An Eye Tracking Examination of Men’s Attractiveness by Conceptive Risk Women

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Abstract
Previous research has indicated that women prefer men who exhibit an android physical appearance where fat distribution is deposited on the upper body (i.e., shoulders and arms) and abdomen. This ideal physical shape has been associated with perceived dominance, health, and immunocompetence. Although research has investigated attractability of men with these ideal characteristics, research on how women visually perceive these characteristics is limited. The current study investigated visual perception and attraction toward men in Hispanic women of Mexican American descent. Women exposed to a front-posed image, where the waist-to-chest ratio (WCR) and hair distribution were manipulated, rated men’s body image associated with upper body strength (low WCR 0.7) as more attractive. Additionally, conceptive risk did not play a strong role in attractiveness and visual attention. Hair distribution did not contribute to increased ratings of attraction but did contribute to visual attraction when measuring total time where men with both facial and body hair were viewed longer. These findings suggest that physical characteristics in men exhibiting upper body strength and dominance are strong predictors of visual attraction.

Keywords
attraction, sexual selection, conceptive risk, eye tracking

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Men’s physical characteristics (e.g., broad shoulders, v-shaped torso, and body hair) have often been considered attractive and visually appealing to women in mate choice (Hughes & Gallup, 2002; Maisey, Vale, Cornelissen, & Tovee, 1999; Rantala, Polkki, & Rantala, 2010). These physical characteristics have been referred to as the android shape pattern, which is comprised of having more fat distribution in the upper part of the body (e.g., shoulders, arms, and neck), in contrast to women whose fat distribution (i.e., gynoid shape) is concentrated in the lower region of the body (Singh, 1993). Previous studies have found the android shape pattern in men to be associated with increased testosterone, masculinity, perceived dominance (Dijkstra & Buunk, 2001; Singh, 1994), and immunocompetence (B. J. Dixson, Grimshaw, Ormsby, & Dixon, 2014; Lassek & Gaulin, 2009), whereas body hair has been associated with masculinity (B. J. Dixson & Brooks, 2013; Neave & Shields, 2008), dominance (Neave & Shields, 2008; Sherlock, Tegg, Sulikowski, & Dixson, 2016), and aggressiveness (Dixon & Vasey, 2012). In men’s attraction, a v-shaped torso is measured by using the waist-to-chest ratio (WCR), where lower WCRs are perceived as more attractive. However, a limited amount of research (Little, Jones, & Burris, 2007) has explored whether there exist physical preferences in visual perception in conceptive risk women. Conceptive risk or fertile women have shown differences in scent (Thornhill & Gangestad, 1999), preferences for certain facial features (Penton-Voak & Perrett, 2000), body hair preferences (B. J. Dixson & Rantala, 2016; Rantala et al., 2010), and masculinity (Gildersleeve, Haselton, & Fales, 2014a), to name just a few. This study examines women’s visual perception by recording eye movements to investigate how conceptive risk women make intuitive judgments of men’s attraction. By using eye tracking methodology, objective and precise recordings can be made to determine specifically where women look when viewing men’s bodies and whether conceptive risk predicts changes in visual perception.

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Physical Preferences and Attraction

Some physical characteristics (e.g., broad shoulders, v-shaped torso, body hair) in men have been perceived as salient by women due to their importance in reproductive success. One physical difference between the sexes is that men have more fat distribution toward the upper part of the body, whereas fat distribution in women is centralized in the waist and hips (Singh, 1994). Additionally, men, on average, have greater muscularity than women (Barber, 1995), which could have provided women with protection and security and afforded men a greater advantage in hunting and intrasexual competition (Buss & Schmitt, 1993). This perceived difference in men’s bodies has been associated with advantages in fitness (e.g., good health, masculinity; Singh, 1994) and dominance (Dijkstra & Buunk, 2001). Previous research by A. Dixson, Halliwell, East, Wignarajah, and Anderson (2003) suggests that women prefer specific physical features in men, such as muscularity. In their study, women were more likely to rate mesomorphic (muscular) men as most attractive, as compared to ectomorphic (thin) and endomorphic (heavily built) men. A. Dixson et al. (2003) suggest that women prefer men with upper body strength because mesomorphy is an indicator of optimal fitness, in contrast to endomorphic features which are associated with poor health symptoms.

