would have a differential impact *within* educational groups.

3.1 Hypotheses on the Relationship Between Personality Traits and Time to First Birth

As mentioned previously, extraversion relates to sociability and therefore an extrovert is expected to interact more with the opposite sex than an introvert. Evidence does show that there is a positive association between extraversion and the number of sex partners (Miller et al. 2004; John et al. 2008) and short-term mating (Schmitt and Shackelford 2008). Similarly, an individual who scores high on this trait is more likely to have (or have had) a larger pool of potential partners. Consequently, he or she is also more likely to be in a partnership—almost always a pre-condition for a planned birth. Indeed, Jokela et al. (2011) find that extraversion is positively associated with getting married, and early. Concerning specifically the relationship between personality traits and fertility, Miller (1992) finds that affiliation (a trait related to Extraversion) has a significant positive relationship with women's positive childbearing motivation. Jokela et al. (2011) show that high extraversion is associated with greater odds of becoming a parent and that among those who experience this transition, extroverts do it sooner rather than later. As we also include women who did not have children in the analysis, we expect extraversion to show a negative correlation with time to first birth due to its association both with childbearing motivation and the partnership status.

We hypothesise that agreeableness is negatively associated with delayed childbearing. As those on the high end of this personality trait are characterised by being caring and by experiencing empathy for others, it is reasonable to assume that they value the rewarding aspects of childbearing highly (Jokela et al. 2011). Consequently, they probably have a strong childbearing motivation. Miller (1992) provides evidence of this. On the other hand, low agreeableness is associated with early sexual debut, number of sex partners at age 20 and the use of alcohol or drugs before or during sex (Miller et al. 2004). Although all of these could result in early childbearing, the link is not confirmed by the findings of Miller et al. (2004) and, according to Jokela et al. (2011), the negative association between agreeableness and timing of motherhood seems to prevail.

One of the dimensions of conscientiousness is an individual's propensity to follow socially prescribed norms and rules (Roberts et al. 2005). In relation to childbearing, there is a well-known and studied normative sequencing in which childbearing comes after completing studies and finding a stable partner (Blossfeld

and Huinink 1991). The social norms against having children too early are therefore entwined with those urging individuals to complete their education. Striving for achievement is another dimension of conscientiousness, and given the well-known association between that trait and educational attainment, it is possible that the association between conscientiousness and timing of first childbearing is in great part explained by education. If there is evidence of such a relationship even after controlling for education, we expect it to be positive. The will to achieve might foster women's career attachment irrespective of their educational qualifications, leading them to postpone childbearing.

Neuroticism contrasts with emotional stability. Insofar as women think of children as a potential stabilising factor in their lives, more neurotic women might want to start a family as early as possible. Friedman et al. (1994) argue that having a child is a strategy to reduce the uncertainty of how life will unfold (though not economic uncertainty). A similar argument comes from evolutionary psychology. Johns et al. (2011) argue that early motherhood may be an adaptive response to risk and uncertainty. Still in the same line, other scholars have argued that some individuals may have a child in an attempt to boost self-esteem (Oates 1997). Having a first child gives women a role identity, that of a mother. On the other hand, high neuroticism could be associated with delayed motherhood as it is linked with unstable relationships (Kiernan 1986; Lundberg 2012). However, as Jokela et al. (2011) do not find a statistically significant association between neuroticism and either probability of marriage or age at first marriage, we expect a negative relationship between neuroticism and time to first birth.

As openness relates to independence and willingness to have different experiences, it is not surprising that this trait has been found to be associated with postponing marriage and not getting married (Jokela et al. 2011; Lundberg 2012). Jokela et al. (2011) also find high openness to be associated with the number of children, shorter reproductive lifespan, longer time between first marriage and parenthood, and longer inter-birth intervals. On the other hand, low openness is associated with early sex debut and unprotected sex and is strongly correlated with early childbearing (Miller et al. 2004). Miller (1992) finds that autonomy (a trait associated with openness) is negatively associated with childbearing motivation. Altogether, these findings suggest a positive relationship between openness and time to first birth.

