OVULATION, STIMULUS DISCRIMINATION, AND MATE PREFERENCES

by

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ABSTRACT

Past research has shown that women experience shifts in their mate preferences across their ovulatory cycle. More specifically, during ovulation (the phase of the ovulatory cycle in which conception is possible) women experience a shift in their preferences towards men that express high quality genes such as greater levels of facial masculinity and facial symmetry. These preferences have led researchers to believe that women may be more attuned to traits including masculinity and symmetry during ovulation. We aimed to test this idea by examining whether or not ovulating women were better at detecting subtle differences in facial masculinity and facial symmetry in comparison to when they were not ovulating and in comparison to women taking hormonal contraceptives. A sample of 240 participants will be included in this study consisting of 120 who are naturally cycling and 120 who are taking hormonal contraceptives. Each participant came in to the lab twice, once during high fertility (when conception is possible) and once during low fertility (when conception is not possible). Although data collection is still ongoing, we predict that ovulating women will be able to detect subtle differences in the stimuli reflecting mating cues in comparison to naturally cycling women who are not ovulating and women who take hormonal contraceptives.

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INTRODUCTION

Over evolutionary time, women have adapted mating preferences aiding in their choosiness in order to ensure reproductive success for their offspring (Bateman, 1948). Women have always been the "choosier" sex in comparison to men because of their higher obligatory investment in their offspring (Trivers, 1972). Women have a minimum investment in their offspring of nine months, whereas men's minimum investment is much less. Because of women's large minimum investment in their offspring, it would have been adaptive for women to have developed the ability to discriminate between high and low quality mates in order to ensure they have successful offspring. The current research has aimed to test whether or not women during the ovulatory phase of their cycle are better able to discriminate between differences in masculinity and symmetry in faces, masculinity in gait, and errors in musical pieces. For the purposes of this paper, the focus will remain on women's ability to discriminate between changes in the masculinity and symmetry of faces.

The Female Ovulatory Cycle

The female ovulatory cycle is an average length of 28 days. Women experience a fertile window for approximately 6 days during their ovulatory cycle, the last day ending in ovulation, with fertility peaking 1 – 2 days before ovulation occurs (Thornhill & Gangestad, 2008). The phases that occur throughout each woman's ovulatory cycle include the menstrual phase, follicular phase, ovulation phase, and luteal phase. Each phase of the female ovulatory cycle is marked by changes in hormones. More specifically, females experience a fluctuation in levels of luteinizing hormone and estrogen. Levels of luteinizing hormone and estrogen surge 20 – 48 hours before ovulation occurs, acting as a good indication of when a woman is supposed to ovulate and when the probability of conception is at its highest. The surge in luteinizing hormone

and estrogen is known as the ovulatory phase of the female ovulatory cycle. After ovulation, there is a steep drop in the level of luteinizing hormone, indicating the beginning of the luteal phase of the female ovulatory cycle (Eichner & Temple, 2004).

Preferences for Good Gene Quality

In response to the changes in fertility that occur across the female ovulatory cycle, it has been hypothesized that females have evolved to prioritize mating cues in males that indicate good genes during the ovulatory phase of their cycle. The Ovulatory Shift Hypothesis proposes that women's preferences shift during ovulation towards mating cues that indicate good genetic material for their offspring (Gangestad &Thornhill, 2008). During ovulation, conception is possible, making women's mating decisions more important. According to the good-gene hypothesis, women should seek mates who can provide their offspring with the best genetic material possible in order to guarantee greater reproductive success. Women have to make tradeoffs between the direct and indirect benefits that they could receive from a potential mate. Direct benefits include resources such as investment, time, and financial prospects, while indirect benefits refer to good gene qualities including high levels of testosterone (Eastwick & Finkel, 2008). So, women have to make tradeoffs between men who have high levels of testosterone and good genes and men who have lower levels of testosterone, but would make good parents/investors (Kokko, Brooks, Jennions, & Morley, 2003). Past research has shown that women become more attuned to these indirect benefits during ovulation and that masculinity and symmetry in men's faces serve as cues of high genetic quality (Gangestad, Thornhill & Garver-Apgar, 2010).