One physical feature that has been associated with attraction in men is a v-shaped torso. This torso configuration indicates broad shoulders relative to the waist and hips (Hughes & Gallup, 2002), features considered ideal in women mate preferences. Men exhibiting this body profile have shown differences in sexual activity, mate competition, and overall perceived levels of attraction. Hughes and Gallup (2003) found that men with higher shoulder-to-hip ratios (SHRs), which indicate upper body strength, had more sexual partners, earlier sexual experiences, and more extra-pair copulations. Dijkstra and Buunk (2001) have shown that men who exhibited SHRs induced higher levels of jealousy in same-sex rivals. This was primarily more salient in younger men in comparison with older men, indicating the importance of intrasexual competition. In measuring waist-to-shoulder ratios, Braun and Bryan (2006) found that women rated men who had a “manly” physical appearance as more attractive and desirable for a first-time sexual encounter. Additionally, WCR has also been a physical characteristic perceived as attractive by women. A low WCR (0.7) is considered attractive because it represents upper body strength and muscularity, consistent with having broad shoulders and a narrow waist (Maisey et al., 1999; Swami & Tovee, 2005; Swami et al., 2007). Interestingly, A. Dixson et al.’s (2003) findings revealed that low waist-to-hip ratios (WHRs) and waist-to-shoulder ratios were rated as more attractive in mesomorphs but not in other men with thin or over-weight body shapes.

Hair distribution is a salient secondary sexual characteristic that has shown to increase the perception of men’s dominance, aggressiveness, maturity, attractiveness (B. J. Dixson & Brooks, 2013; B. J. Dixson & Rantala, 2016; B. J. Dixson & Vasey, 2012; Neave & Shields, 2008), and social status (B. J. Dixson & Brooks, 2013; B. J. Dixson & Rantala, 2016; Neave & Shields, 2008). A. Dixson et al. (2003) examined the extent to which body hair predicted attraction in men with different somatotypes. Using British and Sri Lankan women, body hair was found to be attractive in both mesomorphs and endomorphs; however, subjective ratings were higher for muscular men. In other work, B. J. Dixson, Dixson, Morgan, and Anderson (2007) showed that body hair could be a culturally salient physical feature. Moreover, using a Chinese sample, B. J. Dixson et al. (2007) found that women preferred men who were either cleanly shaven or showed little body hair. In research looking at clean-shaven versus full-bearded men, full-bearded men are perceived as being less attractive and increasing in aggressiveness, social status, and age. Neave and Shields (2008) showed that facial hair or beardedness increased the level of dominance and masculinity, in comparison with clean-shaven men. Variation in facial hair, such as light stubble, dark stubble, and full beard, also affects the direction of perceived attractiveness. Clean-shaven, light-stubbly, and dark-stubbly men are often rated as most attractive, while men who display full beards are rated as less attractive, more aggressive, and more masculine (B. J. Dixson & Brooks, 2013; B. J. Dixson & Rantala, 2016; Neave & Shields, 2008).

Conceptive Risk in Mate Preferences

Women’s preferences for men’s attractiveness are predicted by the different phases of their menstrual cycle, thereby increasing the probability of conception (e.g., the follicular phase, Days 6–14; Baker & Bellis, 1995; Rantala et al., 2010; Regan, 1996; Thornhill & Gangestad, 1999; Wilcox, Dunson, Weinberg, Trussell, & Baird, 2001). If there are perceived fitness advantages to women’s future offspring, one would predict that women would be selective to phenotypical traits that advertise good genes (e.g., symmetry, muscularity, and masculinity), especially during the most fertile phase of the menstrual cycle. Thornhill and Gangestad (1999) used fertility risk as a predictive measurement in preferences for men’s traits. Based on their increased probability of conception, women were classified into “high fertility risk” (probability risk = .16–.39) and “low fertility risk” (probability risk = .01–.11). The probability of fertility is at least .15 during Days 6–14 of the menstrual cycle (Gangestad et al., 2016). Thornhill and Gangestad found that high fertility risk women preferred the body scent of symmetrical men, in contrast to nonovulating women who did not indicate such a preference. Penton-Voak and Perret (2000) investigated the role that conceptive risk plays in preferences for masculine faces. In puberty, testosterone is linked to the growth of secondary sexual characteristics (e.g., prominent brow ridges and cheekbones), which are considered attractive due to their advertisement of immunocompetence. In a study using manipulated images to represent fluctuating levels of masculinity and femininity, high conceptive risk women were more likely to find masculine faces more attractive than women in the menses and luteal phases of the menstrual cycle. These
findings suggest that women prefer masculine physical characteristics that advertise immunocompetence during those phases in the menstrual cycle that increase their probability of conception (Penton-Voak & Perret, 2000). Other research (e.g., Little et al., 2007) examining preferences for masculinity across the menstrual cycle found that women preferred masculinity in men when conceptional risk was high, especially during the follicular phase of their menstrual cycle. More recently, a meta-analytic study (Gildersleeve et al., 2014a) showed clear support for women’s preferences for characteristics reflecting genetic quality (e.g., masculinity and dominance) across cyclic shifts in high-fertile days as compared to low-fertile days.

