

Early Menarche is Associated With Preference for Masculine Male Faces and Younger Preferred Age to Have a First Child

Carlota Batres¹ and David I. Perrett¹

Abstract

One developmental factor that is associated with variation in reproductive strategy is pubertal timing. For instance, women who experience earlier menarche have their first pregnancy earlier and prefer more masculinized male voices. Early menarche may also lead to preferences for masculine faces, but no study has shown such a link. We therefore investigated the relationships between pubertal timing, reproductive plans, sexual attitudes and behaviors, and masculinity preferences in nulliparous women aged 18–30 from the United Kingdom ($N = 10,793$). We found that women who experienced earlier menarche reported a younger preferred age to have a first child and showed stronger masculinity preferences. This provides evidence that women experiencing early menarche not only have children earlier but notably *plan* to have children earlier. Additionally, our findings provide evidence that age of menarche influences partner selection, which is instrumental for the implementation of reproductive strategies.

Keywords

menarche, puberty, masculinity, faces, preferences, reproduction

Introduction

Life history theory proposes that individuals face a trade-off between effort spent on survival and effort spent on reproduction (Chisholm et al., 1993; Stearns, 1992). Moreover, within reproductive effort, individuals must also balance mating and parenting effort (Chisholm et al., 1993). Much research on life history theory has focused on understanding how different reproductive strategies influence an individual's reproductive success. For example, some individuals may pursue a quantitative reproductive strategy of having a greater number of children with a relatively low level of investment in each, while other individuals may pursue a qualitative reproductive strategy of having fewer children with a relatively high level of investment in each (Chisholm et al., 1993; Hoier, 2003). In addition to quantity versus quality, speed is also a factor in reproductive strategy. For instance, individuals who choose to have children can exercise a “fast and early” or a “slow and late” reproductive strategy (Draper & Harpending, 1982).

According to life history theory, reproductive strategies depend on both developmental and environmental factors and can be adaptive (Belsky, Steinberg, & Draper, 1991; Hoier, 2003). One developmental factor that has been identified as

influential in life history trajectory is pubertal timing (Belsky et al., 1991; Hoier, 2003). In women, early pubertal timing is associated with early onset of ovulatory cycles (Vihko & Apter, 1984). Even after menarche, women who experienced early pubertal timing have been found to have higher estradiol levels as adolescents (Vihko & Apter, 1984) and up until early adulthood (Apter, Reinilä, & Vihko, 1989; Bernstein, Pike, Ross, & Henderson, 1991).

Research proposes that there is a complex relationship between exposure to adversity and psychosocial stress early in life and biological reactivity (Boyce & Ellis, 2005; Ellis, 2004). For instance, girls with high psychosocial stress arising from father absence tend to experience earlier menarche than girls whose fathers were present in their home (Doughty &

¹ School of Psychology and Neuroscience, University of St Andrews, Scotland, UK

Corresponding Author:

Carlota Batres, School of Psychology and Neuroscience, University of St Andrews, St Andrews, Fife, KY16 9JP, Scotland, UK.
Email: jcb23@st-andrews.ac.uk



Creative Commons CC-BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 3.0 License (<http://www.creativecommons.org/licenses/by-nc/3.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

Rodgers, 2000; Ellis, McFadyen-Ketchum, Dodge, Pettit, & Bates, 1999). Boyce and Ellis (2005) suggest that girls with early father absence develop in a manner that speeds pubertal maturation and accelerates onset of sexual activity, since they are exposed to an environment where male parental investment is unreliable. Indeed, research has shown that girls who experience early menarche have romantic relationships at an earlier age, engage in sexual intercourse at an earlier age, and have their first pregnancies earlier (Hoier, 2003; Udry, 1979). It is unknown, however, whether women who experience menarche at an earlier age *plan* to have children earlier or whether they have their first pregnancy earlier as a by-product of having romantic relationships and sexual intercourse at an earlier age. We therefore aimed to investigate whether, in addition to their actual reproductive outcomes, age of menarche also influences women's reproductive plans. We predicted that women who reported an earlier age of menarche would also report a younger preferred age to have a first child.

It has also been argued that speed of sexual development influences mate preferences because partner selection is instrumental for the implementation of reproductive strategies (Cornwell et al., 2006). One preference that has been suggested to influence reproductive strategies is that for masculinity. There is some evidence that masculinity is a cue to health as indicated by findings that males with higher levels of facial masculinity are perceived to be healthier (Rhodes, Chan, Zebrowitz, & Simmons, 2003). More importantly, although the evidence is still debated (Rantala et al., 2013; Roberts, Buchanan, & Evans, 2004), men with masculine faces might actually be healthier as measured by health histories and medical examinations (Rhodes et al., 2003).