Symmetry. Fluctuations in asymmetry indicate the departure of a typical, symmetrical human body indicating negative and lower genetic quality (Rhodes, 2006). Symmetrical

characteristics serve as a good indication for developmental stability and being able to resist mutations during development (Gangestad, Thornhill, & Yeo, 1994), resist negative health outcomes and being able to fight against stressors (Thornhill & Moller, 1997). Humans that are more symmetrical are seen as more attractive and therefore, tend to experience a larger mating pool with greater access to mates (Moller & Thornhill, 1998).

Masculinity. When any organism possesses a genetic trait that is metabolically costly, it is assumed that the organism has good genes because it is able to maintain such costly traits and continue to survive. As such, masculinity reflects high genetic quality and a good overall condition because having more masculine traits can be costlier for men (Wilson, Rogler, & Erb, 1979). Men experience higher levels of masculinity in response to higher levels of testosterone. Prior studies have shown that women who are in short term relationships experience a greater attraction towards men who are more masculine and who possess such higher testosterone levels (Roney, Hanson, Durant, & Maestripieri, 2006).

Mate Preferences During Ovulation

Prior research has provided support for the premises outlined in the Ovulatory Shift Hypothesis and the Good-Gene hypothesis. Females experience a shift in their mate preferences during their ovulatory cycle. More specifically, females are found to prefer men who display mating cues that indicate high genetic quality including the masculinity and symmetry of men's faces. During ovulation, females begin to express a greater interest in the physical attractiveness of males and even tend to experience a greater desire for sexual activity (Gangestad, Thornhill & Garver-Apgar, 2010) (Pillsworth & Haselton 2006). For example, Johnston, Hagel, Franklin, Fink, and Grammer (2001) tested whether or not women's preferences for masculinized faces shift across their ovulatory cycle. The researchers had each participant come in to the lab during

high and low fertility points of their ovulatory cycle. They then showed each participant video morphs of male and female faces and had the participants indicate if the face was an attractive male face, dominant male/female face or a good-father face. The results of this study showed that women prefer more masculinized faces during the days immediately prior to ovulation. Women also tend to be more attracted to exaggerated masculine traits in males when conception is most likely (Penton-Voak & Perrett, 2000). Similar effects have also been found in regards to male facial symmetry. Women become more attracted and pay more attention to facial symmetry in males during the time when conception is possible (Little, Jones, Burt, & Perrett, 2007).

Current Research

The current research aimed to take the prior research findings a step further by using a large sample of participants to test whether or not ovulating women are better at discriminating between low and high quality mates in comparison to when they are not ovulating and their hormonal contraceptive counter parts. More specifically, the purpose of this study is to test women's ability to discriminate between different levels of masculinity and symmetry in faces. Participants' ability to discriminate between the different stimuli was tested during the ovulatory phase of their cycle indicating high fertility and during the luteal phase of their cycle indicating low fertility. Females taking hormonal contraceptives were chosen as a control for this study as they do not experience ovulation. We predict that ovulating women will be better at detecting differences in stimuli reflecting mating cues in comparison to when they are not ovulating and in comparison to women taking hormonal contraceptives.

METHODS

Participants

Although data collection is still ongoing, we plan to recruit 240 female university students to participate in this study. 120 will be naturally cycling women and 120 women will be taking hormonal contraceptives. Participants were recruited via email based off of information from Texas Christian University's prescreen survey and were either awarded course credit or Amazon gift cards for their participation.

Recruitment

Participants who indicated their desire to participate were contacted via phone call in order provide the participants with more information about the study and determine their eligibility by asking them questions about the characteristics of their menstrual cycle and reproductive history. Participants qualified for the study if they were female, if they did not have any form of hormonal disorders, were not pregnant or breast feeding a child and if they were either naturally cycling (not on any form of contraception) or taking a hormonal contraceptive. Females taking hormonal contraceptives were excluded from the study if they were not taking a 1^{st}-3^{rd} generation oral contraceptive, as other forms of hormonal contraceptives do not reliability and consistently prevent ovulation from occurring.

If a participant met these qualifications, the forward counting method was used to schedule their first session. The forward counting method uses the participant's start date of their last period and the length of their ovulatory cycle to estimate which phase of the ovulatory cycle that the participant was in, further determining whether each participant would be scheduled for their high or low fertility session first. Some participants completed their high fertility session

first and their low fertility session second, while others completed their low fertility session first and their high fertility session second.