3.2 Self-Selection Into Education

While the positive relationship between education and postponement of fertility is indisputable, its nature is far less clear. As argued by Billari and Philipov (2001), it may be spurious. For example, cognitive ability, which is known to be associated with education, might also be related to the timing of childbearing (Retherford and Sewell 1989; Shearer et al. 2002). Career orientation is another example. As more career-oriented women strive to obtain more education, if this characteristic also leads them to delay childbearing, then education would be endogenous. The comprehensive review by Phillips and Imhoff (1997) of the empirical psychological literature on women's career development conveys precisely the idea that women's

decisions about career and family are very intertwined and that they are shaped quite early in their lives. The findings of Rodgers et al. (2008), who use a behaviour genetic model, suggest that differences in education (and cognitive ability) among sisters in the same family are not causally related to differences in age at the birth of their first child.

The aforementioned studies suggest that selection is an important mechanism underlying the association between education and the timing of first childbearing. Several individual characteristics might be relevant in the process of self-selection into education. Personality traits are a 'natural candidate', and they have been referred as possible unobserved confounders (e.g. Van Bavel 2010). Pursuing this idea, we investigate whether some personality traits play a role in the potentially spurious relationship between education and the timing of motherhood. To this effect, we will see how the estimated coefficient of the educational variables changes when personality traits are included in the model.

Which personality traits are likely to be relevant in self-selection into education? Conscientiousness is undoubtedly the strongest personality predictor of academic performance (Chamorro-Premuzic 2006), which implies that this trait might be linked to self-selection into education. The same applies to openness which has also been shown to be associated, to a lesser extent, with educational attainment (Chamorro-Premuzic 2006).

3.3 Education as a Moderator Variable

There is some evidence to suggest that the inter-individual variation in the timing of motherhood is higher among the more educated group. When looking at first birth rates of women after the age of 30, Martin (2000) finds that from the 1970s to the 1990s, first births decreased before the age of 30 for all women but increased after this age only for women with a four-year college degree. Here, we explore the hypothesis that women with higher qualifications may be more heterogeneous than their less educated counterparts in terms of the timing of first childbearing because the additional education fosters a freer expression of their basic traits. Note that unlike the selection mechanism, this hypothesis is based on the idea that the education groups might actually be fairly similar, both trait-wise and in terms of their childbearing intentions, with the observed gap in time of first childbirth arising from the *realisation* of these intentions.

According to the biosocial models literature, social forces control the *expression* of biological factors in behaviour. Hence, the more choices individuals are allowed, the more the variance in their behaviour is controlled by biological forces (Udry 1996). Kohler et al. (1999, 2002) document moderate effects of shared family environment and low genetic effects, except for the cohorts experiencing the demographic transitions. They interpret their findings as suggesting that the weakening of social norms regarding childbearing over time—one of the tenets of the Second Demographic Transition (SDT)—permitted genetically mediated differences to be expressed as observed fertility outcomes.

While this might be true for the whole population—and we do expect to find an association between personality traits and time to first birth for all educational

groups—it is reasonable to suppose that this process of weakening of the social norms associated with the SDT did not occur uniformly across the population but was particularly strong within the more educated segment of the population (and probably still is). This view is consistent with the biosocial models. An implication of the general principle that social forces control the expression of biological predispositions is that, in complex societies, biological forces will exert more influence on the parts of the population that are least constrained by social forces and have the most opportunity to exercise individual choice (Udry 1996). One may think of more educated women as belonging to this part of the population—a hypothesis that Udry himself set forth but did not test. Here, we investigate whether differences in personality *manifest* themselves strongly in the fertility timing of more educated women by testing whether the association between personality traits and time to first childbirth is stronger for women with higher qualifications.

4 Data and Methods

The analysis makes use of the first 18 waves of the British Household Panel Survey (BHPS). The BHPS has been conducted annually since 1991 on a nationally representative sample of more than 5000 households. Given that BHPS is household-based, each year every adult (16 years old or more) within each sample household is interviewed. A consolidated marital, cohabitation and fertility file containing the retrospective lifetime histories and subsequent panel data relating to respondents' partnerships and childbearing provides the fertility history of BHPS respondents (Pronzato 2010).

In 2005, the BHPS introduced questions on personality traits for the first time. Given that these variables are essential for the analysis, the sample includes only the women who 'survived' as BHPS respondents up until the last wave, and for whom these variables are not missing. The same applies to educational qualifications and the variables concerning family background. Finally, only women under the age of 80 years at the time of the last interview were included in the sample. Older women were excluded to minimise potential recall errors. The final sample consists of 5754 women.

