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Compatibility in personalities and non-cognitive skills, problem gambling and relationship dissolution in Australia

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Abstract

Relationship dissolution affects wellbeing, particularly that of children. We jointly model the duration of relationships and time to birth of children for 10,827 partnered women over twenty years in Australia, focusing on personality, non-cognitive skills and the risk of problem gambling. We apply Simulated Maximum Likelihood to a bi-variate duration model incorporating non-parametric duration dependence, time-varying covariates, unobserved heterogeneity and correlation between outcomes. Less agreeable, less conscientious or more emotionally unstable individuals have relationships which last less long than others. External locus of control, partner mismatch and problem gambling all contribute to shorter relationships.

Keywords: relationship dissolution; assortative mating; problem gambling; joint duration models; personality; locus of control.
JEL codes: C14, J12, J24

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1 Introduction

Although the nature of marital relationships has evolved and individuals are increasingly single by choice, domestic marriage-like partnerships maintain a central role in most societies. The dissolution of these 'marital'[1] relationships affects the wellbeing of individuals and has profound implications for children.

In this paper, we study the impacts on marital dissolution of two important determinants of lasting (or otherwise) relationships: (1) spouses' compatibility in personality and non-cognitive skills, and (2) the risks imposed by problem gambling. We introduce these factors in a duration model of relationship continuation.

Our paper makes an important methodological contribution. Rather than simply examine the effect of personality and problem gambling on relationship duration, we estimate a joint duration model of relationship duration and time to the birth of a child, including first children and subsequent children. Given that children impact upon relationship duration and given that more stable relationships are more likely to produce children, it is important to model these processes jointly. Importantly, we allow the unobservable determinants of the two duration processes to be correlated. Our model builds on work by Lillard (1993).

Estimation of the joint duration model via Simulated Maximum Likelihood allows for the inclusion of non-parametric duration dependence in the two outcomes, time-varying covariates, endogenous and time-varying children effects and unobserved heterogeneity. Our paper is the first to address the question of relationship duration using this approach to account for the presence and arrival of children.

Our second contribution is to examine the impact of characteristics of both members of the couple and differences in those characteristics. While we include a broad range of socio-economic and demographic characteristics, our main focus is on three things: personality traits, non-cognitive skills (Locus of Control) and the risk of problem gambling.

We show that partners' compatibility in personality, non-cognitive skills, education and linguistic background play an important role in partnership duration. In general, we find that skills, personality traits, and characteristics that indicate better capabilities associate with more stable marriage relationships. Marriages in which partners have more compatible personality and skills are more stable. The findings are mostly consistent with positive assortative mating. The results are consistent with consumption complementarity explanations but may also be explained by lower relationship management costs.

As explained below, we include the estimated risk of problem gambling as an explanatory variable. While we estimate this risk separately for males and females, there is a strong correlation in the expected probability of engaging in problem gambling within couples. Problem gambling propensity has a negative impact on relationship duration with a much larger impact for women than for men.

The rest of the paper is organised as follows. In Section 2 we describe the theoretical background to our study. In section 3, we describe the data and provide information on relationship patterns and gambling behaviour in Australian households. We discuss the construction of the key variables: personality, non-cognitive skills, and propensity to engage in

[1] In this paper, we use the term 'marriage' and 'marital' to refer to both legal marriage and cohabitation (de facto) without distinguishing between the two. The difference between the two types of relationships has increasingly been blurred and many marriages start from de facto relationships. We also use marriage and relationship interchangeably.

gambling. We present the model and its estimation in Section 4. The results are presented and discussed in Section 5. We provide a concluding discussion in Section 6.

2 Background

Since the seminal work of Becker (1973), economists have taken an interest in the study of household relationships and have developed a substantial literature on relationship formation and dissolution. Individuals are modeled as staying in marriages as long as the gains or returns to marriage (the 'marital surplus') remain positive. When partners find they derive 'less favorable outcomes from their marriage than they expected when marrying', the marriage is expected to dissolve (Becker et al. (1977)).

Returns to marriage are considered to accrue from two offsetting sources. When the household is treated as a production unit, each partner provides complementary inputs to home and market production and the returns to the relationship stem from the division of labour, specialization and intra-household trade (Becker (1981)). Such returns are sometimes called production-based gains. However, the household can also be treated as a consumption unit where couples consume a common public good, e.g. enjoying raising a child, enjoying art and culture, living in a comfortable property, etc. (Lam (1988)). In this case, returns to marriage arise from the joint consumption of household public goods, risk pooling, or the utility of staying together. Such returns are therefore labeled consumption-based.

These two sources of returns to marriage lead to different predictions with regard to the direction (and magnitude) of the compatibility or matching of the couples' characteristics. If the gains stem from production complementarities, Becker (1981) predicts negative assortative mating where the partner (usually the male) who specialises in paid market activity would have characteristics associated with high market remuneration and the other partner would have characteristics associated with high productivity in home production. The early literature follows Becker (1981) and emphasizes production-based gains.

However, the literature (e.g., Becker (1981), Smith (1979), Browning et al. (2014)) failed to find evidence for negative assortative mating. Instead, overwhelmingly, the evidence points to positive assortative mating. For example, even after controlling for demographics such as age and education, Smith (1979) finds that couples' wages are positively correlated.

If gains are consumption-based, Lam (1988) argues that positive assortative mating allows couples to derive more utility from the joint consumption of household public goods. Lam (1988) argues also that if the household is regarded as both a production and consumption unit, then the two types of gains would exist simultaneously and the overall direction of the assortative mating effect depends upon which hypothesis dominates in practice. The more recent literature argues persuasively in favour of the consumption-based gains hypothesis. As Stevenson and Wolfers (2007) discussed, 'production complementarities–at least as initially described–are decreasingly central to modern family life'. Profound world-wide changes took hold after the Second World War that challenged the production gains hypothesis as the most important motive for individuals to enter and maintain marital relationships. These changes include increased labour productivity, technological advancements, large improvements in female education and labour force participation, increased longevity, declining fertility, and associated changes in social norms and institutions. Accordingly, individuals in marital markets may now place more weight on the consumption gains of the relationship.

Regardless of the dominant assortative mating process, an important determining factor in the formation and duration of marital relationships is compatibility (or 'match') in partners' economic characteristics. Most of the empirical analysis tackles this question by investigating the impact of partners' demographic characteristics (age, education, race and ethnicity) and family background on marriage formation and dissolution (e.g. Schwartz and Mare (2005), Chiswick and Houseworth (2011), and Furtado and Theodoropoulos (2011)).

But as discussed in Lundberg (2012), much individual variation in marital history still remains unexplained. Economists have in recent times started paying more attention to the psychological drivers of socio-economic behaviour including the roles played by personality and non-cognitive traits. These factors contribute strongly and probably more directly to individuals' preference formation and the development of their capabilities. We should therefore expect these factors to significantly influence the formation and duration of individuals' relationships. Lundberg (2012) looked at personality traits to uncover additional evidence about the source of returns to relationship. Fitting a simple Cox proportional model for marriage duration separately for men and women, she concludes that two types of determinants affect marriage stability: (i) factors common to both men and women and (ii) factors with different cross gender effects.

We argue that what matters most for matching in marriages is the combination of individual characteristics (rather than individual characteristics taken in isolation). In other words, the existing literature's approach of merely looking into partners' individual characteristics and cross-gender correlations might not be sufficient to resolve unanswered questions about assortative mating. Our focus in this paper will thus be on the effects of combining partners' personality, non-cognitive skills, and other characteristics, including the propensity to engage in problem gambling. We use differences in partners' age, educational backgrounds, Locus of Control, personality traits and language background in addition to the levels of those characteristics.

An important aim of our paper is to quantify the impact of problem gambling on the longevity of relationships. It is well documented that problem gambling leads to negative consequences for affected individuals and their families. However, aside from a few descriptive qualitative or small-sample analyses in public health research (e.g., Castellani (2000), Dowling et al. (2009), Svensson et al. (2013), Hing et al. (2014)) little attention has been directed to its consequences on personal and social relationships. This lack of research may be attributable to a lack of data. While it is known that problem gambling can be detrimental to marriage, information on gambling behaviour is hard to observe and monitor throughout the duration of relationships, complicating empirical analysis of its effect.

We can think about the negative effect of problem gambling behaviour on the gains to marriage in two ways. One is to hypothesize that problem gambling is a shock which reveals new information to the other partner.[2] If true, one may expect to see a significant proportion of marriages break down following occurrence and disclosure of problem gambling.

For most functioning couples it is hard to imagine one partner successfully concealing such a problem from the other for any length of time. A second hypothesis is that individuals engaging in problem gambling is a latent risk or tendency. It is possible that such risk may already be known to the partner before the actual occurrence of the behaviour. In this

[2] Charles and Stephens (2004) find a negative effect of job displacement shocks on marriage but no effect from disability shocks, which they find peculiar given the similar economic implications for the household.

case, marriage dissolution may happen before instances of problem gambling behaviour are observed. We account for this by estimating the propensity to engage in problem gambling from observed behaviour in our data. We examine whether such risks have any effect on marriage dissolutions.

3 Data

The data used for the analysis are drawn from the first twenty waves of Australia's Household, Income and Labour Dynamics in Australia (HILDA) Survey, a large-scale, nationally representative household panel survey, which started in 2001. Alongside rich information on labour market dynamics, health and life events, HILDA also collects information on individuals' personality traits, non-cognitive skills, and, since 2015, gambling behaviour. In this paper, we track the relationship and birth histories of 10,827 women and their partners, construct scores for their personality traits and non-cognitive skills, and estimate their propensities to engage in problem gambling.

