Pricing the Biological Clock: The Marriage Market Costs of Aging to Women

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This paper uses an innovative experiment to quantify the causal negative impact of age on women's marriage market value, and thus the economic costs of time-consuming human capital investments that delay marriage. In the experiment, real online daters rate hypothetical profiles with randomly assigned ages. Truthfulness is incentivized through the experiment's compensation—participants receive dating advice that is customized based on their ratings. The experiment shows that for every year a woman ages, she must earn $7,000 more annually to remain equally attractive to potential partners. I demonstrate this preference is connected to women's differential fertility decline with age by showing it is only present for men who have no children and have accurate knowledge of the age–fertility tradeoff.

JEL Codes: J12, J13, J16, C78, C93

1 Introduction

The ticking biological clock has mostly been examined as a personal tradeoff for women between career and family goals. However, if being older on the marriage market reduces match quality, which affects financial wellbeing, then the cost of delaying childbearing in favor of career investments is as much an economic one as a personal one. This paper isolates the causal negative impact of aging on women's marriage market attractiveness and provides a monetary measurement of its cost for the first time: the equivalent of $7,000 of annual earnings per year delay.

Quantifying the effect of aging for women on the marriage market requires separating it from other factors that confound observational data on who marries whom, including correlated characteristics, women's own preferences over partners, social norms, and meeting

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opportunities. Economics literature has improved on this by using data from either online dating sites or speed dating to measure one-sided preferences, rather than equilibrium matches (Fisman et al., 2006; Hitsch, Hortaçsu and Ariely, 2010; Belot and Francesconi, 2013). However, by measuring preferences over real individuals, these studies inherently cannot disentangle age from correlated traits with components the researcher cannot observe or control for. In the case of speed dating, participants interact before submitting their preferences, thus observing many more traits than the researcher does. In the case of dating sites, the profile communicates many age-correlated things, including photographs.

Moreover, a key trait that may be correlated with older age at marriage is human capital, or earnings capacity. While theoretical matching literature would suggest spousal earning capacity should be an unambiguous positive, empirical research suggests higher earning may not always be better for women (Bursztyn, Fujiwara and Pallais, 2017; Bertrand, Kamenica and Pan, 2015). The co-movement of age at marriage and human capital investments makes it difficult to explore preferences for either trait reliably in observational data, a phenomenon I demonstrate in 2.

This paper breaks out of this fundamental dilemma by using a novel incentive-compatible "framed field experiment" (Harrison and List, 2004) where age is randomly assigned to dating profiles. Real daters in their 30s are recruited using Google ads on online dating sites and dating-related keywords (since presumably the dating success of women in their 30s is not determined by undergraduate students). These subjects are asked to rate hypothetical profiles with randomly assigned age and income, but incentivized through the experiment's compensation. For their participation, they receive advice from a dating coach customized to attract the type of partners they are interested in, based on their ratings in the study. This compensation increases in value as ratings more closely reflect the rater's true preferences, incentivizing honest and careful responses. The experiment's key innovation is in creating an environment where the value of personal characteristics can be disentangled through randomization, while maintaining contextually relevant subjects and real stakes. This method of incentivizing responses to profiles with randomly assigned traits without deception has since been modified to provide an alternative to resume audit studies in Kessler, Low and Sullivan (2019), and subsequently used in a number of studies in domains such as eliciting preferences over doctors (Chan, 2022) and loan recipients (Macchi, 2022).

By holding the photo constant and varying age, I isolate the explicit optimization over

partner age from information correlated with age communicated visually, which has been pointed to as the driver of men's preference for age in sociology research (England and McClintock, 2009; Hakim, 2010; Etcoff, 2011). Even if age is seen as a statistical indicator of other factors, it is important to separate the partner's use of age itself as a criteria from correlated factors observed directly, in the same way the discrimination literature's use of audit studies determined that race was used for selection purposes, rather than simply being correlated with factors that interviewers could observe but researcher could not (Bertrand and Mullainathan, 2004). This experiment provides a framework for research in any matching market to isolate preferences for individual traits in a way not previously feasible in a deception-free incentivized setting.

The experiment shows that men, but not women, have a substantial negative preference for age. This preference is robust to multiple adjustments in sample inclusion, checks for attention, and controls. I quantify the preference through the use of randomly assigned income, which becomes a "numeraire" in interpreting preferences. Calculating the marginal rate of substitution between income and age in partner's preferences shows that for every year a woman ages, she must earn an additional $7,000 to receive the same rating, providing a quantitative measure of the marriage-market tradeoff in making time-costly human capital investments.

The penalty to aging in men's preferences would be expected to directly lead to a penalty for older women in spousal quality, and thus overall household income. In matching literature, one's traits being less valued on the marriage market lead to a worse match. Low (2022) demonstrates this theoretically for "reproductive" and human capital, with a transferable utility matching model that results in the richest men not always being matched with the richest women, due to these women's lower reproductive capital.

The experimental data also shows that both men and women value higher partner income, even when the profile out-earns the rater. While the intensity of the income preference declines when profile income is higher than rater income, this decline is symmetric for men and women, and does not cause the valuation of income to become negative in either case. This demonstrates that distaste for female earning may not underlie the apparent negative preference in observational literature (rather, female earning could be expected to be correlated in observational data with fecundity, or preferences for children and home production).

I then turn to exploring mechanisms for the age preference. To explore rater-level heterogeneity as well as confirm external validity, I replicate my experiment using a different and larger sample. Subjects for this second sample were recruited by Qualtrics research from their panel of survey takers. These subjects were similarly restricted to be single men and women in the relevant age category who were actively seeking to date. Although they were also compensated with customized dating advice for participating in the survey, they were not primarily recruited using advertisement of this benefit, and thus provide a good test of external validity. It is reassuring that the point estimates for age are nearly identical between the two samples.

As potential alternate explanations to a fertility preference, men and women could have an asymmetric reaction to age differences, or to a female partner being older in violation of social norms. I control for both potential channels, and find they do not drive men's negative preference for age. I do find, however, that *women's* apparent positive preference for age is entirely explained by a preference for the "social norm" two-year difference between men and women.

The remaining possibility is that age is correlated with expectations about personality or lifestyle traits that are either different, or differently valued, between men and women. To rule this out while providing support for the fertility hypothesis, I demonstrate that multiple factors that should increase men's preference for fertility, but not other youth-related traits, strengthen the negative preference for age. Men who are more interested in marriage and want kids have significantly stronger tastes for younger partners. This heterogeneity runs counter to what one would expect to find if, for example, the preference for age was driven by a preference for carefree youth, in which case we would expect a weaker preference among those seeking to marry.

Most compellingly, men who already have children, and thus have less reason to seek a fertile partner, exhibit no preference over age. Moreover, men who believe that the fertility decline does not start until after age 45 have no negative preference over the ages in the study, which range from 30-40. These two results clearly indicate that residual beliefs about other traits correlated with age do not drive the age penalty, as men who already have children or who misreport the timing of the fertility decline would also respond to other correlated traits. Finally, I show that non-linearity in the age preference aligns with a stronger negative preference closer to the fertility decline. Together, this provides evidence

that when age is randomly assigned, the substantial negative preference for it that remains is driven by fertility desires.

This paper thus contributes to the growing body of evidence that women's loss of fecundity with age affects them in multiple ways, including impacting marriage timing and human capital investments (Gershoni and Low, 2021a; Buckles, 2007; Abramowitz, 2017; Gershoni and Low, 2021b). The experiment presented here provides evidence that in addition to their own preferences to have children, women must contend with potential partners' preferences for younger and more fertile spouses, adding to the economic costs of aging to women. The fact that men do value income on the marriage market mean that women face a tradeoff between investing in one valuable trait, earning power, and depreciating another, fecundity, as modeled in Low (2022). This asymmetric marriage market penalty to aging has broad-reaching policy implications for both firms and governments, and warrants further research.

2 Literature and Observational Evidence

2.1 Literature and Hypotheses

There is ample anecdotal and academic evidence that men tend to match with younger women. Dating website OK Cupid has published data showing that men list their target age ranges as women much younger than themselves, and target their messaging at the younger end of that range).[1] The pattern has also been documented by sociologists England and McClintock (2009), who find that the age gap between spouses is increasing in the man's age at marriage. A 30-year-old man may marry a woman only a couple years younger than himself, whereas a 50-year-old man will, on average, marry a woman ten years younger. Choo and Siow (2006) find an average age gap of men being older than the women they marry by 2.36 years.

This would be consistent with a biological asymmetry in how aging affects men's and women's ability to have children. Whereas men can successfully conceive even as they age, women experience a decline in fecundity as they approach and pass 40, eventually ending in menopause, and thus the cessation of fertility (Frank, Bianchi and Campana, 1994). This decline is not linear from the onset of fecundity, but rather happens sharply beginning in the mid-thirties. Women lose 97% of eggs by 40 (Kelsey and Wallace, 2010), while remaining egg

[1] OK Trends, "The Case for an Older Woman," February 16th, 2010.

quality declines (Toner, 2003). The exact date of this decline may be difficult to pinpoint, but a collage of evidence points to pregnancies being rarer (Menken, Trussell and Larsen, 1986), more likely to end in miscarriage (Andersen et al., 2000), and more likely to result in fetal abnormalities (Hook, Cross and Schreinemachers, 1983) as women age.

If one of the main sources of marital surplus is the production of children, men seeking to capture this value of marriage may seek women young enough to conceive, even as they themselves age. This aligns with literature suggesting that fecundity is an important marriage market trait (Edlund, 2006; Edlund and Korn, 2002; Grossbard-Shechtman, 1986; Arunachalam and Naidu, 2006). The marriage market value of fertility is taken as a given in other disciplines such as evolutionary biology (Trivers, 1972) and anthropology (Bell and Song, 1994), and there is an even broader literature on the valuation of women's youth more generally (e.g., Helleseter, Kuhn and Shen, 2020; Etcoff, 2011). However, this paper aims to separate age itself from correlated attractiveness. While men having tastes for women who *look* younger may nonetheless be rooted in an evolutionary-driven desire for fertility, it would have starkly different policy implications than a true preference for age.[2]

At the same time, matches reveal a tendency toward assortative matching on age, or age similarity, as shown in Shephard (2019); Chiappori, Salanié and Weiss (2017b); Lee and McKinnish (2018), with a modal gap of the husband being older by 1-2 years. At the same time, the asymmetry in couples with older women being rare, and increasingly so as men become older at first marriage, is also documented in this literature. Studies that try to examine preferences through online dating behavior, without confounding from meeting opportunities, also show an observed preference for age similarity (Hitsch, Hortaçsu and Ariely, 2010), but a stronger negative preference on age by men.

