



Reproduction expediting: Sexual motivations, fantasies, and the ticking biological clock

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ABSTRACT

Beginning in their late twenties, women face the unique adaptive problem of declining fertility eventually terminating at menopause. We hypothesize women have evolved a reproduction expediting psychological adaptation designed to capitalize on their remaining fertility. The present study tested predictions based on this hypothesis—these women will experience increased sexual motivations and sexual behaviors compared to women not facing a similar fertility decline. Results from college and community samples ($N = 827$) indicated women with declining fertility think more about sex, have more frequent and intense sexual fantasies, are more willing to engage in sexual intercourse, and report actually engaging in sexual intercourse more frequently than women of other age groups. These findings suggest women's "biological clock" may function to shift psychological motivations and actual behaviors to facilitate utilizing remaining fertility.

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1. Introduction

Popular culture is rife with references to women's biological clocks ticking away their remaining child-bearing years. This would have been a problem for ancestral women as they would have faced a substantial decline in fertility that terminated in zero fertility at menopause. To solve this problem, we hypothesized women evolved a psychological mechanism—a reproduction expediting adaptation – that motivated them to capitalize on their remaining fertility before likelihood of conception became less probable. Because modern women's sexual psychology is a consequence of such evolved mechanisms, we predicted one key design feature of this adaptation is an increased desire and willingness to engage in sexual activity during the period of declining fertility. Increased sexual desire may be expressed in a variety of ways including an increase in thoughts and fantasies about sex, an increase in sex drive, and a greater likelihood of consenting to engage in sexual intercourse after knowing someone a short period of time. The present study used reports of sexual desires and behaviors to test these predictions.

1.1. Reproduction expediting

In modern women, from the onset of menarche to a point in their mid-twenties, women's fertility rises to a peak and then begins a sharp descent, with a 50% reduction in the ability to conceive

from the early twenties to the late-thirties (e.g., Dunson, Colombo, & Baird, 2002; Döring, 1969; Menken, Trussell, & Larsen, 1986). Pregnancy rates for women aged 27–45 are significantly lower on average than for women aged 19–26 (Dunson, Baird, & Colombo, 2004; Dunson et al., 2002). Due to the timing of the onset of fertility decline and how rapidly fertility declines after age 35 (e.g., Dunson et al., 2004, 2002), we suggest women in their late twenties to mid-forties will be most likely to express the reproduction expediting adaptation resulting in psychological shifts promoting opportunities for successful conception while they are still fertile. Furthermore, given the high rates of infant and child mortality, 23% and 46%, respectively in modern hunter-gatherer populations (those most likely to resemble our human ancestors), over evolutionary history there would have been no guarantee current offspring would survive to reproductive age (Hewlett, 1991; see Volk and Atkinson, 2008 for review). This suggests expediting reproduction would have been beneficial for women regardless of whether or not they already had children. Therefore, we hypothesized all women with declining fertility would experience shifts related to reproduction expediting. Women hypothesized to be expressing the reproduction expediting adaptation (RE women) are expected to display a suite of psychological and behavioral shifts functioning to motivate and increase sexual behavior.

1.2. Prediction 1: RE women will have a greater motivation to engage in sexual behavior than will other women

Women experiencing a decline in their fertility should experience an increase in their motivation to engage in sexual inter-

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course, increasing opportunities for conception to occur. Increased motivation may manifest itself as increased cognitive effort devoted to sexual activity, which should occur even if women are not consciously aware of the change in their motivational state, or the functional reason behind this change. Specifically, we predicted RE women will think about sexual activities more than women who are not reproduction expediting (Prediction 1.1).