Patterns of relationship duration in Australia

Family formation and fertility have evolved substantially in the past 150 years. Fertility has declined and fewer people marry, with more people opting for de facto relationships. Divorce and separation rates have been increasing, shortening average marriage duration, but these trends have slowed in the last two decades; see Stevenson and Wolfers (2007); Browning et al. (2014); Raymo et al. (2015); Oláh (2015); and Greenwood et al. (2017).

Australia is no exception to these trends. Divorce rates increased from the post-war period through the early 1980s but have since leveled off (Hewitt et al., 2005). The divorce rate in Australia has declined from around 2.6 divorces per 1,000 people in the early 2000s to 1.9 in 2020 (ABS, 2021a), with a slight uptick in 2021, perhaps related to COVID-19. The highest divorce rates are among individuals in their forties (see Figure 1). In the last two decades, the median duration of marriage to separation or divorce has been relatively stable around 8.5 and 12 years, respectively (see Figure 2).

The HILDA survey collects detailed information on marital and fertility history. This includes month and year of start and end of both current and previous marriages, and birth dates of children. From this, we construct 11,617 marital spells for 10,827 women. These spells include any premarital cohabiting period. We include spells that were formed prior to the beginning of the survey (2001) but which existed at least until the first wave of the survey. We only include spells that began after 1955. The small number of spells that we delete because of this exclusion are very long relationships for which spouse or children information is often missing. We also include spells that have begun since survey inception. We only include spells where both spouses have provided survey responses (in the responding person questionnaire) at least once during the survey period. We exclude same-sex relationships and a small number of repeated relationship spells for the same couple (the difficulty for the latter is determining whether it is reunification after separation or a continuation of the same relationship with missing data).

We create "birth spells" for each of these 11,617 relationships. The starting points of the spells are the beginning of the relationship or the birth of the previous child within the relationship, whichever is later. The end points of the spells are either the birth of the next child (the complete spell), or when no (additional) child is produced, the point when the relationship is dissolved or when the couple is last observed in the survey (the spell is censored). This produces 29,148 birth spells (including no birth) amongst the 11,617 relationships.

Sample statistics are presented in Table 1. The average duration of marriages in our sample is 16.9 years, but for dissolved marriages it is about 12 years. Both figures are higher than the national median years to separation of 8.4 because our statistics include pre-marital years.[3] In Figure 4, we plot the raw (non-parametric) estimates of the marriage hazard rate in our sample. The risk of separation peaks at about three and half years. On average, each marital spell in our data produces 1.55 children.

Personality, non-cognitive skills, and demographics

A rapidly growing economics literature recognises the importance of personality traits and non-cognitive skills in choices, behaviours and life outcomes (e.g, Heckman et al. (2006), Borghans et al. (2008), Cobb-Clark (2015)). Borghans et al. (2008) argue that personality traits are related to preferences and capabilities of individuals. Becker et al. (2012) linked key economic preferences such as attitudes to risk, time preference and social preferences to personality traits and to Locus of Control.

The most widely used taxonomy of personality traits is the 'Big Five' or 'Five-factor model', which originates in the lexical hypothesis of Allport and Odbert (1936). The Big Five traits, which include openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism, are believed to reliably and consistently capture personality traits at the broadest level of abstraction (see Goldberg (1981, 1990)). McAdams and Pals (2006) show that these traits are associated with various facets of social interaction: extraversion relates to social dominance, neuroticism to negativity and instability, agreeableness to cooperation, conscientiousness to trust and commitment, and openness to change to learning and being open to new experiences. Lundberg (2012) argue that 'these modes of interaction are also relevant to mating'.

Locus of Control (LoC) is a measure of individuals' non-cognitive skills. It offers a framework for the social learning theory of personality. Developed by psychologists, it captures individuals' beliefs about the nature of the causal relationship between their own behaviour and its consequences (Rotter (1966), Lefcourt (1976)). Defined over a continuous spectrum from internal to external LoC, it refers to the extent to which individuals believe they have control over events. Those with an internal LoC believe that what happens in life largely stems from their own actions, whereas those with an external LoC attribute life events to external factors beyond their control such as fate and luck.

Growing evidence suggests LoC plays an important role in a wide range of individual socioeconomic behaviours including lifestyle decisions (Cobb-Clark and Schurer, 2013), children's education (Lekfuangfu et al., 2018), job performance (Heywood et al., 2017), risk management (Buddelmeyer and Powdthavee, 2016), and investment behaviours (Salamanca et al., 2016).

Big-Five traits and LoC might seem to be closely related but Becker et al. (2012) find no indication of a strong (linear or a non-linear) association between the two concepts, arguing

[3] We could also be missing some very short spells or unstable relationships that don't appear in the survey because one partner has not provided information.

instead that the two concepts are not substitutes but rather complements in explaining the heterogeneity of life outcomes.

Following Cobb-Clark and Schurer (2013) and Buddelmeyer and Powdthavee (2016), we construct the LoC variable from a set of seven questions in the HILDA survey which are based upon the Mastery Scale of Pearlin and Schooler (1978). The LoC score is constructed such that it decreases with an individual's internal control tendencies. The LoC calculated by summing the responses from the HILDA questions is bounded between 7 (internal) and 49 (external). LoC information was collected in Waves 3, 4, 7, 11, 15, and 19 of HILDA, which means that for most individuals in our sample we can calculate a LoC score.

Likewise, information on the Big Five personality traits (agreeableness, conscientiousness, emotional stability, extroversion, openness) were collected in Waves 5, 9, 13, and 17. Each of these five traits is standardised to range between 1 and 7 in HILDA. We include each of these traits individually in the models that we estimate below.

Cobb-Clark and Schurer (2011, 2013) show that both LOC and Big Five personality traits are relatively stable over time. Variations in individuals' responses to the items measuring LoC are mostly random noise. It has been suspected that major life events such as divorce may affect these traits, but a recent study by Spikic et al. (2020) shows that this is unlikely to be the case.

To minimise measurement errors, for individuals with multiple observations on LoC and Big Five traits, we take the average over different waves. We standardise the LoC and Big Five scores by de-meaning and dividing by their standard deviation. For the individuals with missing traits (about 10 percent for both LoC and personality traits), we impute the scores using other relevant characteristics including birth years, education, birth country, Indigenous status, and presence of both parents at age of 14. As a robustness check, we estimate the model without the observations where LoC or personality traits were missing. The results are unaffected by this.

Comparing the sample statistics of these measures in Table 1 reveals some interesting gender differences. Male partners are less extroverted than an average person whereas female partners are on average more extroverted. Secondly, males are generally less agreeable and their partners more agreeable than average. Thirdly, males are less conscientious and women more conscientious than average. Fourthly, while married men are slightly more open to experience, their partners are slightly less so. Last, women are less emotionally stable than men. These measures are de-meaned and divided by their standard deviation so the 'average' person has a zero score.[4]

Average personality characteristics vary by whether the relationship dissolves or continues. Both males and females in dissolved relationships are less agreeable, less conscientious and more emotionally unstable than those in continuing relationships. Female partners in dissolved marriages are more extroverted than those in continuing marriages while there is no difference for males. The average openness scores for both partners from dissolved marriages are higher than average and female partners in continuing marriages appear to have a less adventurous character, with a below population average openness score.

[4] This standardization is done across the entire survey data so it is still possible for both males and females in the couple sample to have negative or positive averages such as for Locus of Control where both the male and female averages are negative. This indicates that individuals in couples have a lower Locus of Control score than individual who are not in partnerships.

The average LoC score of male partners in dissolved marriages is 0.054, which implies a more external degree of control than the population average. Their female partners also exhibit a higher degree of external control. Partners in continuing marriages tend towards an internal locus of control with average LoC scores of -0.136 (males) and -0.079 (females). Bivariate t-tests confirm these differences in attributes are all significantly different from zero.

In the second part of Table 1, we look at within-couple differences in personality traits and Locus of Control. We do not find consistent or strong patterns across relationship status. Couples in continuing relationships have larger differences in Locus of Control than those in dissolved relationships. Larger within-couple differences in extroversion and agreeableness seem correlated with marital dissolution. There are only small differences in emotional stability, conscientiousness and openness when we compare within-couple differences across continuing and dissolved relationships.

To get some idea of how the pairs' personalities and LoC are correlated, we display the correlation coefficients of these variables in Table 2. All variables except extraversion exhibit quite strong correlation between the partners. The correlations of LoC and agreeableness are stronger among continuing marriages whereas those for conscientiousness and openness are lower among continuing couples.

These patterns may suggest that the partners of dissolved marriages tend to be less capable of taking matters under their own control or are more willing to believe that they are unable to take matters under their own control. Unsurprisingly, those who are less agreeable, less conscientious or more emotionally unstable are also likely to be in relationships that dissolve. Some evidence suggests that partners of dissolved relationships are less well-matched in non-cognitive skills.

We also examine within-couple similarity in demographic characteristics. Most couples exhibit similar levels of education–in 14 percent of couples both partners have tertiary education and in 62 percent both have only non-tertiary education. Among dissolved marriages, the proportion of both partners having no tertiary education is much higher (70 percent) compared to continuing marriages (59 percent). The average age difference between partners is 2.4 years (the median is about 2 years), with males being older. We do not observe ethnicity, but we do observe which language people can speak or write. We use this variable as an indicator for cultural background and whether they can communicate with the same language to indicate their degree of cultural similarity. In the sample, English is the only language for 78 percent of couples; 6.4 percent communicate in the same second language and the rest are characterised by one partner understanding a second language or each partner understanding a second language not shared with their partner. Partners understanding a common second language is correlated with lower marriage dissolution which is perhaps also capturing different cultural norms around divorce in some migrant groups in Australia.