Masculinity is also a cue to dominance (Batres, Re, & Perrett, 2015) and intrasexual competitiveness (Puts, 2010; Scott, Clark, Boothroyd, & Penton-Voak, 2013), since it signals physical strength and fighting ability. For instance, when individuals are asked to vote for someone to run their country in times of war, they select candidates with masculine faces (Little, Burriss, Jones, & Roberts, 2007). Masculine men may be healthier or more dominant, enabling them to win in intrasexual competitions, and as a result of successful competitions, they may have greater access to resources, enabling them to maintain a healthier physique and high status.

Along with the benefits associated with masculinity, there is evidence of certain costs associated with this trait. For instance, increasing facial masculinity results in decreasing perceptions of warmth, cooperation, emotionality, honesty, and perceived quality as a parent (Perrett et al., 1998). Additionally, there is evidence for a link between masculinity and aggression, since masculine faces are considered more threatening, coercive, volatile, and controlling (Johnston, Hagel, Franklin, Fink, & Grammer, 2001). Such evidence supports the idea that women face a trade-off, with preferences depending on the costs and the benefits of choosing a masculine partner. For example, masculinity preferences are higher when women are considering engaging in short-term relationships (Little, Burt, Penton-Voak, & Perrett, 2001; Little, Connely, Feinberg, Jones, & Roberts, 2011).

Masculinity preferences are also influenced by individual differences. For instance, research has found a positive correlation between a woman's age, within fertile years, and preferences for masculinity in male faces (e.g., Little et al., 2001). Another individual difference that has been suggested to influence masculinity preferences is age of puberty. Cornwell et al. (2006) predicted that women who mature earlier would have learned to associate masculine characteristics with potential mates and would therefore prefer faces with higher levels of masculinity. More specifically, girls who experience earlier menarche are more likely to draw the attention of boys who are older and more physically mature (Gowen, Feldman, Diaz, & Yisrael, 2004; Magnusson, Stattin, & Allen, 1985). This early attention from boys with more sexually mature characteristics may then result in early maturing girls preferring more masculine partners (Cornwell et al., 2006).

Hoier (2003) did indeed find that women who experienced earlier menarche gave higher overall attractiveness ratings to male faces when compared to women who experienced later menarche. Cornwell et al. (2006), however, found no effect of menarche age on facial masculinity preferences but did find that women who had intercourse at an earlier age preferred more masculine faces. The link between pubertal timing and partner preferences might not have been found in Cornwell et al.'s (2006) study, since their sample consisted of only 46 women. Furthermore, age of menarche varies depending on country of origin (Pathak & Whittemore, 1992), a variable that was not controlled for in Cornwell et al.'s (2006) study. Physical stress in the environment, such as economic hardship and malnutrition, leads to a delay in puberty, since it is necessary for the individual to channel energy toward growth and survival rather than reproduction (Ellis & Garber, 2000; Surbey, 1998). Given that physical stress in the environment varies greatly across countries, it is helpful to hold country of origin constant when examining age of menarche. Indeed, some studies have found that average age of menarche does not even overlap between some countries (Bernstein et al., 1991). For example, one study classified participants from the United States as having menarche "before age 12," "at age 12," or "at age 13 and older," whereas participants from China were classified as having menarche "before age 15," "at age 15," or "at age 16 and older" (Bernstein et al., 1991). Such differences suggest that country of origin should be held constant in order to better examine the influences of pubertal timing.

Although Cornwell et al. (2006) did not find a link between age of menarche and facial masculinity preferences, Jones, Boothroyd, Feinberg, and DeBruine (2010) did find that women who experience earlier menarche prefer more masculinized male voices. Moreover, research has found that women's preferences for men's facial and vocal masculinity are positively correlated (Feinberg, DeBruine, Jones, & Little, 2008). We therefore aimed to investigate whether age of menarche influences facial masculinity preferences in a large sample of women from the United Kingdom and predicted that women who reported early menarche would prefer more masculine male faces.

Age of menarche has also been linked with the number of partners wanted, with earlier puberty leading to a higher number of partners desired (Hoier, 2003). In addition, Smith et al. (2009) found that women who prefer short-term relationships have stronger preferences for masculine men. These studies (Hoier, 2003; Smith et al., 2009) likely indicate that women who undergo menarche at a younger age may be more interested in short-term sexual relationships. Surprisingly, Hoier (2003) did not find a link between age of menarche and sociosexuality (i.e., willingness to engage in uncommitted sexual relationships). We therefore aimed to further investigate the relationship between age of menarche and women's sociosexual attitudes in a large sample of women. We predicted that women who reported an earlier age of menarche would report both a stronger sex drive and a higher willingness to engage in uncommitted sexual relationships.