Rantala, Polkki, and Rantala (2010) examined the role that conceptional risk plays in preferences for body hair in men. In sexually mature men, body hair varies considerably as some men are completely hairless while others are hairy. Although body hair can be completely removed, it is not known whether there are certain preferences in body hair or whether women find body hair visually appealing, especially during cyclic changes. In the study by Rantala et al. (2010), women were divided into groups associated with specific phases of the menstrual cycle and menopausal states (e.g., fertile phase, nonfertile phase, premenopausal, and postmenopausal) to determine whether conceptional risk resulted in differences in body hair preferences. Overall, women seemed to prefer men who were cleanly shaven, consistent with previous findings indicating cultural variations in body hair preferences (B. J. Dixon, Dixson, Morgan, & Anderson, 2007). Furthermore, women who were in the fertile phase of the menstrual cycle were more likely to prefer nonhairy men than women in the nonfertile phase. Recent research has looked at the effect that beardedness has on perception of men among conceptional risk women (Dixson, Tan, & Awasthy, 2013). Women with higher potential fertility rate men with heavy stubble as more attractive, and low conceptional risk women rate clean-shaven men as more attractive; however, these results were not statistically reliable. In a follow-up study, B. J. Dixon and Rantala (2016) did not find differences between conceptional risk and preferences for beardedness and body hair.

**Eye Movements in Mate Preferences**

The use of eye tracking methodology in evaluating attraction provides a unique opportunity to inspect what individuals find visually appealing when viewing the human body (see, e.g., B. J. Dixon et al., 2011; Garza, Heredia, & Čiščiška, 2016). One important advantage of eye tracking is that it is a sensitive gaze-contingency technique that measures where and when (in milliseconds) people look at stimuli (Garza et al., 2016). Experiments on visual perception reveal that the amount of time spent on specific areas of the human body indicates/is an index of attraction (Fink et al., 2008; Langlois et al., 1987; Maner, DeWall, & Gailliot, 2008) and that stimuli considered sexual or erotic receive longer fixation times if they depict content of the opposite sex (Lykins, Meana, & Kambe, 2006). Others (e.g., Rupp & Wallen, 2007) have found gender differences in visual attraction, where men spend longer times viewing women’s faces and normal cycling women spend more time viewing men’s genitals. Eye movements provide a rich amount of information about visual perception and can be used successfully to find the early- and late-stage (i.e., strategic) responses to images of the human body. In evaluating visual attraction, eye movement measurements (e.g., first fixation and gaze duration) provide insights into early stages of visual information processing. First fixation duration refers to the amount of time spent on a region of interest (ROI) the first time it was viewed. Gaze duration is the sum of all fixation durations made within an ROI. Other measurements such as total time, fixation count, and visual regressions provide insight into late stages of visual processing and allow determining where and how long participants consciously look at appealing areas (Dixson et al., 2011; Garza et al., 2016). In measuring total time, the amount of time (in milliseconds) is recorded for each image. Fixation count refers to the number of times participants fixate on an ROI (e.g., measured when a given fixation lasts more than 50 ms). Visual regressions refer to the average number of fixations that return to a previously fixated area.

Overall, research on eye tracking investigating mate preferences has focused primarily on the visual attention of men viewing women. Eye movement research in mate preferences has highlighted visual differences in where individuals look, suggesting that longer viewing time is associated with attention to a particular ROI (Fink et al., 2008). Suschinsky, Elias, and Krupp (2007) asked men to rate the level of attractiveness of a woman’s body, in addition to measuring their visual movements while manipulating WHR. Men rated women’s bodies with the lowest WHR as more attractive, made more visual fixations, and spent the most amount of visual time on images that included those physical characteristics. The woman’s body was divided into ROIs that included the head, chest, waist/hips, and legs. Suschinsky et al. (2007) showed that most of the visual attention was focused on the upper parts of the woman’s body (i.e., head, breasts, and waist/hips) due to their perceived importance in reproductive relevance. Dural, Cetinkaya, and Gulbertekin (2008) presented participants with images displaying different physical characteristics (i.e., WHR and body weight). ROIs were also created to measure the particular area receiving the most amount of visual attention. Results revealed that men looked at the midriff and breasts longer than at other areas of the woman’s body (e.g., legs/feet). Dixson et al. (2011) manipulated WHR in a woman’s image and measured visual attention by ROI (i.e., head, chest, midriff, groin, thighs, and legs/feet). Similar to Suschinsky et al. (2007), participants found lower WHRs as more attractive, while visual attention was focused on the upper part of the woman’s body. A variety of visual measurements (e.g., first fixations, gaze duration, dwell time, and fixation count) demonstrated that men focused most of their visual attention on the so-called reproductive relevant areas (i.e., breasts and midriff area of the woman’s body). These areas are hypothesized to serve as important cognitive cues to a woman’s potential reproductive success and hence are likely to be fixated on longer by men. Most recently,
Garza, Heredia, and Cieślicka (2016) showed that men do focus most of their visual attention on the upper part of the body. Participants rated attractiveness of women’s images while their eye movements were recorded. Eye movements revealed that when participants rated a woman’s image as attractive, they spent more time viewing the image than when they rated the woman’s image as unattractive. Consistent with previous findings (e.g., Dixson et al., 2011; Suschinsky et al., 2007), Garza et al.’s (2016) results showed that men made more fixations on the breasts and midriff areas and spent more time (i.e., gaze duration) on those ROIs.