In the analysis which follows, education is a categorical variable for the highest educational qualification ever obtained. The three categories are: below A-levels, A-levels and above A-levels, where A-levels is an abbreviation of the British 'Advanced-level' qualifications. Taken at secondary school in the 2 years following the end of compulsory education (usually when students are 17 or 18 years old), these examinations are a primary screening device for university entrance, as well as being important signals for the labour market. Above A-levels correspond to higher qualifications (higher or first degree, teaching or other higher qualifications). Using the highest educational qualifications ever obtained as a measure of education, instead of the qualifications obtained before childbearing, minimises the possibility of education being curtailed by childbearing, in which case we could have a problem of reverse causality.

More than three quarters of the women in the sample (76 %) had given birth (Table 1). Among these mothers, the mean age at first birth is 25.3 years old. As expected, women with higher qualifications have their first child later—there is more than a two-year gap between women with higher qualifications and those with the lowest level of education (26.7 vs. 24.1). The distribution of age at motherhood for the women with the lowest level of qualifications is fairly concentrated at young ages, whereas the distribution for the women with the highest qualifications is more dispersed (Fig. 2).

Table 1 Descriptive statistics

	Had a child	Childless	Total
	76.3	23.7	
Education			
Below A-levels	44.4	26.7	40.2
A-levels	11.7	15.6	12.6
Above A-levels	43.9	57.6	47.2
Intact family			
Yes	82.4	78.9	81.6
Sibs			
0	9.3	9.5	9.3
1	28.2	38.8	30.7
2	24.4	25.8	24.8
3 or more	38.1	25.9	35.2
Mother's qualifications			
No qualifications	60.8	36.9	55.1
Some qualifications	21.3	30.6	23.5
Post-compulsory or higher education	18.0	32.5	21.4
Area lived in childhood			
Suburbs	20.8	25.5	21.9
Inner city area	10.7	7.6	10.0
Village, town, rural, countryside, moved around	68.5	66.9	68.1
Birth cohorts			
Born before 1960	53.1	28.0	47.2
Cohort 1960–1970	27.9	15.4	24.9
Cohort 1971–1990	19.0	56.7	27.9
Age at last interview			
Min	18	18	18
25th percentile	40	25	36
Median	50	34	47
75th percentile	62	50	60
Max	79	79	79

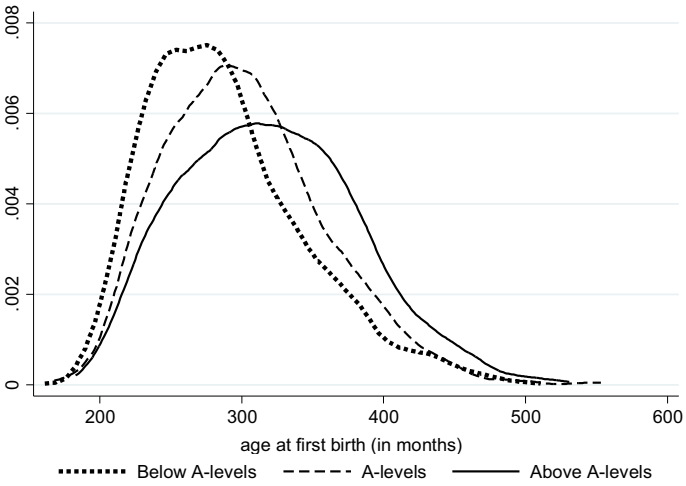

Fig. 2 Distribution of age at first birth by educational group

Consequently, the standard deviation of age at motherhood is larger for the group with higher qualifications (61.94 vs. 56.23 and 55.89 for the A-level and below A-level groups, respectively), and Levene's robust test statistic for the equality of variances between the two groups rejects the null hypothesis that the variances are equal. We used this test statistic instead of the traditional F-test because this variable is not normally distributed and Levene's test statistic is robust under non-normality. Therefore, similar to other studies, we also find evidence of greater variability in timing of the first childbirth among more educated women.

The data show very clearly that childlessness is particularly prevalent in the more educated group. Whereas the percentage of mothers in the lowest and highest education levels is almost identical, almost 60 % of the childless women have higher qualifications (Table 1). It is also interesting to note that half of the childless women are younger than 34 years old and only one quarter are older than 50. Therefore, the women who are really likely to remain childless represent about 6 % of the sample. Thus, we can assume that although childlessness is on the rise, the probability of it occurring is quite low. Hence, it is reasonable to assume a non-defective distribution such as the log-logistic.