Methods

Materials

Male and female university students aged 18–22 were photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths. These images were delineated with 189 points using Psychomorph, a custom face-processing software (Tiddeman, Perrett, & Burt, 2001), and aligned to a standard interpupillary distance (Rowland & Perrett, 1995). Seven male composite images were created (each averaging three original male faces together). Masculinity prototypes were then generated by separately averaging the female faces and the male faces (for details, see Batres & Perrett, 2014). The seven composites were then transformed to create pairs using $\pm 50\%$ of the shape difference between the male and the female prototypes while holding texture and color constant. This resulted in a total of seven pairs of male faces, where each pair was made up of a 50% feminized and a 50% masculinized face shape.

A questionnaire asked for the participant's sex, age, ethnicity, sexual orientation, whether they already had children ("How many children do you have?"), their preferred age to have a first child ("What age would you like to have [or have had] your first child?"), the age at which they had their first sexual intercourse ("About what age were you when you first had sexual intercourse?"), their age of menarche ("How old were you when you started puberty [when you started your first period]?"), their sex drive (on a scale from 1 = *strongly disagree* to 7 = *strongly agree*, "I have a strong sex drive"), and the three attitude questions from the revised sociosexual orientation inventory (Penke & Asendorpf, 2008; the average score for these three questions was used in the analyses). The attitude questions were utilized since of the three facets of sociosexuality (i.e., behavior, attitude, and desire) attitude toward sexual relationships is the best predictor of women's preferences in potential partners (Quist et al., 2012).

Participants and Procedures

A total of 10,793 Caucasian nulliparous heterosexual women aged 18–30 (mean years $\pm SD = 23.70 \pm 3.52$) from the United Kingdom completed all questions of the study online (see Reimers, 2007 for details). Ethical criteria from the British Broadcasting Corporation (BBC) editorial policy and guidelines were followed. Participants were first presented with the questionnaire and instructed to skip any question that did not apply to them (e.g., if they had not had sexual intercourse, then they should skip the question regarding their age at first sexual intercourse) or any question to which they did not recall the answer (e.g., if they did not remember the age at which they started their first period, then they should skip that question). It must be noted that only participants who completed all questions of the study were included in the data analyses, meaning that the sample was restricted to women who were sexually active and wanted to have children at some point. After the questionnaire, participants were then presented with the seven pairs of faces varying in masculinity, where one pair appeared at a time. The order of the pairs and which face was on the left/right were both randomized. Participants were instructed to select which face they considered to be the most attractive.