Sexual fantasies are another hypothesized manifestation of motivation to engage in sexual intercourse, even if only a fraction of those fantasies directly leads to intercourse (Symons, 1979). Individuals report an increased interest in sexual activity after experiencing a sexual fantasy, regardless of whether the fantasy occurred during or before intercourse (Leitenberg & Henning, 1995; Purifoy, Grodsky, & Giambra, 1992). Therefore, because RE women are predicted to experience an increased motivation to engage in sexual intercourse, they should also experience more frequent sexual fantasies than non-RE women (Prediction 1.2). The intensity of a sexual fantasy also influences motivation to engage in sexual activity such that more intense sexual fantasies are correlated with higher rates of sexual intercourse (e.g., Rösler & Witzum, 1998). RE women should therefore experience more intense sexual fantasies than women who are not expediting reproduction (Prediction 1.3). Previous research on differences in sexual fantasies as a function of age indicated women between the ages of 26 and 35 reported more sexual fantasies than younger and older women (e.g., Purifoy et al., 1992), lending partial support to the present predictions.

Women in a relationship who are experiencing a decline in fertility may also experience reproduction expediting by seeking a partner other than their current romantic partner. Although the default method to expedite reproduction would be to engage in sexual intercourse with their current partner, ancestral women may have benefited by searching for a new partner for reasons including obtaining “good genes” for their offspring (Thornhill & Gangestad, 2008) or switching to a higher quality mate (Greiling & Buss, 2000). Because their fertility was declining, these women would not only have benefited from expediting reproduction, but they could have benefited from having the highest quality offspring possible. This would have been a salient concern for all women, but should have been heightened in women with declining fertility, and therefore, fewer remaining opportunities to conceive. If this is another means to expedite reproduction, then sexual fantasies about someone other than a current romantic partner may motivate these women to seek a new partner. Therefore, we predicted RE women in a relationship will report fantasizing more about someone other than their current romantic partner, while non-reproduction expediting women in a relationship will report fantasizing more about their current romantic partner (Prediction 1.4).

1.3. Prediction 2: Women hypothesized to be expressing the reproduction expediting adaptation will report engaging in more sexual activities than will other women

Increased motivation to engage in sexual intercourse should influence actual sexual behavior. RE women should report engaging in sexual activities more frequently and should be more willing to engage in sexual activities than non-reproduction expediting women. Some research suggests women's sexual behavior peaks in the early thirties (e.g., Barr, Bryan, & Kenrick, 2002; Schmitt et al., 2002). Women in their early thirties also report having more orgasms than teenaged women (Kinsey, Pomeroy, Martin, & Gebhard, 1953). Other research suggests sexual activity peaks in women aged 25–29 and gradually declined until around age 50 after which it declined rapidly (Laumann, Paik, & Rosen, 1999). Although previous research focused on women in their late twenties to mid-thirties, we predicted all RE women will report engag-

ing in sexual intercourse more frequently than non-reproduction expediting women (Prediction 2.1).

Reproduction expediting women should also be more willing to engage in sexual activity earlier in a relationship than other women to facilitate opportunities for conception. In general, women are less willing to engage in sexual intercourse than men and report needing to wait longer before having sex than men (Buss & Schmitt, 1993). Women hypothesized to be expressing the reproduction expediting adaptation may display an increased willingness to engage in sexual intercourse by decreasing the amount of time they think they would wait before having sexual intercourse with a desirable partner. One study examined age-related shifts in women's likelihood to engage in sexual intercourse after knowing a potential partner 1 day, but did not find a difference among women (Schmitt et al., 2002). It may be the risks associated with sexual intercourse with a relative stranger (see Buss, 2003 for review) outweighed any potential benefits women may have obtained (e.g., “good” genes; Thornhill & Gangestad, 2008). Therefore, it may be better to examine potential differences in women's willingness to engage in sexual intercourse at longer time intervals than knowing someone for one evening. Specifically, we predicted RE women will be more willing to engage in sexual intercourse after knowing someone for 1 month (Prediction 2.2) or knowing someone for 1 week (Prediction 2.3) than will women who are not expediting reproduction. Based on results from Schmitt and colleagues (2002), women are not predicted to differ in their willingness to engage in sexual intercourse after knowing someone for one evening (Prediction 2.4).