There have been a few studies examining men’s attractiveness and visual attention by women. Fan, Dai, Liu, and Wu (2005) looked at visual perception of men’s body attractiveness in a sample of Chinese women. Chinese and Caucasian men were scanned to obtain a 3-D image of their entire body and different biometric measures were used as predictors of attractiveness (e.g., volume height index [VHI], WCR, and WHR; see, e.g., Maisey et al., 1999; Singh, 1995). Results showed that lower WCR strongly predicted men’ attractiveness and was considered the most important element when compared to VHI and WHR. Other findings suggested VHI as well as WHR to be strong predictors of attractiveness. The optimal WHR was 0.8, similar to Singh’s (1995) finding of 0.9. Both findings from Fan et al. (2005) and Singh (1995) suggest that smaller waist in men is a preferred physical attribute, which may represent the appearance of a v-shaped torso and a reduction in body fat.

In line with the current study, B. J. Dixson, Grimshaw, Ormsby, and Dixson (2014) used eye tracking to record women’s perception of men’s back-posed images. In B. J. Dixson et al.’s (2014) study, men’s somatotypes (i.e., mesomorph, ectomorph, and endomorph) were used as predictors of visual attention. The images used in this study were divided into seven ROIs which were the head, upper back, arms and hands, lower back, buttocks, thighs, and lower legs/feet. For attractiveness, women rated the mesomorph (i.e., muscularity) as most attractive. Moreover, women’s eye movements were distributed across somatotypes in terms of visual fixations and dwell time. Interestingly, mesomorphs received more visual fixations and dwell time on the upper back of the body, suggesting that women make a visual assessment of the v-shaped body type (B. J. Dixson et al., 2014). In contrast, endomorphs (i.e., heavily built) received more visual fixations and dwell time on the lower back of the body, revealing that the waist provides information as to the fitness of the man.

Few studies have investigated women’s visual attention to men’s physiques while manipulating physical characteristics important in attraction, such as WCR. Most research in men’ attractiveness has focused primarily on physical characteristics (i.e., WHR, WCR, and Hair) and their individual effects on attractiveness. To our knowledge, no other research has looked at men’ physical attractiveness as perceived by conception risk women and measured by eye movements. In this study, we follow Swami and Tovee’s (2005) and Maisey, Vale, Cornelissen, and Tovee’s (1999) procedures to investigate the relationship between v-shaped body type and WCR. Since research on the v-shaped body type has consistently found that broad shoulders and small waist sizes are more attractive, we predict that men who have lower WCRs and classified as a 0.7 will be rated as most attractive. In relation to body hair, we predict that women will find hairless men most visually appealing (see, e.g., B. J. Dixson et al., 2007; Rantala et al., 2010).

Given the relationship between conception risk and perceptions of attractiveness, we examine the extent to which women might have specific visual preferences when viewing a man’s front-posed image as conception risk probability increases. We predict eye movement differences where all will show an attentional bias toward the upper part of the man’s body, due to its association with strength and dominance. We also expect differences in eye movements when comparing conception risk women, where increases in conception risk probabilities will more likely show more visual attention to specific regions of the man’s body (i.e., head, chest, and midriff). Therefore, as fertility risk increases, women will show an attentional bias to those ROIs. Consistent with previous research on hair distribution in the perception of men (B. J. Dixson & Vasey, 2012), we predict that hairless men will be rated as more attractive and receive the most visual attention. To our best knowledge, this is the first study to examine eye movements in the perception of men’s attractability by conception risk women. In addition, we expand on previous research (Dixson et al., 2014) on eye movements in image processing and the extent to which physical characteristics (i.e., WCR and hair distribution) are salient in rating men’s attractability.