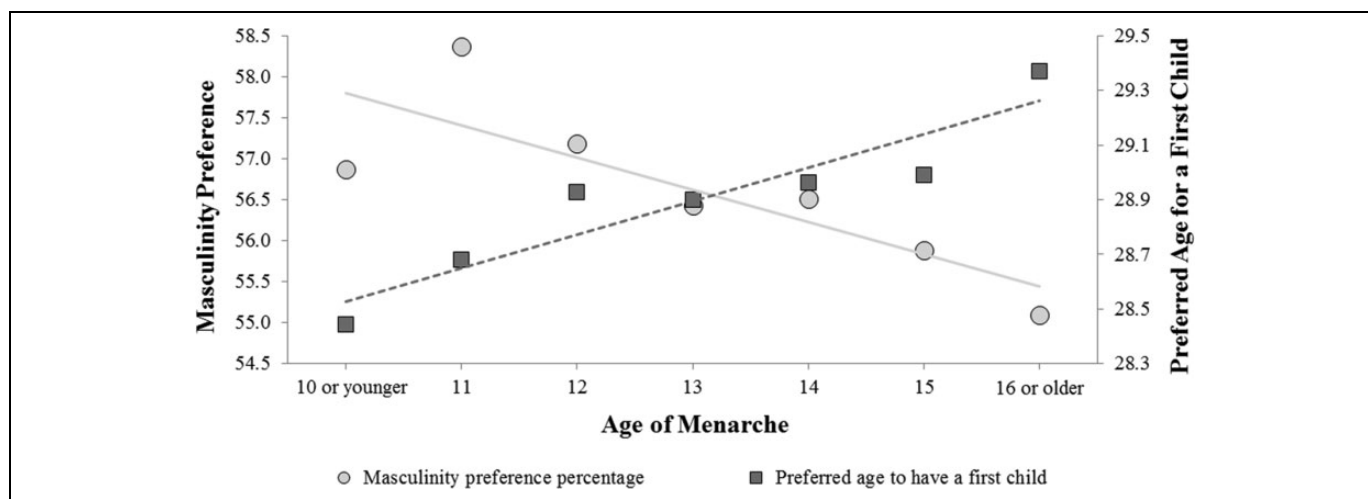
Results

Given that less than 5% of the sample reported age of menarche at 10 years or younger and 16 years or older, we winsorized those responses into two categories. Using those categories, 4.9% of women reported their age of menarche as 10 years or younger, 16.8% reported age 11, 25.4% reported age 12, 29.9% reported age 13, 15.2% reported age 14, 5.5% reported age 15, and 2.3% reported age 16 or older. For all the analyses, masculinity preferences were calculated by taking the proportion of masculine faces selected across the seven pairs. Partial correlations controlling for current age were conducted (see Table 1). There were significant positive correlations between age of menarche and both age of first sexual intercourse, $r(10,790) = .081, p < .001$, and preferred age to have a first child, $r(10,790) = .029, p = .003$ (see Figure 1). There were significant negative correlations between age of menarche and both masculinity preferences, $r(10,790) = -.024, p = .014$ (see Figure 1) and sex drive, $r(10,790) = -.037, p < .001$. There was no significant correlation between age of menarche and sociosexual attitude, $r(10,790) = .007, p = .437$.

The data were further analyzed using a two-step hierarchical regression analysis (dependent variable: masculinity preference; first-step independent variable: current age; second-step independent variables: age of menarche, preferred age to have a first child, age of first sexual intercourse, sex drive, and sociosexual attitude). Variance inflation factors (all ≤ 1.450) and tolerance values (all ≥ 0.690) indicated that multicollinearity was not an issue. Current age ($\beta = .010, p = .319$) was not a significant predictor of masculinity preferences in the first model, R^2 change $< .001, F(1, 10,792) = 0.992, p = .319$. In the second model, current age ($\beta = .008, p = .517$) and

Table 1. Partial Correlations Controlling for Current Age.

	Sociosexual Attitude	Sex Drive	Masculinity Preferences	Preferred Age to Have a First Child	Age of First Sexual Intercourse	Age of Menarche
Sociosexual attitude		0.148***	0.023*	0.088***	−0.174***	0.007
Sex drive			0.035***	−0.005	−0.056***	−0.037***
Masculinity preferences				0.006	0.019*	−0.024*
Preferred age to have a first child					0.078***	0.029**
Age of first sexual intercourse						0.081***
Age of menarche						

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.**Figure 1.** Scatterplot with linear regression trend lines depicting the negative relationship between age of menarche and masculinity preferences and the positive relationship between age of menarche and preferred age to have a first child.

preferred age to have a first child ($\beta = .003$, $p = .791$) were not significant predictors of masculinity preferences, but age of first sexual intercourse ($\beta = .027$, $p = .006$), sex drive ($\beta = .032$, $p = .001$), sociosexual attitude ($\beta = .023$, $p = .023$), and menarche age ($\beta = -.025$, $p = .010$) did significantly predict masculinity preferences, R^2 change = .003, $F(6, 10,792) = 5.140$, $p < .001$. A second identical two-step hierarchical regression analysis was conducted with the addition of interaction terms (Age of Menarche \times Preferred Age to Have a First Child, Age of Menarche \times Age of First Sexual Intercourse, Age of Menarche \times Sex Drive, and Age of Menarche \times Sociosexual Attitude). None of the interaction terms significantly predicted masculinity preferences ($\beta = .184$, $p = .159$; $\beta = .192$, $p = .063$; $\beta = -.042$, $p = .654$; $\beta = .059$, $p = .537$).

Given that sociosexuality is not related to age of menarche but appears to be significantly related to masculinity preferences, we also ran a two-step hierarchical regression model that controlled for sociosexual attitude (dependent variable: masculinity preference; first-step independent variables: current age and sociosexual attitude; second-step independent variables: age of menarche, preferred age to have a first child, age of first sexual intercourse, and sex drive). Variance inflation factors

(all ≤ 1.450) and tolerance values (all ≥ 0.690) indicated that multicollinearity was not an issue. Current age ($\beta = .008$, $p = .412$) was not a significant predictor of masculinity preferences, but sociosexual attitude ($\beta = .023$, $p = .018$) was a significant predictor of masculinity preferences in the first model, R^2 change = .001, $F(2, 10,792) = 3.273$, $p = .038$. In the second model, current age ($\beta = .008$, $p = .517$) and preferred age to have a first child ($\beta = .003$, $p = .791$) were not significant predictors of masculinity preferences, but sociosexual attitude ($\beta = .023$, $p = .023$), age of first sexual intercourse ($\beta = .027$, $p = .006$), sex drive ($\beta = .032$, $p = .001$), and menarche age ($\beta = -.025$, $p = .010$) did significantly predict masculinity preferences, R^2 change = .002, $F(6, 10,792) = 5.140$, $p < .001$.