1.4. Current study

As part of a larger study examining psychological and behavioral changes in women as they age, participants completed an online questionnaire regarding their sexual thoughts, fantasies and behaviors. Previous research assessing the effects of fertility on behavior has categorized women into age groups because age is currently the best predictor of amount of remaining fertility (e.g., Dunson et al., 2002; Maheshwari, Bhattacharya, & Johnson, 2008). Therefore, women were classified into the following three age groups (pre-RE: 18–26; RE: 27–45; menopausal: 46 and older). The RE group was based on previous research indicating from their later twenties until menopause women's fertility is consistently lower than younger women's (Dunson et al., 2004, 2002; Heckhausen, Wrosch, & Fleeson, 2001; Menken et al., 1986). The menopausal group was based on the median age of menopause onset in America (e.g., Bromberger et al., 1997).

We predicted RE women (ages 27–45) would report thinking about sexual activity more frequently, would experience a greater frequency of sexual fantasies and more intense sexual fantasies than women in the other two age groups (Predictions 1.1, 1.2, and 1.3, respectively). Additionally, we predicted RE women in a relationship would report fantasizing more about an extra-pair partner than their current romantic partner (Prediction 1.4). Women aged 27–45 were also predicted to engage in more sexual activities than other women. RE women were predicted to engage in more sexual intercourse (Prediction 2.1) and to be more willing to engage in sexual intercourse after knowing someone for 1 month or 1 week than women in other age groups (Predictions 2.2 and 2.3, respectively).

2. Method

2.1. Participants

We recruited participants from two sources: the subject pool at the University of Texas at Austin and from Craigslist.com. Partici-

pants recruited from the subject pool received partial course credit for their participation. Participants recruited from Craigslist.com received no compensation. There were a total of 827 women. Ages ranged from 18 to 65 ($M = 25.73$, $SD = 9.38$). A total of 528 participants reported being in a current committed relationship with an average relationship length of 37.05 months ($SD = 63.56$). The majority of our sample ($n = 661$) had no children and of the remainder, 99 participants had at least two children. Participants were grouped into the following age categories: ages 18–26 (pre-RE women: $n = 554$, $M = 20.46$, $SD = 2.72$), ages 27–45 (RE women: $n = 222$, $M = 32.86$, $SD = 5.08$), and ages 46 and older (menopausal women: $n = 51$, $M = 51.96$, $SD = 4.72$).

2.2. Materials and procedure

Participants answered several questions regarding their sexual thoughts, fantasies, and behaviors. Using 1–7 Likert scales, participants answered how often they think about sexual activities (never to over 10 times a day), how frequently they fantasize about sex (never to daily) and how intense their fantasies are (very mild to very intense). Lower scores indicated less time, frequency, or lower intensities. Participants in a committed relationship also indicated whether they fantasized more about their current romantic partner or another individual. All participants then reported how frequently they engage in sexual intercourse, which was rated on a 1 (never) to 8 (everyday) Likert scale. Participants also completed the willingness to engage in sexual intercourse measure from Buss and Schmitt (1993). Using a scale from –3 (definitely not) to +3 (definitely yes), participants rated their willingness to have sex with someone after knowing them for a range of time lengths from 5 years to 1 hour (see Buss & Schmitt, 1993 for wording).

All participants completed the survey online. They received the link to the survey either through an ad placed on Craigslist.com or after signing up through the subject pool. The survey took between 30 and 45 minutes to complete. After completion, participants received an online debriefing and, if necessary, received instructions for obtaining course credit.

3. Results

All predictions except Prediction 1.4 (see below) were tested using a series of one-way ANOVAs with age (3 levels: pre-RE, RE, and menopausal) as the independent variable and a set alpha level of .05. Individuals who did not report a heterosexual orientation ($n = 125$) were excluded from all analyses. *A priori* planned comparisons were conducted for each ANOVA comparing women in the reproduction expediting group to women in the pre-reproduction expediting group and the menopausal group. Non-reproduction expediting women were not grouped together to explore the effects of varying fertility levels on sexual motivations and behaviors.