**Method**

**Participants**

One hundred and twenty-five Hispanic women ($M = 23.15, SD = 5.65$) of Mexican American descent from Texas A&M International University participated in the experiment. Participants received class credit or volunteered for the experiment. Twenty-four participants were unable to provide accurate information about their menstrual cycle, three participants had long menstrual cycle lengths (i.e., over 35 days), five participants used contraception, and three participants did not respond to the question asking about their menstrual cycle. The resulting sample size was 90 women, aged 18–38 ($M = 22.12, SD = 3.59$), with menstrual cycles ranging from 25 to 35 days.

**Materials**

A color photograph of a full front-posed young Caucasian man in his early 20s was taken from an online source. Consistent with previous research on men’s attractiveness (Fan, Dai, Liu, & Wu, 2005; Price, Pound, Dunn, Hopkins, & King, 2013; Swami & Tovee, 2005), the only part of the body that was covered was the groin (e.g., black underwear). Using Adobe Photoshop CS6, Version 13.0.1.1, the image’s waist was manipulated by either making the waist smaller or larger in comparison with the chest. The resulting images were men
from the chin rest to the computer screen was 55 cm. Experi-
ences Dixson et al. (2011) and Garza et al. (2016); the distance
setup of the eye tracker and computer used the same procedure
were monocular (i.e., only the right eye was recorded). The
participants’ eye movements. Visual recordings on the eye tracker
were given oral instructions on how to proceed with the experi-
ment. Visual calibrations and validations were done first to
being .10.

WCR and hair. Images were separated into six ROIs, which
included the following: (1) the face and neck, from the top of
the head to the clavicle; (2) the chest, as measured from the
clavicle to the border of the bottom of the chest; (3) the midriff,
which included the waist and extended from the bottom of the
chest; (4) the groin, which encompassed the pubic area; (5) the
thighs, beginning at the end of the midriff border to the knee;
and (6) the legs and feet. The images were entered into the SR-
Experiment Builder and altered to meet the requirements for
clear viewing. Images were 783 × 1,599 pixels, and the bit
depth was set at 24.

**Procedure**

Upon consent, participants were asked to complete a short
menstrual cycle questionnaire which asked, (1) “Are you on
any type of contraceptive pill or medication?” (2) “Please
select the first day of your last menstrual cycle” and (3) “Please
specify the typical length (in days) of your menstrual cycle.” A
female research assistant was available to answer any of the
questions pertaining to the participant’s menstrual cycle. Con-
ceptive risk was determined by using the likelihood of concep-
tion mean probability values provided by Wilcox, Dunson,
Weinberg, Trussell, and Baird (2001, p. 213). Mean probability
value is the likelihood of conception with a single act of inter-
course based on a woman’s day of her menstrual cycle. Accord-
ingly, Day 7 has a mean probability of conception of .01, while
Day 13 has a higher mean probability (.08) of conception. As
argued by Gangestad et al. (2016), continuous measures of
conceptive risk outperform discreet ones (i.e., high vs. low
conceptive risk). In line with Zaadstra et al. (1993), women
who had menstrual cycle lengths between 25 and 35 days were
used as our sample. The average conceptional risk probability
was $M = .03, SD = .02$, with the highest probability of con-
ception being .10.

Before participants were given on screen instructions, they
were given oral instructions on how to proceed with the exper-
iment. Visual calibrations and validations were done first to
ensure that the eye tracker was adequately measuring the par-
ticipants’ eye movements. Visual recordings on the eye tracker
were monocular (i.e., only the right eye was recorded). The
setup of the eye tracker and computer used the same procedure
as Dixson et al. (2011) and Garza et al. (2016); the distance
from the chin rest to the computer screen was 55 cm. Experi-
mental stimuli were presented using the SR-Experiment
Builder running Windows OS 7. The Eye Link 1000 (1,000
Hz) eye tracker was controlled using a host computer running
DOS. A Microsoft Sidewinder Plug and Play Gamepad was
used to make ratings of attractiveness. Participants were
instructed to use the left D-pad to proceed from picture to
picture. As in Garza et al. (2016), the left trigger of the game
pad was designated as a no (not attractive) and the right trig-
ger as a yes (attractive) rating. There was no time limit set for
the images. In total, 12 images were shown for each individual
session, and each session’s images were randomized. After
the experiment, participants rated the experimental images in
relation to attractiveness, where $1 = \text{not attractive}$, $2 = \text{slightly attractive}$, $3 = \text{moderately attractive}$, $4 = \text{attractive}$,
$5 = \text{very attractive}$, and $6 = \text{extremely attractive}$. This second
phase of the study was done on an iMac running OpenSesame
Experiment Builder (Mathôt, Schreij, & Theeuwes, 2012).