These patterns are consistent with the predicted outcomes of assortative mating. The strong positive correlations in partners' personalities, their non-cognitive skills, and indeed their other characteristics are consistent with the positive assortative mating hypothesis. We are nonetheless cautious in taking our observed correlation as supporting evidence for the consumption complementarity hypothesis. Neither the model of Becker (1981) nor Lam (1988) includes management or transaction costs. Marriages are organisations where managing or containing costs might not be negligible, especially if a common good is produced within the household. These costs (including communication costs) may depend upon the degree of compatibility among partners. Coming from a similar background could reduce communication costs, but could also imply common preferences, which lead to higher consumption gains. When such costs are considered, the association between the direction and magnitude of assortative mating and the consumption or production complementarity may no longer be as clear-cut as those two simple models predict. See the discussion in Browning et al. (2014).

Gambling and problem gambling

Many Australians regularly engage in gambling activities. AIHW (2021) estimates that around 35 percent of Australian adults (18 and over) participate in gambling in a typical month. While not harmful for most practitioners, gambling can become seriously problematic for a small proportion of gamblers. Problem gambling is often defined using the Canadian Problem Gambling Index (CPGI) of Ferris and Wynne (2001), which is based on nine questions (with a scale from zero to three) related to problem gambling behaviour and its adverse consequences.[5] The index is defined as the sum of the scores from these questions and ranges from 0 to 27. The higher the index, the greater the risk that gambling is a problem for an individual. An individual who has a score of 3 to 7 is considered to have a moderate risk of problem gambling and a score of 8 or higher is associated with a high risk of problem gambling. AIHW (2021) estimated that around 7.2 percent of Australians 'were . . . at some risk of experiencing gambling-related problems' in 2018. Browne et al. (2016) considered gambling-related problems and harms across different domains: relationships, health emotional/psychological, financial, work/study, and other harms. They estimated that about one quarter of gambling-related harms in the state of Victoria in Australia were harms to relationships (see Figure 3).

As discussed in Gong and Zhu (2019), psychologists often view gambling and problem gambling behaviours in the context of risky behaviours such as substance use, dangerous driving, promiscuous sex, and delinquency. They tend to explain problem gambling behaviour as driven by personality and attitudes toward risk (a practice that economists only started to pick up in recent years). For example, the literature finds that personality traits such as sensation-seeking and impulsivity associate with problem gambling (see the review by Mishra et al. (2010)). Low self-control is also likely to associate with gambling and other risk-taking behaviours but this association has not been studied extensively. An early study by Corless and Dickerson (1989) finds that problem gamblers tend to have lower self-control. Baron and Dickerson (1999) also find that drinking alcohol, which may lead to a temporary reduction of self-control, contributes to "impaired control of gambling behaviour".

Gambling questions have recently been added to the HILDA survey and information on gambling is available in Waves 15 and 18. For the purpose of examining gambling behaviour

[5]The nine questions to the gamblers are: 'In the last 12 months: (i) Have you bet more than you could really afford to lose?; (ii) Have you needed to gamble with larger amounts of money to get the same feeling of excitement?; (iii) When you gambled, did you go back another day to try to win back the money you lost?; (iv) Have you borrowed money or sold anything to get money to gamble?; (v) Have you felt that you might have a problem with gambling?; (vi) Has gambling caused you any health problems, including stress or anxiety?; (vii) Have people criticised your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?; (viii) Has your gambling caused any financial problems for you or your household?; and (ix) Have you felt guilty about the way you gamble or what happens when you gamble?'. To each of these questions, individuals can answer: 'Never' (score 0); 'Sometimes' (score 1); 'Most of the time' (score 2); or 'Almost always' (score 3).

on risk of separation and divorce, it would be ideal to have a much longer time series of observations on gambling behaviour. As discussed earlier, the effect of problem gambling on marriages may be hard to identify from observed behaviour. Tendencies toward problem gambling may exist for a long time before they are observed in the data by the econometrician. For both of these reasons, we use the predicted risk of problem gambling to explain relationship dissolution. We estimate one model to predict problem gambling across all waves and age groups, so we are implicitly assuming gambling behaviour has not changed dramatically from cohort to cohort. Using predicted problem gambling will also reduce endogeneity that could arise from unobservable characteristics which are related to both relationship dissolution and problem gambling behaviour.

With the two waves of information on problem gambling, we estimate the propensities of gambling and problem gambling for men (m) and women (f) separately using a Probit model:

$$Prob\{G_{it}^{p} = 1\} = \Phi(X_{it}^{p'}\pi^{p}), \quad p = m, f; \quad t = \text{Wave 15, Wave 18} \tag{1}$$

where G_{it}^{p} is the indicator that individual i of gender p gambles (or is a problem gambler) in Wave t, X_{it}^{p} is a vector of individual characteristics and π^{p} are the associated coefficients. In the explanatory variables we include age, birth cohort, education, the five individual personality traits, LoC, religion, birth country/region, Indigenous status, current socio-economic environment and family background.[6] Specifically, we control for the Socio-Economic Indexes for Areas (SEIFA) where the individual lives and we control for parent ever divorced or lived with lone parent at age 14.[7]

Estimated coefficients from Equation (1) are reported in Table 3 for the propensity to gamble and the propensity to engage in problem gambling, separately for women and men. The results are of interest in their own right. We find that cognitive and non-cognitive skills play an important role in determining engagement in gambling and problem gambling. For example, individuals who are less educated, less emotionally stable, with low conscientiousness, more extroversion, or (significant for women only) with low internal control (high LoC), are more likely to engage in problem gambling. Indigenous individuals are not more likely to engage in gambling but they are more likely to engage in problem gambling. Having parents who divorced or having lived with a lone parent at age 14 are associated with a higher likelihood of problem gambling for men but have no effect for women. Those who are in regions with low socio-economic status are more likely to engage in problem gambling. This effect is particularly pronounced for women. These results are consistent with the findings in Gong and Zhu (2019).

Practitioners of Islam are less likely to gamble and Christians are more likely to gamble compared to other religions or to those who do not report a religion. We exclude religion from the problem gambling equation as the coefficients are all close to zero. The number of problem gamblers is small and we are unable to identify any effects of religion.

We use the estimates from the four models based upon Equation (1) to predict gambling and problem gambling propensities for each spouse at the start of their relationship. The

[6] We pool across two years and do not include a time dummy because we use the predicted probabilities from this equation to estimate the propensity of engaging in problem gambling at the beginning of the relationship which can be at any point between 1955 and 2020. The average propensity to engage in gambling or problem gambling is nearly identical in waves 15 and 18.

[7] SEIFA was developed by the Australian Bureau of Statistics and ranks areas according to their relative socio-economic advantage and disadvantage using census data (ABS, 2021b).

estimated propensity of gambling scores are summarised in Table 4. The average propensities indicate the proportions of spouses who are predicted to engage in gambling and problem gambling, respectively. On average we expect about 1.1 and 3.7 percent of female and male spouses to engage in problem gambling. To see how the risk of problem gambling might be related between couples, we plot the estimated correlation in problem gambling propensities in Figure 5. The figure shows that, even though the propensities are estimated separately for each spouse and exclude information about the partner, they are positively correlated. In fact, the correlation is as high as 0.26. This high correlation may be a result of positive 'assortative mating'.

4 Methodology

4.1 Model

For each woman, we observe one or more marriage spells and within each spell, potentially, multiple births. Our focus in this paper is on the duration of the relationship. Children are an important factor which affects a couple's decision to continue or dissolve their relationship. The presence or absence of children may affect the break up decision but the stability of the relationship will also be an important factor in determining whether children are desired. Our approach allows for correlation in the unobservable characteristics which determine the arrival of children and the duration of the relationship. We construct a joint random effects duration model of relationship and fertility which includes time-varying effects and allows for non-parametric duration dependence. The framework is similar to the Lillard (1993) model. Not modelling the two processes jointly would likely lead to inconsistent estimates. In addition, as discussed in Van den Berg (2001), controlling for unobserved heterogeneity is necessary to identify the structural parameters of the duration processes.

Specifically, we model the following log hazard (h) equations for the two processes: dissolution of relationship r ($r = 1, \ldots, R$) and birth b ($b = 1, \ldots, B_r$) in relationship r:

$$\log h_r^d(t) = \alpha_0 + \alpha_1' C(t) + \alpha_2' A(t) + \alpha_3' M_r(t) + \alpha_5' Z^d(t) + \alpha_6' K_r(t) + \epsilon, \qquad (2)$$

$$\log h_{rb}^k(t) = \beta_0 + \beta_1' C(t) + \beta_2' A(t) + \beta_3' M_r(t) + \beta_4' L_{rb}(t) + \beta_5' Z^k(t) + \eta. \qquad (3)$$

R is the total number of relationships that a woman has had. B_r is the total number of births from that relationship. $Z^d(t)$ and $Z^k(t)$ are vectors of exogenous regressors where the d and k superscripts refer to the equations for relationship duration and birth of subsequent child, respectively. In $Z^d(t)$, we include the wife's Locus of Control and big five personality traits. We also include the signed difference between the spouses for the Locus of Control and big five personality traits. This controls for both the husband's characteristics and the difference in characteristics between the spouses. It also allows the difference in characteristics to have an asymmetric effect depending upon whether the male or female partner has a larger value for the characteristic. For each set of characteristics for the female and male partner, x_i^f and x_i^m, we include three terms in Z^d: x_i^f, $I(x_i^m >= x_i^f) * (x_i^m - x_i^f)$, and $I(x_i^m < x_i^f) * (x_i^m - x_i^f)$. The coefficients on these terms will capture (1) the female's characteristics; (2) the difference between male and female characteristics when the male characteristic is larger (we call this

(+) in Table 5); and (3) the difference between male and female characteristics when the female characteristic is larger (we call this (-) in Table 5). The symmetry of the effects can be tested by comparing the last two coefficients. If these two are the same, then the effects of differences in male and female characteristics are the same irrespective of the sign of the difference. If these two are both zero, it indicates that the impact of the male's characteristic is identical to that of the female partner.