4.1 The Big Five in the BHPS

Several personality questionnaires are designed to measure the Big Five traits, each of which has been thoroughly tested and their validity well established (John et al. 2008). In surveys where the participants' time is at a premium, an instrument like the short Big Five Inventory (BFI-S) is an efficient solution. The BFI-S is composed of fifteen questions—each rating on a 7-point scale ranging from 1 ('Does not apply to me at all') to 7 ('Applies to me perfectly')—three on each of the five personality domains: "I see myself as someone who…" 'Is talkative', 'Is outgoing, sociable', 'Is reserved' (Extraversion); 'Is sometimes rude to others', 'Has a forgiving nature',

'Is considerate and kind to almost everyone' (Agreeableness); 'Does a thorough job', 'Tends to be lazy', 'Does things efficiently' (Conscientiousness); 'Worries a lot', 'Gets nervous easily', 'Is relaxed, handles stress well' (Neuroticism); 'Is original, comes up with new ideas', 'Values artistic, aesthetic experiences', 'Has an active imagination' (openness). Each personality scale was constructed using only the observations for which none of the three answers is missing. The internal consistency of the personality trait scales[1] obtained from the personality traits questionnaire is acceptable, particularly for the neuroticism and openness scales for which the Cronbach's alpha is around 0.67.

The distribution of conscientiousness for the higher educational level is more skewed to the right than for the other educational levels (Fig. 4 in the "Appendix"), reflecting the well-known association between this trait and educational attainment. As for openness, the distributions are similar for the three educational levels, but the distribution of the higher educational level is shifted to the right (Fig. 5 in the "Appendix"). The distributions of the other three personality traits differ very little between educational levels, indicating that any evidence of self-selection into education would be found through the other two personality traits.

A last remark about the personality scales relates to when the personality traits were measured. Ideally, personality traits should be measured before the event of interest, childbirth. That is not the case here, and given that personality is not absolutely fixed throughout adulthood, we cannot entirely dismiss the possibility of some reverse causality. However, this is not likely to be a serious problem as personality traits are fundamentally stable. Another implication of having personality traits measured after childbirth—when women are older—is a potential measurement error. If we had measured them before childbirth, the values might have been different. This might create statistical biases in the estimates. In order to find out the extent of these potential biases, we ran the regressions using age-adjusted personality traits—a procedure adopted by Nyhus and Pons (2005), Heineck and Anger (2008) and Stormer and Fahr (2010) to get around similar problems—but the results remained essentially unchanged.

4.2 The Statistical Model

Since our aim is to explain time to first birth, we use a duration model. Unlike the linear or logistic models, this kind of model not only takes into account whether or not the event (childbirth) occurred, but also when it occurred, by using time as the dependent variable. Thus, it is necessary to establish when to start the clock. The most natural "time origin'' is the moment when individuals become at risk of experiencing the event. In the case of childbirth, a plausible onset of risk is the age at menarche. As the BHPS does not have information on the women's menarcheal age, we set it to 13 years old.[2] The duration time ends with whichever of the

[1] 0.5384, 0.5275, 0.5138, 0.676 and 0.6731 for Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness, respectively.

[2] According to Creighton (2005) the onset of puberty in girls occurs between the ages of 8 and 13.5 years, and Thomas et al. (2001) propose 13.3 years old as the mean age at menarche in Britain.

following event occurs first: the first child is born, the end of the study (these are the right-censored cases) or the 50th birthday, by assumption the age at menopause.[3] The survival times used here are measured in months, and we choose a continuous specification. We use a log-logistic regression model which, in its linearised form, can be written as

$$\ln(T) = \beta' X + \varepsilon \tag{1}$$

where T is the survival time and ε follows a logistic distribution.

The logistic distribution can have a non-monotonic hazard function and therefore can accommodate the hazard suggested by the literature and by the shape of the Kaplan–Meier estimate of the empirical hazard. The model specification was based on several tests, and the choice of the log-logistic, in particular, was determined by the Akaike information criterion.[4] The log-logistic model is estimated by Maximum Likelihood. The whole sample likelihood function is given by

$$L = \prod_{i=1}^{N} \left[f\left(T_i, X\right)\right]^{c_i} \left[S\left(T_i, X\right)\right]^{1-c_i} \tag{2}$$

where c is a censoring indicator denoted 0 if the observed duration is censored and 1 if it is not.