We measured the following eye movements: first fixations
(e.g., the first ROI that was fixated on), first fixation duration
(e.g., the amount of time spent on the ROI that was first fixated
on), gaze duration (measured by the sum of all fixation dura-
tions made within an ROI), total time (measured by the amount
of time participants spent on each image), fixation count (num-er of fixations made on an ROI measured), and visual regres-
sions (measured by the amount of time participants regressed
back to an ROI). Data Viewer version 1.7 was used to analyze
the visual recordings from the Eye Link 1000.

**Results**

**Attractiveness**

A logistic regression using WCR (0.7, 0.8, 0.9), hair (hairless,
facial, chest, facial/chest), and conceptive risk as predictor
variables was conducted to determine the likelihood of rating
the man’s image as attractive. A logistic regression was used
due to the binary nature of the ratings (yes/no) that women
made when evaluating the man’s attractiveness. We used the
highest WCR as the reference category, since previous research
has shown that women find men with low WCR as more attrac-
tive (Hughes & Gallup, 2002; Swami & Tovee, 2005). The
analysis was statistically significant, $\chi^2 = 1,220.54$, $p < .001$.
Women were 13 times more likely to rate the 0.7 WCR as
attractive and 7 times more likely to rate the 0.8 as attractive.
For hair distribution, it has been shown that hairless body types
are considered more attractive (B. J. Dixson et al., 2007;
Rantala et al., 2010); therefore, we used the image that had
both facial and chest hair as a reference category. All hair
distribution types were almost 2 times as likely to be rated as
attractive when compared to images that had both facial and
chest hair. Conceptive risk did not significantly increase the
likelihood of rating the image as attractive. Results for the
logistic regression are described in Table 1.

A 6-point Likert-type scale was used to measure the ratings
of attractiveness using WCR and hair as predictor variables and
conceptive risk as a covariate. (Throughout the analyses, if the
covariate is statistically significant, it is followed by additional
linear regression models.) Data were analyzed using IBM SPSS V.20 linear mixed effects (LME) models with fixed (i.e., WCR and hair) and random effects (i.e., images and subjects) and conceptional risk as a covariate. The model conformed to a 3 (WCR: 0.7, 0.8, and 0.9) × 4 (hair: hairless, facial, chest, and body) design. LME models revealed that the covariate conceptional risk was significantly related to attraction, $F(1, 1056) = 9.63, p = .002$. Further analysis utilizing a linear regression revealed that conceptional risk was a weak predictor of attractiveness, $F(1, 1102) = 6.53, p = .01, \beta = .07$. There was a significant main effect for WCR, $F(2, 1056) = 128.84, p < .001$. Follow-up multiple comparisons showed that low WCR (0.7), $M = 4.24, SD = 1.65$, was rated as the most attractive in comparison with the 0.8 WCR, $M = 3.08, SD = 1.60, t(1056) = 10.45, p < .001$, or the 0.9 WCR, $M = 1.53, SD = 1.14, t(1056) = 24.45, p < .001$. The main effect for hair and the interaction between WCR and hair did not reach significance, $F < 1$.

### Table 1. Logistic Regression Analysis for Ratings of Attractiveness.

|            | B    | SE β | Wald  | df | Exp(β) |
|------------|------|------|-------|----|---------|
| Intercept  | -2.25| 0.09 | 523.71| 1  | 0.10    |
| WCRs       |      |      |       |    |         |
| 0.7        | 2.62 | 0.09 | 854.41| 1  | 13.90   |
| 0.8        | 1.56 | 0.09 | 510.85| 1  | 7.07    |
| 0.9        | 0    |      |       |    |         |
| Hair       |      |      |       |    |         |
| Hairless   | 0.67 | 0.09 | 52.14 | 1  | 1.96    |
| Facial     | 0.76 | 0.09 | 65.47 | 1  | 2.15    |
| Chest      | 0.73 | 0.09 | 64.34 | 1  | 2.09    |
| Facial/chest CR | 0 |      |       |    |         |
| Prob       | 1.86 | 1.07 | 2.98  | 1  | 6.43    |

Note. WCR = waist-to-chest ratio; CR = conceptional risk; Prob = mean conceptional risk probability. Mode $\chi^2(6) = 1220.54, p < .001, R^2 = .30$ (Nagelkerke).

*Reference category.

### Table 2. Number of First Fixations on ROI as a Function of WCR.

| WCR | Head | Chest | Midriff | Groin | Thighs | Legs/Feet |
|-----|------|-------|---------|-------|--------|-----------|
| 0.7 | 87   | 120   | 87      | 2     | 5      | 0         |
| 0.8 | 86   | 121   | 77      | 2     | 6      | 0         |
| 0.9 | 102  | 119   | 70      | 6     | 7      | 1         |

Note. ROI = region of interest; WCR = waist-to-chest ratio.