Thus, from the literature, one might hypothesize that men would place a negative value on women's age. One would also hypothesize that men's preference for age would be connected to fertility, and thus would be stronger for men who care more about fertility or have more knowledge about it, and would be more intense closer to the period of fertility decline. One would expect women to have a preference for age *similarity*, but no secular preference for younger men, since there is no fertility motive.

[2]Easier access to assisted reproductive technologies would help reduce a fertility tradeoff, whereas if the age penalty were driven entirely through attractiveness, policymakers might consider a botox subsidy instead.

Age is often correlated with income, which is another crucial trait on the marriage market. Interestingly, the literature is somewhat ambiguous as to whether women's income is a valuable marriage market trait. Studies on revealed preferences from observed matching appears to indicate that both men and women value partner income and human capital. Assortative matching on income is the norm, and generally believed to be getting stronger over time (Chiappori, Salanié and Weiss, 2017a; Hurder, 2013; Greenwood et al., 2016, 2014; Fernandez, Guner and Knowles, 2005; Schwartz and Mare, 2005; Reynoso, 2018; Chiappori et al., 2022).

However, some evidence points to women's preference for income being stronger, and men potentially even having an aversion to women being especially high earning. Fisman et al. (2006) uses a speed dating experiment to show men place a much stronger value on attractiveness than intelligence, compared to women. Bertrand, Kamenica and Pan (2015) points to an apparent discontinuity in the distribution of households where the wife earns more as evidence that there may be an aversion to high earning women. Bursztyn, Fujiwara and Pallais (2017) notes that unmarried female business school students deliberately downplay their earnings ambitions when they will be publicly revealed to a class including male peers. However, Binder and Lam (2018) shows that the "missing mass" of female breadwinner couples can be explained entirely by couples with equal earnings, while Shenhav (2021); Grow and Van Bavel (2020) point to the role of relative earnings distributions in explaining the gap. A positive taste for income by both genders is shown in online dating behavior in Hitsch, Hortaçsu and Ariely (2010), and although women's preference is stronger, men's is not found to vary substantially by own income.

Thus, from the literature, one might hypothesize that both men and women would value partner income. However, one might expect women's preference to be stronger, and men's valuation of female earning to decline or even turn negative at the point where income is higher than their own.

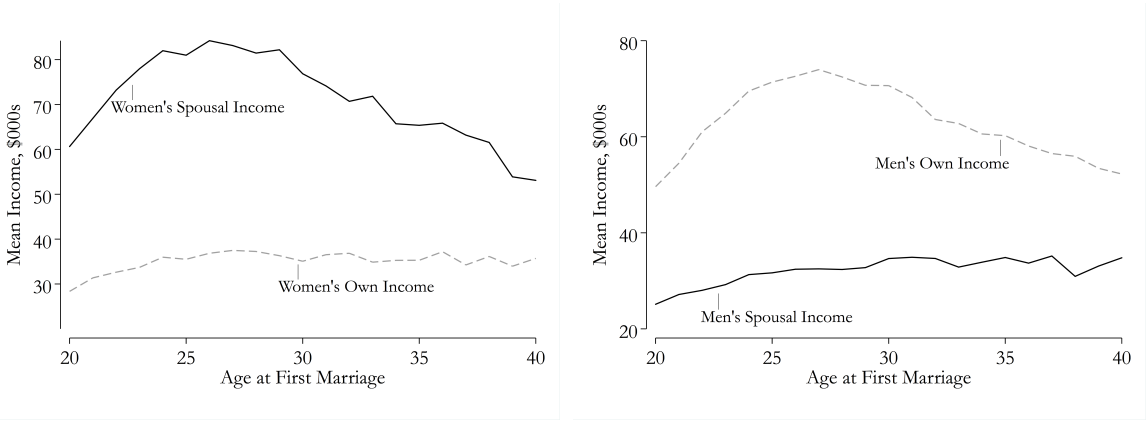
2.2 Observational Evidence

In this section, I examine the limits of observational data in examining these relationships, and why an experiment will be helpful in isolating and quantifying each men's and women's preferences for age and income.

Literature on matching tells us that traits being valued on the marriage market would

Figure 1: Spousal Income and Own Income by Age at First Marriage

(a) Women (b) Men



Notes: Data from 2010 American Community Survey, for women and men aged 41-50, so there is no sample selection by age of marriage. Restricted to first marriages. Spousal income is current spousal income. Income measure is total income, in USD.

correspond to a correlation between those traits and positive traits in one's spouse (Chiappori, 2017). Thus, one way we can think about measuring whether men value women's youth is to look at the relationship between women's age at marriage and spousal income.

Figure 1 shows that while women's own income is increasing in age at marriage, her spouse's income is decreasing in age at marriage beyond age 26.[3] This provides some suggestion that older women may be considered less "valuable" for the marriage market, especially as the pattern is different for men—spousal income for men is monotonically increasing in age at marriage. However, the relationship of men's own income to age at marriage also illustrates how difficult it can be to infer valuations from matching patterns alone: men's own income is decreasing in age at marriage past their late twenties,[4] indicating that the decreasing spousal income shown for women could be linked to them marrying older, and lower earning, spouses.

To further illustrate the challenges with observational data, Table 1, Column (1) shows that regressing spousal income on age at marriage for women actually yields a positive coefficient. This makes sense, since age at marriage is correlated with a host of socioeconomic factors, as shown by the positive selection by age at marriage for women, exhibited in Figure 1. Controlling for whether a woman has earned a college degree flips the sign to negative, as shown in Column (2).

[3]Note: a similar figure to the left panel of Figure 1 appears in Low (2022).

[4]As first noted by Zhang (2021).

Table 1: Age and Education Relationship to Women's Spousal Income

	Dependent Variable: Spousal Income			
	(1)	(2)	(3)	(4)
Doctoral Degree (vs. College)			16,364***	17,489***
			(2,824)	(2,829)
Age at Marriage	446.7***	-240.1***		-573.0***
	(37.69)	(36.76)		(103.2)
College Plus		47,182***		
		(472.0)		
Constant	60,354***	60,095***	96,902***	112,104***
	(983.4)	(942.2)	(577.4)	(2,798)
Observations	111,796	111,796	28,485	28,485
R-squared	0.001	0.083	0.001	0.002

Notes: Column 1 regresses spousal income on age at marriage, while Column 2 adds a control for having a college degree. Column 3 regresses spousal income on having a doctoral degree, among women with college degrees, while Column 4 controls for age at marriage. 2010 American Community Survey, for women 41-50, restricted to first marriages. Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Similarly, age at marriage can confound measurements of the valuation of other positive traits on the marriage market. Columns (3) and (4) show the relationship between women having a doctoral, versus college, degree and spousal income. The coefficient on a doctoral degree jumps $1,000 in column (4) once the $500 per year penalty of marrying older is accounted for.

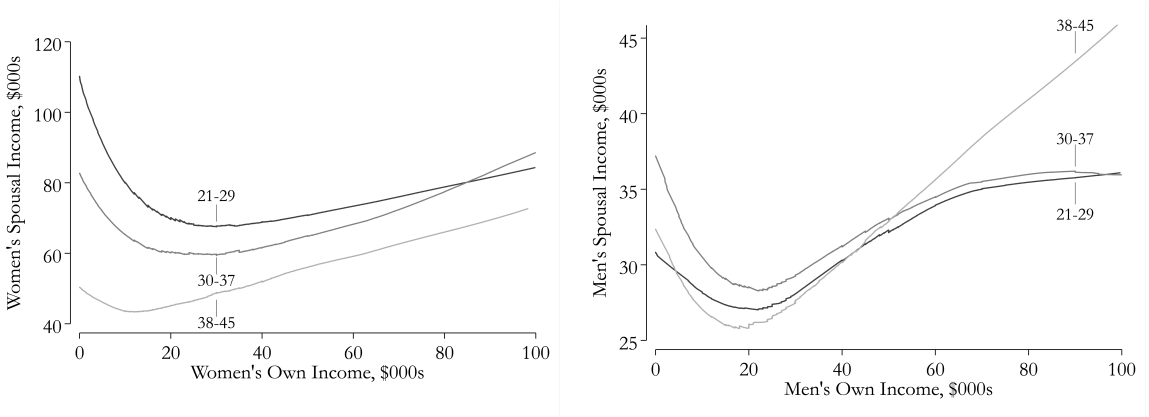
The valuation of women's income is something that is also difficult to measure in observational data, as it is so often correlated with other traits, and is endogenously determined by the couple's choices about specialization.

Figure 2 shows that for both women and men, the relationship between own income and spousal income is u-shaped. This suggests that either only those who have a fairly high-earning spouse can afford to stay home, or that the spouses of people earning low income endogenously increase their own income. This highlights the difficulty in using observational data on income matching to measure preferences over partner income.

When controlling for own income, higher age at first marriage is associated with lower spousal earnings for women, but not for men, unlike the similar patterns for spousal income. As Figure 2 shows, at each level of own income, women marrying older is associated with

Figure 2: Spousal Income by Age at First Marriage, Controlling for Own Income

(a) Women (b) Men



Notes: Data from 2010 American Community Survey, for women and men aged 46-55, so there is no sample selection by age of marriage. Restricted to first marriages. Spousal income is current spousal income. Income measure is total income, in USD.

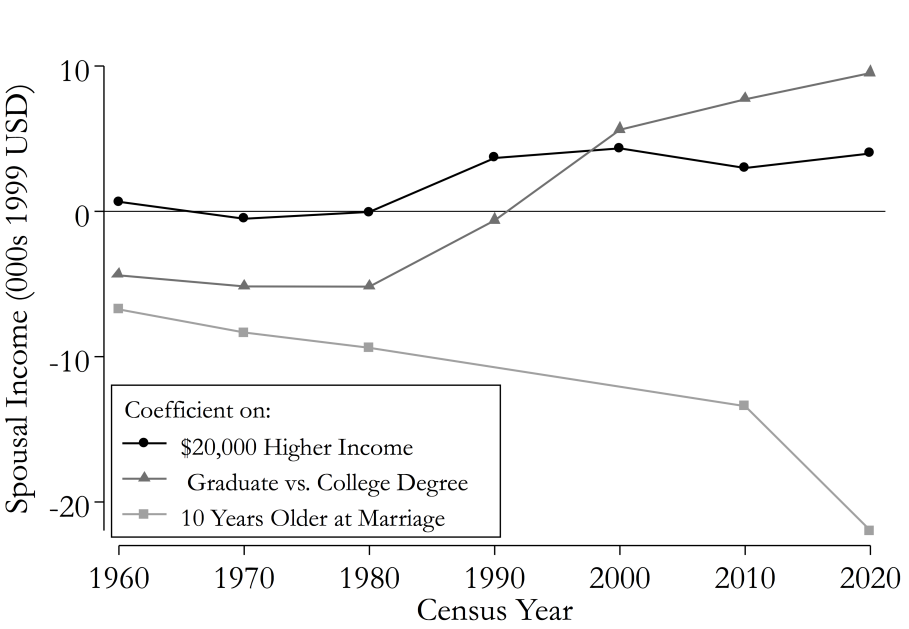
having a poorer spouse. Women who marry between 30 and 37 are married to lower-earning spouses than women who marry between 21 and 29. And women who marry between 38 and 45 are married to poorer spouses still.