Giving that the hazard function $h(T,X)$ for the log-logistic model is[5]

$$h(T,X) = \frac{\varphi^{\frac{1}{\gamma}} t^{\left(\frac{1}{\gamma}-1\right)}}{\gamma\left[1 + (\varphi t)^{\frac{1}{\gamma}}\right]} \tag{3}$$

where $\varphi \equiv \exp(-\beta' X) > 0$ is a scale factor and γ is a shape parameter, and the survivor function $S(T,X)$

$$S(T,X) = \frac{1}{1 + (\varphi t)^{\frac{1}{\gamma}}} \tag{4}$$

taking also into consideration that $f(T,X) = h(T,X) \times S(T,X)$, we can substitute in (2) and re-write it as

$$L = \prod_{i=1}^{N} \left[\frac{\frac{1}{\gamma}\varphi^{\frac{1}{\gamma}} t^{\left(\frac{1}{\gamma}-1\right)}}{\left[1 + (\varphi t)^{\frac{1}{\gamma}}\right]^2}\right]^{c_i} \left[\frac{1}{1 + (\varphi t)^{\frac{1}{\gamma}}}\right]^{1-c_i} \tag{5}$$

[3] Based on data on age at menopause obtained for 67 and 26 countries, Thomas et al. (2001) calculated the mean age of menopause to be 49.24 years (SD ± 1.73). (obs: their study has no specific data for Britain).

[4] The comparison of the Akaike information criterion of the log-normal with the Akaike information criterion of the log-logistic showed that the latter was lower (10128.05 vs. 10272.03), which makes the log-logistic the preferred model. The choice of a parametric model over a nonparametric one was due to the fact that the shape of hazard of having a first child is known. In this case, the use of a parametric model is justified on efficiency grounds.

[5] From Jenkins (2005).

In the full model, the vector of time-invariant covariates, X, includes the standardised personality traits,[6] education (A-levels and above A-levels, below A-levels is the reference category), dummy variables indicating the woman's birth cohort, and family background variables such as mother's education (some qualifications and post-compulsory or higher education; no qualifications is the reference category), number of siblings, a dummy variable indicating whether the woman lived with both parents up to the age of 16, and the area in which she lived during childhood (inner city, suburbs or rural area). In order to investigate whether the association between personality traits and timing of childbearing is stronger for women with higher qualifications, we also estimated Eq. (1) including interaction terms between the educational levels and each of the personality traits.

5 Results

Table 2 reports the maximum likelihood estimates of our model of time to first childbirth. The first column shows the estimated coefficients of the personality traits when no other covariates are included. All the personality traits are statistically significant except conscientiousness. Whereas higher levels of agreeableness, extraversion and neuroticism accelerate childbearing, higher levels of openness prolong time to motherhood. Openness is the most influential trait. One standard deviation increase in openness is associated with a 10.8 % increase in timing of first childbearing,[7] or 18 months. The lack of association between conscientiousness and time to first childbirth, also found by Jokela et al. (2011), may be due to the fact that the traditionality dimension of conscientiousness—that could otherwise be relevant to avoiding an early pregnancy—is likely to be correlated with openness (Roberts et al. 2005).

Model 2 includes the education variables only. As expected, education shows a strong positive association with time to first birth. Women with A-levels have their first child 18.3 % later, i.e. 25.6 months later, than those without these qualifications. For women with higher qualifications, the delay is substantially bigger as first childbearing happens 37.8 % later, i.e. 52.3 months later. In models 3 and 4, the family background variables and the dummy variables for birth cohort are added to the list of covariates in models 1 and 2, respectively. Not surprisingly, when all family background variables and cohort dummy variables are added, the association between education qualifications and timing of first birth weakens considerably. Having A-levels and higher qualifications is now associated with having the first child 17.2 months later and 37.2 months later, respectively. The coefficients on personality traits also change, but not nearly as much.

Finally, model 5 includes all independent variables. All the estimated personality trait coefficients, which were statistically significant in model 3, remain statistically

[6] The scales were standardised for the sample used in the estimations so that the mean is zero and the standard deviation is one.

[7] This results from calculating the so-called time ratio, i.e. $\exp(0.103) = 1.108$, which can also be interpreted as the factor by which the expected time-to-failure is multiplied for by every unit increase in the independent variable (Cleves et al. 2008).