To analyze whether the significant relationship between age of menarche and masculinity preferences was being driven by a specific age group, partial correlations controlling for current age were rerun excluding each menarche age category. The relationship between age of menarche and masculinity preferences remained significant when excluding every menarche category except for that of age 11. When excluding participants who reported menarche as age 11, there was no significant correlation between age of

menarche and masculinity preferences, $r(8,975) = -0.014$, $p = .181$.

A two-step hierarchical regression analysis for preferred age to have a first child was also conducted (dependent variable: preferred age to have a first child; first-step independent variable: current age; second-step independent variables: sociosexual attitude, age of menarche, masculinity preferences, age of first sexual intercourse, and sex drive). Variance inflation factors (all ≤ 1.059) and tolerance values (all ≥ 0.944) indicated that multicollinearity was not an issue. Current age ($\beta = .546$, $p < .001$) was a significant predictor of preferred age to have a first child in the first model, R^2 change = .298, $F(1, 10,792) = 4,587.791$, $p < .001$. In the second model, masculinity preferences ($\beta = .002$, $p = .791$) and sex drive ($\beta = -.013$, $p = .116$) were not significant predictors of preferred age to have a first child, but current age ($\beta = .527$, $p < .001$), sociosexual attitude ($\beta = .089$, $p < .001$), menarche age ($\beta = -0.017$, $p = .039$), and age of first sexual intercourse ($\beta = .080$, $p < .001$) did significantly predict preferred age to have a first child, R^2 change = .012, $F(6, 10,792) = 809.546$, $p < .001$.

Discussion

The results from this study replicate the finding that women who experience menarche at an earlier age have sexual intercourse earlier (Hoier, 2003). This study also replicates the finding that there is no link between age of menarche and sociosexuality (Hoier, 2003). Along with previous literature (Provost, Kormos, Kosakoski, & Quinsey, 2006), this study shows that sociosexuality is related to masculinity preferences, and since we found that early menarche is also related to masculinity preferences, we expected for earlier menarche to be related to a less restricted sociosexual attitude. Our study, however, did not find this link, and, with such a large sample, it provides strong evidence that there is no relationship between age of menarche and sociosexual attitudes. One possible explanation for this finding is that age of menarche may not relate to sociosexual attitudes but may relate to one or both of the two other dimensions of sociosexuality (i.e., behavior and desire). As mentioned earlier, girls who experience earlier menarche draw more attention from boys (Gowen et al., 2004; Magnusson et al., 1985). Such increased levels of attention could mean that women who experience menarche earlier may have similar sociosexual attitudes to women who experience menarche later, but those with earlier menarche may simply engage in more sociosexual behaviors as a consequence of having more opportunities to do so. This study only examined sociosexual attitudes, and therefore, future research would be needed in order to investigate the relationships between sociosexual behaviors and desires with pubertal timing.

Our results showed that even after controlling for other factors known to influence masculinity preferences (e.g., sociosexual attitude), women who experience earlier menarche prefer more masculine male faces. This suggests that developmental factors influence not only reproductive strategies but also partner selection, which is instrumental for the

implementation of such strategies. Our findings support one explanation proposed by Cornwell et al. (2006) in which girls who experience early menarche may consider themselves to be of higher quality, given their social success through puberty, and therefore, these earlier maturing girls may in turn prefer higher quality mates (i.e., more masculine). Alternatively, our findings could also support a further explanation proposed by Cornwell et al. (2006) and Jones et al. (2010) in which early maturing girls might have learned to associate masculinity with desirable mates, since girls who experience earlier menarche are more likely to draw the attention from boys who are older and more physically mature (Gowen et al., 2004; Magnusson et al., 1985). Additionally, girls who experience early menarche are more likely to have engaged in sexual and romantic activity with older males and also receive more attention and positive feedback from older males (Prokopčakova, 1998). These early positive interactions with older males could lead early maturing girls to develop a preference for masculine-looking partners later on in life, since older males look more masculine (Batres et al., 2015). Indeed, research has found that facial attractiveness judgments in adulthood reflect the effects of visual exposure during critical periods of development (Perrett et al., 2002; Saxton, Little, DeBruine, Jones, & Roberts, 2009).