For men, on the other hand, marrying in one's 30s is actually associated with a higher level of spousal income than marrying in one's 20s. And, while marrying between 38 and 45 is associated with the lowest spousal income for low-earning men, it is associated with the highest spousal income for high-earning men. This suggests the possibility of an asymmetry in how aging impacts men and women on the marriage market, mirroring the biological asymmetry in the impact of aging on fertility.

But, while these patterns provide suggestive evidence that age at marriage may be a negative trait for women, they also further demonstrate why an experiment that could isolate age at marriage and income from one another is necessary to truly causally identify the effect of either age or income.

To further examine interesting patterns in correlations between women's traits and spousal income, I chart the relationship to spousal income of three factors over time using US Census data from 1960 to 2020: having a $20,000 higher income, having a graduate versus a college degree, and marrying 10 years older (from 30 to 40–above the ages where there is significant correlation with education). Interestingly, until 1990, having higher income was not at all correlated with higher spousal income. Post 1990, it is correlated with around $5,000 in higher spousal income. Having a graduate degree versus a college degree was negatively related to spousal income until 1990, then positively from 2000 onward.

Figure 3: Spousal Income Penalties and Premiums Over Time



Notes: Figure shows regressions of spousal income on own income being $20,000 higher, having a graduate degree versus a college degree (among the population of college graduates), and marrying 10 years later for marriage ages between 30 and 40. Data from the 1960-2000 decennial Census and 2010 and 2020 American Community Survey, for women age 41-50, so there is no sample selection by age of marriage. Spousal income is current spousal income. Income measure is total income, in 1999 USD.

Low (2022) shows that this can be explained by a bi-dimensional matching model where education is correlated with higher human capital but lower reproductive capital, and the reproductive capital costs of educational investments falling as family sizes have lowered over time. This is consistent with the confounding from age at marriage shown in Table 1. Marrying 10 years later, after age 30, which will be correlated with lower reproductive capital, has always been negatively correlated with spousal income, but appears to be more-so in 2010 and 2020 (age at marriage information is not available in 1990 and 2000, and 2020 data should be interpreted with caution.)

If there is a causal relationship between women's age at the marriage market and their appeal to potential partners, we would further expect a causal relationship with equilibrium match quality, since the appeal of one's own traits influences the quality of one's partner and the share of surplus one is expected to receive. In this way, having "worse" marriage market traits makes women economically poorer, through lower total household income, and a lower surplus share within the household. But, whether these relationships are causal

and if so, how to quantify their costs, has not been adequately determined.

Thus, I now turn to an experiment designed to disentangle the causal impact of each partner age and income on marriage market preferences. By doing so, I will be able to examine and test hypotheses generated by the literature on how partner age and income enter into each men's and women's preferences. I will also be able to quantify the preference for age by using income as a benchmark, and thus measure the economic tradeoff between human capital investments and the ticking of the biological clock for women on the marriage market.

3 Methodology

3.1 Experimental Design

3.1.1 Incentives

The experimental design aims to overcome the fact that personal characteristics are naturally correlated in real people. While speed dating experiments such as Fisman et al. (2006) offer the researchers more control, they still face this challenge in isolating correlated characteristics, especially because, as in job interviews, many things are observable to the decision maker that are not quantifiable by the researcher. To truly separate age from other factors, such as attractiveness, the researcher needs to be able to *randomly assign* age. But, if age is randomly assigned, potential dating partners cannot be real, and so the incentives present in a speed-dating experiment would be absent. While one could in theory simply ask real daters to evaluate hypothetical profiles, it would not have the validity of an incentive-compatible experiment. And, if the profiles were instead presented as real, it would violate the norm in experimental economics against deceptive practices (see, e.g., Hertwig and Ortmann (2001)), introducing a host of issues related to subject pool contamination, rational expectations, and experimental ethics.

To solve this problem, I employ a unique hybrid of a field and lab experiment. Real online daters were recruited to rate profiles to which age was randomly assigned. Participants were informed that the profiles themselves were hypothetical, but that their ratings would be used to customize professional dating advice on how to attract partners that fit their preferences. Because recruitment ads promoted this compensation, and participants spend their time on the study in expectation of receiving it, it can be assumed they place value on the dating

advice and therefore want to increase its quality. The best way to do so is to respond accurately regarding their preferences over the hypothetical profiles. Thus, researcher and subject incentives are aligned.

To provide the advice, I hired a professional dating coach to offer advice on optimizing each subject's own profile based on their ratings in the study. I provided the dating coach a summary of each subject's preferences for different traits based on their responses in the study, in order for her to prepare customized advice. To satisfy IRB requirements, participants needed to agree to have their information shared with a third party in order to receive the advice.

This type of non-monetary incentive structure for rating hypothetical objects has been expanded to study employer preferences in Kessler, Low and Sullivan (2019), where employers rated hypothetical resumes and then received recommendations of real candidates in return, in lieu of a deceptive audit study. A similar model has subsequently been used in a range of experiments, such as for measuring racial discrimination in preferences for doctors (Chan, 2022) and measuring the value of being overweight for loan applicants in Uganda (Macchi, 2022). The model of using advice in particular to incentivize truthful survey answers could be used to provide incentives for experiments in many other settings, ranging from investment portfolio choice to real estate tastes to job seeker valuations of firm amenities.

3.1.2 Recruitment

For the initial sample, subjects were recruited using online ads, placed on dating sites such as Match.com or OKCupid, or linked to searches of dating-related keywords, using Google Ads. I call this sample the Web Ad sample. A sample ad is shown below:

A Better Dating Profile

Single & 30-40? Take this survey &

get expert dating profile advice!

www.columbiadatingstudy.com

Clicking the link in the ad brought them to a website explaining the study and the dating advice incentive, where they could click to begin rating profiles.

Following the implementation of this initial experiment, I conducted a second experiment with a larger sample in order to test for heterogeneity in men's preferences for age. In order to recruit the larger sample and test the external validity of my results, I enlisted a survey firm, Qualtrics, to recruit respondents. This second population was also incentivized with the free dating advice, but may have valued it less due to being offered other incentives Qualtrics typically gives to survey respondents on their panels (e.g., frequent flyer miles, gift certificates, raffles). As these respondents were not exclusively interested in receiving dating advice, they may be a more general population than the initial sample.

Subjects were recruited to be single, heterosexual, between the ages of 30 and 40, and white. The ages of 30-40 were chosen because the profiles were going to be in this age range. White raters (and profiles) were chosen to avoid the noise from cross-racial ratings. In the initial recruitment, which I will call the "Web Ad sample," 151 men and 168 women rated at least one profile. However, I restrict my main analysis to those who completed all 40 ratings and reached the post-survey, as well as those meeting the race and age eligibility requirement, leaving 36 men (1440 observations) and 45 women (1800 observations), and show robustness to other sample decisions. The Qualtrics sample contains only completed responses, comprising 202 men (8080 observations) and 101 women (4040 observations).[5]

3.1.3 Profile Generation and Randomization

The profiles shown to participants each contain fixed and randomized components. The fixed components includes the photo, the username, "Looking for: Long-term relationship," a height, and a set of three interests. The randomized components, which are drawn each time a rater views a profile, and thus randomized at the rater-profile level, are age and income. The experiment was coded in Qualtrics, using html tools to make the rating screen appear more like a hypothetical dating profile, and then using a JavaScript add-on within Qualtrics to allow the inclusion of random objects (age and income) drawn from an underlying list.

To generate the fixed portion of the hypothetical dating profiles, I purchased stock

[5]In order to test for heterogeneity in men's preferences, male respondents in the Qualtrics sample were enrolled at a 2:1 ratio to female respondents. The extra sample was drawn from the higher end of the income distribution, with the objective of better mirroring the general population (Qualtrics respondents, in absence of this sampling concentration, tended to be lower-income). Additionally, 1 man in the Web Ad sample, 5 men in the Qualtrics sample, and 3 women in the Qualtrics sample were dropped due to using a javascript blocker, which blocked the random assignment of age and income to the profiles.

photos that were similar in appearance to photos on dating websites and of ambiguous age, meaning no balding or gray hair, no obvious facial wrinkles, and no overly youthful hairstyles or clothing. I then had 120 undergraduate students rate each photo's physical attractiveness and guess the age of the individual in the photo.[6] The final 40 photos of each gender were selected to balance attractiveness and visually perceived age between the male and female profiles (with photos with a visually perceived age outside 30-40 removed). Appendix figure A2 shows a sample of photographs used for both men and women.

Figure 4: Sample Profile Image and Rating Screen

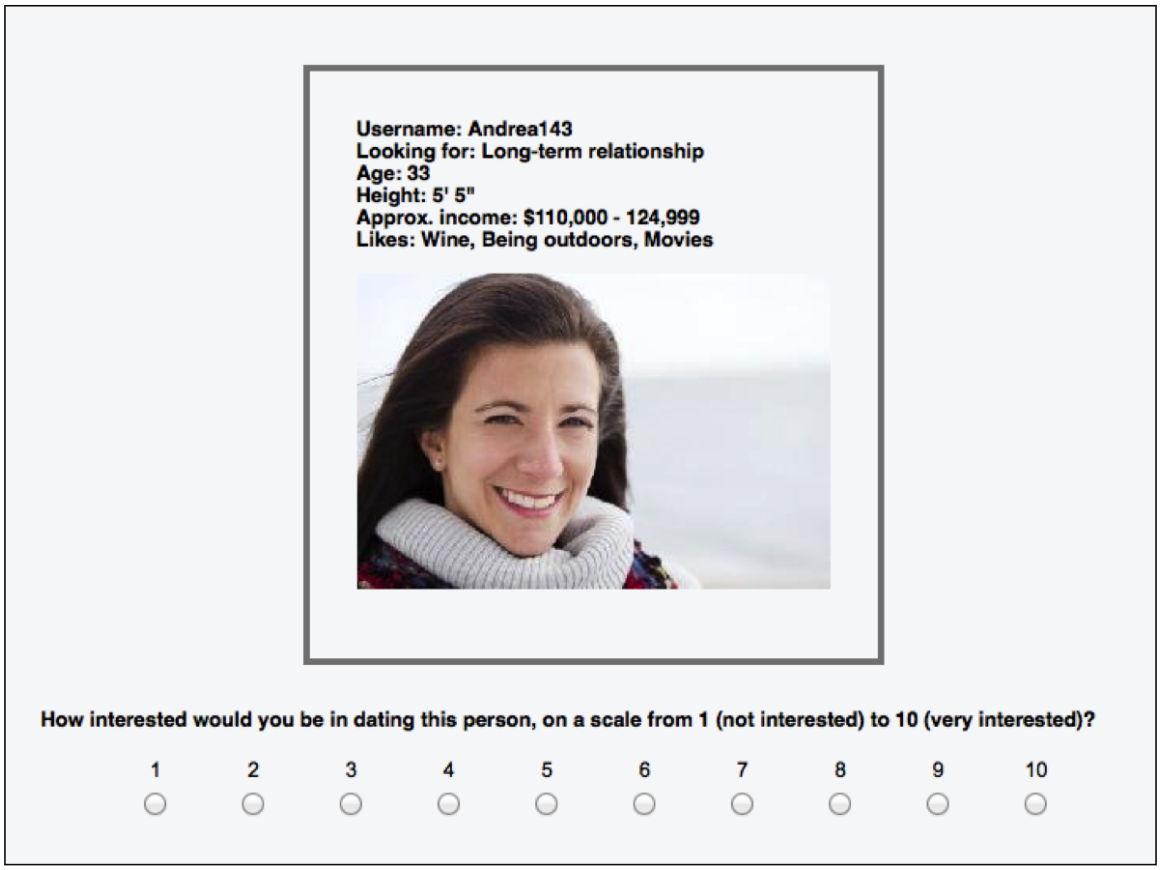


Image depicting profiles shown to study participants. Age and income are randomly assigned for each rater - profile pair, while other characteristics are initially randomly combined, and then fixed to a profile.