We also include two indicators for large age differences between the members of the couple (one if the age difference is in the top quartile of age differences and one if the age difference is in the bottom quartile of age differences), couple's education (three indicator variables for whether the husband has tertiary education and the wife has non-tertiary education (Tert(m)-Non(f)), for whether the husband has non-tertiary education and the wife has tertiary education (Non(m)-Tert(f)), or whether both have tertiary education (Tert-Tert) and an omitted category where neither has tertiary education), and whether both members of the couple speak the same non-English language (Lang2-same) or both speak only English (Eng.-only). For each member of the couple we include the propensity to engage in problem gambling at the start of the relationship, indigenous status and whether the individual's parent was ever divorced. Finally, we include an indicator for the presence of a child in the relationship (*kchd*) and the number of additional children (*kchda*) after the first.

In $Z^k(t)$, we include the mother's characteristics including education, country/region of birth, indigenous status, and whether the mother's parents were ever divorced. We include male partner's indigenous status and an indicator for whether or not his parents were ever divorced.

$K_r(t)$ is a time-varying vector of the endogenous birth outcomes which are expected to affect the hazard rate of the relationship. The entire relationship spell is segmented into different spells depending upon how many children the couple has and the baseline hazard shifts at different numbers of children. Time/duration dependence of the baseline hazards are captured by separate 'clocks' $C(t)$ (for calendar time), $A(t)$ (for age), $M_r(t)$ (for relationship duration), and $L_{rb}(t)$ (for elapsed duration since the start of the spell) which are unknown functions of time. Finally, ϵ and η are the unobserved heterogeneities in the two equations where

$$\begin{pmatrix} \epsilon \\ \eta \end{pmatrix} \sim N\left(0, \Sigma\right),$$

and

$$\Sigma = \begin{pmatrix} \sigma_\epsilon^2 & \sigma_{\epsilon\eta} \\ \sigma_{\epsilon\eta} & \sigma_\eta^2 \end{pmatrix}$$

The random effects in the two equations are potentially correlated, which is indicated by a non-zero parameter $\sigma_{\epsilon\eta}$. αs βs, and $\sigma_{\epsilon\eta}$ are parameters that we estimate.

The (log) hazard equations are defined over each episode of relationship or birth interval. For relationship durations, it is from t^d_{0r}, the starting time of the relationship, to either t^d_{er}, the time of dissolution (divorce or separation), or t^d_{cr}, the time when it is censored (the observation dropped out or at the end of the available survey data). Birth spells within each relationship r start from the beginning of the relationship or the previous birth, t^b_{0rb}, and end at the birth t^b_{erb}, or the time of censoring t^b_{crb}.

As in Lillard (1993), the 'clock' functions are specified as piecewise linear spline functions. This allows for flexible duration dependence of the hazard from the different sources of age, cohort, and calendar time. For example, the term $\alpha_3' M_r(t)$ represents dependence of the relationship hazard on its duration. It is defined as

$$\alpha_3' M_r(t) = \sum_{s=1}^{N_M+1} \alpha_{3s} M_s(t),$$

where $M_r(t) = (M_{r,1}(t), \ldots M_{r,N_M+1}(t))$ is a vector of $N_M + 1$ spline variables that sum to the duration of the relationship and are separated by the 'nodes' μ_s $(s = 1, \ldots, N_M)$:

$$M_r(t) = \max[0, \min(t - \mu_{s-1}, \mu_s - \mu_{s-1})]$$

The slope coefficients α_3 may differ in the $N_M + 1$ intervals. Other 'clock' terms are similarly defined. Within each spell, these terms evolve perfectly collinearly, but from different origins both across and within individuals. This allows for identification of these separate effects. The total duration dependence is the sum of the three 'clock' terms. For example, the baseline hazard of relationship breakdown at time t is a piecewise linear Gompertz function given by

$$\ln h_r^d(t) = \ln h_{0r}^d(t_{0r}^d) + \alpha_1'(C(t) - C(t_{0r}^d)) + \alpha_2'(A(t) - A(t_{0r}^d)) + \alpha_3' M_r(t),$$

where $\ln h_{0r}^d(t_{0r}^d) = \alpha_0 + \alpha_1' C(t_{0r}^d) + \alpha_2' A(t_{0r}^d)$.

The baseline hazard of birth, in addition to time since previous birth (or beginning of relationship), also depends upon the relationship duration M_r:

$$\ln h_{rb}^k(t) = \ln h_{0rb}^k(t_{0rb}^b) + \beta_1'(C(t) - C(t_{0rb}^b)) + \beta_2'(A(t) - A(t_{0rb}^b)) + \beta_3'(M_r(t) - M_r(t_{0rb}^b)) + \beta_4' L_{rb},$$

where $\ln h_{0rb}^k(t_{0rb}^b) = \beta_0 + \beta_1' C(t_{0rb}^b) + \beta_2' A(t_{0rb}^b) + \beta_3' M_r(t_{0rb}^b) + \beta_4' L_{rb}(t_{0rb}^b)$.

4.2 Estimation

The model is estimated by Simulated Maximum Likelihood. Note that given the observed ($Z's$) and unobserved heterogeneity (ϵ and η), the outcomes of each relationship and birth episode are independent, and the joint probability for an individual's observed event is the product of the probabilities of the outcomes. From Equations (2) and (3), we can obtain the baseline survivor functions for each relationship and birth spell, for $t > t_{0r}^d$ and for $t > t_{0rj}^k$ respectively:

$$S_{0r}^d(t) = exp\{-\int_{t_{0r}^d}^t exp(\alpha_0 + \alpha_1' C(\tau) + \alpha_2' A(\tau) + \alpha_3' M_r(\tau)) d\tau\}, \quad (4)$$

$$S_{0rb}^k(t) = exp\{-\int_{t_{0rb}^k}^t exp(\beta_0 + \beta_1' C(\tau) + \beta_2' A(\tau) + \beta_3' M_r(\tau) + \beta_4' L_{rb}(\tau)) d\tau\}. \quad (5)$$

The piecewise linear spline functions produce integrals which have closed form solutions.

We denote the full history (since the beginning of the spell) of the observables Z^d and Z^k as $\chi(t)$, and divide the spells into sub-intervals within which the time-varying variables remain constant. The survival function for relationship dissolution conditional on the observed and unobserved heterogeneity can be defined as:

$$S_r^d(t,\chi(t),\epsilon) = \prod_{i=1}^{I_r}\left[\frac{S_{0r}^d(t_{ri}^d)}{S_{0r}^d(t_{ri-1}^d)}\right]^{exp(\alpha_5' Z^d(t_{ri}^d)+\alpha_6' K_r(t_{ri}^d)+\epsilon)}, \tag{6}$$

where I_r are the subintervals within which the regressors Z^d and K_r remain constant, $S_{0r}^d(t_{r0}^d) = 1$ and $t_{rI_r} = t$.

For the birth equation, there are no time-varying covariates, therefore the survival function is simpler:

$$S_{rb}^k(t,\chi(t),\eta) = \left[S_{0rb}^k(t)\right]^{exp(\beta_5' Z^k(t)+\eta)}. \tag{7}$$

Depending upon whether the spell is censored, the likelihood contribution of each relationship or birth spell is defined differently. For the spells that are censored, the likelihood contribution is just the value of the survival function at the censored date. For the spells that are not censored, the likelihood is the survival function multiplied by the hazard rate at the date.

$$Lik^d(s|\cdot) = \begin{cases} S^p(t) & \text{if the spell is censored at } t; \\ S^p(t)\cdot h^p(t) & \text{if the event occurred at } t, \end{cases} \tag{8}$$

where $p = d, k$ is the process (relationship dissolution or birth) and $s = r, rb$ is the spell.

The conditional likelihood for a relationship spell r is

$$Lik^d(r|\epsilon) = (S_r^d(t_{er}^d,\chi(t_{er}^d),\epsilon))^{\delta_r}\cdot(S_r^d(t_{er}^d,\chi(t_{er}^d),\epsilon)h^d(t_{er}^d,\chi(t_{er}^d),\epsilon))^{(1-\delta_r)}, \tag{9}$$

where δ_r is an indicator equal to one if the spell is censored. t_{er}^d is the time when the relationship ended or was censored.

The conditional likelihood for a birth spell rb is similarly given

$$Lik^k(rb|\eta) = (S_{rb}^k(t_{erb}^k,\chi(t_{erb}^k),\eta))^{\delta_{rb}}\cdot(S_{rb}^k(t_{erb}^k,\chi(t_{erb}^k),\eta)h^k(t_{erb}^k,\chi(t_{erb}^k),\epsilon))^{(1-\delta_{rb})}, \tag{10}$$

where δ_{rb} is again an indicator equal to one if the spell is censored and t_{erb}^d is the time when the birth was given or the spell was censored.