Eye Tracking Analysis

LME model analyses were performed with items (images) and subjects as random effects; WCR, ROIs, and hair as fixed effects; and conceptional risk as a covariate. The model conformed to a 3 (WCR: 0.7, 0.8, and 0.9) × 4 (ROI: head, chest, midriff, groin, thighs, legs/feet) design. Analyses were conducted on both early (first fixation and gaze duration) and late (total reading time, fixation count, and visual regressions) stages of visual processing.

### First Fixations

First fixations showed significant differences between ROIs, $\chi^2 = 636.36, p < .001$ (see Table 2). The chest was the region that was fixated on first; however, it was not affected by WCR, $\chi^2 = 2.74, p = .84$. This suggests that, regardless of WCR, the chest is the ROI that is first viewed in comparison with other ROIs. The covariate conceptional risk was not significant.

### First Fixation Duration

Results revealed a significant main effect for ROI, $F(5, 3660) = 22.70, p < .001$. Figure 1 shows the first fixation duration for ROI. Women’s first fixation duration was longer for the head than the thighs, $t(3746) = 14.51, p < .001$; midriff, $t(3746) = 6.06, p < .001$; chest, $t(3746) = 10.34, p < .001$; groove, $t(3746) = 12.94, p < .001$; and legs/feet, $t(3746) = 2.83, p = .006$. The covariate conceptional risk was not significant. There were no other significant main effects or interactions.

### Gaze Duration

There was a significant main effect for ROI, $F(5, 33746) = 59.69, p < .001$. Women viewed the upper portion of the body longer than the lower portion, most notably the head, chest, and midriff. The head received the longest gaze duration in comparison with the chest, $t(3746) = 7.70, p < .001$; midriff, $t(3746) = 2.86, p = .01$; groove, $t(3746) = 17.90, p < .001$; thighs, $t(3746) = 17.20, p < .001$; and legs/feet, $t(3746) = 3.89, p < .001$. There was an interaction between ROI and WCR, $F(10, 3746) = 1.98, p = .03$. In all three WCRs, the head and midriff received a considerable amount of visual attention. The interaction indicated that women spent more time on the head with 0.9 WCRs (see Figure 2). The covariate conceptional risk was not significant. There were no other significant main effects or interactions.
Total Time

A significant main effect for hair, $F(3, 3353.76) = 55.73, p < .001$, showed that women looked at men with both facial and chest hair longer than at men with facial hair only, $t(3,781) = 7.98, p < .001$; chest hair only, $t(3,781) = 6.16, p < .001$; and hairless men, $t(3,781) = 4.91, p < .001$. There was an interaction between WCR and hair, $F(6, 3781) = 7.71, p < .001$. Follow-up multiple comparisons showed that men with both facial and chest hair were viewed longer if their WCR was 0.9, as compared to men with facial and chest hair with a 0.8 WCR, $t(3,781) = 2.31, p = .02$, and a 0.9 WCR, $t(3,781) = 4.91, p < .001$. There was an interaction between WCR and hair, $F(6, 3781) = 7.71, p < .001$. Follow-up multiple comparisons showed that men with both facial and chest hair were viewed longer if their WCR was 0.9, as compared to men with facial and chest hair with a 0.8 WCR, $t(3,781) = 2.31, p = .02$, and a 0.9 WCR, $t(3,781) = 4.91, p < .001$ (see Figure 3). The covariate conceptive risk was significantly related to total time, $F(1, 3781) = 42.21, p < .001$. A follow-up linear regression showed that conceptive risk was a weak predictor of total time, $F(1, 3797) = 39.83, p < .001, \beta = -.10$. This suggests that as conceptive risk probability increased, total time spent on the man’s image decreased.

As in Garza et al. (2016), ratings for attractiveness were used as predictors for total time. This method of analysis is important because it shows if the amount of time needed to complete visual processing relates to attractiveness ratings.

Fixation Count

There was a significant main effect for ROI, $F(5, 3756) = 87.63, p < .001$. Overall, women made more visual fixations on the midriff area than the head, $t(3,746) = 5.28, p < .001$; chest, $t(3,746) = 3.85, p < .001$; groin, $t(3,746) = 18.71, p < .001$; thighs, $t(3,746) = 14.85$; and legs/feet, $t(3,746) = 3.37, p < .001$ (see Figure 5). The covariate conceptive risk was not significant. There were no other significant main effects or interactions.