Figure 4 shows the profile and rating screen shown to participants. A random username, height, and three interests were then assigned to the photos to create 40 male and 40 female dating profiles. The usernames were assigned by using the top 40 names for men and

[6]This guessed age is also used to construct the "*Visual age* − *age*" variable. Students were recruited from an introductory econometrics class and given course credit for their participation.

women from the decade of birth for 30-40 year olds, then assigning a random three-digit number. The heights were assigned randomly from a normal distribution using the mean and standard deviation of heights for white men and women. Gender-neutral interests were assigned from a list of top hobbies, with more popular interests being assigned more frequently. All profiles listed the person as "looking for: serious relationship," in order to signal that the rater should consider this person as a potential long-term partner. Each of these characteristics were assigned to the profile and remain fixed throughout the experiment.

As each profile was shown, age and income were randomly assigned at the rater-profile level: age between 30 and 40 (inclusive), and an income range from roughly the 25th to 95th percentile for single individuals with at least an associate's degree in the 2010 Census. Each respondent would see the same picture and other profile details, but paired with a different income and age. The random variation in age isolates it from other factors that may be correlated with it, such as physical attractiveness. Income also being randomly assigned provides a "numeraire" by which to quantify the preference for age.

3.1.4 Experiment Protocol

The experiment proceeded as follows: Respondents click a link either from the website linked to an online ad (Web Ad sample) or from a Qualtrics recruitment email, and are brought to a consent form that explains the study and describes the dating advice. Appendix figure A1 shows the experiment's instructions and how the dating advice was described to participants. After agreeing to proceed, they are shown a series of dating profiles, and asked for each one, "How interested would you be in dating this person, on a scale from 1 (not interested) to 10 (very interested)?"

After 10 profiles, respondents are asked to rank the previous 10 profiles in terms of who they were most interested in, both to provide a break between rating sessions, and as an attention check. The correlation between the ratings and rankings is high, providing validation of the incentives for careful rating being operative. Moreover, as a robustness check, I exclude responses with a low correlation. After rating 40 profiles, respondents complete a brief post-survey including demographic information, dating preferences, and, finally, their knowledge of age-fertility limits for men and women. The last screen asks them to agree to sharing their data with dating coach in order to receive the advice by entering

their email address. For additional details on the experimental methodology, as well as data summary statistics and histograms of ratings, see Appendix A.

3.2 Data and Empirical Method

3.2.1 Data Summary Statistics

Table 2 presents summary statistics for the post-survey, for the target sample.[7] Men and women taking the survey display similar characteristics. although the men are more likely to be high-income, defined as income over $65,000 per year, in the Web Ad sample. In the Qualtrics sample, income is lower generally, since this is a panel of people interested in taking surveys. Men who were high income were deliberately over-sampled, leading to the large disparity between the male and female samples. Respondents from the Web Ad sample are also more likely to be college graduates (67% of men and 69% of women), than those from the Qualtrics sample (49% of men and 47% of women).

Aligning with other observational evidence, one place where men and women differ substantially is their stated preferences for the age of their partner. In the Web Ad sample, men state on average that the youngest they would date is a 26 year old and the oldest is a 41 year old, whereas women state averages of 33 and 47. (When it comes to their preferred dating range, men look for women aged 29 to 37, whereas women seek partners between the ages of 35 and 44.) The Qualtrics sample shows a similar pattern. This lower target dating range for men shows some preliminary evidence that men have differential preferences over partner age than do women.

The sample is about evenly split in terms of who is seeking marriage in the near future, with 47% of men and 43% of women seeking marriage in the Web Ad sample, and 47% of men and 44% of women in the Qualtrics sample. In terms of wanting kids, or more kids, now, fewer people express this: 25% of men and 16% of women in the Web Ad sample, and 18% of each in the Qualtrics sample. However, those who do not already have children may be interested in having kids at some point. 36% of men and 43% of women already have

[7]The consent form required respondents to certify that "I am between 30 and 40 years old, currently single, and seeking a partner of the opposite gender." However, in the post survey, some initial-sample respondents listed birth years outside the 30-40- year old range. In my main specification, I exclude these responses. Also, although the profiles feature only white men and women, I did not restrict the race of respondents, so I also exclude non-white respondents during the analysis phase, since cross-racial rankings may be driven by different factors. Without these restrictions, in the Web Ad sample 77% of male and 78% of female participants are white, and 74% fall within the targeted age range. For the Qualtrics sample, respondents were pre-screened based on race, relationship status, and age.

Table 2: Summary Statistics

	Web Ad Sample				Qualtrics Sample			
	Male raters N=36		Female raters N=45		Male raters N=202		Female raters N=101	
Rater Traits	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age	35.3	3.7	35.9	3.5	34.7	3.0	34.4	3.2
High income	0.50	0.51	0.36	0.48	0.40	0.49	0.16	0.37
College grad	0.67	0.48	0.69	0.47	0.49	0.50	0.47	0.50
Lowest age would date	25.9	3.6	33.0	3.9	24.9	4.4	30.1	4.1
Highest age would date	40.9	5.5	46.9	6.9	41.6	6.1	44.2	7.4
Wants marriage	0.47	0.51	0.43	0.50	0.47	0.50	0.44	0.50
Wants (more) kids now	0.25	0.44	0.16	0.37	0.18	0.39	0.18	0.38
Already has kids	0.36	0.49	0.43	0.50	0.19	0.40	0.43	0.50
Female infertility age	41.4	6.4	39.7	4.7	43.1	7.2	41.1	6.3
Infertility knowledge	0.75	0.44	0.79	0.41	0.61	0.49	0.67	0.47
Profile Traits	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Visual Age > Profile Age	0.44	0.50	0.32	0.47	0.44	0.50	0.33	0.47
Profile Age > Rater Age	0.41	0.49	0.38	0.49	0.48	0.50	0.51	0.50
Profile Inc > Rater Inc	0.48	0.50	0.58	0.49	0.56	0.50	0.70	0.46

Notes: Summary statistics for in-sample men and women from online dating experiment. High income is classified as earning over $60,000 annually. Female infertility age is from a question asking at what age it becomes biologically difficult for women to conceive. "Infertility knowledge" is a binary variable for answering an age before 45. Visual Age > Listed Age is a binary variable for the visual appearance of the profile photo, as rated by undergraduate students, being higher than the randomly assigned age.

kids in the Web Ad sample, whereas this is only 19% of men, but still 43% of women, in the Qualtrics sample. Importantly, for later heterogeneity analysis, these variables do not perfectly overlap. For example, for men in the Qualtrics sample, 73% of those who want to get married soon do not want kids soon, and of those who want kids soon, 32% do not want to get married soon.

The final questions on the survey ask men and women at what age they believe it becomes biologically difficult for women to conceive a child. Male raters believe the fertility decline starts on average at 41.4 in the Web Ad sample (whereas female raters guess an average of 39.7 years), and 43.3 in the Qualtrics sample (41.1 for female raters). Respondents are coded as having accurate infertility knowledge if they state the female fertility decline is before age 45, and this applies to 75% of men and 79% of women in the Web Ad sample, and 61% of men and 67% of women in the Qualtrics sample. To check attention and consistency,

respondents were also asked about a male fertility decline, and were more likely to state that there was no age at which fertility declined, and if they did provide a cutoff, estimated it to be substantially later than for women.

I also provide some information on frequency for traits later used that occur at the profile $\times$ rater level. First, the profile photo looking visually older (as rated by undergraduate students) than the randomly assigned age. This occurs 44% of the time for the male raters (rating female profiles) and 32% of the time for the female raters (rating male profiles). Because this differs by rater gender, I control for it in Table 3 to ensure it does not impact results. Second, the interaction between rater age and profile age may be important. The profile age is older than the rater age 41% of the time for male raters and 38% of the time for female raters in the Web Ad sample, and 48% of the time for male raters and 51% of the time for female raters in the Qualtrics sample, where the raters were slightly younger on average. And, finally, profile income is higher than rater income 48% of the time for male raters and 58% of the time for female raters in the Web Ad sample, and 56% of the time for male raters and 70% of the time for female raters in the Qualtrics sample.