Procedure

All participants came in to the lab and completed two one hour sessions, once during high fertility and once during low fertility point in their cycles. They were asked to provide informed consent, complete the computer survey and provide a saliva sample during each session. Naturally cycling participants were also asked to complete a urine test each time they entered the lab in order to determine whether or not they were experiencing an LH surge indicating ovulation. If the urinalysis indicated that the participant was in the correct phase of her cycle for her first session, she would proceed with the scheduled session. If the urinalysis for a participant was negative (no LH surge was detected) and it was supposed to be positive (an LH surge was detected) for her first session, the participant would not continue with the scheduled session and instead be asked to continue to come into the lab until an LH surge was detected or would be rescheduled for next month. If the urinalysis for a participant was positive for her first session but it was supposed to be negative, the participant would complete her high fertility session.

At the end of each participant's first session, the forward counting method was used again to determine when their second session would be scheduled. Upon completing a urine test for her second session, if the participant was in the correct phase of her ovulatory cycle, she would complete the session. If the urinalysis for the second session indicated that the participant was in the wrong phase of her cycle, the participant would be rescheduled to come in during their next ovulatory cycle. Each participant in this study was also asked to provide a saliva sample

during each session. These samples were stored in a -80 degrees' freezer for later hormonal analysis not central to the focus of this paper.

Participants taking hormonal contraceptives followed the exact same procedure as naturally cycling participants. They were asked to come in to the lab two times (once for each session) and completed the same computer survey during each session. Women taking hormonal contraceptive were not asked to complete urine tests because they do not ovulate and therefore do not experience a surge in their luteinizing hormone.

Each participant had the option to receive SONA credit, which could be used as extra credit towards their classes, or Amazon gift cards for their participation. Naturally cycling women were given greater compensation because they came in to the lab more often in order to complete their urine tests. Participants taking hormonal contraceptives were offered either course credit or $20 in Amazon gift cards. Naturally cycling women were offered either course credit or $30 in Amazon gift cards. Each participant received partial compensation and was partially debriefed at the end of their first session. Once the participant completed both sessions and were fully compensated, they were given a full debriefing of the study and thanked for their participation.

Materials

LH Ovulation Midstream Urine Test. The naturally cycling participants were asked to complete the LH Ovulation Midstream Urine test that was ordered off of www.meditests.com each time they entered the lab. The LH Ovulation Midstream Urine test was chosen for this study because of its ability to detect the presence of luteinizing hormone (LH) in urine. Research has shown that women experience a surge in luteinizing hormone immediately prior to ovulation.

Therefore, whether or not LH was present in a participant's urine provided an indication as to whether or not participants were in the ovulation phase of their ovulatory cycle.

Before entering the lab, each naturally cycling participant was asked not to urinate or drink an excessive amount of fluid for up to four hours before the urine test in order to prevent the urine test from showing invalid results. Upon entering the lab, the participant was reminded that the urine test would only be testing for normal fluctuations in body chemistry and would not be testing for pregnancy, disease, or drug use. Participants were asked to provide informed consent and then were given directions on how to complete the urine test. The participants took the urine test according to the manufacturer's recommendations. Once the urine test was complete, the researcher would ask the participant to wait for her results, which would determine whether or not she would complete her session that day.

The results of the urine test were read approximately 5-7 minutes after the test was completed. Urine tests were considered positive if the testing line was the same color or darker than the reference line. Positive results indicated that participants had high levels of luteinizing hormone in their urine, were in the ovulation phase of their ovulatory cycle and could complete their high fertility session. Negative results with a test line that was only slightly lighter than the reference line were rescheduled to come in within the next two days because these results indicated that the participant had some luteinizing hormone in her system and would therefore, possibly reach the ovulation phase of her cycle within the next couple days. Negative results with test lines that did not appear or were very light indicated that participants had little to no luteinizing hormone in their urine, were past the ovulation phase of their ovulatory cycle and could complete their low fertility session. Results were considered invalid if the reference line

did not appear and participants were asked to return later that day or the next day to complete another urine test.

The surge of luteinizing hormone in urine occurs briefly, 24-48 hours prior to ovulation, making the process of detecting such spikes in LH a specific and difficult process. Therefore, participants often had to come in to the lab multiple times before a positive urine test to be detected. Because of this specificity, if a participant had not completed their high fertility session and their urine test was positive, that participant would complete their high fertility session.