The marginal likelihood for each individual is obtained by multiplying the conditional probabilities of all her relationship and birth spells and 'integrating out' the unobserved heterogeneity ϵ and η:

$$L_i = \int_\epsilon\int_\eta f(\epsilon,\eta)\prod_{r=1}^{R} Lik^d(r|\epsilon)\prod_{rb=1}^{RB} Lik^k(rb|\eta)d\epsilon d\eta \tag{11}$$

where R is the total relationship spells of the individual and RB is her total number of birth spells in all relationship spells.

We approximate the numerical multi-dimensional integral by a simulated mean: for each individual, we take M draws from the distribution of the error terms (ϵ and η) and compute the average of the M likelihood values conditional on these draws. The integral equation (11) is thus approximated by

$$L = \frac{1}{M}\sum_{m=1}^{M}\prod_{r=1}^{R} Lik^d(r|\epsilon^m)\prod_{rb=1}^{RB} Lik^k(rb|\eta^m). \tag{12}$$

where ϵ^m and η^m are draws from the distribution of (ϵ,η).[8] The estimator resulting from

[8]Note that the distribution of the error terms is known for a given Σ.

random independent draws is consistent as M tends to infinity with the number of observations of the sample. Specifically, if $\sqrt{n}/M \to 0$ and with independent draws across observations, the method is asymptotically equivalent to maximum likelihood estimation (see Lee (1992) or Gourieroux and Monfort (1993)). Instead of independent draws, we use draws taken from Halton sequences using the procedure described in Train (2003). Many studies (e.g., Caflisch (1995), Sloan and Woźniakowski (1998), Bhat (2001), Train (2003), Sándor and Train (2004)) show that 'quasi-random' draws such as Halton draws provide better coverage than independent draws and can be more efficient at reducing simulation errors for a given number of draws compared to independent draws (also see Bhat (2001), Train (2003), and Sándor and Train (2004) for more evidence).

5 Results

We present the estimated coefficients from the log hazard functions in Tables 5 and 6. They can be interpreted as the approximate increase (or decrease) in percentage terms of the hazard rate induced by a one unit change in the corresponding variable. For example, -0.556, the coefficient on the presence of a child in the relationship, indicates that, holding everything else constant, when a child is present the hazard rate decreases by 55.6 percent. In other words, the relationship becomes more stable and the probability of dissolution goes down by 55.6 per cent. Our results show that unobserved heterogeneity plays a significant role in both hazard equations and the two heterogeneity terms are correlated (see Table 7). Tables 8, 9 and 10 present the results where we drop the imputed values for LoC and personality traits. The results are largely unchanged.

5.1 Duration dependence

Both processes (relationship duration and duration to next birth of a child) exhibit strong non-linear duration dependence. For the marriage equation, the hazard rate initially decreases quickly with the duration of the relationship before increasing with it, and it decreases with the age of the partners. It also increases with time. Our results show that marriages become increasingly fragile the longer they continue. There are clear time effects with relationships more likely to dissolve today than in the past. This effect appears to increase over time. At the same time, marriages become more stable as the age of the woman increases. All of these effects could be related to a range of factors, including the process of partners gaining information about each other, the outside options of the partners, and changes in the institutional environment.

Figure 6 illustrates the duration dependence and the age, cohort and time effects for a marriage in which the female married at age 25 in 1990 and the characteristics of the partner are set at the sample mean.

For the duration to next (or first) birth, the hazard rate (the 'risk' of having a child) declines in the first year (either following a birth or from the start of the marriage) and then increases in the subsequent one to three years, and decreases after that. The birth hazard rate also increases with time when the mother is aged between 20 and 30 years and during the period running from the second to the fifth year of the relationship, but decreases with time when the mother is aged over 30, and when the duration of the relationship is longer than 5 years.

5.2 Compatibility between partners

We first discuss the impacts of the woman's own characteristics before looking into the differences in characteristics between partners. Personality plays a significant role in the duration of relationships. More extroverted females have much less stable relationships–the coefficient is 0.261 and highly statistically significant. Female openness is statistically significant and more open females have less stable relationships. A one standard deviation increase in openness leads to a 20 percent increase in the likelihood of relationship dissolution. Being extroverted and more open to experiences may generate more outside options, thus lowering the returns to marriage. This finding is consistent with Lundberg (2012) who observes that 'individuals who are more impulsive and desirous of variety (openness), more extroverted, and less conscientious' are more likely to divorce. We find that the coefficient for conscientiousness is negative but not statistically significant.

The coefficient for female LoC indicates that if a woman's LoC index increases by one standard deviation (she becomes a more 'external control' type of person) then the likelihood of her relationship breaking down significantly increases, by about 26 percent. Other estimation outcomes are consistent with our a priori expectations: having an Indigenous partner or one's own parents or the partners' parents having divorced contribute to marriage instability.

As discussed earlier, compatibility between partners may be even more important for the relationship. Our first observation is that the magnitude of the partners' difference in Locus of Control plays a significant role in marriage dissolution. The marriage becomes more fragile the larger the difference in LoC–a one standard deviation increase in the difference between the partners' LoCs raises the hazard rate by 27.1 percent if the male has a higher (more external) locus of control and 11.6 per cent if the wife has a more external locus of control.

Differences in Agreeability and Openness lead to higher levels of relationship dissolution if the male is more agreeable or more open than the female partner. These effects are asymmetric, and we find no statistically significant effects if the female partner is more agreeable or open than the male partner. For the other Big Five personality traits, we do not find any impact of differences in characteristics within the couple.

Large age differences of the partners have negative effects on the stability of the relationship and the effects are similar whether the husband is older or younger. For example, the relationship is less stable when the male is four or more years older than the female partner with an increase of 21 percent in the probability of the relationship ending. The effect is similar when the female is older than the male partner.

Differences in education do not seem to play a large role, but the level of partners' education matters for marriage stability. Relationships are least stable for couples in which neither partner has achieved tertiary education and most stable for those in which both partners have received tertiary education. Relationships in which one of the partners has tertiary education and the other does not lie in between these two extremes. In addition, similarity in cultural backgrounds also seems to be important. We use partners' ability to communicate in the same language as a proxy for cultural similarity. The results show that if the partners are able to communicate in the same second language, their relationships are more stable.

Most of these findings lend support to the positive assortative mating hypothesis. However, as discussed above, identifying a direction for assortative mating might not necessarily be helpful in establishing the presence of consumption-based and production-based complementarities. Personality traits, non-cognitive skills, and other characteristics may matter both for the production and the consumption of the household's common good, especially if transaction or management costs within the marriage are substantial. For instance, the effect of age difference on marriage stability may be consistent with the production complementarity argument, but our finding of the negative effects of a large age difference may suggest complex and adverse effects on the partners' commonality of preferences or on the transaction costs the partners face when making decisions, or both. The strong positive effect of LoC (and the LoC difference) on marriage stability is consistent with the argument that internal transaction costs might be lower for couples with high and similar levels of non-cognitive skills. Similarity in couples' cultural backgrounds is again consistent with both arguments of a higher gain from consumption of common goods and a lower transaction cost in production.

5.3 Problem gambling

We include in the marriage duration equation problem gambling propensities of both partners, $Prop.Pg(f)$ and $Prop.Pg(m)$. The propensity of the female to engage in problem gambling has a statistically significant impact on relationship dissolution. From Table 5, we can see that for a one per cent increase in the female partner's risk of problem gambling, the hazard increases by 28.5 per cent. A one per cent increase in the male partner's risk increases the risk of marriage breakdown by about 3 per cent but this latter effect is not statistically significant.

5.4 The effect of children

The variable *kchd* is an indicator for the presence of a child in the relationship and *kchda* for the number of additional children after the first. The coefficients of both variables are highly negatively significant, which implies that children are strong factors in the continuity of relationships. For example, compared to a childless relationship, the chance for a one-child marriage to break down at any point in time is reduced by about 56 percent. Each additional child reduces the likelihood of break-up further by about 36 percent. As argued in the existing literature, children can be regarded as a common good in the marriage, their presence in the household increasing the gains from joint 'consumption'.

These effects are estimated after the two variables' potential endogeneity is taken into account with the birth and marriage equations estimated jointly and the inclusion of correlated random effects. From Table 6, we can see that the effect of the partners' characteristics conform with expectations. Mothers in the 20-30 age range are more likely to have a child and those above age 30 are less likely to have children. Having had a child within the last year makes it less likely to have another child but having had a child in the last 1-3 years makes it more likely to have a child. The probability of having a child first increases with relationship duration and then decreases, reflecting completed fertility spells.

Compared to Australians and New Zealanders, couples who were born in Europe or North America tend to have fewer children (the hazard rate of their birth spells are about 14 percent lower). Similarly for couples from East Asia, where birth rates are very low in the origin countries, the hazard rate of birth spells are about 23 per cent lower. However, those who were born in the Middle East tend to have more children–with the hazard rate of their birth spells about 28 percent higher. Indigenous couples also tend to have more children. Those from other parts of Asia (South Asia and Southeast Asia) do not have birth spells which differ from Australians. All these effects are significant at least at the 5 percent level. In addition, some evidence suggests mothers with tertiary education have fewer children–the hazard rate of their birth spells about 6 percent lower. However, the effect falls slightly short of being significant at the 10 per cent level.

6 Conclusions

In this paper, we estimate a joint, non-parametric model of relationship dissolution and birth spells with random effects and time-varying explanatory variables, in which non-linear duration dependence, endogenous and time-varying children effects and unobserved heterogeneity are taken into account. We examine 11,617 relationship (marriages and de facto partnerships) episodes and 29,148 birth episodes associated with these relationships. Data are drawn from the first twenty waves of Australia's HILDA Survey.