3.2.2 Empirical Specification

I identify the effect of randomly assigned ages on ratings for men rating women and women rating men, using the specification:

$$Rating_{ij} = \beta_0 + \beta_1 age_{ij} + \beta_2 income_{ij} + \alpha_i + \theta_j + u_{ij},$$

where $Rating_{ij}$ is the rating on a 1-10 scale that individual i gives profile j. Age and income are assigned at the rater–profile level. Because each individual rates 40 profiles, and each profile is seen by multiple individuals, both rater, α_i, and profile, θ_j, fixed effects can be accounted for. Where no interactions are included between rater and profile characteristics, I present heteroskedasticity-robust standard errors, since "group status"—the rater—is not correlated with the x variable of interest, age, due to the random assignment. When examining heterogeneity among respondents, I present standard errors clustered at the respondent level.[8]

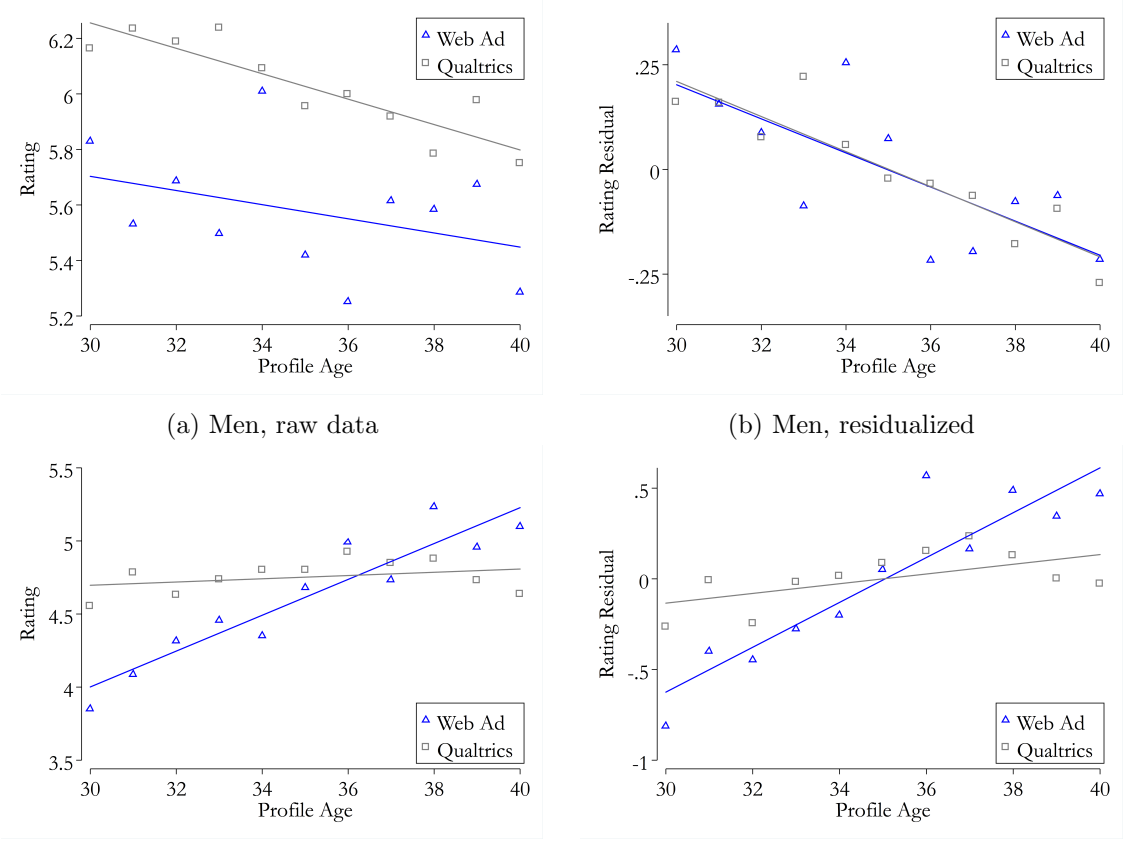
[8] See: Angrist and Pischke (2008), page 311.

4 Results

4.1 Preferences Over Age

Figure 5 charts average ratings by profile age for men rating women, top panel, and women rating men, bottom panel. The right-hand side graphs remove noise and standardize the ratings in the two samples by first regressing ratings on profile and rater fixed effects, and then graphing the residuals over profile age. Men's ratings are decreasing in women's ages, while women's ratings are increasing—a stark contrast. When residualized, the slope in ratings with age for male raters is nearly identical between the Web Ad and Qualtrics sample. Interestingly, female raters exhibit a slightly higher slope in men's age in the Web Ad sample. Women's ratings are also more variable generally, as shown in Appendix Figure A3.

Figure 5: Age Preferences



(a) Men, raw data

(b) Men, residualized

(c) Women, raw data

(d) Women, residualized

Notes: Web Ad data from 36 men (1440 observations), 45 women (1800 obervations) and Qualtrics data from 202 men (8080 observations) and 101 women (4040 obervations). Ratings are on a 1-10 scale. Right panels plot the residuals from regressing on rater and profile fixed effects.

Table 3 shows a regression of ratings on randomly assigned profile age and income in the Web Ad sample (Panel A) and Qualtrics Sample (Panel B). Starting with the Web Ad Sample, Column (1) shows that for male raters, each year of women's age is associated with a 0.044 decrease in rating, significant at the 1% level. Thus, if a woman is 10 years older, she will be rated almost a half point lower on average. A woman who is $10,000 poorer is rated 0.06 points lower, indicating a positive preference for income, when age is controlled for (section 4.2 further examines the preference for income). Thus to make up for each additional year of age, a woman must earn approximately $7,000 more.

This provides a benchmark for firms in thinking about the economic costs to women of career investments that delay marriage and childbearing. If these investments are unlikely to yield at least a $7,000 increase in salary, they would lead to marriage market costs that may hurt women financially, in addition to the personal loss of lower expected fertility and potentially invasive fertility-extending medical procedures. To further interpret the magnitude of this coefficient, consider that median income for women in the United States is $35,838,[9] and thus being willing to give up $7,000 in annual earnings for a partner who is one year younger means giving up around 20% of women's median income. Kleven, Landais and Sogaard (2019) find a decline in women's earnings of around 30% from having a child—male raters are thus willing to give up about two-thirds of this amount to have a wife with a higher chance of fertility. The annual cost of childcare in the United States is $11,165,[10], and thus men seeking a one-year younger partner are willing to give up around 60% of this amount in household earnings.

Column (4) shows the sharp contrast between men's and women's preferences for age: while men rate women lower when the profile is presented with a higher age, women rate men more highly when a higher age is shown. The contrasting results for men versus women demonstrate that the negative relationship between a female profile's listed age and the rating cannot only be a "lemons" effect, where older women still on the market are expected to be less appealing. If men's negative preference were explained by this channel, we would expect women rating men to show a similar aversion to age, although potentially less intense because men marry later.

The large effect size on women's age preference may stem from the higher variance of

[9]US Census Bureau: https://www.census.gov/library/publications/2021/demo/p60-273.html.
[10]World Population Review: https://worldpopulationreview.com/state-rankings/child-care-costs-by-state

Table 3: Age-Rating Relationship for Male versus Female Raters

	Dependent variable: Profile rating					
	Panel A: Web Ad Sample					
	Male Raters			Female Raters		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.044***	-0.024**	-0.087***	0.131***	0.079***	0.111***
	(0.015)	(0.010)	(0.023)	(0.015)	(0.010)	(0.021)
Income ($0,000s)	0.061***	0.023**	0.061***	0.134***	0.147***	0.134***
	(0.016)	(0.011)	(0.016)	(0.016)	(0.011)	(0.016)
Visual Age > Age			-0.434***			-0.231
			(0.161)			(0.161)
Constant	6.252***	5.811***	8.099***	-0.160	4.493***	1.533*
	(0.662)	(0.467)	(0.965)	(0.692)	(0.457)	(0.880)
Observations	1440	3752	1440	1800	4220	1800
R-Squared	0.471	0.487	0.474	0.394	0.452	0.394
Sample:	Eligible	All	Eligible	Eligible	All	Eligible
	Panel B: Qualtrics Sample					
	Male Raters			Female Raters		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.043***	-0.062***	-0.047***	0.028***		0.025*
	(0.006)	(0.009)	(0.009)	(0.010)		(0.014)
Income ($0,000s)	0.032***	0.007	0.032***	0.036***		0.036***
	(0.007)	(0.009)	(0.007)	(0.010)		(0.010)
Visual Age > Age			-0.044			-0.031
			(0.067)			(0.106)
Constant	6.250***	7.475***	7.226***	3.340***		3.441***
	(0.435)	(0.426)	(0.407)	(0.552)		(0.652)
Observations	8080	4040	8080	4040		4040
R-Squared	0.490	0.479	0.490	0.463		0.463
Sample:	Eligible	Natural	Eligible	Eligible		Eligible

Notes: Regression of profile rating on randomly assigned age and income from Web Ad and Qualtrics data. All columns contain rater and profile fixed effects. "Eligible" columns include all respondents who rated 40 profiles, and are between 30 and 40 and white. Panel A, Columns (2) and (5) include all respondents who rated at least one profile. Columns (3) and (6) include a control for "Visual age," as rated by undergraduate students, being higher than the listed age. In Panel (B), there are no incomplete or ineligible responses, so those columns are omitted. Column (2) includes only the "natural" sample of Male Raters, without the over-sampling for high income that was done to better match the income distribution in the Web Ad sample, and allow for tests of income heterogeneity. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

their ratings. Whereas men display essentially a normal distribution in ratings with a mode of 6, women have a bi-modal distribution with peaks at 1 and 5, as shown in Appendix Figure A3. Female raters also display a larger preference for income in this sample, although both male and female raters positively and significantly value profile income.

Moreover, women's positive view of a male partner's age could be consistent with a model where women know their own fertility time window is limited, and thus seek a partner who is equally ready to start a family as they are. If this is the case, we would see the preference be mostly driven by a preference for age homophily, or for a male partner who is a small amount older, consistent with the average marriage age gap, which I examine in Section 4.3.

Columns (2) and (5) show results are similar, although attenuated, when including incomplete and ineligible responses, possibly due to less interested or attentive responses from those who only partially completed the rating exercise. Appendix Table A3 displays two additional robustness checks. First, restricting to only those who opted in to having their email address shared to receive the dating advice, at the end of the survey, and thus are most motivated by the offered compensation. The coefficient on age is largely unaffected. Next, I use the correlation between the profile ratings and the "rankings" at the end of each section as an attention check, and restrict to only those with a correlation above 0.5. This again has little effect on the coefficient.

Finally, columns (3) and (6) check whether photographic appearance versus reported age may be influencing the results. Photos likely *look* a certain age, and so when these photos are paired with higher ages, the person looks "good for their age," whereas when paired with lower ages the person looks "bad for their age." The appearance of the photograph itself is already controlled for through the profile fixed effect, but by adding a control for "Visual Age > Age," I control for the interaction between the photo's age and the reported age. Indeed, having an appearance older than reported age has a negative and significant effect for ale raters, but controlling for this only strengthens the main age effect. There is no effect for female raters.

Next, I examine whether these same preferences hold in the second, larger sample gathered from Qualtrics, which can be used to examine the drivers of men's preferences. Column (1) exhibits the same tradeoff between age and rating for male respondents, despite the different recruitment technique. In fact, the coefficient on age is remarkably similar between

the two samples. The contrasting positive coefficient for women is also present in this sample, though smaller. The preference for income, by both men and women, is somewhat smaller in this sample, but still significantly positive, and is similar between male and female raters.

Again, I conduct some robustness checks, first limiting the sample to the "natural" sample without oversampling high-income men in column (2), which slightly increases the size of the Age coefficient.[11] In the appendix excluding those who opt out or have a low correlation does not alter results. And, controlling for "Visual age > age" does not change the significance of the main coefficient, although in this case it does not have a significant effect itself.