Tasks

The study was conducted in a lab via computer and included tasks to assess whether or not women were able to detect differences in masculinity and symmetry in men's faces, masculinity in men's gait, and errors in music across their ovulatory cycle. Although all three variables were included in the study, this paper will only focus on the facial discrimination tasks.

After providing informed consent and their saliva samples, participants completed a computer survey that included various questions about their demographics, ovulatory cycle, reproductive history, relationship status, as well as various facial discrimination tasks that determined whether or not the participants were able to detect subtle differences in facial masculinity and facial symmetry. Each face used in the morphs for this study had been pre-rated as either average or attractive by independent raters.

Changing Face Task. For the changing face task, participants were shown videos of different morphs that were each 15 frames per second and were instructed to click on the screen if they saw a change. The time passed before the participant clicked on the screen was used in order to measure their ability to detect a change in the stimulus. Participants were then asked to indicate how certain they were that there was a change in the face they had just viewed (7-point

scale; 1 = *I don't think there was a change,* 4 = *There may have been a change,* and 7 = *I am certain there was a change*). It is expected that ovulating women will have a lower mean reaction time for the videos of male morphs and should have the same mean reaction time as non-ovulating women and women taking hormonal contraceptives in response to all of the other videos included in the changing face task.

Symmetry. The ability for women to discriminate between different levels of symmetry in men's faces was tested by morphing pictures of average faces and attractive faces together using the Fantamorph software (Cheetham, Suter, & Jancke, 2014). An average asymmetrical face and attractive symmetrical face were morphed together in order to create differences in facial symmetry, while maintaining the normal characteristics of a realistic looking face. Three different morphs were included in this portion of the study, one morph was of an average male face morphed into an attractive male face, another morph was of a different average male face morphed into a different attractive male face and the final morph was of an average female face into an attractive female face. A video of each morph was shown to the participants in random order.

Masculinity. The ability for women to discriminate between different levels of masculinity in men's faces was tested by morphing an attractive male face into an attractive female face using the same Fantamorph software. An attractive male face was used as opposed to an average male face in order to prevent the facial morph from becoming more feminine and more symmetrical in the same stimulus. Additionally, morphing an attractive male face into an attractive female face would allow the face to become less masculine, while maintaining the characteristics of a realistic looking face for this task as well. Three different morphs were included in this portion of the study, an attractive male face morphed into an attractive female

face, a different attractive male face morphed into the same attractive female face and the same female morph used for the symmetrical stimuli. A video of each morph was shown to the participants in random order.

Control Stimuli. The female face morph was included in this study as a control because women are not utilizing the same mating cues when looking at a female face in comparison to when they are looking at a male face. Participants were also shown videos of the unchanging original average and attractive male faces to ensure participants were complying with study procedures and waiting to make a response until they saw a change. A video morph of an orange into a lemon was also included in this portion of the study in order to test whether or not women's ability to discriminate between differences in stimuli during ovulation is specific to mating cues as opposed to being generalized to all stimuli.

Forced Choice Task. The ability to detect subtle symmetrical and masculine changes in faces was also tested using a forced choice task. Two pictures positioned next to each other were shown on the screen and participants were asked to click on the picture that they found more attractive. Participants then reported how strongly they felt about their choice (7-point scale; 1 = *Not at all strongly,* 4 = *Neutral,* and 7 = *Very strongly*). Participants also reported how different they thought the two pictures were (7-point scale; 1 = *Not at all different,* 4 = *Neither the same nor different,* and 7 = *Very different*). Participants completed seven trials for each morph, comparing the original face to faces that were morphed 0% to 30%, shown in 5% increments. The participant's ability to accurately determine which faces were different was used to measure their ability to discriminate between different levels of facial symmetry and masculinity. The strength of the participant's preference for more symmetrical and more masculine faces was also measured by asking the participant to indicate which picture they found more attractive. It is

expected that ovulating women will be more likely to indicate the more masculine and symmetrical men as more attractive and will be better detecting a difference between the stimuli.

Symmetry. The ability for women to discriminate between different levels of symmetry in men's faces was tested by using the same morphs created for the changing face task. An average asymmetrical face and attractive symmetrical face were morphed together in order to create differences in facial symmetry, while maintaining the normal characteristics of a realistic looking face. Two different morphs were included in this portion of the study, one morph was of an average male face morphed into an attractive male face and the other morph was of a different average male face morphed into a different attractive male face. The average asymmetrical faces acted as the original faces that were shown in comparison to the partially morphed faces for the forced choice task.