We examined the impacts on relationship dissolution of partners' personality, non-cognitive skills and demographics. We examine the effect of differences in partners' personality and non-cognitive skills to assess their compatibility. We find that partners' compatibility in non-cognitive skills, extroversion, openness and education play important roles in the duration of relationships. Overall, individuals who are more agreeable, more conscientious or more emotionally stable have relationships that are more likely to persist.

These findings are mostly consistent with the positive assortative mating hypothesis. However, if there are significant transaction or management costs within relationships, these results could also provide evidence that compatibility reduces the cost of production of common household goods, such as children. Our results therefore cannot be interpreted as providing evidence which helps us to distinguish between the consumption complementarity theory or the production complementarity theory. Our results do help us to understand the mechanisms through which households realize the benefits of relationships.

We also estimated how the risk of one of the partners' engaging in problem gambling impacts relationship duration and dissolution. We find that if the female partner has a high risk of engaging in problem gambling, relationships are almost 30 per cent less likely to persist. If the male partner has a high risk of engaging in problem gambling, the relationship duration decreases by about three per cent, but the effect is not statistically significant.

Our focus on the propensity to engage in problem gambling means that we are not looking at the shock effect of a member of the couple suddenly becoming a problem gambler. Rather, we are focused on problem gambling as a latent risk or tendency. It is possible that such risk may already be known to the partner before the actual occurrence of the behaviour. In this case, relationship dissolution may happen before instances of problem gambling behaviour are observed. Our approach accounts for this effect which might be difficult to observe from the actual occurrence or onset of problem gambling.

The relationships examined in this study exhibit strong duration dependence on their own duration, age, and calendar time. Consistent with the extant literature, we find that children play an important role in relationship duration. This continues to be the case when spells to the birth of a child are jointly modeled with relationship duration in a way that accounts for unobserved heterogeneity and the inter-relationship between these two outcomes.

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Tables and figures

Table 1: Sample statistics

Variables	Total		Dissolved		Continuing	
Duration	16.924(15.68)		12.042(13.94)		18.861(15.9)	
No. of children	1.551(1.55)		1.216(1.50)		1.684(1.55)	
			Spouse characteristics			
	Males	Females	Males	Females	Males	Females
LoC	-.082(0.84)	-.034(0.87)	.054(0.89)	.079(0.91)	-.136(0.82)	-.079(0.85)
Extrov.	-.065(0.79)	.107(0.90)	-.067(0.79)	.137(0.92)	-.064(0.79)	.096(0.90)
Agreeable.	-.183(0.82)	.220(0.77)	-.233(0.87)	.194(0.84)	-.163(0.80)	.230(0.75)
Emot. stability	-.019(0.82)	-.070(0.88)	-.121(0.85)	-.180(0.94)	.021(0.80)	-.027(0.85)
Consc.	-.030(0.81)	.088(0.88)	-.115(0.84)	-.023(0.92)	.003(0.80)	.132(0.86)
Openness	.042(0.80)	-.012(0.86)	.056(0.87)	.047(0.92)	.037(0.78)	-.036(0.83)
Indigenous	.028	.031	.042	.047	.022	.025
Having a religion	.477	.408	.469	.382	.480	.469
Lone par. age 14	.124	.136	.158	.175	.111	.120
Parent divorced	.092	.102	.113	.118	.084	.096
Tertiary	.232	.286	.159	.225	.261	.311
Vocational edu	.385	.298	.407	.344	.376	.280
Year 12	.114	.130	.128	.133	.109	.129
Low edu	.208	.254	.255	.274	.189	.245
Previous relation	.370	.341	.450	.429	.338	.306
Had kids before	.521	.515	.628	.669	.478	.454

Standard deviations are in the parentheses.

Table 1: Sample statistics (continued)

Variables	Total	Dissolved	Continuing
Differences in spouse characteristics			
ΔLoc. control	-0.048(1.02)	-0.024(1.11)	-0.057(0.98)
ΔExtrov.	-0.172(1.20)	-0.203(1.21)	-0.160(1.19)
ΔAgreeable.	-0.403(1.06)	-0.427(1.15)	-0.393(1.03)
ΔEmot. stability	0.051(1.06)	0.058(1.13)	0.048(1.04)
ΔConsc.	-0.118(1.12)	-0.092(1.16)	-0.129(1.11)
ΔOpenness	0.055(1.05)	0.009(1.12)	0.073(0.83)
Large ΔExtrov.	0.106	0.104	0.107
Large ΔAgreeable.	0.083	0.098	0.076
Large ΔEmot. stability	0.067	0.077	0.063
Large ΔConsc.	0.085	0.087	0.085
Large ΔOpenness	0.066	0.076	0.062
ΔAge	2.371(4.96)	2.409(5.45)	2.356(4.75)
Large Δage (-)	0.259	0.268	0.255
Large Δage (+)	0.284	0.309	0.274
Education comb Tert.-Tert.	0.140	0.084	0.162
Education comb Tert.-Non T.	0.092	0.075	0.099
Education comb Non T.-Tert.	0.147	0.141	0.149
Education comb Non T.-Non T.	0.621	0.700	0.590
Same 2nd language	0.064	0.032	0.076
No 2nd language	0.781	0.793	0.777
No. of relationships	11,617	3,300	8,317

Δ indicates within-couple differences (male less female) between partners.
Standard deviations are in the parentheses.

Table 2: Correlation of partners' personality and non-cognitive skills

Variables	Total	Dissolved	Continuing
Loc. of control	0.294	0.236	0.312
Extrov.	0.009	0.009	0.008
Agreeable.	0.112	0.102	0.115
Emot. stability	0.212	0.203	0.209
Consc.	0.121	0.140	0.105
Openness	0.199	0.218	0.189

Table 3: Estimated gambling equations

Variables	Gambling		Problem gambling	
	Females	Males	Females	Males
Education (completed year 12 is omitted category)				
Tertiary	-0.136***	-0.021	-0.172**	-0.187***
Vocational	0.115***	0.168***	0.095	0.093*
Low edu	0.103***	0.076**	0.163**	0.137**
Religion (no reported religion is the omitted category)				
Buddhism	0.018	0.158		
Christian	0.125***	0.135***		
Hindu	0.223*	0.141		
Islam	-0.439***	-0.416***		
Other	0.015	0.069		
Personality and non-cognitive skills				
Loc. control	-0.437***	-0.852***	0.292**	-0.067
Extrov.	0.008	0.026**	0.063**	0.064***
Agreeable.	0.054***	0.023*	-0.035	0.018
Emot. stability	-0.125***	-0.120***	-0.194***	-0.204***
Consc.	0.023*	0.020	-0.077***	-0.067***
Openness	-0.083***	-0.085***	-0.008	-0.040*
Deciles of SEIFA index				
2nd	0.021	0.075	-0.046	0.022
3rd	0.017	0.042	-0.193**	-0.098
4th	0.004	0.008	-0.305***	-0.075
5th	0.063	-0.036	-0.303***	-0.140*
6th	-0.056	-0.032	-0.242***	-0.059
7th	-0.057	-0.040	-0.399***	-0.180**
8th	-0.051	-0.012	-0.301***	-0.201**
9th	-0.125***	0.012	-0.243**	-0.051
10t	-0.235***	-0.090*	-0.560***	-0.091
Birth Country				
Europe/N. America	-0.101***	0.011	0.040	-0.097
Mid. East	-0.527***	-0.098	0.157	0.203
SE. Asia	-0.033	-0.163**	0.296***	0.094
E. Asia	-0.377***	-0.208	0.312**	-0.130
S. Asia	-0.210**	-0.080	0.089	0.059
Other	-0.198***	-0.028	0.039	0.036
Indigenous status and family background				
Indigenous	0.007	0.106	0.473***	0.319***
Parent divorced	0.059*	0.071**	-0.012	0.221***
Lone parent at 14	0.035	0.046	0.046	0.153***
Cons.	-0.596**	-0.686***	-3.020***	-1.982***

Significance: *** at 1%; ** at 5%; * at 10%.

Table 3: Estimated gambling equations (continued)

Variables	Gambling		Problem gambling	
	Females	Males	Females	Males
Cohorts (pre-1931 is the omitted category)				
1935	0.106	0.109	0.210	-0.118
1940	0.243***	0.184*	0.084	0.325*
1945	0.265***	0.266***	0.176	-0.242
1950	0.226**	0.236**	0.375*	0.123
1955	0.072	0.174	0.334	0.050
1960	0.040	0.301*	0.484	-0.041
1965	0.027	0.279*	0.361	-0.103
1970	-0.226	0.230	0.561	-0.152
1975	-0.333*	0.147	0.221	-0.235
1980	-0.418**	0.052	0.409	-0.273
1985	-0.687***	-0.010	0.244	-0.095
1990	-0.749***	-0.109	0.284	-0.047
1995	-0.861***	-0.392	0.507	-0.161
2000	-1.095***	-0.463*	0.425	-0.110
Age groups (less than age 21 is the omitted category)				
21-25	0.312***	0.346***	0.141	0.278**
26-30	0.439***	0.287**	0.361	0.260
31-35	0.525***	0.263**	0.581**	0.245
36-40	0.521***	0.362**	0.487	0.390
41-45	0.431**	0.281*	0.654*	0.483*
46-50	0.468**	0.369**	0.601	0.498*
51-55	0.397*	0.392**	0.618	0.325
56-60	0.449**	0.499**	0.713	0.359
61-65	0.472**	0.499**	0.678	0.269
66-70	0.326	0.586**	0.591	0.081
71-75	0.201	0.535**	0.866	0.147
Obs	19,295	17,856	19,295	17,856
$\log lik$	-10,154.095	-10,363.411	-1666.268	-2748.078

Significance: *** at 1%; ** at 5%; * at 10%.
Cohort 1935 indicates born between 1931-1935.
Cohort 1940 indicates born between 1936-1940, etc.