This robust negative preference for age by men on the marriage market shows that aging carries not just a personal cost to women, but an economic one, impacting the quality of partner they can attract for the same level of other positive attributes, such as income.

4.2 Income preferences

Observational evidence has suggested that women's income may be viewed negatively by male partners, especially when the woman earns more. While not the main focus of this study, my experimental data offers an opportunity to test this. I have already shown that income on women's profiles has a positive and significant effect on male subjects' ratings, in both the Web Ad and Qualtrics data. Additionally, it should be noted that women's valuation of income is statistically significantly greater than men's in the Web Ad sample, but not in the Qualtrics sample, where the coefficients are approximately equal.

Based on the literature, such as Bertrand, Kamenica and Pan (2015), one might expect this positive preference for income to turn negative for male raters if the profile earns more than the rater's own income. To test this, I define "Income > Rater Income" as the randomized profile income exceeding the income of the rater according to the post-survey, which is true for around 50% of profiles male raters see and 40% of profiles female raters see in the Web Ad sample (and 49% for male and 48% for female raters in the Qualtrics

[11] Looking at this lower-income sample sheds some light on the one difference between the Qualtrics and Web Ad results: the Qualtrics sample places a lower value on income. When we restrict to the low-income portion of the Qualtrics sample, the coefficient on income reduces further, demonstrating that perhaps this lower valuation on income comes from the Qualtrics sample containing more very low-income men than the Web Ad sample (and preferences for income being of the super-modular form, where the valuation of partner income increases in own income).

sample). Note that because the profile incomes were listed in 7 discrete ranges, and rater incomes were also collected in "buckets," this cutoff is not exact, but rather reflects the profile income being one bucket above the rater income. This means there is a discrete jump in income level at this cutoff.

Table 4, Column (1) in each Panel A, for the Web Ad data, and Panel B for the Qualtrics data, shows that men do not show a negative preference over the profile having a higher income than theirs. There is also no significant effect of this threshold for women, as shown in Column (3).

I then add an interaction between "Income > Rater Income" and the profile income to see if the slope of the income preference is different once the profile's income exceeds the rater's income. This interaction, shown in Column (2) for male raters, is indeed negative, showing that there is a lower valuation of income for incomes exceeding the rater's own, in both the Web Ad and Qualtrics data. The valuation of income before this threshold also becomes higher. However, the interaction does not turn the coefficient itself negative (although zero preference, as well as negative preferences, would be within the confidence bounds of the sum of the main effect and the interaction) and, additionally, once this interaction is controlled for, there is now a positive discrete shift at the threshold where the profile income is higher than the rater's income.[12]

And, interestingly, far from results for male raters showing very different income valuations than those of female raters, the results in Column (4) for female raters mirror this pattern exactly. There is a negative interaction between income and profile income being higher than rater income, but a positive discrete shift at this threshold. This indicates that both men and women value partner income, value partner income more strongly when it is lower than their own income, and value partner income being higher than their own, but additional increases beyond that less. This stands in stark contrast to the results for age, where male raters' preferences are markedly different than female raters' preferences.

4.3 Drivers of Age Preference

Thus far I have isolated age from other characteristics and demonstrated that men exhibit a robust negative preference over it that is starkly different than women's preferences for

[12]Because income is not fully continuous in either the profiles or the rater data, this should be interpreted with caution, since the break essentially represents one discrete notch in income levels.

Table 4: Income-Rating Relationship for Male versus Female Raters

	Dependent variable: Profile rating			
	Panel A: Web Ad Sample			
	Male Raters		Female Raters	
	(1)	(2)	(3)	(4)
Age	-0.043**	-0.044**	0.131***	0.130***
	(0.018)	(0.018)	(0.032)	(0.032)
Income ($0,000s)	0.059*	0.101**	0.144***	0.253***
	(0.032)	(0.044)	(0.030)	(0.042)
Income > Rater Income	0.028	0.736*	-0.097	0.972***
	(0.201)	(0.380)	(0.182)	(0.295)
(Income > Rater Income) × Income		-0.095*		-0.173***
		(0.050)		(0.043)
Constant	6.245***	5.989***	-1.625	-2.305*
	(0.722)	(0.726)	(1.216)	(1.196)
Observations	1440	1440	1800	1800
R-Squared	0.471	0.473	0.394	0.399
	Panel B: Qualtrics Sample			
	Male Raters		Female Raters	
	(1)	(2)	(3)	(4)
Age	-0.043***	-0.042***	0.028*	0.028*
	(0.009)	(0.010)	(0.015)	(0.015)
Income ($0,000s)	0.027***	0.053***	0.028*	0.087**
	(0.010)	(0.016)	(0.016)	(0.036)
Income > Rater Income	0.053	0.333**	0.102	0.450**
	(0.082)	(0.149)	(0.122)	(0.216)
(Income > Rater Income) × Income		-0.043**		-0.072*
		(0.019)		(0.038)
Constant	8.878***	8.655***	3.320***	5.486***
	(0.354)	(0.378)	(0.623)	(0.701)
Observations	8080	8080	4040	4040
R-Squared	0.490	0.490	0.463	0.464

Notes: Regression of profile rating on randomly assigned age and income from Web Ad and Qualtrics data. All columns contain rater and profile fixed effects. Odd Columns include a dummy for the profile's (bucketed) income being higher than the rater's (bucketed) income. Even columns interact this dummy with profile income. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

partner age. I now dive into mechanisms for this preference. An important potential driving mechanism is fertility, as fertility changes asymmetrically between men and women with age, and naturally relates to marriage market surplus. In this section, I rule out some potential alternative explanations for men's negative preference for partner age, before providing evidence that this preference stems from fertility. This section uses the larger Qualtrics sample which allows me to examine heterogeneity by rater more reliably. To do this, I interact different rater traits with age, to see how rater traits influence the preference for age.

4.3.1 Age Homophily

I first examine how the interaction between rater age and profile age may impact preferences, and thus whether preference for age homophily or other social norms explain the apparent distaste for age for either men or women. We know that it is socially normal for husbands to be older than wives, and in fact for husbands to be approximately two years older than wives, both in observational data, and as estimated in preference decompositions (Hitsch, Hortaçsu and Ariely, 2010; Choo and Siow, 2006; Buss, Shackelford and LeBlanc, 2000). Table 5 first controls for the profile age being older than the rater's age, for men in Column (1), or younger than the rater's age, for women in Column (4). This is true for 48% of profiles male raters see, and 51% of profile female raters see in the Qualtrics sample.

This coefficient on profile age being older (for male raters) or younger (for female raters) than own age is not significant in either case, although including it for women essentially eliminates the main effect of *Age*, demonstrating the importance of relative age in women's preferences.

Next, I examine whether the taste could, instead, be for similarly aged partners, rather than a secular negative preference for age. Column (2) controls for the age difference squared (i.e., a quadratic loss function in distance from equal ages), and finds that indeed this is significantly negative for men, but controlling for it has no impact on the coefficient on age itself. The coefficient is also negative and significant for women (column 5), and twice the size. I next perform a rescaling, instead controlling for the profile age minus the rater age plus two, for male raters, or minus two, for female raters, squared–i.e., the distance from the "socially ideal age difference," squared. Note that the coefficient on this variable will

Table 5: Relative Age Preferences: Qualtrics Sample

	Dependent variable: Profile rating					
	Male Raters			Female Raters		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.051***	-0.040***	-0.024**	0.019	0.036**	0.004
	(0.012)	(0.009)	(0.010)	(0.016)	(0.015)	(0.012)
Income ($0,000s)	0.032***	0.032***	0.032***	0.036**	0.035**	0.035**
	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)
Age > Rater Age	0.084					
	(0.076)					
Age < Rater Age				-0.098		
				(0.134)		
(Age Diff.)^2		-0.004***			-0.008***	
		(0.001)			(0.002)	
(Age Diff. $\pm$ 2)^2			-0.004***			-0.008***
			(0.001)			(0.002)
Observations	8080	8080	8080	4040	4040	4040
R-Squared	0.490	0.491	0.491	0.463	0.468	0.468

Notes: Regression of profile rating on randomly assigned age and income from Qualtrics data. All columns contain rater and profile fixed effects. Columns (1) and (4) control for the random profile age being older, for men, or younger, for women, than the rater. Columns (2) and (5) control for profile age minus rater age, squared. Columns (3) and (6) control for profile age minus rater age plus two, for men, or minus two, for women, squared. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

be identical to that measured in the previous exercise, but rescaling it in this way accounts for the impact on the main age coefficient, removing two years of age difference from the coefficient on age. Accounting for this reduces the coefficient for men, mechanically, but does not eliminate its significance. In other words, men may prefer a women two years younger than himself, but they prefer even younger women more.

In the case of women, we see that accounting for the "ideal" two-year age difference is enough to completely eliminate the apparent preference for older partners. Thus, this apparent preference for older men can be entirely accounted for by preferences over *relative*, rather than absolute, age. This preference could itself be driven by a personal awareness of time-limited fertility, and thus the need to seek a partner on a similar timeline for starting a family. Appendix Table A1 shows that a strong preference for age similarity by female raters also explains the apparent positive preference for age by women in the Web Ad sample.

4.3.2 Fertility

Now that I have ruled out age homophily as the driver of men's negative age preference, I establish evidence that tastes over fecundity are, in fact, the source of this preference, as well as ruling out that the preference reflects beliefs about youth-correlated personality traits. The first strategy I use to do this is to interact age with rater characteristics that may make men care more or less about fertility, with divergent impacts on preferences for other youthful traits. The characteristics examined are wanting to get married, *Want marr*, wanting kids, *Want kids*, having no children, *No kids*, and having accurate knowledge of the age–fertility tradeoff, *Knowledge*. These variables create different cuts of the data, grouping men together who are dissimilar in other ways, but each with reason to care more about fertility in a potential partner.

Each of these are interacted with the main explanatory variable, *Age*, while the main effect for each rater characteristic is absorbed by the rater fixed effects. Table 6 demonstrates that when each of these characteristics is interacted with profile age, the interaction is negative and significant, while the main effect gets smaller. (Appendix Table A2 reproduces this analysis in the Web Ad data, where there are fewer men, and thus heterogeneity analysis is less reliable.)

First, in Column (1), I interact profile age with the rater wanting to get married soon, which is true for 47% of men in the Qualtrics sample. Men who want to get married dislike age *more* than men who may be looking for more casual relationships. This provides some evidence of fertility as a driver, since if the preference was for the amenity value of younger women, we may expect men who do not want to get married to value it more. Column (2) looks at men who want children (or more children) soon, which is true for 18% of men in the Qualtrics sample. Men who want children soon similarly demonstrate a stronger preference for younger partners.