Upon further inspection, the significant relationship between age of menarche and masculinity preferences seems to be driven by women who experienced menarche at age 11. As evidenced by Figure 1, masculinity preferences peak for those women who reported age of menarche as 11. These findings suggest that there might be something special about experiencing menarche at that age. Indeed, at age 11, most girls in the United Kingdom transition from primary school, where they are surrounded by younger boys, to secondary school, where they are surrounded by older boys. Thus, it appears that, in the United Kingdom, age 11 is a critical period during development that has long-lasting influences on partner preferences. It would be interesting to examine the relationship between age of menarche and masculinity preferences in countries where the transition between primary and secondary school falls at a different age in order to further test the influence of being exposed to older boys during sexual maturation.

Our results also provide new evidence that women who experience menarche at an earlier age have a younger preferred age to have a first child than women who experience menarche at a later age. This relationship persisted even after controlling for other factors. This suggests that women who experience early pubertal timing not only have children earlier (Udry, 1979) but notably *plan* to have children earlier. This distinction is important, as it provides evidence that women experiencing earlier menarche are planning to reproduce earlier, not simply having earlier pregnancies as a by-product of having romantic relationships and sexual intercourse at an earlier age. Additionally, it is important to note that, although statistically significant, several effect sizes in our regression analyses, including the effect size of menarche age on preferred age to have a first child, were statistically quite small. That said, our findings are

of theoretical importance since they provide evidence that even after many years, age of menarche still relates to our variables of interest (e.g., preferred age to have a first child).

One possible explanation for our findings is that levels of female reproductive hormones may underlie all of our variables of interest (i.e., age of menarche, preferred age to have a first child, and masculinity preferences). Women who experience earlier menarche have higher estradiol levels as adolescents (Vihko & Apter, 1984) and even up until early adulthood (Apter et al., 1989; Bernstein et al., 1991). Reproductive hormones have been found to influence feminine appearance (Jasińska, Ellison, & Thune, 2004), partner preferences (Feinberg et al., 2012), and ideal number of children (Law-Smith et al., 2012). For instance, women with higher levels of estrogen are more likely to have feminine body shapes (Jasińska et al., 2004) and faces (Smith et al., 2006). Feminine women are rated as more attractive (Rhodes et al., 2003), and consequently, they may be able to choose masculine partners and enforce demands of paternal investment more successfully than less feminine women (Feinberg et al., 2012). Indeed, research has found that women who rate themselves as more attractive are more attracted to masculinity (Feinberg et al., 2012; Little et al., 2001). Estrogen levels have also been found to correlate positively with maternal tendencies (Law-Smith et al., 2012). Given such findings, it is possible that levels of reproductive hormones may explain the links between early menarche and both desire to have children at a younger age and preferences for more masculine partners.

It would be beneficial for future studies to examine whether the links between early menarche, preferred age to have a first child, and masculinity preferences are also present in other countries. As mentioned earlier, physical stress in the environment, such as economic hardship and malnutrition, leads to a delay in puberty, since it is necessary for the individual to channel energy toward growth and survival rather than reproduction (Ellis & Garber, 2000; Surbey, 1998). The United Kingdom is a developed country with high gross national income per capita and high life expectancy (United Nations Development Programme, 2014); hence, it would be interesting to compare the influence of age of menarche in a country that has low gross national income per capita and low life expectancy. Additionally, women from the United Kingdom have access to free public health care and contraception, both of which may influence their reproductive strategies. It would therefore be interesting to examine how age of menarche influences reproductive plans as well as sexual attitudes and behaviors in countries where women do not have access to such services. Lastly, even within the same country, women's environments will vary, and therefore, future research would benefit from delving further into how physical stress in the environment (e.g., socioeconomic status) influences reproductive strategies and mate preferences through pubertal timing.

Acknowledgments

We thank Dengke Xiao for the experimental interface; Benedict C. Jones, David R. Feinberg, and Lisa M DeBruine for initial setup of the

BBC survey; Anne Perrett for proofreading; and Lesley Ferrier for logistical support.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

- Apter, D., Reinilä, M., & Vihko, R. (1989). Some endocrine characteristics of early menarche, a risk factor for breast cancer, are preserved into adulthood. *International Journal of Cancer*, 44, 783–787.
- Batres, C., & Perrett, D. I. (2014). The influence of the digital divide on face preferences in El Salvador: People without internet access prefer more feminine men, more masculine women, and women with higher adiposity. *PLoS ONE*, 9, e100966.
- Batres, C., Re, D. E., & Perrett, D. I. (2015). Influence of perceived height, masculinity, and age on each other and on perceptions of dominance in male faces. *Perception*, 44, 1293–1309.
- Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development*, 62, 647–670.
- Bernstein, L., Pike, M. C., Ross, R. K., & Henderson, B. E. (1991). Age at menarche and estrogen concentrations of adult women. *Cancer Causes & Control*, 2, 221–225.
- Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: I. An evolutionary–developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology*, 17, 271–301.
- Chisholm, J. S., Ellison, P. T., Evans, J., Lee, P. C., Lieberman, L. S., Pavlik, Z., . . . Worthman, C. M. (1993). Death, hope, and sex, life-history theory and the development of reproductive strategies. *Current Anthropology*, 34, 1–24.
- Cornwell, R. E., Smith, M. J. L., Boothroyd, L. G., Moore, F. R., Davis, H. P., Stirrat, M., . . . Perrett, D. I. (2006). Reproductive strategy, sexual development and attraction to facial characteristics. *Philosophical Transactions of the Royal Society B, Biological Sciences*, 361, 2143–2154.
- Doughty, D., & Rodgers, J. L. (2000). Behavior genetic modeling of menarche in US females. In J. L. Rodgers, D. C. Rowe, & W. B. Miller (Eds.), *Genetic influences on human fertility and sexuality* (pp. 169–181). New York, NY: Springer US.
- Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy, an evolutionary perspective. *Journal of Anthropological Research*, 38, 255–273.
- Ellis, B. J., & Garber, J. (2000). Psychosocial antecedents of variation in girls' pubertal timing: Maternal depression, stepfather presence, and marital and family stress. *Child Development*, 71, 485.
- Ellis, B. J., McFadyen-Ketchum, S., Dodge, K. A., Pettit, G. S., & Bates, J. E. (1999). Quality of early family relationships and

- individual differences in the timing of pubertal maturation in girls: A longitudinal test of an evolutionary model. *Journal of Personality and Social Psychology*, 77, 387.
- Ellis, C. (2004). *The ethnographic I: A methodological novel about autoethnography*. Lanham, MD: Rowman Altamira.
- Feinberg, D. R., DeBruine, L. M., Jones, B. C., & Little, A. C. (2008). Correlated preferences for men's facial and vocal masculinity. *Evolution and Human Behavior*, 29, 233–241.
- Feinberg, D. R., DeBruine, L. M., Jones, B. C., Little, A. C., O'Connor, J. J. M., & Tigue, C. C. (2012). Women's self-perceived health and attractiveness predict their male vocal masculinity preferences in different directions across short- and long-term relationship contexts. *Behavioral Ecology and Sociobiology*, 66, 413–418.
- Gowen, L. K., Feldman, S. S., Diaz, R., & Yisrael, D. S. (2004). A comparison of the sexual behaviors and attitudes of adolescent girls with older vs. similar-aged boyfriends. *Journal of Youth and Adolescence*, 33, 167–175.
- Hoier, S. (2003). Father absence and age at menarche. *Human Nature*, 14, 209–233.
- Jasińska, G., Ellison, P. T., & Thune, I. (2004). Large breasts and narrow waists indicate high reproductive potential in women. *Proceedings: Biological Sciences*, 271, 1213–1217.
- Johnston, V. S., Hagel, R., Franklin, M., Fink, B., & Grammer, K. (2001). Male facial attractiveness: Evidence for hormone-mediated adaptive design. *Evolution and Human Behavior*, 22, 251–267.
- Jones, B. C., Boothroyd, L., Feinberg, D. R., & DeBruine, L. M. (2010). Age at menarche predicts individual differences in women's preferences for masculinized male voices in adulthood. *Personality and Individual Differences*, 48, 860–863.
- Law-Smith, M. J., Deady, D. K., Moore, F. R., Jones, B. C., Cornwell, R. E., Stirrat, M., . . . Perrett, D. I. (2012). Maternal tendencies in women are associated with estrogen levels and facial femininity. *Hormones and Behavior*, 61, 12–16.
- Little, A. C., Burriss, R. P., Jones, B. C., & Roberts, S. C. (2007). Facial appearance affects voting decisions. *Evolution & Human Behavior*, 28, 18–27.
- Little, A. C., Burt, D. M., Penton-Voak, I. S., & Perrett, D. I. (2001). Self-perceived attractiveness influences human female preferences for sexual dimorphism and symmetry in male faces. *Proceedings: Biological Sciences*, 268, 39–44.
- Little, A. C., Connely, J., Feinberg, D. R., Jones, B. C., & Roberts, S. C. (2011). Human preference for masculinity differs according to context in faces, bodies, voices, and smell. *Behavioral Ecology*, 22, 862–868. doi:10.1093/beheco/arr061
- Magnusson, D., Stattin, H., & Allen, V. L. (1985). Biological maturation and social development: A longitudinal study of some adjustment processes from mid-adolescence to adulthood. *Journal of Youth and Adolescence*, 14, 267–283.
- Pathak, D. R., & Whittemore, A. S. (1992). Combined effects of body size, parity, and menstrual events on breast cancer incidence in seven countries. *American Journal of Epidemiology*, 135, 153–168.
- Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations, a more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology*, 95, 1113–1135.
- Perrett, D. I., Lee, K. J., Penton-Voak, I. S., Rowland, D., Yoshikawa, S., Burt, D. M., . . . Akamatsu, S. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature*, 394, 884–887.
- Perrett, D. I., Penton-Voak, I. S., Little, A. C., Tiddeman, B. P., Burt, D. M., Schmidt, N., . . . Barrett, L. (2002). Facial attractiveness judgements reflect learning of parental age characteristics. *Proceedings of the Royal Society of London B: Biological Sciences*, 269, 873–880.
- Prokopčakova, A. (1998). Drug experimenting and pubertal maturation in girls. *Studia Psychologica*, 40, 287–290.
- Provost, M. P., Kormos, C., Kosakoski, G., & Quinsey, V. L. (2006). Sociosexuality in women and preference for facial masculinization and somatotype in men. *Archives of Sexual Behavior*, 35, 305–312.
- Puts, D. A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans. *Evolution and Human Behavior*, 31, 157–175.
- Quist, M. C., Watkins, C. D., Smith, F. G., Little, A. C., DeBruine, L. M., & Jones, B. C. (2012). Sociosexuality predicts women's preferences for symmetry in men's faces. *Archives of Sexual Behavior*, 41, 1415–1421.
- Rantala, M. J., Coetzee, V., Moore, F. R., Skrinda, I., Kecko, S., Krama, T., . . . Krams, I. (2013). Adiposity, compared with masculinity, serves as a more valid cue to immunocompetence in human mate choice. *Proceedings of the Royal Society B: Biological Sciences*, 280, 1. doi:10.1098/rspb.2012.2495
- Reimers, S. (2007). The BBC internet study, general methodology. *Archives of Sexual Behavior*, 36, 147–161.
- Rhodes, G., Chan, J., Zebrowitz, L. A., & Simmons, L. W. (2003). Does sexual dimorphism in human faces signal health? *Proceedings: Biological Sciences*, 270, S93–S95.
- Roberts, M. L., Buchanan, K. L., & Evans, M. R. (2004). Testing the immunocompetence handicap hypothesis: A review of the evidence. *Animal Behaviour*, 68, 227–239. doi:10.1016/j.anbehav.2004.05.001
- Rowland, D. A., & Perrett, D. I. (1995). Manipulating facial appearance through shape and color. *Computer Graphics and Applications, IEEE*, 15, 70.
- Saxton, T. K., Little, A. C., DeBruine, L. M., Jones, B. C., & Roberts, S. C. (2009). Adolescents' preferences for sexual dimorphism are influenced by relative exposure to male and female faces. *Personality and Individual Differences*, 47, 864–868.
- Scott, I. M. L., Clark, A. P., Boothroyd, L. G., & Penton-Voak, I. S. (2013). Do men's faces really signal heritable immunocompetence? *Behavioral Ecology*, 24, 579–589.
- Smith, F., Jones, B., Little, A., DeBruine, L., Welling, L., Vukovic, J., & Conway, C. (2009). Hormonal contraceptive use and perceptions of trust modulate the effect of relationship context on women's preferences for sexual dimorphism in male face shape. *Journal of Evolutionary Psychology*, 7, 195–210.
- Smith, M. L., Perrett, D. I., Jones, B. C., Cornwell, R. E., Moore, F. R., Feinberg, D. R., . . . Pitman, R. M. (2006). Facial appearance is a cue to oestrogen levels in women. *Proceedings of the Royal Society of London B: Biological Sciences*, 273, 135–140.

- Stearns, S. C. (1992). *The evolution of life histories* (Vol. 249). Oxford, England: Oxford University Press.
- Surbey, M. K. (1998). Parent and offspring strategies in the transition at adolescence. *Human Nature*, 9, 67–94.
- Tiddeman, B. P., Perrett, D. I., & Burt, D. M. (2001). Prototyping and transforming facial textures for perception research. *Computer Graphics and Applications, IEEE*, 21, 42–50.
- Udry, J. R. (1979). Age at menarche, at first intercourse, and at first pregnancy. *Journal of Biosocial Science*, 11, 433–441.
- United Nations Development Programme. (2014). *2014 Human development statistical tables*. Retrieved from <http://hdr.undp.org/en/data>
- Vihko, R., & Apter, D. (1984). Endocrine characteristics of adolescent menstrual cycles: Impact of early menarche. *Journal of Steroid Biochemistry*, 20, 231–236.