Visual Regressions

A significant main effect for ROI, $F(5, 3746) = 13.72, p < .001$, showed that the upper part of the man’s body received the most
visual regressions, most notably the head and chest region. Overall, women made more visual regressions to the chest than the thighs, $t(3,746) = 5.25, p < .001$; midriff, $t(3,746) = 6.00, p < .001$; groin, $t(3,746) = 11$; and legs/feet, $t(3,746) = 4.46, p < .001$. Visual regressions to the chest were not significantly different than those to the head, $t(3,356.01) = .75, p = .45$ (see Figure 6). The covariate conceptive risk was not significant. There were no other significant main effects or interactions.

**Discussion**

The purpose of the present study was to examine eye movements among conceptive risk women by manipulating WCR and hairiness in men’s images they were asked to rate for attractiveness. Previous studies have examined the role of eye movements while manipulating fat distribution (B. J. Dixson et al., 2014); however, research on visual attraction and conceptive risk is lacking. The results of the present study revealed that women are influenced by certain physical characteristics in men, most notably WCR. When WCRs were low (e.g., 0.7), women were more likely to rate the man as attractive, in comparison with high WCRs (e.g., 0.9), which were considered unattractive. These findings were further supported using a 6-point Likert-type scale where women rated the attractiveness of the man. The 0.7 WCR received the highest rating of attractiveness, as compared to 0.8 and 0.9 WCRs. Other factors (e.g., hairiness) were not as strong in predicting attractiveness. In other words, all hair manipulations resulted in the same likelihood of attractiveness ratings. In addition, conceptive risk was not a meaningful predictor of attraction when using a Likert-type scale, as it was significant but very weak.

A consistent finding throughout the eye movement analyses was that women directed most of their visual attention toward the upper part of the man’s body. Unequivocally, women exhibited an attentional bias toward the upper part of the man’s body, which could be due to the importance that upper body strength offers in mate selection. First fixations showed that women first viewed the chest upon initial processing, followed by the head, midriff, and lower portions of the body. However, women who first viewed the head and midriff spent more time on those regions, as opposed to the area first viewed (i.e., chest). This suggests that, upon the initial stage of visual attraction processing, the head and midriff are crucial areas that must be carefully examined before considering other physical characteristics of the man’s body. Moreover, gaze duration results showed similar patterns; women’s visual attention was directed toward the head, chest, and midriff.

In relation to total time, higher WCRs (0.9) received the most visual attention and women viewed men who had both facial and chest hair longer than they did for other body types. Similar to attraction, conceptive risk was not a meaningful predictor of total time, as it was significant but very weak. Furthermore, 0.9 WCR men were viewed longer when women rated them as attractive. For fixation count, the results were similar to other visual measurements where women made more visual fixations toward the upper region of the man’s body; conceptive risk, however, did not play a significant role in predicting fixation count. Congruent with our overall findings from other eye tracking measures, for visual regression, women were more likely to return to the ROIs in the upper part of the man’s body (i.e., head and chest). The midriff and thighs were identical in visual regressions, suggesting that early stages of visual processing (i.e., first fixations, first fixation duration, and gaze duration) are prioritized differently than a late-stage measure, such as visual regressions.

Overall, the present findings on physical attraction support the notion that men who display physical characteristics of upper body strength are favored in mate selection. Men who display upper body strength, as noted by the 0.7 WCR, are more likely to attract women who find these physical characteristics important due to their reproductive implications (i.e., protection, immunocompetence, health). These findings support previous research suggesting that the narrower the WCR, the more attractive women will perceive it (Braun & Bryan, 2006; Fan et al., 2005; Hughes & Gallup, 2002; Lavrakas, 1975; Swami & Tovee, 2005). Thus, it appears these salient characteristics are optimal for sexual selection where musculature will provide men with an advantage over men who have excessive fat distribution (Barber, 1995; Buss & Schmitt, 1993; A. Dixson, Halliwell, East, Wignarajah, & Anderson, 2003).

Previous research (B. J. Dixson et al., 2007; Rantala et al., 2010; B. J. Dixson & Vasey, 2012) found that women prefer clean-shaven men; however, in our sample of women, body hair did not play a significant role in self-report ratings of attractiveness. Moreover, conceptive risk predicted attractiveness using a Likert-type scale; however, the relationship was weak. In making binary ratings (i.e., yes/no) during visual attraction processing, conceptive risk failed to influence attractiveness. Indeed, these findings are consistent with B. J. Dixson and Rantala (2016) where conceptive risk did not play a role in predicting attractiveness. These findings are not surprising, considering nonhormonal methods were used in measuring conceptive risk. However, research on menstrual cycle effects on mate preferences has been particularly mixed. For example, a meta-analytic study involving the examination of 58
published research studies assessing conceptive risk failed to find support for an evolved preference during cyclic shifts (Wood, Kressel, Joshi, & Louie, 2014). One particular issue that Wood, