The Proverbial Ticking Biological Clock: A Symbolic TMT Perspective on Mate Selection

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Keywords: facial perceptions, terror management theory, fertility, hormonal status

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ABSTRACT

Past research has shown that mortality salience increases desire for offspring. Additionally, past studies have illustrated that women in a high fertility phase within a menstrual cycle show greater preference for masculine faces while performing facial judgment tasks than do women in a low fertility phase or women using hormonal contraception. However, mortality salience has been shown to influence mate selection. The current study explored whether or not a cue related to fertility salience may produce similar outcomes to cues of mortality salience observed in past studies. In partial replication of a study conducted by Vaughn, Bradley, Byrd-Craven, and Kennison (2010), the current study included 151 heterosexual female participants who self-identified as falling within cyclical high fertility or low fertility categories, or who reported using hormonal contraception. These participants were randomly assigned to either a control condition, a mortality salience condition, or a fertility salience condition and then instructed to judge images of male faces provided by Re, DeBruine, Jones, and Perrett (2013). Participants rated faces in categories of attractiveness, dominance, and health. The study predicted significant interaction effects of salience condition and fertility status on opposite sex facial perceptions. Additionally, participants were asked about procreation preferences. No effects of mortality salience or fertility salience were observed in regard to opposite sex facial perceptions, number of children desired, or preferred age for having a first child. Thus, the current research does not provide support that the fertility salience cue used in the study influences opposite sex perceptions or procreation preferences.

Keywords: facial perceptions, terror management theory, fertility, hormonal status

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Introduction

Studies have shown that women are able to pick up on visual cues signifying genetic characteristics, hormonal markers, and even personality traits in images of male faces. Through digital images, women may form quick perceptions about a male's attractiveness, masculinity, and health. From these perceptions, women form judgments about a man's dominance, as well as prosocial personality traits (Boothroyd, Jones, Burt, & Perrett, 2007). Using this wealth of information assessed in facial cues, women form preferences regarding a man's suitability as a short-term or long-term mate (Buss, 2009).

However, female perception formation is not as cut and dried as beholding a man's face. Research indicates that mate perception is influenced by hormonal states brought on by the female menstrual cycle. Women close to ovulation tend to prefer images of masculine faces, whereas women closer to menstruation tend to prefer less masculine images (Jones, DeBruine, Perrett, Little, Feinberg, & Law Smith, 2008). Thus, it has been established that overall mate perception results in an interplay between the female image viewer's hormonal state and the visual hormonal cues of the man on display (i.e., high testosterone, indicated by a dynamic jawline and thick brow bones) (Johnston, Hagel, Franklin, Fink, & Grammer, 2001). The matter is complicated even further when considering the interference of synthetic hormones found in birth control (Little, Burriss, Petrie, Jones, & Roberts, 2013), as well as psychological threats. Studies have shown that when a woman's self-esteem or confidence is threatened (Walster, 1965), or when she is reminded of her mortality (Hirschberger, Florian, & Mikulincer, 2002), her attraction perceptions are altered.

Terror management theory posits that when a person is made momentarily aware of mortality, he or she will behave in a way intended to prevent the possible anxiety provoked by death-related thoughts, as doing so protects self-esteem, and supports personal worldview (Becker, 1973; Solomon, Greenberg, & Pyszczynski, 1991). Those who receive literal reminders that death is inevitable

experience mortality salience. Mortality salience may also pertain to a *symbolic* notion of mortality, such as birth, growth, religion, or reproduction (Arndt, Greenberg, & Cook, 2002; Conrad, 2009; Florian & Mikulincer, 1998). Past research has shown that a woman is more likely to alter her desired qualities in a chosen mate when she is reminded of her impending death (Hirschberger, Florian, & Mikulincer, 2002; Hirschberger, Florian, & Mikulincer, 2003; Strachman & Schimel, 2006). Under normal circumstances in which no psychological threat is perceived, women's attraction perceptions are guided by specific biological cues. However, in human beings, altered attraction perceptions may result from a specific psychological threat—the impermanence of fertility.

Research conducted over the past few years suggests that the majority of college-aged women intend to become mothers in the future. One study revealed that 111 out of 114 female undergraduates at a Midwestern university anticipated having at least one child (Fetterolf & Eagly, 2011). In a survey that included 466 students from colleges and universities in Virginia, 98% of females indicated a "drive to have children" (Erchull, Liss, Axelson, Staebell, & Askari, 2010, p. 256), responding affirmatively to items such as: "Becoming a parent will make me complete" and "I can't wait to have children" (p. 256). In spite of a seemingly strong desire to procreate, recent trends show that women—specifically those with college degrees (Glasier, 2011)—are delaying motherhood for the sake of other pursuits (Alpert, 2013; Avishae, 2013; Glasier, 2011; Ludden, 2011; Mathews & Hamilton, 2009). Because fertility is a *temporary* and thus impermanent state in a woman's life, time-related anxiety may cause distress as women experience an innate desire to have children (Rotkirch, 2007). As stated previously, humans are unique in comparison to other animals, in that they have knowledge of mortality (Becker, 1973). Humans, specifically women, are privy to knowledge of reproduction limitations as well.

The National Institute of Environmental Health Sciences conducted a fertility study indicating that women's fertility begins declining by age 27, resulting in a 10% less chance of conceiving per

ovulation cycle. By age 35, the odds of conceiving have dropped an additional 10% (Graham, 2002). According to the American Society for Reproductive Medicine, age 35 is also around the time that egg quality and quantity diminishes. The average age for menopause among females is 51 (American Society for Reproductive Medicine, 2012). Menopause is the milestone that officially marks the end of reproductive capabilities. As stated by Jones, Jurgenson, Katzenellenbogen, and Thompson (2012), "all women that live long enough will experience a biological decline in ovarian function leading to reproductive senescence marking the end of their fertility and capacity for reproduction" (p. 3).

Along with this milestone come many physical and psychological changes. The Midlife Women's Health Survey (MWHS) surveyed a sample of 280 middle aged American women about sexual habits. Out of the sample, 40% indicated more decreases than increases in sexual response throughout the aging process. Women attributed these decreases to the physical and emotional changes brought on by menopause, as well as life circumstances (Mansfield, Koch, & Voda, 2010). Medical data has shown that more than 51% of sexually active middle-aged women experience sexual dysfunction, and that sexual function further declines with age (Castelo-Branco, Blumel, Araya, Riquelme, Castro, Haya, & Gramegna, 2003). Post-menopausal women recall vivid memories of menopause after it is over. Symptoms commonly recollected are hot flushes, vulnerability to weight gain, night sweats, tiredness, insomnia, irritability, and depression (Goldani von Mühlen, Kritz-Silverstein, & Barrett-Connor, 1995). Research suggests that physiological and psychological changes brought on by menopause are caused by a decline in estrogen levels. The hormonal and psychological changes may lead to negative impacts on self-esteem and self-image (Bachmann & Leiblum, 2004). Brown (1976) stated that menopausal women's anxiousness often stems from the fact that the end of menstruation is an undeniable physical manifestation of aging: "There is considerable emotional and philosophical readjustment to make, in the case of the menopause to the recognition of the passage of

time, the loss of youth and potential and the approach of death…These are all to do with frightening ideas of loss, change and end" (Brown, 1976, p. 110).

In an article recommending healthy attitude and lifestyle habits to women combatting symptoms of menopause, Cornforth (2009) suggested that women should consider menopause as a new beginning, rather than an end. However, translated from Greek, the word *menopause* means "the end of the monthlies" (Cornforth, 2009). In spite of positive attitudes and new ways of thinking, menopause is indisputably a biological endpoint. This raises several questions: How does this knowledge of fertility limitations affect a woman's general perceptions? More specifically, is fertility salience capable of altering perceptions of the opposite sex?

Terror management theory has been used as the foundation of several mate selection studies (Birnbaum, Hirschberger, & Goldenberg, 2011; Hirschberger, Florian, & Mikulincer, 2002; Laubach, 2013), showing that human beings are likely to alter mate preferences when primed with literal death reminders. What is not known, however, is whether or not a woman may alter her preferences after she is reminded of her narrow window for fertility and the inevitability of menopause. If a woman's attraction perceptions are indeed altered, then her ultimate mate choice may deviate from what would be expected had she not engaged in thoughts of menopause.

Considering research findings regarding the relationship between menopause and self-esteem, as well as the relationship between terror management theory and altered mate preferences, fertility may serve as a form of mortality salience that is symbolic in nature (Fritsche, Jonas, Fischer, Koranyi, Berger, & Fleischmann, 2007; Goldenberg, 2013; Mathews & Sear, 2008; Solomon, Greenberg, and Pyszczynski, 1991). The notion of fertility served as a prompt for *symbolic* mortality in the current study. No studies to date have addressed the notion of fertility as a symbolic mortality factor in regard

to mate selection. The present study investigated whether or not reminders of reproduction limitations influenced women's opposite sex perceptions.

Literature Review

Female Visual Cues: Masculine Hormonal Status

As far as scholarly research is concerned, opposite sex attraction perception is a very gray area. Masculine hormonal markers are among the many factors that play a role in females' perceptions of males. Scholarly evidence supports that subtle visual facial cues may play a small, but significant role in a woman's process of forming opposite sex perceptions.

Love at first sight is a cliché that many scoff at or dismiss as unrealistic. However, research findings support that many physiological traits can be observed at a glance when assessing a potential romantic partner's facial features. Sight can yield a lot of information about a person's genetic traits. Research has discovered that women's perceptions of attractiveness in men's facial features correlate to facial symmetry when measured digitally. This suggests that genetic fitness may be assessed through digital imagery (Rikowski & Grammar, 1999; Scheib, Gangestad, & Thornhill, 1999). Alas, studies such as these illustrate that women are able to make quick judgments and decisively form preferences based entirely on subtle visual cues.

Genetics and hormones are responsible for the appearance of a human face. Moore et al. (2011) linked symmetrical and rugged male facial features with testosterone and cortisol, identifying these hormones as integral to female attraction perceptions. Not only can women perceive attraction through visual symmetry and masculinity in photographs, they can also experience another kind of reaction—disgust. Using a scale to measure the knee-jerk feeling of disgust, Jones, Feinberg, Watkins, Fincher, Little, and DeBruine (2013) found that women could quickly experience negative emotion when unconsciously picking up on physical cues indicating pathogen stress.

Scientists theorize that these attraction perceptions evolved in humans as a way to protect and perpetuate the genes that would lend well to a strong human species (Miller, 2011). Studies support that general perceptions of beauty can reveal a wealth of information about a person's reproductive abilities. Etcoff (2011) challenged the popular belief that the notion of beauty is culturally constructed, armed with evolutionary evidence that some perceptions associated with beauty are universally shared cues indicative of fertility and fecundity. In the 21st century, however, mate choice is far more complex in motivation—no longer solely driven by primal instincts and procreation desires. Studies show that *personality* influences mate choice as well, and this too, can be subtly extracted from the human face. Boothroyd et al. (2007) investigated the health, aging, and masculinity of male faces, focusing primarily on women's perceptions of photographed males' personality traits based on visual cues. Researchers found that masculine faces, indicated by strong jaw and brow lines were perceived as dominant, yet generally undesirable for long term mate preferences, and healthy faces, indicated by symmetry and softer features, were associated with perceptions of prosocial behavior. Indeed, multiple facial cues work together, revealing a variety of different clues that offer perceptual insights as to what a hypothetical mate may be like.

However, a mate's appeal is not an objective area. If this were so, then women would universally agree on what constitutes as an "attractive" male or a suitable partner. If this were the case, there would be no variety in taste. This is where the process becomes a bit more complicated. This perception of a mate's appeal may depend not only on the hormonal status of a *man* in a photograph, but also on the hormonal status of the *woman* assessing a photograph.

Female Visual Cues: Feminine Hormonal Status

Women are sensitive to certain hormonal markers displayed through facial features depending on their own personal hormonal status, and ebbs and flows of fertility within the female menstrual

cycle often determine preferences. Women's hormonal surges predispose mating preferences and attraction perceptions in a variety of ways. When a woman is in a highly fertile phase within her cycle (i.e., close to ovulation), her hormonal status differs from when she is within a less fertile phase (i.e., close to menstruation).

A review of past literature conducted by Jones et al. (2008) offered support for the contention that menstrual cycle shifts affect mate preferences. Studies have noted that ovulating women preferred masculine faces more than did women who were not ovulating. Johnston et al. (2001), for example, tested 42 female volunteers at different points of their respective menstrual cycles for digital image facial preferences. In general, females tended to prefer male faces that were on the masculine side of average along the feminine-to-masculine range. The high fertility phase females preferred the most masculine male faces on the spectrum. To conclude, researchers suggested that attraction perceptions depend on a relationship between hormonal cues presented on the face in the photograph and the hormonal status of the person assessing the photograph. Based on the previous research mentioned above, when a woman is in a less fertile point of her cycle, she is less likely to choose a highly masculine face as "attractive." However, when she is in a highly fertile point in her cycle, the opposite is true.

Hormone-driven preferences are not only influenced by the authentic hormonal phases of the menstrual cycle, but also by synthetic changes caused by hormonal contraception. Oral contraceptive pills, the birth control patch (Ortho Evra), and the birth control vaginal ring (NuvaRing) contain the hormones estrogen and progestin (Planned Parenthood, 2013). The birth control implant (Implanon or Nexplanon), the birth control shot (Depo-Provera), and the hormonal intrauterine device also contain the hormone progestin (Planned Parenthood, 2013). Estrogen and/or progestin are released via hormonal contraception to effectively prevent a woman's egg from leaving her ovaries, as well as to

thicken cervical mucus, so that sperm cannot swim through her reproductive canal (Planned Parenthood, 2013).

The American College Health Association reported that nearly 40% of college-aged women are on birth control (Richards, 2012). This is worth noting, considering that hormone altering birth control has consistently been shown to alter women's attraction perceptions, mate selection, and long-term romantic satisfaction. Little et al. (2013) found that not only do women on birth control judge men with less masculine features as more attractive in photographs; but they are also more likely to choose these men as long-term romantic partners in reality. The team of researchers created two different photographs of each man in a group. The photographs were digitally altered so that one picture was masculinized, and the other was feminized. A group of women viewed the pictures before beginning a pill regimen, and then again after beginning oral contraception. After beginning the pill regimen, women's preferences for masculinity in male faces significantly decreased. Little et al. (2013) wanted to see if these findings exist in the real world. They conducted another study in which they recruited a sample size of 170 women. Some had chosen their current romantic partners while on birth control; others had chosen their current romantic partners while not on birth control. Volunteers were shown photographs of the significant others of the women in both groups. On average, the volunteers rated the romantic partners chosen by women using birth control as more feminine than the men who had been chosen by women not on birth control.

Scholars have wondered about long-term relationship implications for women who choose their partners while on birth control. Roberts, Klapilova, Little, Burriss, Jones, DeBruine, Petrie, and Havlicek (2011) explored long-term satisfaction in women who met their partners while taking oral contraception. In comparison to women who met their partners while experiencing natural waves of fertility, women who met their partners while on hormonal birth control reported lower sexual

satisfaction, higher sexual dissatisfaction, and less attraction to their partners later in life. They were also found less likely to separate, but more likely to initiate the parting of ways in the event of a separation. Roberts et al. (2011) noted that the general relationship satisfaction in women who met their husbands while taking oral contraception may compensate for or override the lack of sexual satisfaction. It has not yet been established how women under the influence of hormonal contraception will be affected in the way of attraction perception, within both control and mortality salience conditions.

Terror Management Theory: Symbolic Mortality

A vast amount of research has been conducted on hormonal factors and sensory cues in the mate selection process. However, there is another aspect that tends to play an integral role in the primal, yet modern civilized process of mate selection—the anxiety that stems from awareness of human mortality limitations. The notions of mortality and reproduction are intertwined. Fertility exists as a function of symbolic mortality, and thoughts and ideals pertaining to reproduction function as an anxiety-buffering effect for the fear of death (Becker, 1973; Florian & Mikulincer, 1998; Matthews and Sear, 2008; Wisman & Goldenberg, 2005). Thus, it stands to reason that when participants are reminded that reproductive abilities will one day inevitably come it an end, they may feel defensive. These defense mechanisms tend to influence mate selection strategies and reproduction ideals in general (Hirschberger, Florian, & Mikulincer, 2002; Silveira, Graupmann, Agthe, Gutyrchik, Blautzik, Demirçapa, Berndt, Pöppel, Frey, Reiser, & Hennig-Fast, 2013; Vaughn et al., 2010).

Becker (1973) laid the foundation for terror management theory by proposing that human civilization is a symbolic defense system against the knowledge of death. He argued that human life is a dualistic existence between the physical world of objects and the symbolic world of created meaning. Thus, humans engage in "immortality projects" in order to be part of something eternal that will outlive

the physical body. One symbolic effort to deny mortality is to pass on genes to offspring through reproduction. In this way, fertility allows hope for a means by which to pursue immortality (Becker, 1973).

Florian and Mikulincer (1998) conducted three studies, revealing that attachment style, beliefs regarding symbolic immortality, and the fear of death are all interconnected. The first study uncovered an inverse relationship between ideals of symbolic immortality and death anxiety. The second study revealed that beliefs regarding symbolic immortality diminished the effects of a mortality salience manipulation on the extent to which a socially deviant citizen should be punished. The third study found that securely attached individuals displayed an inverse relationship between beliefs in symbolic immortality and death anxiety. These findings suggest that symbolic immortality ideals, such as those that pertain to procreation, may be closely tied to a person's attachment style, as well as a person's anxiety concerning death.

Past findings have suggested that men and women sometimes differ in their attitudes regarding fertility and sexual essence in the physical form. Greenberg, Solomon, and Arndt (2008) pointed out that the cognitive abilities that have allowed humans so much flexibility and domination on the planet in comparison to less civilized creatures, are the very same abilities that cause humans emotional stress brought on by knowledge of death. Thus, humans employ strategies, such as procreation, to achieve symbolic immortality as a way to cope with knowledge of basic animal functions.

Goldenberg (2013) argued that women's fertility cycles—encompassing the functions of menstruating, lactating, and childbearing—result in complicated cognitive consequences. Along with natural abilities to procreate, women are burdened with expectations to possess beauty. In addition, Goldenberg (2013) argued that in possessing this beauty and the accompanying features of fertility, a woman's sexuality is an undeniable symbol of mortality.

A series of studies conducted by Landau, Goldenberg, Greenberg, Gillath, Solomon, Cox, Martens, and Pyszcynski (2006) illustrated the extent to which mortality reminders can impact sexual perceptions. Study results strongly support the notion that women's bodies are symbols of mortality. In the first study, a subliminal mortality prime led to a decrease in men's attractiveness perceptions of a sexy woman. In the second study, mortality salience led to a decrease in men's reported sexual intent toward a sexy woman. In the third study, mortality salience led to a decrease in men's interest in a sexy woman, but not a less sexy woman. In the fourth study, mortality salience led to a decrease in men's attraction perceptions of an appealing opposite-sex target. This effect was not seen in women. In the fifth study, a lust prime led to an increase in men's tolerance of aggression directed at women. These results suggest that mortality salience may lead to sexual ambivalence in males. Although this study did not indicate that women's mate perceptions are affected by mortality reminders, other studies have. That study's results spark curiosity about women's sexuality in general, which necessitates the need for more research on mortality salience and female subjects.

Further, past research has established a link between mortality salience and the desire to have children. In two studies, Wisman and Goldenberg (2005) found that mortality salience increased the desired number of children for both men and women. Regardless of career ambitions, mortality salience led to an increased number of desired children among men. One study showed that career concerns inhibited a desire for many children in women. However, in another study, when both career success and procreation were made salient, women reported a higher number of desired children.

Taking into account gender discrepancies among males and females regarding procreation, Fritsche et al. (2007) conducted three studies with an attempt to understand the relationship between mortality salience and a desire for children. Results from the first study showed that mortality salience increased the desire to reproduce in both men and women. The second study showed that mortality

salience increased the accessibility of death-related thoughts, as well as thoughts related to reproduction. The third study showed that when the notion of offspring was made salient, the mortality salience effect on ingroup bias disappeared. Authors discussed the ability to produce offspring as a buffer against death-related anxiety. For this reason, human beings are willing to procreate in spite of the burden on resources that results from the decision.

Matthews and Sear (2008) presented compelling evidence that mortality perceptions and procreation preferences are intertwined. The experimental group received a questionnaire that was designed to prime mortality awareness and then inquire about fertility preferences and attitudes regarding the costs and benefits of reproducing. The control group received only a financial portion of the questionnaire. The results showed a preference in males for higher ideal number of children after mortality priming. Although no significant attitude differences were found in terms of costs and benefits, the data showed a slight shift specifically among men who expressed that children were not costly after mortality priming. The researchers argued that there exists a direct link between "mortality perceptions and reproductive behavior" (Matthews & Sear, 2008, p. 155).

Mortality cues as simple as word association tasks are powerful enough to increase the desire for offspring. Zhou, Liu, Chen, and Yu (2008) carried out a study in which death cues in a word-completion task led to disapproval of a governmental birth-control policy among Chinese women. Researchers asserted that the notion of offspring is an existential function, offering symbolic protection against mortality salience. Zhou, Lei, Marley, and Chen (2009) proposed that babies offer an anxiety-buffering function. In the first study, mortality salience enhanced college-aged participants' interest in human babies. In the second experiment, depictions of newborn animals decreased the number of death-related thoughts reported by participants. In the third experiment, female factory employees were

instructed to read news articles pertaining to the deaths of babies. Consequently, the women reported pessimistic ideas regarding their own longevity.

Researchers proposed that ideas concerning babies support cultural worldviews and increase self-esteem by perpetuating procreation as symbolic mortality. Before human beings can engage in procreation activities and capitalize on fertility, they must employ a series of sexual behavioral steps. This involves sorting through cognitive processes and civilized constructions surrounding beliefs about sexual intercourse.

Mortality Salience and Sexual Expression

A great deal of past research has tested mortality salience on mate perception, human attraction, and general sexual behavior. Studies have shown that sexuality and reproduction notions are linked to mortality salience. Indeed, sexual and reproductive cycles have perpetuated the human race for generations. Thus, these notions are inseparable. Studies have shown that mortality salience increases the desire for offspring, alters sexual behavior, and influences mate choice.

Taubman-Ben-Ari (2004) investigated the interconnectedness of mortality salience, fear of intimacy, and risky sex. In the first study, mortality salience led to increased willingness to partake in risky sexual behaviors. Also, fear of intimacy led to higher sexual riskiness. Death-related thoughts were found to be more accessible among participants who had previously reflected on thoughts of risky sex or fear of intimacy, in comparison to participants who thought about a neutral theme. These findings present the possibility that sex, intimacy, and mortality salience are all connected. Birnbaum, Hirschberger, and Goldenberg (2011) pointed out that in some cases sexual behavior exists as a defense mechanism against mortality threats, whereas other times, sexual behavior increases the mortality threats. Researchers included four studies on the effect of mortality salience on sexual motivation. In the first three studies, participants rated their desire for sex in different contexts after being primed for

mortality salience. The fourth study explored the motives for sexual behavior. Mortality salience increased the desire for a romantic expression of sexuality for both men and women. Avoidant men expressed a desire for casual sex. This study highlighted how individual personality differences play a role in motivations for sexual behavior.

Mortality salience has also been linked to a willingness to engage in risky sexual behavior. Lam, Morrison, and Smeesters (2009) conducted three studies, exploring the discrepancies between genders in terms of mortality salience and sexual behavior responses. In the first study, mortality salient men indicated greater intentions to take sexual risks than did mortality salient women. This effect was not observed in the control condition. In the second study, mortality salient men expressed a desire for a higher quantity of sexual partners and a lower need for intimate relations, in comparison to mortality salient women. Once again, this was not seen in the control condition. The third study included a behavior as the dependent measure. Mortality salient men were less likely than mortality salient women to choose a package of condoms rather than a pen as a free gift at the end of the experiment. This lends further credibility to the idea that Landau et al. (2006) proposed—that mortality salience may lead to sexual ambivalence in males.

Terror management researchers have also discovered that humans rely on romantic relationships as a psychological defense mechanism against fears of death. Romantic coupling is a commonly used strategy through which humans defend cultural worldview and bolster personal confidence. Laubach (2013) concluded that romantic partners offer more protection against existential-anxiety than friends. In an experiment, participants were told that they would have to give a speech. They then received a standardized note offering support from a friend or romantic partner, after which, they were instructed to rate their perceptions of the note and the person who presumably sent it, as well as their perceptions of a pro-American and anti-American essay, which was used as a measure of

worldview defense. Results revealed a significant interaction between mortality salience and support from a romantic partner for worldview defense. Participants who had received a note from a presumed romantic partner engaged in less worldview defense than did those who received the note from a platonic friend.

Mikulincer, Florian, and Hirschberger (2003) argued that close relationships should be considered a third death-anxiety buffering mechanism, along with the traditional notions of cultural worldview validation and self-esteem enhancement. Researchers reviewed empirical data as evidence, asserting two claims. The first was that death reminders increase motivation to create and continue intimate relationships. The second was that in continuing intimate relationships, people create symbolic protection against the terror of death. Conversely, when close relationships are broken, death awareness is heightened. To tie it all together, Mikulincer, Florian, and Hirschberger (2003) offered empirical findings that indicate intimate relationships are related to self-esteem and cultural worldview mechanisms; yet relationships operate independently in terms of buffering mortality effects.

Further, Hirschberger, Florian, and Mikulincer (2003) found that when mortality is salient, the need for romantic intimacy is high. Israeli undergraduates in both a mortality salience and control condition were instructed to read one of three scenarios. One scenario described a situation in which participants' romantic partners offered them praise. Another described a situation in which participants' romantic partners gave a specific complaint. Another described a situation in which participants' romantic partners criticized them. All participants then answered questions from a scale measuring their desires for intimacy with their romantic partner. In the control condition, participants' desires for intimacy were highest in the praise scenario, followed by a decrease in the complaint scenario, and decreasing even more under the criticism scenario. In the mortality salient condition, participants' desires for intimacy were high regardless of scenario, suggesting the need for romantic intimacy as a

buffer against mortality salience.

In some cases, desire for intimacy in the face of mortality salience is so high in fact, that people are willing to alter personal mate criteria. Hirschberger, Florian, and Mikulincer (2002) presented compelling evidence that mortality salience leads men and women to change desired mate qualities. Participants filled out a self-esteem measurement and completed a scale pertaining to ideal mate preferences. They were then grouped into a mortality salience condition, physical pain salience condition, or neutral condition. Mortality salience led participants to significantly compromise on their previously reported mate preferences when they were instructed to choose images of a desirable mate.

On the other hand, mortality salience has been shown to reduce feelings of commitment to romantic partners when men and women reflect on worldview dissimilarities. Strachman and Schimel (2006) discussed the importance of the worldview component in mortality salience and the resulting potential threat to romantic commitment. Assessing partner similarity and differences from a terror management theory perspective, researchers assigned undergraduate students in committed relationships, to either a mortality salience or control condition, as well as a worldview prime condition, in which they were instructed to reflect and report on similarities and differences between themselves and their partners. Mortality salience decreased feelings of commitment to romantic partners if they had been primed to reflect on worldview dissimilarities.

Romantic relationships and commitment factors aside, research is lacking on the effects of mortality salience on primal sexual attraction, although a few studies have shed light on this. In one recent study, Silveira et al. (2013) explored mortality salience effects on mate perceptions. Researchers primed heterosexual male and female participants with death-related words, after which they investigated neurocognitive processing of attractive faces of the opposite sex. Participants were asked whether or not they would like to meet the person of the opposite sex. Men in the mortality condition

showed more enthusiasm toward the idea of meeting an attractive woman, than men in the control condition. Women showed no significant effect of this nature. In terms of brain chemistry, researchers discovered that both men and women in the mortality salient condition, showed increased neural activity in the left anterior insula and the adjacent lateral prefrontal cortex (LPFC). This LPFC activity suggested the use of a defense mechanism employed in dealing with thoughts of death. The results lend credibility to the relationship between mortality salience and mating motivation.

Thus far, Vaughn et al. (2010) has conducted the most eye-opening research contribution of mortality salience effects on female mate preference. In the Vaughn et al. (2010) study, female psychology students who were not on birth control and who identified as falling within high fertility or low fertility statuses within their respective menstrual cycles, were assigned to mortality salience and control conditions. The mortality salience group was asked to reflect on death and the process their bodies would go through while dying. The control group was asked to reflect on an upcoming exam and the process they would go through in preparation. Then both groups ranked men's faces, using a program developed by Johnston et al., (2001), which includes facial images ranging from extremely masculine to extremely feminine.

Ovulating women in the mortality salience condition found less masculine faces significantly more attractive, dominant, and healthy compared to both non-ovulating mortality salient women and ovulating women in the control condition. Researchers concluded that biological processes are sensitive to environmental factors like death reminders. This could be why ovulating mortality salient women found men with a more sensitive appearance attractive.

A possible explanation for this effect is offered by Life History Theory (LHT), which holds that procreative choices are made based on an analysis of trade-offs or costs and benefits (Brumbach, Figueredo, & Ellis, 2009). Under certain dire circumstances, such as a threat to the human species or a

widespread famine, a woman may strategically or unconsciously reason that strong genes are imperative, and opt for a more masculine partner likely to pass on hardy traits. Under other circumstances that pertain to threats to self-esteem or the desire to choose a respectful mate to bring home and introduce to family, a woman may reason that she would prefer a less masculine, but loyal, caring, and kind mate who places her wants and needs above his own.

Self-Esteem Defenses

Terror management theorists posit that the notion of self-esteem is uniquely inherent to human beings as a civilized species. Pyszczynski et al. (2004) stated that people are motivated to maintain positive self-esteem because this offers a protective buffer against the potential for anxiety caused by mortality awareness. Solomon, Greenberg, and Pyszczynski (1991) asserted that as cultural animals, human beings have unique needs, possessing instincts of self-preservation. All living creatures have this instinct as well. However, because of the ability to imagine future possibilities of death, which can result in terror, humans apply symbolic and cultural meaning to innate animal tendencies. Therefore, copulation and reproduction are not simply means by which to perpetuate the human species. Rather, symbolic meaning and cultural significance is assigned to these primal abilities. Fertility offers humans a sense of self-importance and purpose in life.

Empirical findings have shown that high self-esteem lowers anxiety physiologically and behaviorally. When a person is reminded of death, that person strives to enhance self-esteem as a defense mechanism. Extensions of self-esteem include beliefs regarding life after death, as well as reproduction (Pyszczynski et al., 2004). These beliefs tie into strategies of self-presentation (Greenburg, Pyszczynski, & Solomon, 1986). Greenberg, Pyszczynski, Solomon, Pinel, Simon, and Jordan (1993) conducted two studies illustrating that self-esteem offers protection against potential anxiety. In one study, subjects received positive personality feedback; in the other, subjects received

negative personality feedback. In both studies, mortality was made salient. Those in the negative feedback study denied vulnerability to dying young. In contrast, those who received positive feedback were less likely to deny vulnerability to a possible untimely death. This suggests that when confidence is low, people employ defense mechanisms. When confidence is high, no such mechanisms are necessary.

Given that self-esteem and mate selection are interrelated and that one process affects the other, it stands to reason that when self-esteem is threatened, human beings employ specific strategies of mate selection as a defense mechanism. Few natural processes are as threatening to a woman's self-esteem as that of menopause. Bachman (1994) presented evidence that women undergoing menopause suffer in the areas of self-image, self-esteem, and sexual desire. These problems are exacerbated by a loss of estrogen, physical weakening of muscles and bones, aging of the skin, and negative societal beliefs regarding aging women's loss of vitality and sexual appeal.

Fertility Salience

For our prehistoric female ancestors, mate selection was much more primal than it is today. Devoid of civilized desires for education, financial status, and materialism, upon initial sexual maturity, ancient humans were predisposed to seek compatible mates with whom to create strong genes. This was all in an unconscious effort to perpetuate the early human species (Miller, 2011). Fast forward a few millennia and American civilization exists in a time at which women are delaying childbirth for the pursuit of higher education, financial security, career fulfillment, the desire for adventure, the pursuit of a compatible mate, and avoidance of childrearing responsibility (Alpert, 2013; Avishai, 2013; Elms, 2013; Ludden, 2011).

The United States Centers for Disease Control and Prevention reported that the birth rate for women in their 30s and 40s increased in 2012, at the same time birth rates for teenagers and young

adults declined to record-breaking lows. Women between the ages of 30 and 34 experienced a 1% increase in 2012. Respectively, women aged between 35 and 39 experienced a 2% increase; women aged between 40 and 44 accounted for a 1% increase. On the opposite end of the spectrum, teen births among girls aged between 15 and 19 decreased by 7% (Mathews & Hamilton, 2009).

United States Census Bureau 2010 statistics suggested a "delayer bloom" among childbearing women. Number of children per woman directly correlated to education level, with educated women giving birth later, and to fewer children. Women between the ages of 35 and 44 who had earned at least a bachelor's degree had birthed an average of 1.7 children, in contrast to women in the same age group with less than a high school education, who had birthed 2.5 children (Glasier, 2011). Women are now giving birth at older ages after first pursuing education and a career. However, evolution has not yet caught on to this civilized trend of females delaying parenthood. Thus, in spite of practical reasons for modern day humans to avoid youthful procreation, the window of fertility is a narrow one in which a woman's fertility declines steadily over time.

On average, this decline begins at the socially agreed upon "young" age of 27 (Graham, 2002) and continues throughout the 30s. A healthy, fertile 30-year-old woman will have only a 20% chance of conceiving per ovulatory cycle. By age 40, the odds drop to less than 5% per cycle. Additionally, with age, egg quality declines, resulting in more chromosomal abnormalities and the increased risk of miscarriage in the event of a pregnancy (American Society for Reproductive Medicine, 2012). In an era of reproductive delay, it stands to reason that a woman might experience some psychological discomfort upon being reminded that the sand in the hourglass of fertility will one day run out. "Baby fever" is a slang expression describing a state in which desire to capitalize on fertility overwhelms a woman, consuming her thoughts and behavior with baby-related themes. According to scholarly research, this is a legitimate phenomenon. Rotkirch (2007) examined the evolved emotional yearning

for children, identifying the symptoms, triggers, and behavior involved in longing to reproduce. Evolutionary reasons for "baby fever" were discussed, and Rotkirch (2007) suggested that this instinct is rooted in a desire to nurture, and that it acts as an extension of the mate selection process and is brought on by aging.

Several modern movies and television shows have poked fun at the desperation of women to have babies before time runs out. *Baby Mama* is a 2008 comedy starring Tina Fey, who portrays an infertile 37-year-old business woman who hires an unlikely quirky surrogate (Kavanaugh, Messick, Rosner, & McCullers, 2008). In *The Switch,* which premiered in 2010, Cassie, a woman in her 30s portrayed by Jennifer Aniston, opts for artificial insemination after coming to terms with the fact that she may not find the right man before her fertility comes to an end (Aniston, Hahn, Kahane, Gordon, & Speck, 2010).

The Fox television program *New Girl* featured an episode in the fall of 2012, in which the heroine, Jess, portrayed by Zooey Deschanel, experiences a great amount of anxiety, upon learning from a gynecologist friend that her time of fertility may be coming to an end because of her age. Expressing a sentiment echoed by many modern women, Jess hysterically laments, "I don't think I'm ready to bring new life into the world, but what if all that's left are the weird eggs?" Her three male roommates proceed to debate on which one among them would be chosen if Jess were to become desperate enough to settle for any casual partner to father her child (Meriwether & Brennan, 2012).

The fictional concerns of popular culture mirror those of real women. Kate Donnellon Nail, a 43-year-old woman trying to conceive, told National Public Radio that she had undergone six unsuccessful in vitro fertilization attempts, in spite of having practiced yoga for the past 15 years and living an overall healthy lifestyle. "Unfortunately, that doesn't always translate to those little eggs in your ovaries. They're not getting the message!" Nail said (Ludden, 2011, p. 5). In spite of the grim facts

available through studies, research, literature, and personal testimonies, many women shy away from these age-related fertility thoughts, preferring to remain hopeful. Filmmaker Monica Mingo vented to National Public Radio. "You tell us your fertile years rapidly decline in your mid-20s. Well, if I'm not dating anyone, and I want to have a family, what's that information going to do for me?" (p. 17). Mingo, who did not even meet her husband until age 32, stated at the time of the online article release that she had been trying to conceive for a decade (Ludden, 2011).

Mingo raises an important point. Of what practical use is this knowledge that often induces such panic? Before procreation is even possible, one must find a mate—another possibly anxiety-inducing, stressful form of societal pressure. If a woman yearns for a baby, yet has no mate, is she more likely to hurry up and settle on whoever is available, regardless of previous standards? Few studies have looked at the effects of dwindling fertility notions on mate selection. However, many studies have looked into mate selection—a process as old as the human species itself.

Some say that the yearning for a romantic mate is an inherent aspect to being human. Fisher (2000) asserts that this biological yearning is deeply knitted within our DNA. Spiritualists often say this desire comes from a deeper aspect of our souls—an attachment desire necessitated by religious belief (Kirkpatrick & Shaver, 1992). Whatever the reason, human beings appear to enjoy the throes of romantic desire, as can be inferred when analyzing the common themes of modern day entertainment. Hefner and Wilson (2013) reported that the romantic comedy genre grossed more than $10 billion between 1995 and 2010. These popular themes offer an insight into the prevalence of love ideals and romantic longings of our modern day culture.

The mate selection process continues to change and evolve as humanity moves forward. Scholars strive for a better understanding of the cognitive processes modern day humans employ when seeking a suitable mate. Researchers attempt to tap into secrets known to our ancient ancestors, as well

as to uncover new motivations and impairments in this timeless process of mate selection. Studies have discovered that women are sensitive to cues of health and attractiveness, indicated from male facial symmetry perceived in photographs (Moore et al., 2011). Women's fertility, indicative of hormonal levels controlled by the monthly menstrual cycle, largely determines attraction preferences. Ovulating women have been shown to prefer masculine men expressing visual markers of high testosterone, and non-ovulating women close to menstruation have been shown to prefer healthy, yet less masculine men (Vaughn et al., 2010). Women on birth control have been shown to prefer men with feminine faces (Scheib, Gangestad, & Thornhill, 1999).

Yearning for a suitable mate stems from desires that are both primal and civilized in nature. While women express preference for masculinity in a male counterpart, they also indicate a desire for men with prosocial, kind and loyal qualities—traits that are thought to be more suitable for a long-term, everlasting bond (Boothroyd et al., 2007). Awareness of mortality and other humanistic limitations, such as fertility are said to make the human species separate and unique in comparison to other animals (Becker, 1973). This unique knowledge of fertility limitations may be inherent to the process of human mate selection. Under normal circumstances, a highly fertile female assessing male facial images would express preference for a masculine face (Becker, 1973; Florian & Mikulincer, 1998; Matthews & Sear, 2008; Wisman & Goldenberg, 2005). "Normal circumstances" refers to scenarios under which no psychological threats are perceived. In other words, under normal circumstances, a woman would form an authentic perception with no interference.

However, multiple studies have shown that when humans are reminded of impending death, they tend to employ different strategies in mate selection and thus, express sexual preferences that are atypical to what has been formerly established regarding primal mate selection (Birnbaum, Hirschberger, & Goldenberg, 2011; Laubach, 2013; Mikulincer, Florian, & Hirschberger, 2003). As

mentioned by Vaughn et al. (2010), one possible explanation about highly fertile women's altered perceptions is that mortality reminders may cause anxiety inclining women to shy away from risks of pregnancy at times of high conception risk.

Less understood is whether or not symbolic mortality salience may inspire the same anxiety as death reminders. To date, no studies have looked into the effects of fertility salience as an extension of mortality. Although fertility has been identified as a symbol of mortality (Becker, 1973), research has not yet investigated the effects of fertility salience on mate selection. Vaughn et al. (2010) noted that literal mortality salience resulted in atypical participant perceptions regarding an "attractive" male face choice, a "dominant" male face choice, and a "healthy" male face choice. It was predicted that the current study's findings would mirror those of Vaughn et al. (2010) in regard to symbolic mortality salient participants who have indicated a high fertility status within the monthly menstrual cycle.

The following hypotheses were proposed:

H1a. Fertility salient females and mortality salient females with a high fertility status will consider the least masculine face of three choices more attractive compared to fertility salient females with a low fertility status.

H1b. Fertility salient females and mortality salient females with a high fertility status will consider the least masculine face of three choices more dominant compared to non-fertility salient females with a high fertility status.

H1c. Fertility salient females and mortality salient females with a high fertility status will consider the least masculine face of three choices healthier compared to non-fertility salient females with a high fertility status.

Indeed, it was predicted that similarly to the findings of Vaughn et al. (2010), women closer to ovulation would experience an alteration in mate perception following a mortality salience reminder. In addition, past studies have suggested that symbolic mortality notions are closely tied to thoughts of death (Florian & Mikulincer, 1998; Fritsche et al., 2007; Zhou, Liu, Chen, & Yu, 2008) and that mortality reminders inspire wishes to procreate (Becker, 1973; Florian & Mikulincer, 1998; Matthews and Sear, 2008; Wisman & Goldenberg, 2005). An influence on perception was expected in participants who indicated a low fertility or hormonal contraception status.

The following hypotheses were proposed:

H2a. Fertility salient females and mortality salient females with a low fertility status will consider the most masculine face of three choices more attractive compared to non-fertility salient females with a low fertility status.

H2b. Fertility salient females and mortality salient females with a low fertility status will consider the most masculine face of three choices more dominant compared to non-fertility salient females with a low fertility status.

H3a. Fertility salient females and mortality salient females using hormonal contraception will consider the most masculine face of three choices more attractive compared to non-fertility salient females using hormonal contraception.

H3b. Fertility salient females and mortality salient females using hormonal contraception will consider the most masculine face of three choices more dominant compared to non-fertility salient females using hormonal contraception.

Overall, the women in the symbolic mortality salience condition were expected to deviate from traditional opposite sex perceptions. This perception alteration was expected to happen as a result of psychological interference brought on by menopause reminders. Fertility salience was predicted to arouse the potential for anxiety in a similar way that death reminders did in the Vaughn et al. (2010) study.

In assessing the modern day reproductive ideals among young women, one study found that 94% of university students desired children in the future, and 28 years old was the median age that women chose for when to ideally have their first child (Virtala, Vilska, Huttunen, & Kunttu, 2011). However, mortality salience has been shown to influence participants' desires to have children, and in some cases, participants wanted more children when mortality was salient in comparison to participants in non-salient conditions (Becker, 1973; Florian & Mikulincer, 1998; Matthews & Sear, 2008; Wisman & Goldenberg, 2005). Moderating factors such as romantic relationship status (Laubach, 2013; Mikulincer, Florian, & Hirschberger, 2003) and career ambition (Wisman & Goldenberg, 2005) have been shown to play a role in procreation desires influenced by mortality salience.

Thus, the following research questions were proposed:

RQ1. Will mortality salience and fertility salience, along with fertility status, influence women's desired number of children?

RQ2. Will relationship status moderate mortality salience and fertility salience, along with fertility status, influencing women's desired number of children?

RQ3. Will further education ambition moderate mortality salience and fertility salience, along with fertility status, influencing women's desired number of children?

RQ4. Will mortality salience and fertility salience, along with fertility status, influence women's age preference for having a first child?

RQ5. Will relationship status moderate mortality salience and fertility salience, along with fertility status, influencing women's age preference for having a first child?

RQ6. Will further education ambition moderate mortality salience and fertility salience, along with fertility status, influencing women's age preference for having a first child?

Method

Design

An online experiment tested for hypothesized effects of literal mortality salience (death reminders) and fertility salience (menopause reminders) manipulations on female participants' opposite-sex face perceptions. Participants self-identified as falling within a high fertility, low fertility, or hormonal contraception status were randomly assigned to one of three conditions. An online

questionnaire asked participants to complete two writing prompts, a distractor task, and a digital facial judgment task. Additionally, the questionnaire assessed participants' fertility status and inquired about relationship status, future lifestyle plans, and general demographic information.

Participants

A group of female participants (N = 179) was recruited for this study in exchange for course credit. All were undergraduates enrolled in communication courses at Virginia Polytechnic Institute and State University. If participants reported that they were males, identified as any sexuality other than heterosexual, or expressed menstrual cycle confusion, their responses were eliminated from the study. A total of 151 responses were used for the final data analysis. Ages ranged from 18-25. The mean age of participants was 19.74 (SD = 1.23). Ethnic participant distribution consisted of 80.13% Caucasian, 9.27% Asian, 4.64% African-American, 5.30% multi-racial, and .66% of participants who indicated "other." The women were randomly distributed evenly into different conditions, with 51 participants in the control condition, 50 participants in the mortality salience condition, and 50 participants in the fertility salience condition. Out of the 151 participants, 14.57% indicated a high fertility (ovulatory) status, 54.30% indicated a hormonal contraception status, and 31.13% indicated a low fertility (non-ovulatory) status.

Independent Variable/Stimulus Materials

Writing prompts. The independent variable was a salience cue assigned to participants in mortality salience, fertility salience, and control conditions. Stimulus materials in the current study for both the mortality salience group and the fertility salience group were adapted and modified from writing prompts used in past terror management research (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). Participants in the mortality salience group were instructed to complete writing prompts from a questionnaire regarding (a) the emotions that the thought of their own death

aroused in them, and (b) what would happen to them physically as they died and once they are already dead. Participants in the fertility salience group were instructed to complete writing prompts regarding (a) the emotions that the thought of their own menopause aroused in them, and (b) what would happen to them physically as they underwent menopause and once they had completed the process. Participants in the control group were instructed to complete writing prompts regarding (a) the emotions that the thought of a dentist removing one of their teeth aroused in them, and (b) what would happen to them physically as a dentist removed one of their teeth (Arndt, Greenberg, & Cook, 2002).

Quasi-Independent Variables

Fertility status. An individual difference quasi-independent variable was the fertility status of participants. This was assessed via questions pertaining to birth control use and participants' menstrual status. Participants indicated whether or not they use hormonal contraception by answering yes or no. Following this, participants answered a question about menstrual cycle regularity, identifying cycles as usually regular or usually irregular. Finally, participants indicated the point at which they currently stood in their monthly cycle. They selected one of the following choices: menstrual/post-menstrual, ovulatory/mid-cycle, post-ovulatory/pre-menstrual, suspected or confirmed pregnancy, or unsure/other. Hormonal status questions were guided by research on reproduction, menstruation, and contraception (Dunson, Baird, Wilcox, & Weinberg, 1999; Lein, 1979).

Relationship status. Another individual difference quasi-independent variable was the relationship status of participants, assessed via one question gauging participants' current relationship status out of the following choices: single (not currently seeing anyone), single (casually seeing one or more persons, but not in a committed relationship), in a non-serious, but committed relationship (only seeing one person), in a serious, committed relationship (would describe myself as "in love"), engaged

to be married, married, polyamorous (in a committed relationship with more than one person), or other. This question was used to answer research questions related to participants' procreation preferences.

Further education. Lastly, one other individual difference quasi-independent variable was participants' plans for further education. Participants answered yes or no to a question about intentions for pursuing further education beyond an undergraduate degree (i.e., graduate school, law school, dental school, medical school, etc.). This question was used to answer research questions related to participants' procreation preferences.

Dependent Variables

Positive and negative affect scale. The PANAS (Watson, Clark, & Tellegen, 1988) measured participants' affective states to make sure they did not vary significantly between conditions. The 20-item scale measured the extent to which participants were currently experiencing the following 20 negative and/or positive affective states: interested, distressed, excited, upset, strong, guilty, scared, hostile, enthusiastic, proud, irritable, alert, ashamed, inspired, nervous, determined, attentive, jittery, active, and afraid. The 10-items measuring negative affect were used in analyses. Participants indicated the intensity at which they currently felt each state by choosing "very slightly or not at all," "a little," "moderately," "quite a bit," or "extremely." The index was reliable (Cronbach's $\alpha = .86$).

Facial perceptions. Facial perceptions were the behavioral measure of face judgment after the stimulus and a distractor task. Participants viewed three facial images provided by Re, DeBruine, Jones, and Perrett (2013). Faces were constructed by digitally feminizing and masculinizing Caucasian male facial images (*M* age = 25.3) taken from a commercially available database (found at www.3d.sk). Photographs were taken under consistent lighting and camera angles. A single composite was used to create a continuum of 20 faces total. Participants viewed three faces: one on the extreme feminine end of the continuum, one right in the middle, and one on the extreme masculine end of the

continuum. They assigned each face a score of 0-10 within the perceptual categories of attractiveness, dominance, and health.

Procreation preferences. Adapted from Virtala et al. (2011), procreation preferences were measured by three multiple choice questions that inquired about whether or not participants would like to have children, the total number of children participants would like to have, and the age at which they would ideally desire to have their first child. The first question item, inquiring about participants' desires to have children, was also used as a filter during the data analysis process. All participants who answered "no," indicating that they did not want to have children, were assigned a score of zero for number of children desired and no response for their ideal desired age at which to have a first child. Those who answered "yes," indicating that they did want to have children, were assigned scores based on their responses for the other two measures.

Other Measures

Media and technology usage and attitudes scale. The Media and Technology Usage and Attitudes Scale (Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013) served as a distractor task after the stimulus and before the face judgment task. This scale consists of 31 items designed to measure media and technology attitudes and lifestyle habits. The collected data were not analyzed.

General demographics. A general demographic section collected basic information about participants' gender, sexuality, age, and ethnic group.

Marriage intentions. For the purpose of collecting demographic information about participants, marriage intentions were assessed by one question that asked whether or not participants were already married or could envision themselves getting married in the future.

Post-graduation work plans. For the purpose of collecting extra demographic information about participants, post-graduate work plans were assessed by three questions that asked for a yes or no

answer regarding whether or not participants could envision themselves working full-time, being a stay at home mother, or working part-time in an effort to balance career and childrearing responsibilities in the future.

Fertility awareness. Fertility awareness was measured by assessing participants' correct or incorrect answers to three open-ended fertility awareness questions from Virtala et al. (2011) *(e.g., At what age is there a slight decrease in a woman's ability to become pregnant?).* Responses were used for the purpose of collecting basic information about participants' knowledge and awareness related to fertility.

Procedure

Students enrolled in communication courses at Virginia Polytechnic Institute and State University were recruited through the department's research participation system to participate in the study in return for course credit. Those who signed up to participate in the study were directed to an online questionnaire site. After reading a description of the study and consenting to participate, women were randomly assigned to one of three conditions and received a writing prompt.

In the control condition, participants were asked to write about (a) the emotions that the thought of a dentist removing one of their teeth aroused in them, and (b) what would happen to them physically as a dentist removed one of their teeth (Arndt, Greenberg, & Cook, 2002). In the mortality salience condition, participants were asked to write about (a) the emotions that the thought of their own death aroused in them, and (b) what would happen to them physically as they died and once they were already dead (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). In the fertility salience condition, the word "death" was substituted for "menopause," and participants were asked to write about (a) the emotions that the thought of their own menopause aroused in them, and (b) what would

happen to them physically as they underwent menopause and once they had completed the process (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989).

Participants in all three groups then completed a Media and Technology Usage and Attitudes Scale (Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013) as a distractor task. Included in the Media and Technology Usage and Attitudes Scale were sets of questions that gauged media users' behaviors, attitudes, and amount of time spent engaging in technology activities. After this, participants in both groups performed the face judgment task. They were presented with a series of faces that were randomized in the order in which they appeared to participants. These images consisted of a feminine male face, a midrange male face, and a masculine male face. Participants were asked to rate each face with a score of 0-10 for (a) attractiveness of each face, (b) dominance of each face, and (c) health of each face.

Next, participants indicated whether or not they were using hormonal contraception. They then completed a menstrual cycle portion of the questionnaire, which inquired about the regularity of participants' menstrual cycle, as well as current menstrual status. High fertility and low fertility status were determined by the nearness of participants to ovulation. In a typical menstrual cycle, ovulation occurs 14 days before the beginning of menses in women with average 28-day cycles, and every 20 days for women with 34-day cycles (Lein, 1979). In a 28-day cycle, high fertility would be experienced between days 10-17, and low fertility would be experienced between days 1-7 and 20-28 (Dunson, Baird, Wilcox, & Weinberg, 1999).

Participants then completed the PANAS, indicating the extent to which they were currently experiencing a range of positive and negative affective states. They then filled out a demographic questionnaire, inquiring about gender, sexuality, age, and ethnicity, followed by a series of multiple choice lifestyle questions pertaining to relationship status, marriage intentions, desire for children,

desired number of children, ideal age for having first child, plans for furthering education, and whether or not they could envision themselves working full-time, being a stay at home mother, or working part-time. Finally, participants answered three fertility awareness questions, based on declining fertility and conception odds.

Results

Participant Descriptive Information

Out of 151 participants, most (87.42%, *n* = 132) reported menstrual regularity. The majority of participants demonstrated a lack of fertility awareness. Only 1.99% (*n* = 3) knew that a woman experiences a slight fertility decline in her late 20's. Only 23.84% (*n* = 36) knew that a woman between the ages of 25-30 would have an 80-89% chance of conceiving within one year, and only 15.23% (*n* = 23) knew that a woman between the ages of 35-40 would have a 50-59% chance of conceiving within one year. In terms of relationship status, 54.97% of participants (*n* = 83) were single, while 45.07% (*n* = 68) were in a romantic relationship. Most participants (86.75%, *n* = 131) wanted to have children in the future, while 3.97% (*n* = 6) did not, 8.61% (*n* = 13) were unsure, and .66% (*n* = 1) was already a mother. Participants desired to have a mean of 2.72 children (*SD* = 1.04). Most participants (74.83%, *n* = 113) reported a preference to have their first child at 25-29 years old, followed by 15.89% (*n* = 24) who wanted to have their first child at 30-35 years old, followed by 5.30% (*n* = 8) who wanted to have their first child at 21-24 years old, followed by 3.97% (*n* = 6) who did not want to have children at any age. None of the participants indicated a desire to have children after age 35. In terms of future lifestyle plans, 94.04% (*n* = 142) of participants could envision themselves getting married, 1.99% (*n* = 3) could not, 3.31% (*n* = 5) were unsure, and .66% (*n* = 1) were already married. In terms of education, 51.66% of participants (*n* = 78) reported intentions to terminate their education with an undergraduate degree, while 48.34% (*n* = 73) intended to pursue further

education beyond an undergraduate degree. In terms of future career plans, 91.39% of participants (n = 138) could envision themselves working full-time. About half of the participants (50.33%, n = 76) could envision themselves as a stay at home mother, and 75.50% (n = 114) could envision themselves working part-time in an effort to balance career and family life.

Positive and Negative Affect

As a prerequisite to hypothesis testing, the PANAS (Watson, Clark, & Tellegen, 1988) was employed to ensure that negative affect, specifically, did not vary significantly as a result of salience condition. A one-way analysis of variance (ANOVA) with salience condition as the independent variable and the negative (PANAS) index as the dependent variable showed no significant effect of salience condition on PANAS score, $F(2, 148) = .72$, $p = .49$.

Perceptions of the Least Masculine Face

H1a predicted that fertility salient females and mortality salient females with a high fertility status would consider the least masculine face more attractive compared to fertility salient and mortality salient females with a low fertility status. A two-way ANOVA with salience condition and fertility status as the independent variables and attractiveness perceptions of the least masculine face as the dependent variable found no significant main effect of salience condition on attractiveness perceptions of the least masculine face, $F(2, 142) = .31$, $p = .74$. There was no significant main effect of fertility status on attractiveness perceptions of the least masculine face, $F(2, 142) = .82$, $p = .44$. The ANOVA found no significant interaction effect between salience condition and fertility status on attractiveness perceptions of the least masculine face, $F(4, 142) = .55$, $p = .70$. Therefore, H1a is not supported.

H1b predicted that fertility salient females and mortality salient females with a high fertility status would consider the least masculine face more dominant compared to non-fertility salient females with a high fertility status. A two-way ANOVA with salience condition and fertility status as the independent variables and dominance perceptions of the least masculine face as the dependent variable found no significant main effect of salience condition on dominance perceptions of the least masculine face, $F(2, 142) = .34$, $p = .71$. There was no significant main effect of fertility status on dominance perceptions of the least masculine face, $F(2, 142) = 1.80$, $p = .17$. The ANOVA found no significant interaction effect between salience condition and fertility status on dominance perceptions of the least masculine face, $F(4, 142) = .26$, $p = .90$. Therefore, H2a is not supported.

H1c predicted that fertility salient females and mortality salient females with a high fertility status would consider the least masculine face healthier compared to non-fertility salient females with a high fertility status. A two-way ANOVA with salience condition and fertility status as the independent variables and healthiness perceptions of the least masculine face as the dependent variable found no significant main effect of salience condition on health perceptions of the least masculine face, $F(2, 142) = .58$, $p = .56$. There was no significant main effect of fertility on health perceptions of the least masculine face, $F(2, 142) = .17$, $p = .84$. The ANOVA found no significant interaction effect between salience condition and fertility status on health perceptions of the least masculine face, $F(4, 142) = .48$, $p = .75$. Therefore, H1c is not supported.

Perceptions of the Most Masculine Face

H2a predicted that fertility salient females and mortality salient females with a low fertility status would consider the most masculine face more attractive compared to non-fertility salient females with a low fertility status, and H3a predicted that fertility salient females and mortality salient females using hormonal contraception would consider the most masculine face more attractive compared to

non-fertility salient females using hormonal contraception. A two-way ANOVA with salience condition and fertility status as the independent variables and attractiveness perceptions of the most masculine face as the dependent variable found no significant main effect of salience condition on attractiveness perceptions of the most masculine face, $F(2, 142) = .60$, $p = .55$. There was no significant main effect of fertility status on attractiveness perceptions of the most masculine face, $F(2, 142) = .78$, $p = .46$. The ANOVA found no significant interaction effect between salience condition and fertility status on attractiveness perceptions of the most masculine face, $F(4, 142) = 1.66$, $p = .16$. Therefore, H2a and H3a are not supported.

H2b predicted that fertility salient females and mortality salient females with a low fertility status would consider the most masculine face more dominant compared to non-fertility salient females with a low fertility status, and H3b predicted that fertility salient females and mortality salient females using hormonal contraception would consider the most masculine face more dominant compared to non-fertility salient females using hormonal contraception. A two-way ANOVA with salience condition and fertility status as the independent variables and dominance perceptions of the most masculine face as the dependent variable found no significant main effect of salience condition on dominance perceptions of the most masculine face, $F(2, 142) = .20$, $p = .82$. There was no significant main effect of fertility status on dominance perceptions of the most masculine face, $F(2, 142) = .73$, $p = .48$. The ANOVA found no significant interaction effect between salience condition and fertility status on dominance perceptions of the most masculine face, $F(4, 142) = .06$, $p = .99$. Therefore, H2b and H3b are not supported.

Procreation Plans

RQ1 asked if salience and fertility status variables would influence participants' desired number of children. A two-way ANOVA with salience condition and fertility status as the independent

variables and desired number of children as the dependent variable found no significant main effect of salience condition on participants' desired number of children, $F(2, 142) = 1.09$, $p = .34$. There was no significant main effect of fertility status on desired number of children, $F(2, 142) = 2.48$, $p = .09$. The ANOVA found no significant interaction effect between salience condition and fertility status on desired number of children, $F(4, 142) = .98$, $p = .42$.

RQ2 asked if relationship status would moderate salience and fertility status variables on participants' desired number of children. A three-way ANOVA with salience condition, fertility status, and relationship status as the independent variables and desired number of children as the dependent variable found no significant main effect of salience condition on participants' desired number of children, $F(2, 133) = 1.62$, $p = .20$. There was no significant main effect of fertility status on desired number of children, $F(2, 133) = 1.70$, $p = .19$. There was no significant main effect of relationship status on desired number of children, $F(1, 133) = 1.15$, $p = .29$. The ANOVA found no significant interaction effect between salience condition and fertility status on desired number of children, $F(4, 133) = .40$, $p = .81$. There was no significant interaction between salience condition and relationship status on desired number of children, $F(2, 133) = .93$, $p = .40$. There was no significant interaction between hormonal status and relationship status on desired number of children, $F(2, 133) = 1.67$, $p = .19$. There was no significant interaction between salience condition, hormonal status, and relationship status on desired number of children, $F(4, 133) = 1.57$, $p = .19$.

RQ3 asked if further education ambition would moderate salience and fertility status variables on participants' desired number of children. A three-way ANOVA with salience condition, fertility status, and further education ambition as the independent variables and desired number of children as the dependent variable found no significant main effect of salience condition on participants' desired number of children, $F(2, 133) = 1.69$, $p = .19$. There was no significant main effect of fertility status on

desired number of children, $F(2, 133) = 1.76$, $p = .18$. There was a significant main effect of further education ambition on desired number of children, $F(1, 133) = 7.98$, $p = .0055$, with participants who intended to further their education, ($M = 2.92$, $SD = .14$) indicating a higher number of desired children than participants who did not intend to further their education, ($M = 2.53$, $SD = .14$). There was no significant interaction between salience condition and fertility status on number of desired children, $F(4, 133) = .88$. $p = .48$. There was no significant interaction between salience condition and further education ambition, $F(2, 133) = .75$, $p = .48$. There was no significant interaction between fertility status and further education ambition, $F(2, 133) = 1.22$, $p = .30$. There was no significant interaction between salience condition, fertility status, and further education ambition, $F(4, 133) = 1.46$, $p = .22$.

RQ4 asked if salience and fertility status variables would influence participants' ideal age for having their first child. A two-way ANOVA with salience condition and fertility status as the independent variables and ideal age for having first child as the dependent variable found no significant main effect of salience condition on participants' ideal age for having first child, $F(2, 136) = 1.09$, $p = .34$. There was no significant main effect of fertility status on ideal age for having first child, $F(2, 136) = .28$, $p = .75$. The ANOVA found no significant interaction effect between salience condition and fertility status on ideal age for having first child, $F(4, 136) = 1.02$, $p = .40$.

RQ5 asked if relationship status would moderate salience and fertility status variables on participants' ideal age for having their first child. A three-way ANOVA with salience condition, fertility status, and relationship status as the independent variables and participants' ideal age for having first child as the dependent variable found no significant main effect of salience condition on participants' ideal age for having first child, $F(2, 127) = 1.80$, $p = .17$. There was no significant main effect of fertility status on ideal age for having first child, $F(2, 127) = .55$, $p = .58$. There was no significant main effect of relationship status on ideal age for having first child, $F(1, 127) = .23$, $p = .88$.

The ANOVA found no significant interaction effect between salience condition and fertility status on ideal age for having first child, $F(4, 127) = .61$, $p = .66$. There was no significant interaction between salience condition and relationship status on ideal age for having first child, $F(2, 127) = .47$, $p = .63$. There was no significant interaction between fertility status and relationship status on ideal age for having first child, $F(2, 127) = 2.30$, $p = .10$. There was no significant interaction between salience condition, fertility status, and relationship status on ideal age for having first child, $F(4, 127) = .58$, $p = .68$.

RQ6 asked if further education ambition would moderate salience and fertility status variables on participants' ideal age for having their first child. A three-way ANOVA with salience condition, fertility status, and further education ambition as the independent variables and ideal age for having first child as the dependent variable found no significant main effect of salience condition on participants' ideal age for having first child, $F(2, 127) = .88$, $p = .42$. There was no significant main effect of fertility status on ideal age for having first child, $F(2, 127) = .14$, $p = .87$. There was no significant main effect of further education ambition on ideal age for first child, $F(1, 127) = .81$, $p = .37$. There was no significant interaction between salience condition and fertility status on ideal age for first child, $F(4, 127) = .96$, $p = .43$. There was no significant interaction between salience condition and further education ambition on ideal age for first child, $F(2, 127) = .29$, $p = .75$. There was no significant interaction between fertility status and further education ambition on ideal age for first child, $F(2, 127) = .52$, $p = .60$. There was no significant interaction between salience condition, fertility status, and further education ambition on ideal age for first child, $F(4, 127) = .48$, $p = .75$.

Discussion

General Discussion and Theoretical Implications

The present study attempted to extend terror management theory research by examining the possible relationship between both mortality salience and fertility salience and opposite-sex facial perceptions. A partial replication of a study conducted by Vaughn et al. (2010) yielded nonsignificant effects of mortality salience, fertility salience, and fertility status on facial perceptions and desire to have children. The present study resulted in inconclusive results regarding the role of fertility salience and mortality salience in mate selection.

The current study predicted that after both mortality and fertility salience stimulus exposure, females with a high fertility status would find the least masculine face more attractive, dominant, and healthy compared to females with a low fertility status. This was not the case. In spite of the fact that such effects of mortality salience were observed in another study (Vaughn et al., 2010), in the current study mortality salience did not elicit significant effects. Likewise, females with a low fertility status as well as females on hormonal contraception did not find the most masculine face more attractive, dominant, or healthy compared to females with a high fertility status. Hormonal status and the salience manipulation did not have any significant main effects or interaction effects on facial perceptions. Additionally, fertility status and salience condition had no effects on participants' desired number of children or the age at which they wished to begin having children. Adding relationship status or plans for furthering education as possible moderators also produced no evidence of main or interaction effects.

Study outcomes suggest that neither death reminders nor menopause reminders effectively influenced perceptions of attractiveness or future reproductive preferences. These results stand in stark contrast to many other studies that have observed perceptual effects of mortality salience in regard to sexual preferences (Birnbaum, Hirschberger, & Goldenberg, 2011; Laubach, 2013; Mikulincer, Florian, & Hirschberger, 2003; Vaughn et al., 2010) and desires for future children (Becker, 1973; Florian &

Mikulincer, 1998; Matthews & Sear, 2008; Wisman & Goldenberg, 2005). There are several possible reasons as to why the manipulations used in the current study may have been ineffective at influencing the study's outcome measures, which are hinted at by results related to the thought-listing and awareness measures.

Past studies have asserted that symbolic mortality notions are connected to thoughts of death (Florian & Mikulincer, 1998; Fritsche et al., 2007; Zhou, Liu, Chen, & Yu, 2008). It was a key assumption within the present study that the word "menopause" used in the fertility salience condition would trigger thoughts of diminished fertility, which are symbolically tied to mortality (Becker, 1973). However, an informal post-hoc revealed that this manipulation may have been ineffective at influencing thoughts related specifically to fertility. Written responses of participants in the fertility salience group were analyzed for wording that acknowledged menopause as an endpoint for reproductive abilities. Out of the 50 women in the fertility salience condition, only 22.00% (n = 11) expressed thoughts and emotions in regard to menopause indicating a loss of fertility and childbearing abilities. (e.g., "It is natural, but saddening that you are losing a gift that had been a part of you for your whole life – the ability to have children.") The other 78.00% (n = 39) expressed ambiguity or confusion about the topic or thoughts and emotions related to general aging, vanity, and physical and emotional discomfort. (e.g., "I am not completely sure of all the physical symptoms that happen when you go through menopause but I know it includes hot flashes and mood swings. Afterwards I am completely unsure of what happens physically when the process is complete.") Many women did not mention the fertility-related implications of the menopause process. Based on responses to the thought-listing task, in the majority of cases the "menopause" writing prompt did not arouse thoughts and emotions related to potential threats of existential anxiety, so fertility salience may not have been effectively manipulated by the "menopause" construct.

Surprisingly, death reminders did not produce effects consistent with past studies either. Vaughn et al. (2010) found that women's opposite sex facial perceptions were altered after death reminders. Several studies have shown that when mortality was made salient, individuals expressed a greater desire for children (Becker, 1973; Florian & Mikulincer, 1998; Matthews & Sear, 2008; Wisman & Goldenberg, 2005). The current study did not observe significant effects of mortality salience on facial perceptions or procreation preferences. One possible explanation for the lack of significant results in the death condition is that certain life circumstances or personality dispositions among participants may have buffered potential effects.

The anxiety-buffer hypothesis holds that high self-esteem or worldview faith can reduce the effects of mortality salience. Further, people with high self-esteem who are reminded of death tend to rely less on coping mechanisms than do those with moderate or low self-esteem (Harmon-Jones, Simon, Greenberg, Pyszczynski, Solomon, & McGregor, 1997). The current study did not include a self-esteem measure. An established scale, such as Rosenberg's Self-Esteem scale, which includes items inquiring about perceptions of attitude, worthiness, and confidence in abilities (Robins, Hendin, & Trzesniewski, 2001), would have shed some light on how participants view themselves. If this measure had revealed, for instance, that the current study's participant pool consisted of a group of young women with exceptionally high self-esteem, this may have explained why expected effects were not observed in the death condition. Although no such scale was incorporated into the study, trends in answers to the questions relating to future goals suggest that the group of women who completed the study likely had fairly high self-esteem. Many women reported that they could envision themselves getting married (94.04%, n = 142), having children (86.75%, n = 131), pursuing further education (48.34%, n = 131), working full-time (91.39%, n = 138), being a stay at home mother (50.33%, n = 76), and working part-time (75.50%, n = 114). Although a formal analysis would be necessary in order

to suggest high self-esteem among participants, the women in the study demonstrated open-mindedness and ambitious thinking in regard to future plans.

It is also worth noting that according to the anxiety-buffer hypothesis, another aspect of the self that acts as a buffer to death reminders is faith-based or cultural worldview (Harmon-Jones, Simon, Greenberg, Pyszczynski, Solomon, & McGregor, 1997). Personal worldviews pertaining to faith have been shown to reduce the effects of death reminders. This is another specific extension of self-esteem, since religious ideals are thought to tie human beings to certain standards of living associated with self-worth. Beliefs in heaven and the associated religious ideals may also offer a sense of protection against possible existential anxiety. Such symbolic constructions inspire hope of an afterlife and increase one's sense of purpose, well-being, and perceptions of human nature (Solomon, Greenberg, & Pyszczynski, 1991). An informal post-hoc revealed that out of the 50 participants in the mortality salience condition, many (54.00%, n = 27) wrote about spiritual beliefs and religious ideals pertaining to an afterlife when describing what would happen to them during death. (i.e., "I am a Christian, so I believe that once I am pronounced, my soul will ascend to heaven and I will meet with my creator. Like anyone else, my body will be laid to rest.") The rest of the participants (46.00%, n = 23) focused on the more literal and physical aspects of death. (i.e., "When I die, I feel like the visions around me will fade to a blur and slowly go to black. I won't be able to smell and I'll be gasping for breath, hoping it's not the end. My body will become cold and unresponsive and once I'm dead, I'll turn to black and rot.") It is possible that cultural worldview constructs acted as a buffer against mortality salience, thus interfering with effects that were expected. Perhaps after participants completed the writing prompt and the distractor task, they were no longer experiencing any effects of mortality salience by the time that they reached the facial perception task and later, the procreation preference portion.

Past studies have also indicated that relationships may protect against the potential anxiety aroused by death reminders (Laubach, 2013). People in romantic relationships may be less affected by death reminders compared to people who are unattached to a mate. Although the current study did not observe that relationship status significantly moderated facial perceptions or procreation preferences, it may have been pronounced enough to prevent significant effects rather then moderating effects. In other words, relationship status may have created interference in the study design.

Terror management theory aside, hormonal status also had no significant effect of facial perceptions. A body of past research supports the notion that ovulatory women typically prefer more masculine faces and that non-ovulatory women (Jones et al.,2008), and women using hormonal contraception typically prefer less masculine faces (Little et al., 2013). The current study found no meaningful relationship between fertility status and facial perceptions. However, it could be that facial preferences are part of an increasingly nuanced range of factors that drive even initial preferences for potential mates. One recent study found that women with perceptions of high quality personal "mate value" seek mates who are simultaneously masculine, financially stable, family-oriented, and emotionally attentive (Buss & Shackelford, 2008). This is a very specific combination of qualities that are very diverse from one another. These multi-dimensional factors make it difficult to isolate variables in opposite sex perception studies. Furthermore, much is left to be determined about the revealing nature of perceptual cues on a face. While masculinity can be assessed through physical traits such as dynamic jawlines, broad shoulders, or thick eyebrows, it is more difficult to objectively determine the physical appearance of a financially stable man or an attentive father. More research should be conducted in regard to personality perceptions formed from facial appearance.

Practical Implications

The salience manipulation and hormonal status were expected to significantly influence participants' desired number of children. It was also presumed that relationship status and ambitions for further education would moderate these factors. Results revealed one significant effect in the current study. Participants who expressed intentions of pursuing higher education desired more children than did participants who did not intend to further their education. Women who expressed intentions to pursue further education desired a mean of 2.92 children, which was significantly higher than women who intended to terminate their education after completion of an undergraduate degree, (M = 2.53).

This finding is very surprising considering that data from the 2010 United States Census Bureau revealed a direct correlation between American women's high education levels and low numbers of children. More educated women are in fact giving birth later in life and having fewer children, which is a trend that has been labeled a "delayer bloom" (Glasier, 2011). The fact is that the vast majority of college aged women plan to pursue careers, and they also want to become mothers. Indeed, another recent study discovered that 98% of college aged women in Virginia wanted to have children (Erchull, Liss, Axelson, Staebell, & Askari, 2010). Yet, there is a disparity between women's desires and the actual outcomes. Involuntary childlessness is on the rise due to procreation postponement (Roy, Schumm, & Britt, 2014).

Even more alarmingly, fertility struggles are sometimes due to a lack of awareness about risks of delaying conception. A recent journal article (Miura, 2013) featured personal testimonies from women in medicine who struggled along the path to motherhood as a direct result of delaying childbearing. Two female physicians recounted troubles with conception, recurring miscarriages, and expensive fertility treatments. In spite of years studying human biology and medicine, the women did not anticipate reproductive challenges and admittedly lacked awareness of fertility limitations. If fertility

knowledge is not salient to female physicians, it is no wonder why women outside of the medical realm are often unaware.

The current study highlights a lack of fertility knowledge among young women. The vast majority of participants did not know the age at which a woman experiences her first slight decline in fertility, or the odds of conception between ages 25 and 30 and ages 35 and 40. Some women believed that a woman between within the age range of 35-40 would have a 100% chance of conceiving within one year. Many participants believed that women do not experience a slight decline in fertility until they have reached the 40's and 50's age range. These perceptions are decades off from the correct answer. This finding is not unique to the current study. Another study found that college aged males and females made extreme overestimations regarding the age at which women's fertility declines, the odds of pregnancy after unprotected intercourse, and the odds of successful in vitro fertilization treatments (Peterson, Pirritano, Tucker, & Lampic, 2012).

This disconnect between young women's intentions and outcomes reflecting the reality of fertility limitations suggests shortcomings in young women's health literacy. The current study raises several important question: Why are women so seemingly unaware of basic biology in regard to something as important as procreation? When having children is clearly a matter of importance in women's lives, why isn't fertility more salient in every day society? Given the importance of childbearing in the future goals of participants in this study and others, coupled with the low knowledge about relationships between age and declining fertility observed in this study and others, increased efforts to educate young women about the risks that even small increases in age pose for fertility may be advisable.

Limitations

Although these results revealed no significant effects of mortality salience or fertility salience on opposite sex facial perceptions, they certainly do not negate past terror management findings. Although

the phenomenon was not observed in this study, there were several limitations that may have hindered such effects. First of all, the primary limitation was the possible ineffectiveness of the menopause-related writing prompt as a manipulation of fertility salience. Participant responses suggested that this stimulus was an insufficient manipulation of fertility salience. Women's responses demonstrated a lack of associations between the menopause process and reproduction abilities. In responses, they commonly associated this life stage with vanity concerns, discomfort, and general fears of aging.

Another important oversight of the current study is that it did not incorporate a self-esteem scale as a measure. Considering that past terror management studies have found that self-esteem may act as a buffer against threats to mortality and that responses to death reminders vary according to self-esteem of respondents, this would have been enlightening. To address questions as to why results were inconsistent with past research, a self-esteem measure could have provided some valuable information about participants' perceptual processes.

Additionally, the present research had several logistical limitations. First of all, students completed the study online rather than in a laboratory setting. Participants may have viewed stimuli and completed questionnaire measures on miniature laptops or mobile devices, which could have altered the sensory information perceived from facial images. Past research on opposite sex facial perceptions have established significant results based on women's ability to pick up on subtle sensory cues like dynamic jawlines and thick eyebrows (Jones, DeBruine, Perrett, Little, Feinberg, & Law Smith, 2008). If sensory information was somehow distorted, unclear, or muted, this may have unintentionally inhibited effects of the stimuli. Additionally, with an online study comes the risk of distraction in the external environment. A laboratory setting would have ensured more consistent viewing experiences among participants and limited distractions.

Also, the facial perception judgment task only included three different images used to measure participants' perceptions of attractiveness, dominance, and health. Additionally, the images were derived from a single composite of a male face. If participants did not find the face appealing, this lack of interest may have affected their judgments. Whereas Vaughn et al. (2010) offered 1,200 images for participants to choose from, the current study presented participants with only three. It is possible that a salience effect may have been more pronounced with freedom of choice and more variation among images.

One aspect of the study that was highly subject to error was determining the fertility status of participants. The only sure way to determine a woman's hormonal status is through a blood test or urine sample. This study relied on the women's personal awareness of their menstrual cycle. Women who were somewhat unaware of their own fertility status may have made erroneous guesses and consequently ended up in the wrong category. Also, 12.58% of participants (n = 19) reported irregular cycles, which may have made current fertility status ambiguous. The study also did not recruit equal numbers of participants in each fertility group. With participants' fertility status left to chance, ovulating women were underrepresented in all conditions, which limited comparisons between groups. The study did not include enough participants for adequate fertility status representation in all three conditions.

Further, women's lack of fertility awareness may have prevented fertility salience. Very few participants demonstrated adequate fertility knowledge, with a mere 2% of women answering the first fertility awareness question correctly, only 24% answering the second question correctly, and only 15% answering the third question correctly. An effective salience manipulation may require a baseline of knowledge on the subject matter. A woman who believes she has decades of high fertility left may not experience as much fertility salience compared to a more informed woman. The participants may not

have tended to be informed enough about fertility and age to experience any salience effects related to fertility awareness. Women in the study were also fairly young. Older participants closer to death and/or menopause may have perceived salience with greater intensity as a result of the stimulus material.

Future Research

The current study does provide conclusive evidence about the role of fertility salience or mortality salience in affecting opposite sex perceptions or procreation attitudes. Yet it would be foolish and hasty to conclude that these notions do not affect the human psyche. These research results raise questions and open doors for further research involving symbolic mortality salience, as well as the role of women's fertility and related attitudes.

In exploring the link between fertility salience and mate selection, one of the most important goals for future research should be to find an effective way to manipulate fertility salience. An informal post-hoc of the writing responses suggested that the "menopause" cue was insufficient in creating feelings and emotions related to reproductive concerns. It is very important that future studies find a way to target fertility salience directly by using very specific wording and conducting a manipulation check before incorporating stimulus material into an experiment. In order to make fertility as salient and possible, it is recommended that future studies create a scenario that would encourage women to think about the decline of fertility rather than menopause. As the present study revealed, college aged women tend to lack knowledge pertaining to fertility awareness; ideally, future studies should include information about fertility within the body of the writing prompt. Because there is no single word in the English language that describes the time in a woman's life in which she experiences a slight decrease in her ability to conceive, this idea could be elaborated upon through the use of a hypothetical scenario. This could be employed by a situational description, similar to that of the dental pain writing prompt

used in the current study. For example, a more effective manipulation might involve prompts such as: "Please briefly describe the emotions aroused within you as you imagine yourself visiting a fertility clinic to inquire about hormonal testing after realizing that becoming pregnant is taking a longer time than you expected," or, "Jot down as specifically as you can what you think will happen to you physically as you experience your first slight decline in fertility when you are in your late 20's." These questions leave very little room for misunderstanding, and they simultaneously provide women with specific information related to the science of fertility.

Future research should also incorporate a self-esteem scale to measure this as a possible moderating effect for a salience manipulation. This could come in handy when assessing possible reasons why death reminders, for example, did or did not result in predicted outcomes. For instance, if the majority of participants in a given sample size indicate high levels of self-esteem, they may be less affected by mortality salience. A self-esteem scale would help to clarify this.

Future research should also use a tool that offers participants more freedom of choice. A continuum that includes facial diversity and many choices may offer a new perspective on facial perceptions. Additionally, future research should consider the use of open-ended questions rather than forced choice ranking systems. Participant comments may offer new insight related to mate selection thought processes.

For the sake of precision, future research should use an objective means by which to determine female fertility status. Blood or urine testing would be optimal. This will also provide future experimenters the opportunity to control for even hormonal representation among different conditions. A large sample size of participants would allow not only for adequate representation of high fertility, low fertility, and birth control participant statuses; but it would also increase the possibility for participant reproductive knowledge. Furthermore, since the current research uncovered a disparity in

fertility knowledge among college females, it may be a wise idea for future studies to provide participants with fertility literature for educational purposes and to ensure that salience has a chance to have the presumed effect.

Lastly, perhaps the most important goal of mate selection research is to identify and explore the many factors involved in this complex process. Future research should continue to explore effects of fertility salience and mortality salience, as well as hormonal status, but future studies should also take a look at other factors that may play a role in facial perception formation. Examples of other factors to investigate include, but are not limited to: self-esteem, worldview constructs, age of females, the specifics of a female participant's relationship with her father, childhood trauma, parents' marital status, personality psychology, whether or not a woman has a romantic "type" or repeated patterns of sexual behavior, promiscuity, levels of perceived dominance or submissiveness, self-sabotaging behavior, attitudes toward commitment, and romantic ideals.

Conclusion

It is clear that mate preference is neither a concrete, nor objective subject area. Genetics, aesthetic appearance, and hormones, among other attributes, work in tandem to guide a person's opinions and sexual selections. The current study partially replicated the study conducted by Vaughn et al. (2010) in which literal mortality salience was found to significantly impact women's preferences for male faces. This research investigated mortality salience and fertility salience effects on facial perceptions, yielding no significant effects of the salience cues. Further, neither mortality salience nor fertility salience produced significant effects concerning desired number of children or participants' ideal age for having a first child. All in all, the current study did not observe findings that were consistent with past terror management theory research. This is not to say that this phenomenon does not occur or that past findings hold no merit. A lack of significant results does not suggest that mortality salience and

fertility salience have no bearing on daily perceptions and thought processes. Results simply suggest that within the current experiment, the phenomenon was not strong enough in light of other possible factors or moderating interferences, to consistently explain differences within experimental groups. Future studies should explore a variety of other factors that may affect facial perceptions and procreation preferences.

References

American Society for Reproductive Medicine. (2012). *Age and fertility.* Retrieved from http://www.asrm.org/uploadedFiles/ASRM_Content/Resources/Patient_Resources/Fact_Sheets_and_Info_Booklets/agefertility.pdf

Alpert, E. (2013, August 4). More women in their 40s are having babies. *Los Angeles Times.* Retrieved from http://articles.latimes.com/2013/aug/04/local/la-me-fortysomething-moms-20130729

Aniston, J., Hahn, K., Kahane, N., Gordon, J., & Speck, W. (2010). *The switch.* United States: Miramax Films.

Arndt, J., Greenberg, J., & Cook, A. (2002). Mortality salience and the spreading activation of worldview-relevant constructs: Exploring the cognitive architecture of terror management. *Journal of Experimental Psychology: General*, *131*(3), 307-324. doi: 10.1037/0096-3445.131.3.307

Avishai, O. (2013, March 23). Young women are ambitious, but worried. *CNN Opinion.* Retrieved from http://www.cnn.com/2013/03/23/opinion/avishai-young-women/

Bachmann, G. A., & Leiblum, S. R. (2004). The impact of hormones on menopausal sexuality: A literature review. *Menopause*, *11*(1), 120-130. doi: 10.1097/01.GME.0000075502.60230.28

Becker, E. (1973). *The denial of death.* New York: Free Press.

Birnbaum, G., Hirschberger, G., & Goldenberg, J. (2011). Desire in the face of death: Terror management, attachment, and sexual motivation. *Personal Relationships*, *18*(1), 1-19. doi: 10.1111/j.1475-6811.2010.01298.x

Boothroyd, L. G., Jones, B. C., Burt, D. M., and Perrett, D. I. (2007). Partner

characteristics associated with masculinity, health, and maturity in male faces. *Personality and Individual Differences, 43,* 1161-1173. doi: 10.1016/j.paid.2007.03.008

Brown, M. C. (1976). Emotional response to the menopause. In *The Management of the Menopause & Post-Menopausal Years* (pp. 109-115). Netherlands: Springer. doi: 10.1007/978-94-011-6165-7_9

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature*, *20*(1), 25-51. doi: 10.1007/s12110-009-9059-3

Buss, D. M. (2009). How can evolutionary psychology successfully explain personality and individual differences? *Perspectives on Psychological Science*,*4*(4), 359-366. doi: 10.1111/j.1745-6924.2009.01138.x

Buss, D. M., & Shackelford, T. K. (2008). Attractive Women Want it All: Good Genes. Economic Investment. Parenting Proclivities, and Emotional Commitment. *Evolutionary Psychology, 6*(1). Retrieved from http://www.epjournal.net/articles/attractive-women-want-it-all-good-genes-economic-investment-parenting-proclivities-and-emotional-commitment1/

Castelo-Branco, C., Blumel, J. E., Araya, H., Riquelme, R., Castro, G., Haya, J., & Gramegna, G. (2003). Prevalence of sexual dysfunction in a cohort of middle-aged women: Influences of menopause and hormone replacement therapy. *Journal of Obstetrics and Gynecology*, *23*(4), 426-430. doi: 10.1080/0144361031000120978

Dunson, D.B., Baird, D.D., Wilcox, A.J., and Weinberg, C.R. (1999). Day-specific probabilities of clinical pregnancy based on two studies with imperfect measures of ovulation. *Human Reproduction, 14,* 1835-1839. doi: 10.1093/humrep/14.7.1835

Elms, E. (2013). Too poor to push? Why more and more women are delaying motherhood. *Daily Mail U.K.* Retrieved from http://www.dailymail.co.uk/home/you/article-2492830/Too-poor-push-Why-more-women-delaying-motherhood.html

Erchull, M. J., Liss, M., Axelson, S. J., Staebell, S. E., & Askari, S. F. (2010). Well... she wants it more: Perceptions of social norms about desires for marriage and children and anticipated chore participation. *Psychology of Women Quarterly, 34*(2), 253-260. doi: 10.1111/j.1471-6402.2010.01566.x

Etcoff, N. (1999). *Survival of the prettiest: The science of beauty*. New York: Anchor Books.

Fetterolf, J. C., & Eagly, A. H. (2011). Do young women expect gender equality in their future lives? An answer from a possible selves experiment. *Sex Roles, 65*(1-2), 83-93. doi: 10.1007/s11199-011-9981-9

Fisher, H. (2000). Lust, attraction, attachment: Biology and evolution of the three primary emotion systems for mating, reproduction, and parenting. *Journal of Sex Education and Therapy, 25*(1), 96-104. Retrieved from http://www.profcanterbury.com/upload/Lust%20and%20Attraction.pdf

Florian, V., & Mikulincer, M. (1998). Symbolic immortality and the management of the terror of death—The moderating role of attachment style. *Journal of Personality and Social Psychology, 74*, 725-734. doi: 10.1037/0022-3514.74.3.725

Fritsche, I., Jonas, E., Fischer, P., Koranyi, N., Berger, N., & Fleischmann, B. (2007). Mortality salience and the desire for offspring. *Journal of Experimental Social Psychology, 43*(5), 753-762. doi: 10.1016/j.jesp.2006.10.003

Glasier, V. (2011). Census bureau reports "delayer bloom" as more educated women have children later. *United States Census Bureau.* Retrieved from

http://www.census.gov/newsroom/releases/archives/fertility/cb11-83.html

Goldani von Mühlen, D., Kritz-Silverstein, D., & Barrett-Connor, E. (1995). A community-based study of menopause symptoms and estrogen replacement in older women. *Maturitas, 22*(2), 71-78. doi: 10.1016/0378-5122(95)00917-A

Goldenberg, J. L. (2013). Immortal objects: The objectification of women as terror management. In *Nebraska Symposium on Motivation. Nebraska Symposium on Motivation* (Vol. 60, p. 73). Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23947279

Graham, S. (2002, May 1). Study shows fertility decline begins in late 20s. *Scientific American.* Retrieved from http://www.scientificamerican.com/article.cfm?id=study-shows-fertility-dec

Greenberg, J., Pyszczynski, T., & Solomon, S. (1986). The causes and consequences of a need for self-esteem: A terror management theory. In *Public self and private self* (pp. 189 -212). New York: Springer. doi: 10.1007/978-1-4613-9564-5_10

Greenberg, J., Pyszczynski, T., Solomon, S., Pinel, E., Simon, L., & Jordan, K. (1993). Effects of self-esteem on vulnerability-denying defensive distortions: Further evidence of an anxiety-buffering function of self-esteem. *Journal of Experimental Social Psychology, 29*, 229-251. doi: 10.1006/jesp.1993.1010

Greenberg, J., Solomon, S., & Arndt, J. (2008). A basic but uniquely human motivation. In J.Y. Shah & W.L. Gardner (Eds.), *Handbook of motivation science*, (p.p. 114-134). New York, NY: The Guilford Press.

Harmon-Jones, E., Simon, L., Greenberg, J., Pyszczynski, T., Solomon, S., & McGregor, H. (1997).

Terror management theory and self-esteem: Evidence that increased self-esteem reduced mortality salience effects. *Journal of personality and social psychology*, *72*(1), 24. doi: 10.1037/0022-3514.72.1.24

Hefner, V., & Wilson, B. J. (2013). From love at first sight to soul mate: The influence of romantic ideals in popular films on young people's beliefs about relationships. *Communication Monographs*, *80*(2), 150-175. doi: 10.1080/03637751.2013.776697

Hirschberger, G., Florian, V., & Mikulincer, M. (2002). The anxiety buffering function of close relationships: Mortality salience effects on the readiness to compromise mate selection standards. *European Journal of Social Psychology*, *32*(5), 609-625. doi: 10.1002/ejsp.110

Hirschberger, G., Florian, V., & Mikulincer, M. (2003). Strivings for romantic intimacy following partner complaint or partner criticism: A terror management perspective. *Journal of Social and Personal Relationships*, *20*(5), 675-687. doi: 10.1177/02654075030205006

Johnston, V. S. (1994). Methods and apparatus for generating composites of human faces. U.S Patent no. 5,375,195.

Johnston, V. S., Hagel, R., Franklin, M., Fink, B. and Grammer, K. (2001). Male facial attractiveness: Evidence for hormone-mediated adaptive design. *Evolution and Human Behavior, 22*, 251-267. doi: 10.1016/S1090-5138(01)00066-6

Jones, B. C., DeBruine, L. M., Perrett, D. I., Little, A. C., Feinberg, D. R., and Law Smith, M. J. (2008). Effects of menstrual cycle phase on face perception. *Archives of Sexual Behavior, 37*, 78-84. doi: 10.1007/s10508-007-9268-y

Jones, B. C., Feinberg, D. R., Watkins, C. D., Fincher, C. L., Little, A. C., & DeBruine, L. M. (2013). Pathogen disgust predicts women's preferences for masculinity in men's voices, faces, and bodies. *Behavioral Ecology*, *24*(2), 373-379. doi: 10.1093/beheco/ars173

Jones, E. K., Jurgenson, J. R., Katzenellenbogen, J. M., & Thompson, S. C. (2012). Menopause and the influence of culture: Another gap for indigenous Australian women? *BMC Women's Health*, *12*(1), 43. doi: 10.1186/1472-6874-12-43

Kavanaugh, R., Messick, J.S., Rosner, L., & McCullers, M. (2008). *Baby mama*. United States: Universal Pictures.

Kirkpatrick, L. A., & Shaver, P. R. (1992). An attachment-theoretical approach to romantic love and religious belief. *Personality and Social Psychology Bulletin*, *18*(3), 266-275. doi: 10.1177/0146167292183002

Krucik, G. (2012). What bodily changes can you expect during pregnancy? *Healthline*. Retrieved from http://www.healthline.com/health/pregnancy/bodily-changes-during

Lam, S. R., Morrison, K. R., & Smeesters, D. (2009). Gender, intimacy, and risky sex: A terror management account. *Personality and Social Psychology Bulletin*, *35*(8), 1046-1056. doi: 10.1177/0146167209336607

Landau, M. J., Goldenberg, J. L., Greenberg, J., Gillath, O., Solomon, S., Cox, C., Martens, A., & Pyszczynski, T. (2006). The siren's call: Terror management and the threat of men's sexual attraction to women. *Journal of Personality and Social Psychology*, *90*(1), 129. doi: 10.1037/0022-3514.90.1.129

Laubach, J. L. (2013). Social support from romantic partners versus friends as moderators of mortality salience effects (Thesis, Carnegie Mellon University). Retrieved from

http://repository.cmu.edu/hsshonors/169/?utm_source=repository.cmu.edu%2Fhsshonors%2F169&utm_medium=PDF&utm_campaign=PDFCoverPages

Lein, A. (1979). *The cycling female: Her menstrual rhythm*. San Francisco: Freeman.

Little, A.C., Burriss, R.P., Petrie, M., Jones, B.C., & Roberts, S.C. (2013). Oral contraceptive use in women changes preferences for male facial masculinity and is associated with partner facial masculinity. *Psychoneuroendocrinology,* 1-9. doi: 10.1016/j.psyneuen.2013.02.014

Ludden, J. (2011, December 1). Many women underestimate fertility clock's clang. *National Public Radio.* Retrieved from http://www.npr.org/2011/12/01/142725547/many-women underestimate-fertility-clocks-clang

Mansfield, P., Koch, P., & Voda, A. M. (2000). Midlife women's attributions for their sexual response changes. *Health Care for Women International, 21*(6), 543-559. doi: 10.1080/07399330050130322

Mathews, P., & Sear, R. (2008). Life after death: An investigation into how mortality perceptions influence fertility preferences using evidence from an Internet-based experiment. *Journal of Evolutionary Psychology*, *6*(3), 155-172. doi:10.1556/JEP.6.2008.3.1

Mathews, T.J., & Brady, E.H. (2009). Delayed childbearing: More women are having their first child later in life. *Centers for Disease Control and Prevention.* Retrieved from http://www.cdc.gov/nchs/data/databriefs/db21.htm

McGregor, H. A., Lieberman, J. D., Greenberg, J., Solomon, S., Arndt, J., Simon, L., & Pyszczynski, T. (1998). Terror management and aggression: Evidence that mortality salience motivates aggression against worldview-threatening others. *Journal of Personality and Social Psychology, 74*(3), 590. doi: 10.1037/0022-3514.74.3.590

Meriwether, E., & Brennan, N. (2012). Eggs. In B. Baer, P. Chernin, D. Finkel, J. Kasdan, E. Meriwether, & K. Pope. *New girl.* Beverly Hills, California: Fox Broadcasting Company.

Mikulincer, M., Florian, V., & Hirschberger, G. (2003). The existential function of close relationships: Introducing death into the science of love. *Personality and Social Psychology Review, 7*(1), 20-40. doi: 10.1207/S15327957PSPR0701_2

Miller, G. (2011). *The mating mind: How sexual choice shaped the evolution of human nature*. New York: Random House, Inc.

Miura, L. N. (2013). Women in medicine and the ticking clock. *Ann Fam Med, 381*, 382. doi: 10.1370/afm.1515

Moore, F. R., Cornwell, R. E., Smith, M. L., Al Dujaili, E. A., Sharp, M., & Perrett, D. I. (2011). Evidence for the stress-linked immunocompetence handicap hypothesis in human male faces. *Proceedings of the Royal Society B: Biological Sciences*, *278*(1706), 774-780. doi: 10.1098/rspb.2010.1678

Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., & Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399*(6738), 741-742. doi: 10.1038/21557

Perrett, D. I., Burt, D. M., Penton-Voak, I. S., Lee, K. J., Rowland, D. A., & Edwards, R. (1999). Symmetry and human facial attractiveness. *Evolution and Human Behavior*, *20*(5), 295-307. doi: 10.1016/S1090-5138(99)00014-8

Peterson, B. D., Pirritano, M., Tucker, L., & Lampic, C. (2012). Fertility awareness and parenting attitudes among American male and female undergraduate university students. *Human Reproduction*, *27*(5), 1375-1382. doi: 10.1093/humrep/des011

Planned Parenthood. *Birth control.* (2014). Retrieved from http://www.plannedparenthood.org/health-topics/birth-control-4211.htm

Pyszczynski, T., Greenberg, J., Solomon, S., Arndt, J., & Schimel, J. (2004). Why do people need self-esteem? A theoretical and empirical review. *Psychological Bulletin*, *130*(3), 435. doi: 10.1037/0033-2909.130.3.435

Re, D. E., DeBruine, L. M., Jones, B. C., & Perrett, D. I. (2013). Facial cues to perceived height influence leadership choices in simulated war and peace contexts. *Evolutionary Psychology*, *11*(1), 89-103. Retrieved from http://www.epjournal.net/articles/facial-cues-to-perceived-height-influence-leadership-choices-in-simulated-war-and-peace-contexts/

Richards, C. (2012). Planned parenthood statement on health and human services announcement on birth control coverage benefit. *Planned Parenthood.* Retrieved from http://www.plannedparenthood.org/about-us/newsroom/press-releases/planned-parenthood-statement-on-health-human-services-announcement-birth-control-coverage-benef-39002.htm

Rikowski, A. & Grammer, K. (1999). Human body odour, symmetry and attractiveness. *Proceedings of the Royal Society*, 266, 869-874. doi: 10.1098/rspb.1999.0717

Roberts, S.C., Klapilova, K., Little, A.C., Burriss, R.P., Jones, B.C., DeBruine, L.M., Petrie, M., & Havlicek, J. (2011). Relationship satisfaction and outcome in women who meet their partner while using oral contraception. *Proceedings of the Royal Society B, 279*(1732), doi: 10.1098/rspb.2011.1647

Robins, R. W., Hendin, H. M., & Trzesniewski, K. H. (2001). Measuring global self-esteem: Construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Personality and social psychology bulletin*, *27*(2), 151-161.

doi: 10.1177/0146167201272002

Rosen, L. D., Whaling, K., Carrier, L. M., Cheever, N. A., & Rokkum, J. (2013). The media and technology usage and attitudes scale: An empirical investigation. *Computers in Human Behavior, 29*, 2501-2511. doi: 10.1016/j.chb.2013.06.006

Rosenblatt, A., Greenberg, J., Solomon, S., Pyszczynski, T., & Lyon, D. (1989). Evidence for terror management theory: I. The effects of mortality salience on reactions to those who violate or uphold cultural values. *Journal of Personality and Social Psychology, 57*(4), 681-690. doi: 10.1037/0022-3514.57.4.681

Rotkirch, A. (2007). All that she wants is a(nother) baby'? Longing for children as a fertility incentive of growing importance. *Journal of Evolutionary Psychology*, *5*(1), 89-104. doi: 10.1556/JEP.2007.1010

Roy, R. N., Schumm, W. R., & Britt, S. L. (2014). Voluntary versus involuntary childlessness. In *Transition to Parenthood* (pp. 49-68). New York: Springer.

Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, *266*(1431), 1913-1917. doi: 10.1098/rspb.1999.0866

Silveira, S., Graupmann, V., Agthe, M., Gutyrchik, E., Blautzik, J., Demirçapa, I., Berndt, A., Pöppel, E., Frey, D., Reiser, M., & Hennig-Fast, K. (2013). Existential neuroscience: Effects of mortality salience on the neurocognitive processing of attractive opposite-sex faces. *Social Cognitive and Affective Neuroscience*. doi: 10.1093/scan/nst157

Solomon, S., Greenberg, J., & Pyszczynski, T. (1991). A terror management theory of social behavior: The psychological functions of self-esteem and cultural worldviews. *Advances in Experimental Social Psychology*, *24*(93), 95-96.

Strachman, A., & Schimel, J. (2006). Terror management and close relationships: Evidence that mortality salience reduces commitment among partners with different worldviews. *Journal of Social and Personal Relationships, 23*(6), 965 978. doi: 10.1177/0265407506070477

Taubman-Ben-Ari, O. (2004). Intimacy and risky sexual behavior—What does it have to do with death? *Death Studies, 28*(9), 865-887. doi: 10.1080/07481180490490988

Thompson, D. (2013). More U.S. women having kids in their 30s and 40s. *WebMD.* Retrieved from http://www.webmd.com/baby/news/20130906/more-us-women-having-kids-in-their-30s-and-40s-report?page=2

Vaughn, J. E., Bradley, K. I., Byrd-Craven, J., & Kennison, S. M. (2010). The effect of mortality salience on women's judgments of male faces. *Evolutionary Psychology, 8*(3), 477. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22947814

Virtala, A., Vilska, S., Huttunen, T., & Kunttu, K. (2011). Childbearing, the desire to have children, and awareness about the impact of age on female fertility among Finnish university students. *The European Journal of Contraception and Reproductive Health Care, 16*(2), 108-115. doi: 10.3109/13625187.2011.553295

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063-1070. doi: 10.1037/0022-3514.54.6.1063

Wisman, A., & Goldenberg, J. L. (2005). From the grave to the cradle: Evidence that mortality salience engenders a desire for offspring. *Journal of Personality and Social Psychology, 89*(1), 46-61. doi: 10.1037/0022-3514.89.1.46

Zhou, X., Liu, J., Chen, C., & Yu, Z. (2008). Do children transcend death? An examination of the terror management function of offspring. *Scandinavian Journal of Psychology*, *49*(5), 413-418. doi: 10.1111/j.1467-9450.2008.00665.x

Zhou, X., Lei, Q., Marley, S. C., & Chen, J. (2009). Existential function of babies: Babies as a buffer of death-related anxiety. *Asian Journal of Social Psychology*, *12*(1), 40-46. doi: 10.1111/j.1467-839X.2008.01268.x

Appendix

Dental Pain Writing Prompts (Control Group)

Please respond to the following two open-ended questions with your initial gut-level thoughts.

1. Please briefly describe the emotions that the thought of a dentist removing one of your teeth arouses in you.

2. Jot down as specifically as you can, what you think will happen to you physically as a dentist is removing one of your teeth.

Mortality Salience Writing Prompts (Literal Mortality Salience Group)

Please respond to the following two open-ended questions with your initial gut-level thoughts.

1. Please briefly describe the emotions that the thought of your own death arouses in you.

2. Jot down as specifically as you can, what you think will happen to you as you physically die and once you are physically dead.

Fertility Salience Writing Prompts (Symbolic Mortality Salience Group)

Please respond to the following two open-ended questions with your initial gut-level thoughts.

1. Please briefly describe the emotions that the thought of your own menopause arouses in you.

2. Jot down as specifically as you can, what you think will happen to you as you physically undergo menopause, and once you have physically completed the process.

Distractor Task (Media and Technology Usage and Attitudes Scale)

Please indicate how often you do each of the following e-mail activities on any device (mobile phone, laptop, desktop, etc.)

1. (E-mailing subscale) Send, receive and read e-mails (not including spam or junk mail).

   A. Never

B. Once a week or slightly less
C. Several times a week
D. All the time

2. (E-mailing subscale) Check your personal e-mail.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

3. (E-mailing subscale) Check your work or school e-mail.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

4. (E-mailing subscale) Send or receive files via e-mail.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

Please indicate how often you do each of the following activities on your mobile phone.

5. (Text messaging subscale) Send and receive text messages on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

6. (Phone calling subscale) Make and receive mobile phone calls.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

7. (Text messaging subscale) Check for text messages on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week

D. All the time

8. (Phone calling subscale) Check for voice calls on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

9. (Smartphone usage subscale) Read e-mail on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

10. (Smartphone usage subscale) Get directions or use GPS on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

11. (Smartphone usage subscale) Browse the web on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

12. (Smartphone usage subscale) Listen to music on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

13. (Smartphone usage subscale) Take pictures using a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

14. (Smartphone usage subscale) Check the news on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

15. (Smartphone usage subscale) Record video on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

16. (Smartphone usage subscale) Use apps (for any purpose) on a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

17. (Smartphone usage subscale) Search for information with a mobile phone.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

18. (Text messaging subscale) Use your mobile phone during class or work time. How often do you do each of the following activities?

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

19. (TV viewing subscale) Watch TV shows, movies, etc. on a TV set.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

20. (TV viewing subscale) Watch video clips on a TV set.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

21. (Media sharing subscale) Watch TV shows, movies, etc. on a computer.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

22. (Media sharing subscale) Watch video clips on a computer.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

23. (Media sharing subscale) Download media files from other people on a computer.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

24. (Media sharing subscale) Share your own media files on a computer.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

25. (Internet searching subscale) Search the Internet for news on any device.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

26. (Internet searching subscale) Search the Internet for information on any device.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

27. (Internet Searching Subscale) Search the Internet for videos on any device.

A. Never
B. Once a week or slightly less

C. Several times a week
D. All the time

28. (Internet searching subscale) Search the Internet for images or photos on any device.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

29. (Video gaming subscale) Play games on a computer, video game console or smartphone BY YOURSELF.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

30. (Video Gaming Subscale) Play games on a computer, video game console or smartphone WITH OTHER PEOPLE IN THE SAME ROOM.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

31. (Video gaming subscale) Play games on a computer, video game console or smartphone WITH OTHER PEOPLE ONLINE.

A. Never
B. Once a week or slightly less
C. Several times a week
D. All the time

Face Judgment Task

Please assess the following facial images and rate them according to your perceptions.

Facial image used with permission of Re, DeBruine, Jones, and Perrett (2013)

How attractive do you find this face?

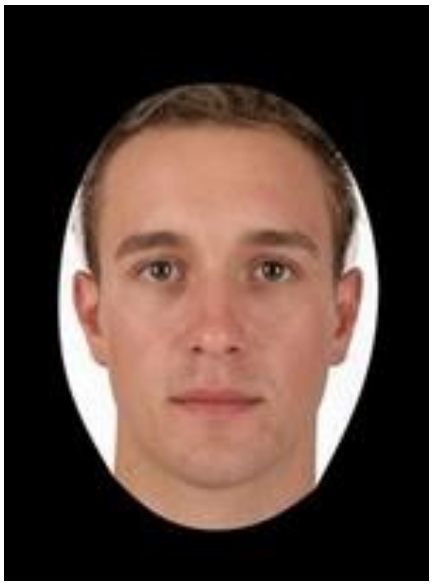
1 2 3 4 5 6 7 8 9 10

How dominant do you find this face?

1 2 3 4 5 6 7 8 9 10

How healthy do you find this face?

1 2 3 4 5 6 7 8 9 10



Facial image used with permission of Re, DeBruine, Jones, and Perrett (2013)

How attractive do you find this face?

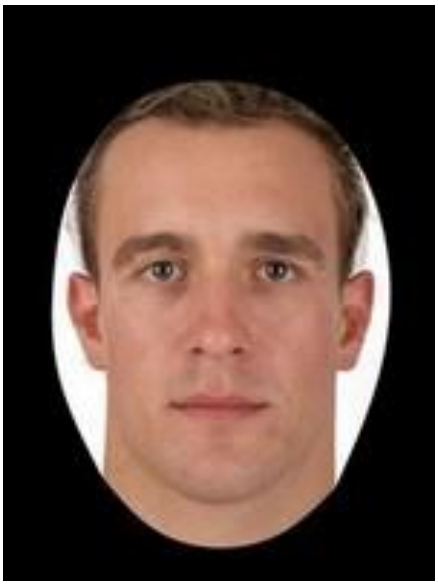
1 2 3 4 5 6 7 8 9 10

How dominant do you find this face?

1 2 3 4 5 6 7 8 9 10

How healthy do you find this face?

1 2 3 4 5 6 7 8 9 10



Facial image used with permission of Re, DeBruine, Jones, and Perrett (2013)

How attractive do you find this face?

1 2 3 4 5 6 7 8 9 10

How dominant do you find this face?

1 2 3 4 5 6 7 8 9 10

How healthy do you find this face?

1 2 3 4 5 6 7 8 9 10

Hormonal Contraception

Hormonal contraception consist of oral contraceptive pills, birth control patches (Ortho Evra), birth control vaginal rings (NuvaRing), birth control implants (Implanon or Nexplanon), birth control shots (Depo-Provera), and hormonal intrauterine devices. Are you currently using hormone-based birth control?

[ ] Yes
[ ] No

Menstrual Cycle

A "regular" menstrual cycle for the average female that is not on birth control, lasts between 28 and 34 days. How regular is your menstrual cycle?

[ ] Usually regular (In the majority of months throughout a year, my period arrives every 28-34 days.)
[ ] Usually irregular (In the majority of months throughout the year, my menstrual cycle is significantly **shorter** or significantly **longer** than 28-34 days.)

According to the best of your knowledge, at what point are you in your current menstrual cycle? (Day one is the first day of your period.)

[ ] **Menstrual/Post-menstrual** (I am on my period/I have just finished my period.): Days 1-9 (28-day cycle); Days 1-15 (34-day cycle)
[ ] **Ovulatory/Mid-cycle** (I am in the middle of my cycle. I expect my next period to arrive in about two weeks.): Days 10-17 (28-day cycle); Days 16-23 (34-day cycle)
[ ] **Post-ovulatory/pre-menstrual** (I expect my next period to arrive in about one week.): Days 18-28 (28-day cycle); Days 24-34 (34-day cycle)
[ ] **Suspected or confirmed pregnancy**
[ ] **Unsure/Other**

The PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way at the moment, that is, how you feel right now.

	Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					

Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
Afraid					

Demographics

Please respond to the following demographic questions, clicking the box beside the appropriate answer or filling in the blank:

What is your gender?

[ ] Male
[ ] Female
[ ] Transgendered

Which of the following best represents your sexuality?

[ ] Heterosexual
[ ] Homosexual
[ ] Bisexual
[ ] Asexual
[ ] Other

What is your age?

Which of the following best represents your ethnic group? (Please check)

[ ] Caucasian
[ ] Asian or Asian American
[ ] Hispanic or Latino/Latina
[ ] Bi- or Multi-Racial
[ ] Black or African-American
[ ] Native American or Alaska Native
[ ] Native Hawaiian or Pacific Islander
[ ] Other (Please list):_____

Relationship Status

How would you describe your current relationship status?

[ ] Single (not currently seeing anyone)

[ ] Single (casually seeing one or more persons, but not in a committed relationship)

[ ] In a non-serious, but committed relationship (only seeing one person)

[ ] In a serious, committed relationship (would describe myself as "in love")

[ ] Engaged to be married

[ ] Married

[ ] Polyamorous (in a committed relationship with more than one person)

[ ] Other

Marriage Intentions

Do you envision yourself getting married in the future?

[ ] Yes
[ ] No
[ ] Undecided
[ ] I am already married

Procreation Preferences

Do you envision yourself having children in the future?

[ ] Yes
[ ] No
[ ] Undecided
[ ] I already have one child or more

What is the total number of children that you would like to have?

[ ] 1
[ ] 2
[ ] 3
[ ] 4
[ ] 5 or more

At what age would you ideally desire to have your first child?

[ ] Younger than 20 years old
[ ] 21-24 years old
[ ] 25-29 years old
[ ] 30-35 years old
[ ] Older than 35 years old

Further Education

At this point in time, do you intend to pursue further education beyond an undergraduate degree (i.e., graduate school, law school, dental school, medical school, etc.)?

[ ] Yes
[ ] No

Post-Graduation Work Plans

At this point in time, do you envision yourself with a full-time (9 a.m.-5 p.m., 40-hour workweek) career after pursuing your education?

[ ] Yes
[ ] No

At this point in time, could you envision yourself as a stay at home mother in the future?

[ ] Yes
[ ] No

At this point in time, could you envision yourself working part-time in an effort to balance career and childrearing responsibilities in the future?

[ ] Yes
[ ] No

Fertility Awareness

Please answer the following fertility awareness questions to the best of your knowledge.

At what age is there a slight decrease in a woman's ability to become pregnant?

(Answer: Between 25-29 years of age)

If a man and a woman regularly have unprotected intercourse during a period of one year, how high is the chance (%) that the woman will become pregnant if she is 25-30 years old?

(Answer: 80-89%)

If a man and a woman regularly have unprotected intercourse during a period of one year, how high is the chance (%) that the woman will become pregnant if she is 35-40 years old?

(Answer: 50-59%)

Institutional Review Board Approval Letter

VirginiaTech

Office of Research Compliance
Institutational Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: March 27, 2014

TO: James Dee Ivory, Kendall Atkins Livick, Robert Gerald Magee, Adrienne Holz Ivory

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: The Proverbial Ticking Biological Clock: A Symbolic TMT Perspective on Mate Perception

IRB NUMBER: **14-355**

Effective March 27, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 2**
Protocol Approval Date:	**March 27, 2014**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.