Table 4: Estimated gambling propensity scores

	Females	Males
Gambling	0.267 (0.14)	0.326 (0.10)
Prob gambling	0.011 (0.01)	0.037 (0.03)

Standard deviations are in the parentheses.

Table 5: Estimated log hazard equation for relationship dissolution

Duration effects Relationship		Difference in Partners' Char.		Characteristics	
0-1	-0.753***	Large age diff (+)	0.210***	Prop. Pg(f)	0.285***
	(0.172)		(0.070)		(0.077)
1-4	-0.009	Large age diff (-)	0.232***	Prop. Pg(m)	0.030
	(0.022)		(0.070)		(0.078)
4-20	0.005	Diff. Loc (+)	0.271***	LoC (f)	0.261***
	(0.009)		(0.055)		(0.052)
20+	0.065***	Diff. Loc (-)	0.116**	Extrov.(f)	0.261***
	(0.008)		(0.059)		(0.052)
Age					
14-20	0.029	Diff. Extrov. (+)	0.039	Agreeable (f)	0.033
	(0.077)		(0.056)		(0.055)
20-30	-0.050***	Diff. Extrov. (-)	0.075	Emo. stab.(f)	-0.006
	(0.011)		(0.049)		(0.061)
30+	-0.029***	Diff. Agree. (+)	0.174**	Conscientious(f)	-0.041
	(0.004)		(0.071)		(0.053)
Time					
-1985	0.038	Diff. Agree. (-)	-0.026	Openness (f)	0.200***
	(0.057)		(0.046)		(0.051)
1986-2010	0.061***	Diff. Emo. Stab.(+)	-0.010	Indigenous (f)	0.082
	(0.012)		(0.063)		(0.161)
2010+	0.151***	Diff. Emo. Stab.(-)	-0.079	Indigenous (m)	0.152*
	(0.008)		(0.060)		(0.088)
Constant	-4.577**	Diff. Consc. (+)	-0.008	Lang2-same	-0.966***
	((2.135)		(0.061)		(0.179)
Kids effects					
kchd	-0.556***	Diff. Consc. (-)	0.030	Eng.-only	-0.082
	(0.093)		(0.051)		(0.076)
kchda	-0.359***	Diff. Open. (+)	0.137**	Tert(m)-Non(f)	-0.232**
	(0.060)		(0.055)		(0.110)
		Diff. Open. (-)	-0.013	Non(m)-Tert(f)	-0.191**
			(0.057)		(0.084)
				Tert(m)-Tert(f)	-0.624***
					(0.108)
				Par. divorce (f)	0.152*
					(0.088)
				Par. divorce (m)	0.201**
					(0.097)

Significance: *** at 1%; ** at 5%; * at 10%.
'Tert' is tertiary educated. 'LoC' is Locus of Control. 'Emo. Stab.' is Emotional Stability
'Prop. PG' is estimated propensity to engage in problem gambling
(+) indicates the difference when the male characteristic is larger than female characteristic;
(-) indicates the opposite. See discussion under equation (3).

Table 6: Estimated log hazard equation for births

Duration effects Birth		Characteristics (female except where indicated otherwise)	
0-1	-0.200*	Tertiary	-0.061
	(0.119)		(0.047)
1-3	0.211***	Vocational	0.001
	(0.023)		(0.047)
3-5	-0.177***	Low edu	0.045
	(0.023)		(0.048)
5+	-0.011	Eur/N. Amer.	-0.136***
	(0.014)		(0.047)
Age			
14-20	-0.007	Mid. East	0.280**
	(0.013)		(0.128)
20-30	0.075***	SE. Asia	-0.014
	(0.010)		(0.075)
30+	-0.064***	E. Asia	-0.229*
	(0.003)		(0.122)
Relation			
0-2	0.028	S. Asia	-0.101
	(0.061)		(0.125)
2-5	0.036*	Other	0.161*
	(0.021)		(0.088)
5-10	-0.112***	Indigenous (f)	0.173**
	(0.011)		(0.078)
10+	-0.176***	Par.divorce(f)	-0.015
	(0.011)		(0.046)
Time		Indigenous (m)	0.254***
-1985	-0.018***		(0.094)
	(0.002)	Par. divorce (m)	0.032
1986-2010	-0.005		(0.052)
	(0.004)	Constant	-1.101***
2010+	-0.009		(0.162)
	((0.007)		

Significance: *** at 1%; ** at 5%; * at 10%.

Table 7: Estimated random effects

σ^2_ϵ	0.557***
	(0.134)
σ^2_η	0.023**
	(0.010)
$\sigma_{\epsilon\eta}$	0.113**
	(0.055)
$\ln -L$	-31031.7
No. of Records	29,148

Significance:
at 1%; ** at 5%; * at 10%.

Table 8: Estimated log hazard equation for relationship dissolution (observations with missing LoC or personality traits dropped)

Duration effects Relationship		Difference in Partners' Char.		Characteristics	
0-1	-0.850***	Large age diff (+)	0.295***	Prop. Pg(f)	0.199**
	(0.221)		(0.091)		(0.101)
1-4	-0.012	Large age diff (-)	0.240***	Prop. Pg(m)	-0.025
	(0.026)		(0.091)		(0.102)
4-20	0.027***	Diff. Loc (+)	0.270***	LoC (f)	0.261***
	(0.010)		(0.064)		(0.063)
20+	0.076***	Diff. Loc (-)	0.096	Extrov.(f)	0.140**
	(0.009)		(0.061)		(0.061)
Age					
14-20	0.006	Diff. Extrov. (+)	-0.006	Agreeable (f)	0.056
	(0.169)		(0.072)		(0.067)
20-30	-0.066***	Diff. Extrov. (-)	0.100*	Emo. stab.(f)	-0.050
	(0.015)		(0.060)		(0.075)
30+	-0.031***	Diff. Agree. (+)	0.165*	Conscientious(f)	-0.071
	(0.005)		(0.092)		(0.065)
Time					
-1985	0.018	Diff. Agree. (-)	-0.010	Openness (f)	0.218***
	(0.062)		(0.057)		(0.061)
1986-2010	0.051***	Diff. Emo. Stab.(+)	-0.066	Indigenous (f)	0.191**
	(0.013)		(0.079)		(0.096)
2010+	0.207***	Diff. Emo. Stab.(-)	-0.099	Indigenous (m)	0.225*
	(0.011)		(0.075)		(0.119)
Constant	-3.549	Diff. Consc. (+)	-0.081	Lang2-same	-1.020***
	(2.520)		(0.078)		(0.211)
Kids effects					
kchd	-0.497***	Diff. Consc. (-)	0.074	Eng.-only	-0.109
	(0.110)		(0.065)		(0.096)
kchda	-0.411***	Diff. Open. (+)	0.110	Tert(m)-Non(f)	-0.316**
	(0.071)		(0.071)		(0.146)
		Diff. Open. (-)	0.026	Non(m)-Tert(f)	-0.166
			(0.071)		(0.104)
				Tert(m)-Tert(f)	-0.646***
					(0.131)
				Par. divorce (f)	0.169
					(0.118)
				Par. divorce (m)	0.304**
					(0.123)

Significance: *** at 1%; ** at 5%; * at 10%.
'Tert' is tertiary educated. 'LoC' is Locus of Control. 'Emo. Stab.' is Emotional Stability
'Prop. PG' is estimated propensity to engage in problem gambling
(+) indicates the difference when the male characteristic is larger than female characteristic;
(-) indicates the opposite. See discussion under equation (3).

Table 9: Estimated log hazard equation for births (observations with missing LoC or personality traits dropped)

Duration effects Birth		Characteristics (female except where indicated otherwise)	
0-1	-0.208	Tertiary	-0.079
	(0.136)		(0.058)
1-3	0.206***	Vocational	-0.020
	(0.026)		(0.058)
3-5	-0.181***	Low edu	0.018
	(0.026)		(0.061)
5+	-0.007	Eur/N. Amer.	-0.110**
	(0.015)		(0.053)
Age			
14-20	-0.011	Mid. East	0.172
	(0.017)		(0.176)
20-30	0.080***	SE. Asia	-0.083
	(0.011)		(0.095)
30+	-0.071***	E. Asia	-0.198
	(0.004)		(0.148)
Relation			
0-2	0.040	S. Asia	-0.129
	(0.071)		((0.154)
2-5	0.044*	Other	0.106
	(0.024)		(0.107)
5-10	-0.104***	Indigenous (f)	0.191**
	(0.012)		(0.096)
10+	-0.179***	Par.divorce(f)	-0.013
	(0.013)		(0.054)
Time		Indigenous (m)	0.225*
-1985	-0.018***		(0.119)
	(0.003)	Par. divorce (m)	0.029
1986-2010	-0.004		(0.059)
	(0.004)	Constant	-1.151***
2010+	-0.005		(0.205)
	(0.008)		

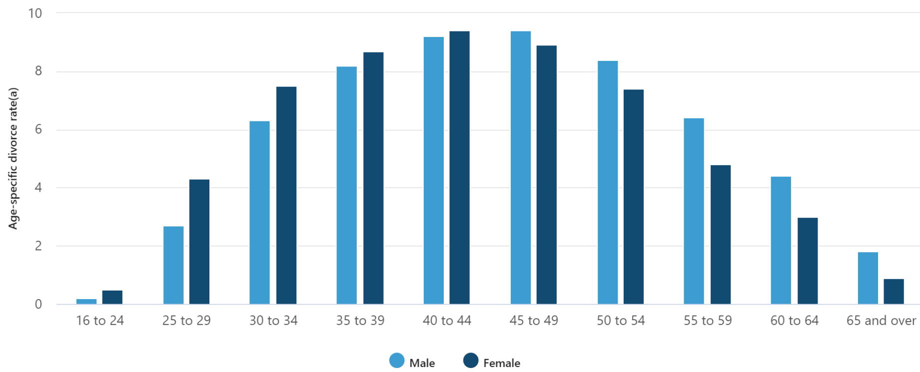
Significance: *** at 1%; ** at 5%; * at 10%.