For amount of time spent thinking about sex (Prediction 1.1), the overall ANOVA was significant, $F(2, 686) = 6.33$, $p < .01$. Planned comparisons indicated RE women ($M = 5.02$, $SD = 1.15$, $n = 157$) thought more about sexual activities than pre-RE women ($M = 4.61$, $SD = 1.39$, $n = 491$), $t(686) = 3.33$, $p < .001$, $d = .31$, and menopausal women ($M = 4.44$, $SD = 1.36$, $n = 41$), $t(686) = 2.47$, $p < .01$, $d = .49$.

For frequency of sexual fantasies (Prediction 1.2), the overall ANOVA was significant, $F(2, 674) = 6.87$, $p < .001$. RE women ($M = 4.85$, $SD = 1.57$, $n = 156$) had more frequent sexual fantasies than pre-RE women ($M = 4.27$, $SD = 1.86$, $n = 480$), $t(674) = 3.52$, $p < .001$, $d = .32$, and menopausal women ($M = 4.07$, $SD = 1.88$, $n = 41$), $t(674) = 2.47$, $p < .01$, $d = .48$.

Table 1

Frequency of person fantasized about with associated percentages for women by age group.

| Age group | Current romantic partner | Someone else |
|------------|--------------------------|--------------|
| Pre-RE | 189 (73.5%) | 68 (26.5%) |
| RE | 55 (48.2%) | 59 (51.8%) |
| Menopausal | 13 (41.9%) | 18 (58.1%) |

There was a significant difference in intensity of sexual fantasies (Prediction 1.3), $F(2, 625) = 6.98$, $p < .001$. RE women ($M = 4.74$, $SD = 1.61$, $n = 151$) had more intense sexual fantasies than pre-RE women ($M = 4.15$, $SD = 1.69$, $n = 440$), $t(625) = 3.71$, $p < .001$, $d = .35$. RE women did not differ from menopausal women ($M = 4.43$, $SD = 1.91$, $n = 37$), $t(625) = .98$, $p = .33$.

To test if individuals in a relationship fantasized more about their current romantic partner or someone else (Prediction 1.4), a chi-square test was conducted with a set alpha level of .05. Results indicated a significant difference between the groups, $\chi^2(2) = 28.96$, $p < 0.001$ (see Table 1 for selection frequencies by age group). As predicted, pre-RE women fantasized more about their current romantic partner than someone else; however, RE women and menopausal women equally fantasized about both their current romantic partner and someone else.

For frequency of engaging in sexual intercourse (Prediction 2.1), there was a difference between groups, $F(2, 666) = 7.17$, $p < .001$. RE women ($M = 4.31$, $SD = 1.61$, $n = 154$) had sexual intercourse more frequently than pre-RE women ($M = 3.62$, $SD = 2.09$, $n = 475$), $t(666) = 3.78$, $p < .001$, $d = .35$. There was a non-significant trend for RE women to engage in sexual intercourse more frequently than menopausal women ($M = 3.70$, $SD = 1.83$, $n = 40$), $t(666) = 1.75$, $p = .08$.

For willingness to engage in sexual intercourse after knowing someone 1 month (Prediction 2.2), there was a significant difference, $F(2, 679) = 41.63$, $p < .0001$. RE women ($M = .79$, $SD = 2.06$, $n = 151$) were more willing to engage in sex after knowing someone 1 month than were pre-RE women ($M = -1.02$, $SD = 2.14$, $n = 492$), $t(679) = 9.11$, $p < .0001$, $d = .85$, and menopausal women ($M = -.79$, $SD = 2.36$, $n = 39$), $t(679) = 4.13$, $p < .0001$, $d = .75$.

There was a significant difference in willingness to have sexual intercourse after knowing someone 1 week (Prediction 2.3), $F(2, 676) = 41.46$, $p < .0001$. RE women ($M = -.21$, $SD = 2.24$, $n = 149$) were more willing to have sex after knowing someone 1 week than pre-RE women ($M = -1.83$, $SD = 1.77$, $n = 491$), $t(676) = 9.10$, $p < .0001$, $d = .86$, and menopausal women ($M = -1.51$, $SD = 2.19$, $n = 39$), $t(676) = 3.81$, $p < .0001$, $d = .59$.