Table 2 Maximum likelihood estimates from the log-logistic model of time to first childbirth

	(1)	(2)	(3)	(4)	(5)
Agreeableness	−0.067***		−0.051***		−0.044***
	(0.009)		(0.009)		(0.009)
Conscientiousness	0.017		0.016		0.012
	(0.009)		(0.009)		(0.009)
Extroversion	−0.032***		−0.044***		−0.043***
	(0.009)		(0.009)		(0.008)
Neuroticism	−0.025**		−0.024**		−0.021*
	(0.008)		(0.008)		(0.008)
Openness	0.103***		0.075***		0.056***
	(0.009)		(0.009)		(0.009)
Education[a]					
A-levels		0.168***		0.113***	0.099***
		(0.026)		(0.026)	(0.026)
Above A-levels		0.317***		0.229***	0.202***
		(0.017)		(0.018)	(0.019)
Family background and birth cohort	No	No	Yes	Yes	Yes
Constant	5.117***	4.944***	5.072***	4.974***	4.983***
	(0.008)	(0.012)	(0.029)	(0.030)	(0.030)
ln gam constant	−1.050***	−1.068***	−1.081***	−1.087***	−1.096***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Observations	5754	5754	5754	5754	5754

Family background includes: intact family, sibs, mother's education, dummies for area lived in childhood

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] Reference category = below A-levels

significant. In terms of the changes in the size of the coefficients, openness shows the biggest proportional change, followed by conscientiousness, which shows that these two traits are positively correlated with educational attainment, as expected. However, only openness has an influence on timing of first birth above and beyond its influence via educational qualifications. At the same time, the coefficients of A-levels and above A-levels decrease when compared to the model where the personality traits were not included (mod. 4), suggesting that part of the association between education and time to first childbirth is due to personality. In this model 5, women with A-levels have their first child 15.2 months later than those without A-levels and having higher qualifications lengthens time to childbearing by 32.7 months. The estimated median survival time is 167.79 months, which means that the estimated median age at first birth is about 27 years. One standard deviation increase in agreeableness, extraversion and neuroticism accelerates childbearing by 6.4, 6.1 and 3.1 months, respectively, whereas the same increase in openness lengthens time to motherhood by 8.3 months.

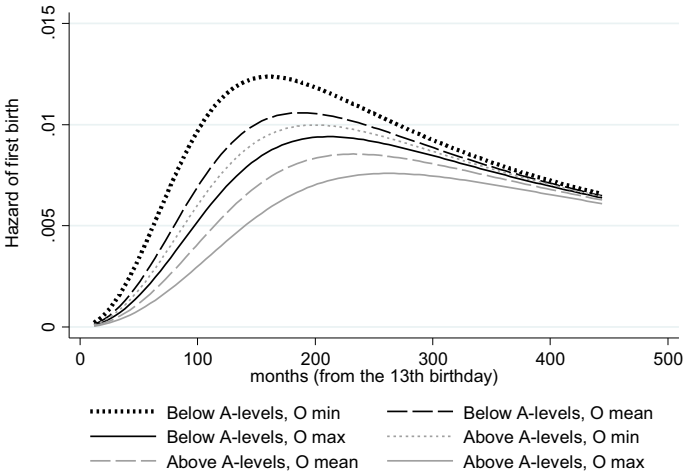

Fig. 3 Estimated hazard of first birth by education and level of openness

By specifying the distribution of survival time, we are implicitly specifying the hazard function. Therefore, we can estimate the hazard function and obtain an approximation to the probability of having remained childless exactly t months conditional on having remained childless until then. Figure 3 shows estimated hazards calculated using different values for the most influential variables in time to first child birth, education and openness (education: below A-levels and above A-levels; openness: minimum, mean and maximum values), while all the other covariates are set at their mean or reference category.

As well as showing that women with higher qualifications delay childbirth longer than women with the lowest qualifications, this figure reveals interesting differences in the childbearing hazard by level of openness within each educational group. It also shows that women with the lowest qualifications who score highly on openness have a lower childbirth hazard than women with higher qualifications who score low on that trait, even though this result might be partly driven by the assumption that the coefficients are the same for the two groups.

5.1 Interaction Between Education and Personality Traits

The first column in the top panel of Table 3 shows estimates of a model identical to the full model (model 5) except that we interact the education variables with each of the personality traits. The second and third columns show the interactions. The bottom panel shows the coefficients of personality traits for the different educational levels for which the interaction terms are statistically significant.