Masculinity. The ability for women to discriminate between different levels of masculinity in men's faces was tested by using the same morphs created for the changing face task. An attractive male face and an attractive female face were morphed together in order to create differences in masculinity, while maintaining the normal characteristics of a realistic looking face for this task as well. Two different morphs were included in this portion of the study, an attractive male face morphed into an attractive female face and a different attractive male face morphed into the same attractive female face. The attractive symmetrical faces acted as the original faces that were shown in comparison to the partially morphed faces for the forced choice task.

Control Stimuli. A morph of two different shades of blue (a darker shade morphed into a lighter shade) and two spot the difference tasks were included in this portion of the study to also

test whether or not women's ability to discriminate between differences in stimuli during ovulation is specific to mating cues.

EXPECTED RESULTS

Data collection is still ongoing, however, the results are expected to show that ovulating participants will be better at detecting subtle difference in masculinity and symmetry in men's faces in comparison to when they are not ovulating and their hormonal contraceptive counterparts. This study was composed of a 2 (naturally cycling vs. oral contraceptive) x 2 (high fertility vs. lower fertility) within subject's design. Once the study is complete, we plan on analyzing our data using a 2 by 2 mixed model ANOVA. More specifically, we expect the results to show that ovulating women are better at performing tasks involving male morphs because they are utilizing mating cues when completing these tasks. We expect ovulating women to have a lower mean reaction time to the changing face tasks and expect ovulating women to have a higher success rate at determining which faces are different in the forced choice task. Furthermore, we expect that ovulating women will have a stronger preference towards the more masculine and symmetrical male faces in the forced choice task in comparison to non-ovulating women and women taking hormonal contraceptives. We also expect that all women should be able to perform equally well on each of the control tasks because women do not utilize the same cues in response to general stimuli as they do not involve mating cues. Lastly, we expect to find a larger effect in ovulating women's ability to detect subtle differences in stimuli as opposed to larger differences because all women should be more attracted to masculine and symmetrical male faces, but ovulating women should be more attuned to mating cues and therefore should be able to pick up on subtle differences that other women are unable to detect.

DISCUSSION

One important limitation arose in regards to reading the urine tests because they often provided ambiguous results. In accordance with the manufacturer's instructions, a urine test would be positive if the test line was the same color or darker than the reference line. This created a limitation because it was often hard to tell whether or not the lines were the same color. We will be addressing this limitation by using the saliva samples to test for levels of estradiol to determine if these levels correlate to the changes in each participant's ability to discriminate between stimuli.

Another important limitation of this study was that participants completed their low fertility session during the luteal phase of the ovulatory cycle. During the luteal phase of a female's ovulatory cycle, estrogen levels are still relatively high. Alternatively, participants could have completed their low fertility session during the follicular phase of a female's ovulatory cycle when estrogen levels are low. If estrogen is a mediating factor when determining women's ability to discriminate between differences in stimuli reflecting mating cues, then testing participants during the follicular phase may have been a better option. When creating the study, we chose to have participants complete their low session during the luteal phase of their ovulatory cycle because this is what has been done in past studies and there are several confounds that could occur while using the follicular phase including shifts in women's attitudes in response to hormonal changes.

One way to address this limitation in future research would be to repeat the study design but to include a subgroup of participants who complete their low fertility session during the follicular phase of their ovulatory cycle in order to determine if estrogen may play a role in women's detection abilities. Furthermore, it may also be beneficial to test how other common

forms of hormonal contraceptives such as the patch, Depo-Provera, or IUDs impact women's mate preferences across their ovulatory cycle and their ability to detect subtle differences in masculinity and symmetry in men.

The findings of this study will lead to better informed research on women's shifts in mate preferences across their ovulatory cycle and will determine if these shifts are driven by shifts in their ability to detect subtle differences in mating cues that emphasize good gene quality. The findings will also allow us to assess the impact of hormonal contraceptives on detecting differences in mating cues. If the hypothesized effects emerge, our findings will be consistent with the general literature of women's mate preferences across their ovulatory cycle. Our findings will also add to the literature by going beyond was has been found in past studies and adding that women also have a shift in their ability to detect differences in mating cues while using a larger sample size and LH testing as opposed to smaller sample sizes and the reliance on the counting method included in past studies.

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