These both provide evidence for the fecundity channel over age-correlated personality traits, since those wishing to marry and have children might be expected to value maturity over a youthful personality, and yet we see that they actually value younger partners more strongly.

In Column (3), I look at whether men already have children, as 19% of men in the Qualtrics data do, as having no children currently may be a stronger indicator of seeking

Table 6: Fertility Mediators: Qualtrics Sample

	Dependent variable: Profile rating (Male raters)					
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.028**	-0.033***	0.002	-0.007		
	(0.011)	(0.009)	(0.019)	(0.010)		
Income ($0,000s)	0.032***	0.032***	0.032***	0.032***	0.033***	0.033***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
Want Marr × Age	-0.032*					
	(0.019)					
Want Kids × Age		-0.055*				
		(0.032)				
No Kids × Age			-0.055**			
			(0.021)			
Knowledge × Age				-0.057***		
				(0.017)		
Years Past Infertile					-0.043***	-0.013
					(0.010)	(0.013)
Years Past Infertile						-0.054***
× 10 to 0 Yrs Before						(0.020)
Observations	8080	8080	8080	7800	7600	7600
R-Squared	0.490	0.491	0.491	0.488	0.479	0.480

Notes: Regression of profile rating on randomly assigned age and income from Qualtrics data. All columns contain rater and profile fixed effects. Column (1) interacts profile age with whether the rater wants to get married. Column (2) interacts age with whether the rater wants kids. Column (3) interacts age with whether the rater has no children currently. Column (4) interacts age with whether the rater is aware that fertility declines for women before age 45. Column (5) uses as the independent variable profile age minus the rater's estimated age at which fertility declines for women. Column (6) allows the impact of this variable to be differential between the time period of ten to zero years before the fertility decline. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

the option value to have kids than stated preferences. As expected, the 81% of men with no kids have stronger preference for younger women than those who already have children. In fact, with this interaction term inserted, the main effect of age becomes very small, and statistically indistinguishable from zero, indicating that men who already have children have *no preference* over randomly assigned age. This provides strong evidence that the preference being identified is really a preference over fertility, as other possible factors would be unlikely to diverge so strongly between men who have children and those who do not.

Column (4) interacts age with knowledge about fertility. The variable "Knowledge" represents the rater being aware that women's fertility begins to decline before age 45, from the question, "At what age does it become biologically difficult for a woman to conceive?"

in the post-survey.[13] 67% of male raters in the Qualtrics data had accurate knowledge according to this definition. For those knowledgeable men, the negative preference for age is much stronger. For men who lack such knowledge, there is again *no preference* over age. Taken together, this table shows that the age preference exhibited by male raters is driven by men who have reason to care about fertility and have the knowledge to connect age to fertility.

Together, these results suggest that at least some of the observed preference for younger partners stems from preferences for fertility. If the negative coefficient on age instead captured a latent preference for attractiveness or other youthful qualities, whether or not the man wants to have children or knows about the age-fertility relationship should have no bearing on the strength of his preference. The zero coefficient for those who already have children and those with inaccurate knowledge rules out that there are other asymmetrically valued age-correlated traits that drive the negative age preference, since there is no reason these particular groups should value other age-correlated features less. These findings are consistent with a model of agents rationally maximizing utility: those with stronger preferences for children and more knowledge to act on these preferences penalize older partners more.

Columns (5) and (6) take advantage of the heterogeneity in men's stated beliefs as to when female fecundity begins to decline to create a metric of how many "Years Past Infertile" the profile is in the rater's mind. This is constructed by subtracting the profile age from the rater's believed cutoff, which has a mean of 43.1. For example, if the profile's age is 30 and the rater believes fertility declines at 50, the age minus the cutoff is -20. Column (5) shows that this variable has a similar coefficient as that on Age.

The advantage of this variable is that it has a much larger range, as the 10-year age range of the profiles may not have been large enough to show any non-linearity that would be associated with the fertility decline. If fertility is driving the negative age preference, we would expect aging that takes place closer to the time when a woman may begin to have difficulty conceiving to be viewed more negatively than aging that is far before or far after this threshold. Column (6) shows exactly the expected non-linearity, by allowing

[13] Although fertility declines earlier than 45, the idea is to separate those who hold beliefs who are close to accurate and for whom the age range 30-40 would be relevant in terms of fertility from those who believe age in that range would not yet impact fertility.

"Years Past Infertile" to have a different slope when between 10 and zero years from the fertility cutoff, i.e., when approaching the fertility decline.[14] This coefficient is negative and significant, and larger than the main age effect. When it is included, the effect of age outside this period, either more than ten years before infertility or after infertility, remains negative but becomes insignificant.

Appendix Figure A4 graphically shows the non-linearity in the relationship between ratings and years to the fertility cutoff, using a lowess function. Interestingly, when more than ten years from the fertility cutoff, the lowess is actually upward sloping, then steeply negative from -10 to zero, and finally it levels off past zero, with further increases in ages not further decreasing ratings. Together, this evidence paints a strong picture that the negative preference for age when it is randomly assigned stems from fertility preferences, and thus that fertility plays a significant role in men's negative preference for age in female partners more generally.

5 Conclusion

From Hollywood films to online dating site data[15] it seems evident that men prefer younger women. And, given that having children may be one reason that people marry, it is natural to think that fecundity might affect women's marriage market appeal. However, since individuals' incomes, lifestyles, and appearances also change with age, it is difficult to separate fertility from other factors. Thus, I designed an experiment specifically to measure the causal impact of age on men's marriage market preferences, separate from other factors that change with age in observational data.

Through this experiment, I find that for every year a woman ages past 30, she must make an additional $7,000 to receive equally high ratings from potential male partners. The experiment's unique design also controls for attractiveness, by randomly assigning age to dating profiles where the picture is held constant. Moreover, I show that this preference over age is only present for men who have no children of their own, and have accurate knowledge of the age-fertility tradeoff, further connecting it to fertility.

The experiment further provides confirmation that both men and women value income

[14] It should be noted that this analysis is only suggestive, as the extreme values of the $Age - Cutoff$ variable are necessarily driven by those who have extreme answers to when they believe the fertility decline begins, either very high or very low.

[15] OK Trends, "The Case for an Older Woman," February 16th, 2010.

in partners, and that although this valuation of income declines for incomes exceeding the rater's own, it does not appear to become a negative trait. Preferences of male and female raters for income are somewhat similar, although women exhibit a more intense income preference in one of the samples. By contrast, women exhibit a positive taste for age, that is explained by a large preference for age homophily, whereas men alone exhibit a secular negative preference for age.

These findings indicates that men also hear the ticking of the biological clock. Seeking to marry and have children, they naturally prefer more fertile partners. Women thus face a tradeoff: human capital investments increase earnings, but take up crucial time during the reproductive years, as it is difficult to co-process career investments and family formation. This loss of reproductive capital may cost them real economic returns on the marriage market, reducing partner quality and income, despite human capital itself being a positive trait. This tradeoff for women pursuing time-consuming human capital investments could potentially be alleviated through policies focused on making it easier to co-process career investments and children, extending the fertility time window, and making career re-entry and investments possible later in life.

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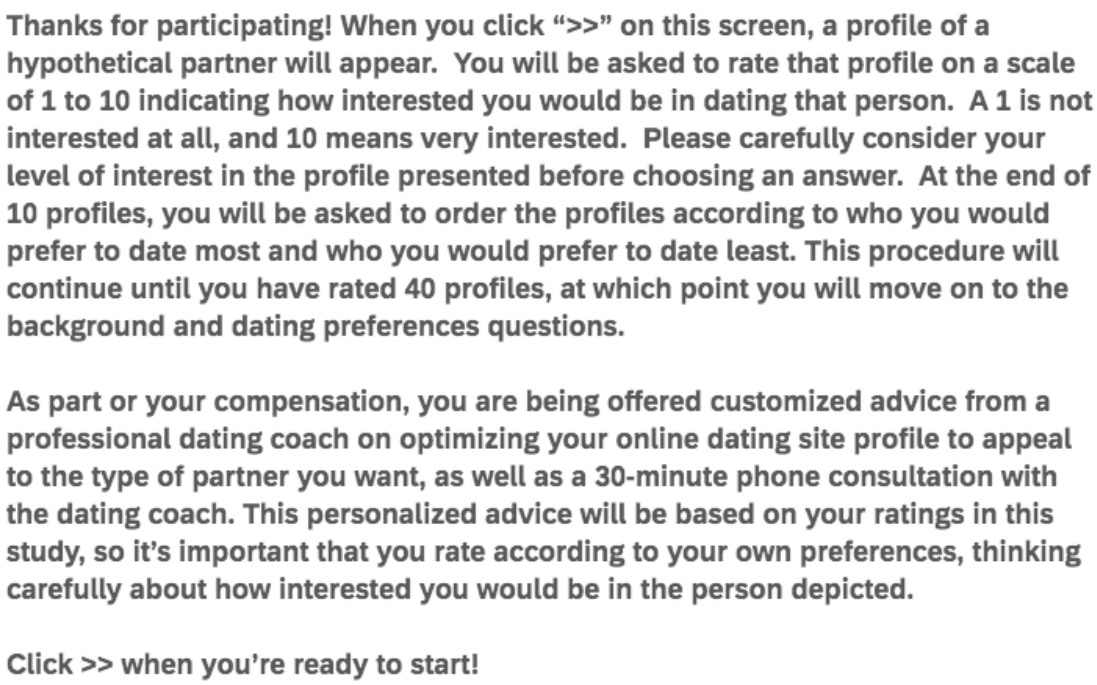
Online Appendix

A Methodology

Figure A1 shows the instructions participants saw and how the dating advice was described to them.

Figure A2 shows samples of the photos used to create the dating profiles.

Figure A1: Instruction Screen



Instructions shown to participants immediately prior to rating profiles.

Figure A3 shows histograms of men's and women's ratings in both samples. Men's ratings are roughly normally distributed while women's ratings contain some stacking at the lowest rating of "1."