The first interesting point to note is that the coefficients on conscientiousness and neuroticism are significant for the least educated group, but not for the more educated groups. The explanation for conscientiousness not being significant within the more educated groups might be self-selection into education in terms of that trait. Within the least educated group, being more conscientious may still make a

Table 3 Estimates of the personality traits and their interaction effects with education

		Interaction with A-levels	Interaction with Above A-levels
Agreeableness (A)	−0.041**	0.064*	−0.032
	(0.013)	(0.027)	(0.019)
Conscientiousness (C)	0.039**	−0.030	−0.063***
	(0.013)	(0.028)	(0.019)
Extroversion (E)	−0.043***	−0.008	0.006
	(0.012)	(0.027)	(0.018)
Neuroticism (N)	−0.041***	0.010	0.043*
	(0.012)	(0.025)	(0.017)
Openness (O)	0.034**	0.017	0.044*
	(0.013)	(0.028)	(0.019)
A + A × A-levels		0.023	
		0.024	
C + C × above A-levels			−0.024
			0.014
N + N × above A-levels			0.002
			0.012
O + O × above A-levels			0.078***
			0.014

Other variables included: A-levels, Above A-levels, intact family, sibs, mother's education, dummy variables for area lived in childhood and birth cohorts

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

difference because it offsets the likelihood of an early pregnancy—either because the will to achieve translates into career attachment irrespective of educational qualifications or because a more traditional tendency precludes an eventual early pregnancy. Interestingly, the results for neuroticism are qualitatively similar even though the three groups are similar with respect to this trait—i.e. there is no self-selection into education on the basis of this trait. Here, we can only speculate. Maybe for some emotionally unstable young women without A-levels having a child early gives them a goal in life; in contrast, a better educated woman (or one considering pursuing her studies) with similar emotional instability might not give this option consideration—neuroticism would be neutralised for the more educated groups. A similar reasoning applies to how these women would deal with an unplanned pregnancy.

As for agreeableness and extraversion, the strength of their association with the timing of childbearing is the same for all educational groups. In contrast, the association between openness and time to first child birth is stronger for the more educated group. Whereas for the least educated one standard deviation increase in openness delays first childbirth by 5 months, the delay for the more educated group is approximately one year (11.8 months).

6 Summary and Discussion

This paper started by exploring whether personality traits are associated with the timing of first childbirth. Based on a multidisciplinary framework, we argued that there are good reasons to expect such a relationship. We conceptualised part of the heterogeneity in timing of first childbirth as a reflection of individual differences, which we measured with the Big Five personality traits: extraversion, agreeableness, conscientiousness, neuroticism and openness. Using data from a large-scale survey, the British Household Panel Survey, as expected we found that high agreeableness, extraversion and neuroticism accelerate childbirth, whereas high openness is associated with postponing childbirth. Of these four personality traits, openness shows the strongest association with time to first childbirth. The latter is in line with the results of Jokela et al. (2011) who also found openness to be the most influential personality trait of the Big Five in terms of reproductive behaviour.

Even though more research would be needed to establish that high openness delays childbearing, this relationship is theoretically reasonable. The link between openness and time to first birth is consistent with both the theory of planned behaviour (Ajzen 1991) and the theory of the value of children (Friedman et al. 1994). According to the former, childbearing intentions (and ultimately behaviour) can be understood as depending on attitude towards childbearing as well on perceived social pressure, and both these determinants may be influenced by openness. As people who score high on openness are characterised by having wide interests, they are more likely to face competing interests and less likely to be exclusively family-oriented. Consequently, they might value their careers more and face higher psychological childbearing costs. This may result in a less positive evaluation of the childbearing consequences (i.e. in a less positive attitude towards childbearing) and, therefore, in fertility postponement (Liefbroer 2005). On the other hand, since more 'open-minded' people are more autonomous in terms of their values, i.e. they are ready to question conventions, tend to undertake actions based on their own beliefs (Van der Zee et al. 2002) and believe that it is good to think for oneself (Langston and Sykes 1997), they might be less permeable to the social pressure to have children. It is noteworthy that, at the individual level, this mirrors the Second Demographic Transition argument of ideational change at the society level—according to which the weakening of the social norms, associated with the right to self-realisation and the rise in individualism—played an important role in the fertility postponement observed at the aggregate level.

The theory of the value of children (Friedman et al. 1994) posits that all individuals want to minimise uncertainty and that there are three main strategies to achieve this: children, marriage and stable careers. Assuming that less 'open-minded' women are more family-oriented and therefore may have less stable careers, this theory would predict these women to feel a stronger urge for motherhood than more 'open-minded' women, for whom being a mother might be a smaller part of their identity.