For willingness to have sexual intercourse after knowing someone one evening (Prediction 2.4), there was a significant difference, $F(2, 676) = 35.25$, $p < .0001$. RE women ($M = -1.02$, $SD = 2.09$, $n = 149$) were more willing to have sex after knowing someone one evening than pre-RE women ($M = -2.28$, $SD = 1.42$, $n = 491$), $t(676) = 8.40$, $p < .0001$, $d = .79$, and menopausal women ($M = -2.00$, $SD = 1.70$, $n = 39$), $t(676) = 3.39$, $p < .0001$, $d = .49$.

As hypothesized, controlling for the number of children women already have did not change results. Additionally, controlling for how much participants consciously desired having another child (or having a child if currently childless) did not change results (analyses available from first author upon request).

4. Discussion

According to our hypothesis, women experiencing a decline in fertility have evolved a reproduction expediting adaptation designed to capitalize on their remaining fertility by increasing motivation to engage in sexual activity and increasing frequency of

actual sexual behavior. Specifically, we predicted women hypothesized to express the reproduction expediting adaptation would think more about sexual activities, have more sexual fantasies, have more intense sexual fantasies, engage in more sexual intercourse, and be more willing to engage in sexual intercourse after knowing someone for 1 month or 1 week than would non-reproduction expediting women. Additionally, we predicted reproduction expediting women in a relationship would fantasize about someone other than their current romantic partner more than their current romantic partner.

Participants in the present study were classified into three age groups based on probable fertility status suggested by previous research (Bromberger et al., 1997; Dunson et al., 2004, 2002; Heckhausen et al., 2001; Menken et al., 1986). When comparing hypothesized RE women to women with relatively high fertility (pre-RE women), all predictions were supported. Reproduction expediting women thought more about sex, had a greater frequency of sexual fantasies and more intense sexual fantasies than women with high fertility (pre-RE women). Hypothesized RE women also engaged in sexual intercourse more frequently and were more willing to engage in sexual intercourse after knowing someone for 1 month or 1 week than were women with high fertility. Unexpectedly, women classified as reproduction expediting were also more willing to have sex after knowing someone for one evening than were women with high fertility. This suggests, as hypothesized, women have evolved a reproduction expediting psychological adaptation that functions to adjust sexual motivations and behaviors in order to capitalize on remaining fertility. These findings support previous research suggesting psychological shifts as a function of declining fertility. Schmitt and colleagues (2002) reported women in their early thirties felt more lustful and seductive and less abstinent than women in other age groups. In the current study women of hypothesized RE age had greater increased sexual motivations and behaviors than menopausal women, except for intensity of sexual fantasies and frequency of sexual intercourse. Menopausal women are no longer able to conceive, and therefore their psychology should not function to increase opportunities for conception.

Contrary to our prediction, women in a relationship classified as reproduction expediting did not fantasize more about someone other than their current romantic partner, but instead equally fantasized about their current romantic partner and other individuals. Women with high fertility did fantasize more about their current romantic partner than other individuals, although this was not the case for menopausal women. Ancestral women in a relationship could have benefited by maintaining a long-term relationship with an investing man while having a short-term relationship with a man of high genetic quality (Thornhill & Gangestad, 2008). However, in the present study, quality of women's mates was not measured, which should affect their desire to engage in an extra-pair relationship. Future research should test the prediction RE women with lower quality mates will be more likely to fantasize about extra-pair partners.

4.1. Alternative explanations

The present findings may reflect mere sexual experience increasing comfort with sexuality, and not by a reproduction expediting adaptation designed to capitalize on remaining fertility. Differences in sexual experience would explain why younger women were consistently different from older women. Previous research indicates sexual fantasy behavior changes as a function of sexual experience. Women with more sexual experience report having more sexual fantasies than those with less sexual experience (e.g., Pelletier & Herold, 1988). However, this alternative explanation cannot account for why in the present study menopausal wo-

men consistently displayed decreased sexual motivations and behaviors. To better determine the role of sexual experience, future research should measure both quantitative (number of partners, how long sexually active) and qualitative (type of experience, how pleasurable) differences in previous sexual experience.