Table 10: Estimated random effects (observations with missing LoC or personality traits dropped)

σ_ϵ^2	0.890***
	(0.227)
σ_η^2	0.024**
	(0.010)
$\sigma_{\epsilon\eta}$	0.145*
	(0.081)
$\ln -L$	-24327.6
No. of records	22,144

Significance:
at 1%; ** at 5%; * at 10%.

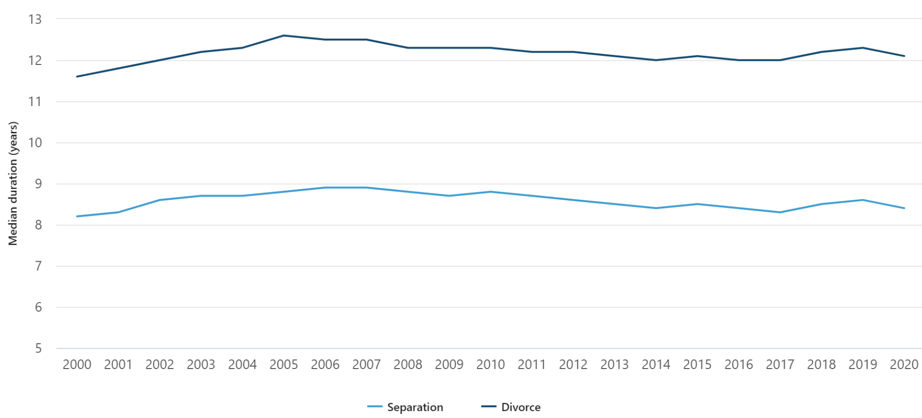
Figure 1: Age-specific divorce rates by sex (2020) (ABS (2021a))



a. Age-specific divorce rates reflect the number of males or females in a specific age group who were granted a divorce during the year, per 1,000 estimated resident population of males or females in the same age group, at 30 June for that year. There are a small number of persons aged under 16 years included in divorces data, who were legally married overseas. These persons are included in the 16-24 year age group when calculating rates. See 'Rates and rounding' in Methodology.
b. Same-sex couples could not be identified separately when calculating age-specific divorce rates by sex. The rates for males presented in this graph include age information for a very small number of females, and vice versa. Due to the small numbers involved, there is minimal impact on output.

Source: Australian Bureau of Statistics, Marriages and Divorces, Australia 2020

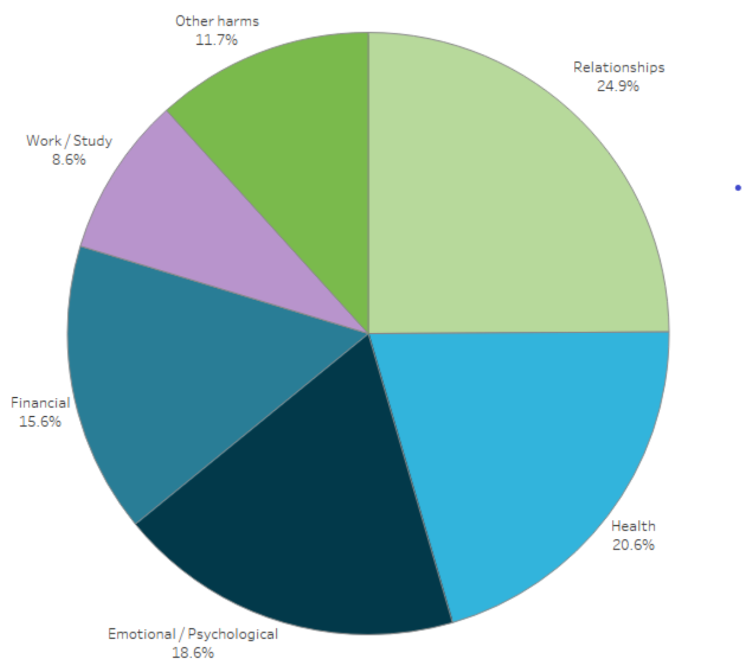
Figure 2: Median duration to separation and divorce, 2000 to 2020 (ABS (2021a))



a. Divorces data for 2018 and 2019 may differ to numbers previously published. See 'Considerations when interpreting data' in Methodology for more information.

Source: Australian Bureau of Statistics, Marriages and Divorces, Australia 2020

Figure 3: Proportion of gambling-related harm contributed by each domain (Browne et al. (2016))



Notes
1. Proportion of harm contributed by each domain, as calculated by random forest variable importance measure.
Source: Browne et al. 2016:136, Figure 19.

Figure 4: Raw hazard rates of relationship durations

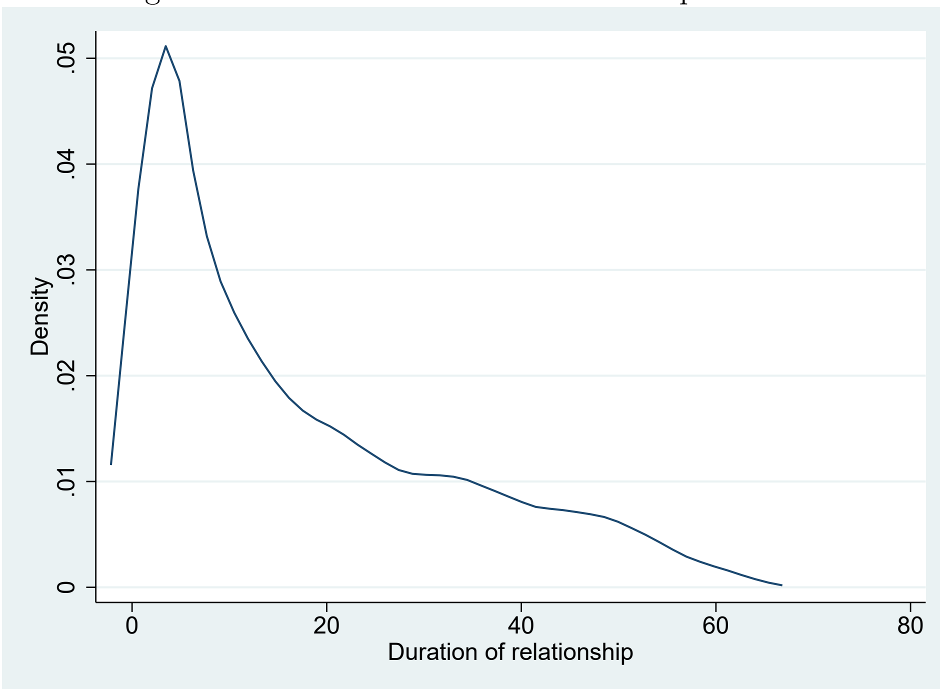


Figure 5: Estimated correlation between spouses' problem gambling propensities

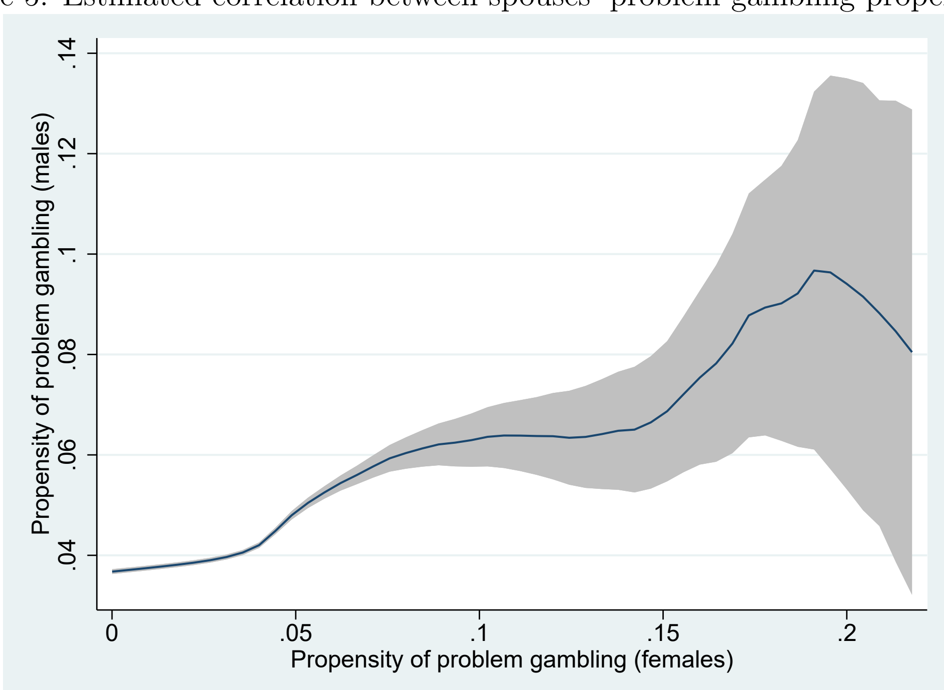


Figure 6: Estimated duration, age, and calendar effects on the baseline hazard