We showed that personality traits help explain the timing of first birth as well as its education gradient. The differences in maternity timing across educational levels

may be due to personality. Our results suggest that conscientiousness and openness are indeed relevant to self-selection into education and that the association between personality traits (particularly openness) and time to first childbirth is in part mediated by education. In other words, part of the relationship between education and time to first childbirth is due to personality. However, conscientiousness does not help explain the difference in age at first birth between educational groups as it does not show a statistically significant relationship with timing of motherhood.

We also explored whether personality would explain differences in timing of first childbearing within educational groups by looking at the interaction between personality and education. The underlying idea was that variations in timing of first childbearing may result not only from differences in personality between women with distinct educational levels but also from differences between groups in the strength of the association with personality. In this respect, it is interesting to note that when speaking about a concept related to individual differences, Hakim (2003) also points out that preferences about the balance between work and family cut across educational groups. At the same time, there is evidence to suggest that inter-individual variation in timing of motherhood is higher among the more educated group (Martin 2000), and we also find evidence of this in our data. More heterogeneity in age at first birth among more educated women simply means that we find very different behaviours within this group, and more so than within the other groups. More specifically, some women have their children early and others quite late. For personality to play a part in the explanation of the *average* timing gap between this more educated group and the other two groups, it must be the case that the *average* age at motherhood among more educated women is being pushed up by a particular type of more educated women who are drastically postponing childbirth. This is what we found, as highly qualified women who are 'open-minded' (and also less extrovert and less agreeable) are more likely to postpone childbirth, and this likelihood is greater than for similar less educated counterparts.

However, overall the results provided limited evidence for the hypothesis that differences in personality manifest themselves more in the fertility timing of women with a higher level of education. If it is true that the association between openness and time to first childbirth is stronger for women with higher qualifications (for the least educated, one standard deviation increase in openness delays first childbirth by 5 months, whereas the delay for the more educated group is approximately one year)—and this is the personality trait for which the association is strongest—the same is not observed for the other four personality traits. On the contrary, the neuroticism trait helps explain the timing of motherhood for the less educated women but not for the more educated group. Regarding this trait, education seems to work as a restraint. These results could be an indication that postponing childbearing is not necessarily the opposite of early childbearing as different factors might be at play in these two situations.

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Appendix

See Figs. 4 and 5.

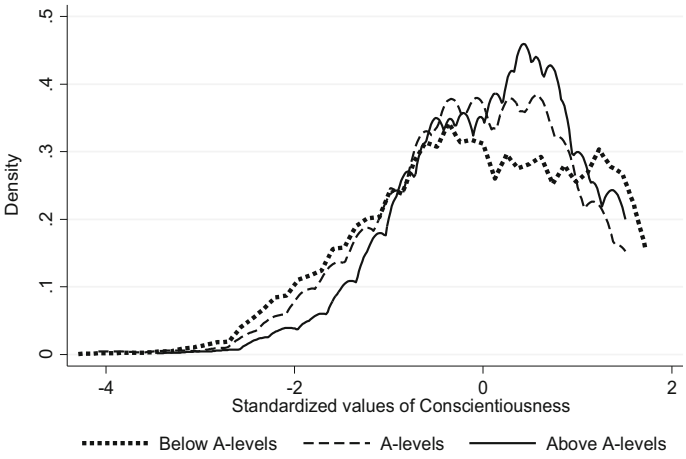

Fig. 4 Distribution of Conscientiousness

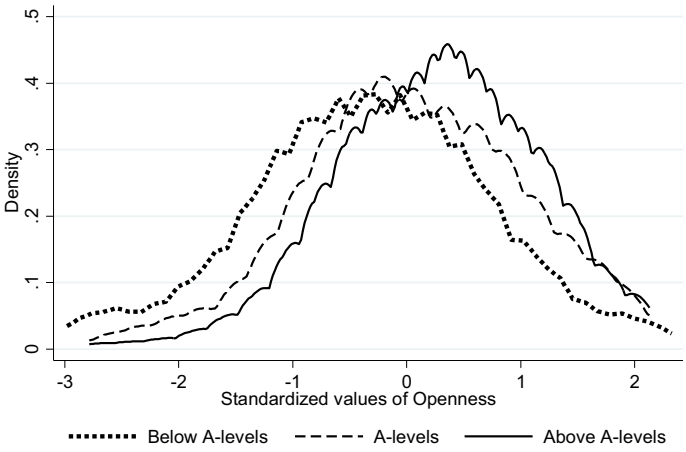

Fig. 5 Distribution of Openness

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