Additionally, the present study conceptualized differences in sexual motivations and behaviors as a function of an age-related decline in fertility. Instead of women having a psychological adaptation functioning to capitalize on remaining fertility, women may have evolved an adaptation designed to prevent inopportune matings when highly fertile. If this is true, younger women would be expected to experience decreased sexual motivations and behaviors, preventing them from making undiscerning choices regarding sexual partners. This would explain the present results as younger women consistently displayed decreased sexual motivations and behaviors than older women. Future research should continue to examine age-related psychological shifts to better determine if young women have an adaptation functioning to prevent them from engaging in highly risky sexual behavior, if older women have a reproduction expediting adaptation, or whether both explanations have merit.

4.2. Limitations and future directions

Participants in the present study were grouped based on age categories used in previous research. We used age groups because although the use of age as a marker of fertility is not ideal, it is the best and most reliable method currently available to researchers (Maheshwari et al., 2008). It would be valuable for future research to directly measure fertility and to correlate actual fertility changes across the life-cycle with women's sexual motivations and behaviors. Additionally, modeling the effects of fertility on sexual behavior by age would provide a better understanding of the reproduction expediting adaptation. The current study lacked predictive power for all ages past 27 prohibiting a model of the data. We suggest future research increase the number of participants at each age and use a regression model of age instead of discrete age groups.

Additionally the present study did not ask about drug therapies already known to affect sexual motivations and behaviors. For example, postmenopausal women may be on androgen replacement therapy to ameliorate menopause symptoms. Testosterone supplements are known to artificially increase sexual behavior and are thought to similarly affect sexual fantasies (Leitenberg & Henning, 1995). Similarly, taking fertility drugs to enhance likelihood of conception may cause women to experience artificial shifts in their sexual psychology. The present study also did not control for use of hormonal birth control which may also affect sexual motivations and behaviors (see Alvergne & Lummaa, 2010, for review). We suggest future research address these limitations by controlling for these potential confounds.

Questions included in the present study were a small subset of a questionnaire examining psychological and behavioral shifts in women as a function of age. Participants did not report on the content of their thoughts and fantasies. Previous research suggests women fantasize about having an emotional connection to a fantasy partner (Barclay, 1973; Ellis & Symons, 1990; Halderman, Zelhart, & Jackson, 1985; Hardin & Gold, 1988; Kelley, 1984). If women experiencing a decline in fertility have evolved a reproduction expediting adaptation, then the content of their sexual fantasies should shift from more emotional to more sexual in nature, further motivating them to engage in behaviors to take advantage of their remaining fertility. Future research should investigate the content of women's sexual fantasies as a function of their age.

The present study was the first study to examine changes in women's reproductive behavior across the life-cycle as a function

of an evolved psychological adaptation. Results from the current study suggest at least one individual difference—currently having offspring – did not influence expression of the reproduction expediting adaptation. However, it may not be the number of current offspring that influence expression, but instead the quality or age of current offspring. Healthy or older offspring may cause a decrease in activation of the adaptation as these offspring may be more likely to reach reproductive age than unhealthy or young offspring. Additionally, there may be other individual differences, such as differences in life history strategy (e.g., Kaplan & Gangestad, 2005) that could affect expression of the reproduction expediting adaptation. To address these limitations, future research should more thoroughly examine women's sexuality across the lifespan to account for how developmental and life differences may affect women's likelihood to experience reproduction expediting as their fertility declines.

The present study examined whether women experiencing a decline in fertility also experience activation of an evolved psychological adaptation that functions to shift their sexual motivations and behaviors in such a way as to capitalize on their remaining opportunities to reproduce. Results indicate women with declining fertility have greater sexual motivations and increased sexual behaviors than do women with relatively high fertility. These findings lend further support to the influence of the biological clock on women's mating psychology to facilitate conception before the window of opportunity closes.

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