B Additional Results

B.1 Drivers of preferences in the Web Ad sample

This section repeats the analysis from Section 4.3 with the Web Ad sample, showing consistent results. The smaller sample makes these results noisier than with the Qualtrics

Figure A2: Example Profile Photos

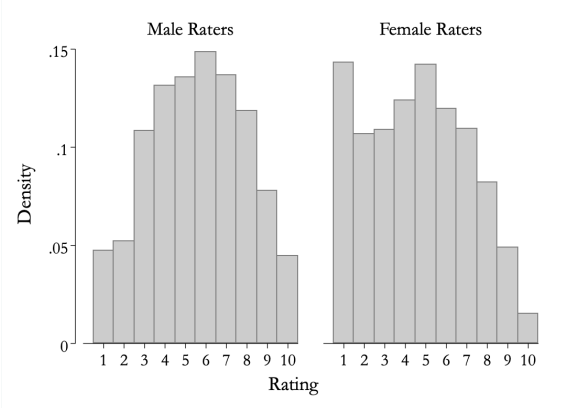
(a) Women

(b) Men

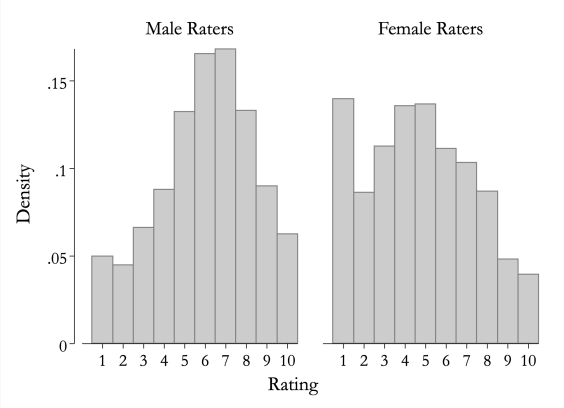
Notes: Samples of the stock images used to create dating profiles. Photos were chosen to be of ambiguous age in the 30-40 range, purchased from stock photo websites.

Figure A3: Rating histogram for male and female raters

(a) Web Ad data



(b) Qualtrics data



Notes: Web Ad data from 36 men (1440 observations) and 45 women (1800 observations). Qualtrics data from 202 men (8080 observations) and 101 women (4040 observations).

sample.

Table A1 shows that preference for age similarity does not explain the negative preference for age by male raters in the Web Ad sample. It does, however, explain the positive preference by female raters. Once the quadratic loss function for distance from the two-year "socially normal" age gap is accounted for, the female age preference is much smaller and no longer statistically significant. This preference would be consistent with women seeking partners similarly interested in starting a family as they are, aware of their own ticking biological clocks.

Table A2 shows that some of the fertility heterogeneity results also hold in the Web Ad sample, although with the exception of knowledge over the fertility decline, the interactions are not significant (as might be expected when examining heterogeneity in a smaller sample). The interaction on "Want marr" is the wrong sign in this sample, but with a large standard error. We still see, however, that age is penalized significantly more within ten years of the rater's subjective "cutoff age" when female fertility declines.

B.2 Non-linearity in preferences over age

Figure A4 examines non-linearity in men's preferences over their partners' ages, using the heterogeneity in men's responses to the question "at what age do you think it becomes biologically difficult for a woman to conceive?" in the Qualtrics sample. First, ratings are regressed on profile and rater fixed effects, and residuals are captured. I then lowess-

Table A1: Relative Age Preferences: Web Ad Sample

	Dependent variable: Profile rating					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.032*	-0.044**	-0.037**	0.117***	0.100***	0.033
	(0.018)	(0.018)	(0.018)	(0.040)	(0.024)	(0.026)
Income ($0,000s)	0.060***	0.061***	0.061***	0.134***	0.136***	0.136***
	(0.021)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)
Age > rater age	-0.152					
	(0.172)					
Age < rater age				-0.169		
				(0.239)		
(Age diff)^2		-0.002			-0.017***	
		(0.002)			(0.003)	
(Age diff $\pm$ 2)^2			-0.002			-0.017***
			(0.002)			(0.003)
Observations	1440	1440	1440	1800	1800	1800
R-Squared	0.471	0.471	0.471	0.394	0.418	0.418

Notes: Regression of profile rating on randomly assigned age and income from Web Ad data. All columns contain rater and profile fixed effects. Columns (1) and (4) control for the random profile age being older, for men, or younger, for women, than the rater. Columns (2) and (5) control for profile age minus rater age, squared. Columns (3) and (6) control for profile age minus rater age plus two, for men, or minus two, for women, squared. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

smooth the plot of residuals against profile age minus the rater's expected fertility cutoff. The graph reveals that years at least ten years before the fertility cutoff have a positive relationship with ratings. There is then a steeply negative relationship from ten years before up to the fertility cutoff. A few years after the fertility cutoff, the relationship becomes flat, with additional years no longer decreasing ratings. Note, these results should be taken as suggestive only, given that very high and very low values on the x-axis can only occur when individuals have outlier views of the age of fertility decline.

Table A2: Fertility Mediators: Web Ad Sample

	Dependent variable: Profile rating (Male subjects)					
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.053***	-0.031	-0.029	0.015		
	(0.017)	(0.021)	(0.036)	(0.026)		
Income ($0,000s)	0.061***	0.062***	0.062***	0.061***	0.061***	0.061***
	(0.021)	(0.022)	(0.021)	(0.021)	(0.022)	(0.021)
Want marr × age	0.019					
	(0.036)					
Want kids × age		-0.048				
		(0.047)				
No kids × age			-0.022			
			(0.041)			
Knowledge × age				-0.079**		
				(0.036)		
Age − cutoff					-0.044**	0.030
					(0.018)	(0.022)
Age − cutoff, -10 to 0						-0.108***
						(0.038)
Observations	1440	1440	1440	1440	1440	1440
R-Squared	0.471	0.472	0.471	0.473	0.471	0.474

Notes: Regression of profile rating on randomly assigned age and income from Web Ad data. All columns contain rater and profile fixed effects. Column (1) interacts profile age with whether the rater wants to get married. Column (2) interacts age with whether the rater wants kids. Column (3) interacts age with whether the rater has no children currently. Column (4) interacts age with whether the rater is aware that fertility declines for women before age 45. Column (5) uses as the independent variable profile age minus the rater's estimated age at which fertility declines for women. Column (6) allows the impact of this variable to be differential between the time period of ten to zero years before the fertility decline. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

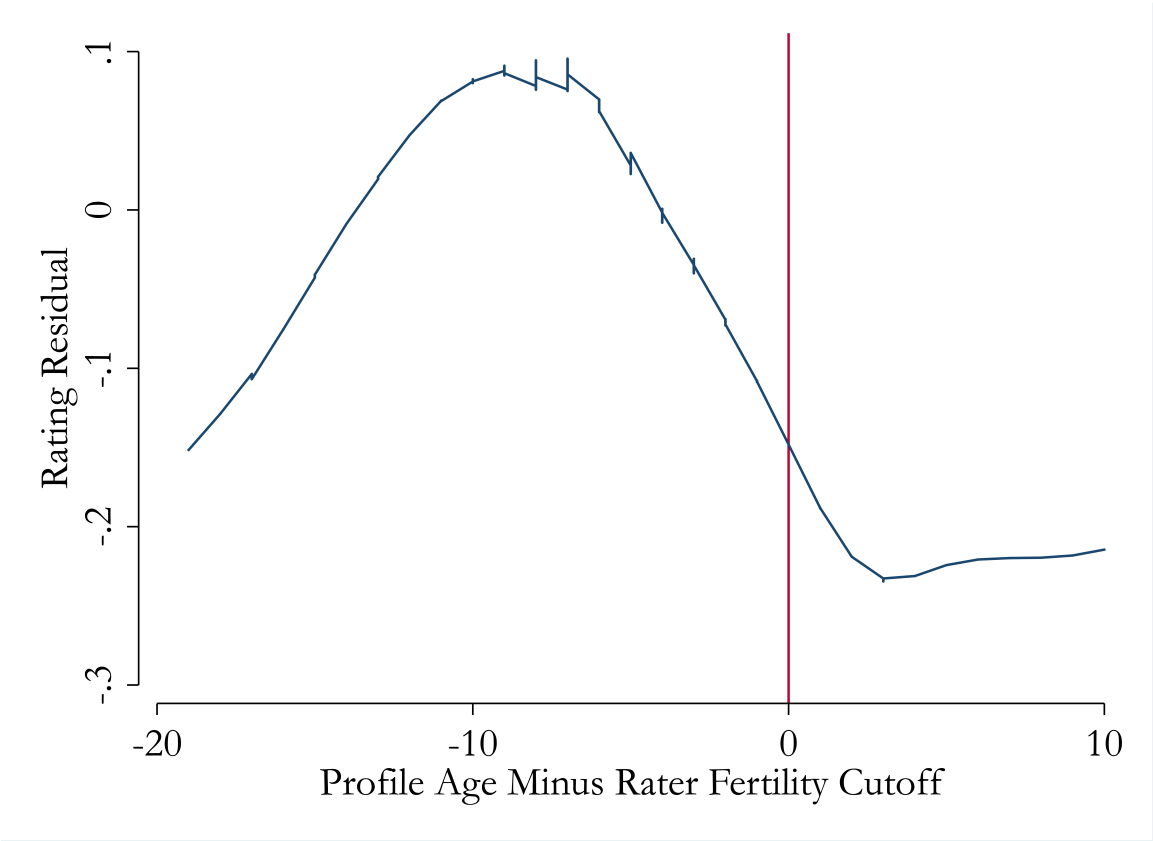
Table A3: Robustness: Both Samples

	Dependent variable: Profile rating			
	Panel A: Web Ad Sample			
	Male Raters		Female Raters	
	(1)	(2)	(3)	(4)
Age	-0.049***	-0.048***	0.127***	0.133***
	(0.016)	(0.016)	(0.017)	(0.017)
Income ($0,000s)	0.069***	0.069***	0.136***	0.137***
	(0.018)	(0.017)	(0.018)	(0.018)
Constant	6.426***	6.337***	-0.025	-0.185
	(0.710)	(0.711)	(0.748)	(0.721)
Observations	1280	1280	1440	1520
R-Squared	0.460	0.446	0.362	0.385
Sample:	Opt In	High Corr	Opt In	High Corr
	Panel B: Qualtrics Sample			
	Male Raters		Female Raters	
	(1)	(2)	(3)	(4)
Age	-0.046***	-0.053***	0.047***	0.026**
	(0.010)	(0.008)	(0.013)	(0.012)
Income ($0,000s)	0.025**	0.035***	0.055***	0.043***
	(0.011)	(0.009)	(0.015)	(0.013)
Constant	6.585***	9.999***	6.112***	5.286***
	(0.468)	(0.356)	(0.568)	(0.505)
Observations	3160	4960	2120	2880
R-Squared	0.489	0.476	0.469	0.385
Sample:	Opt In	High Corr	Opt In	High Corr

Notes: Regression of profile rating on randomly assigned age and income from Web Ad and Qualtrics data, including only those who have Opted In to having their email shared with the dating coach (odd columns) or have a high correlation (greater than 0.5) between their ratings and their rankings (even columns). All columns contain rater and profile fixed effects. Robust standard errors in parentheses, clustered at the rater level.

*** p<0.01, ** p<0.05, * p<0.1

Figure A4: Nonlinearity in Ratings over Time to Infertility



Notes: Qualtrics data from 202 men (8080 observations). Lowess estimation of residuals from ratings regressed on profile and rater fixed effects, over time to rater-specific infertility cutoff.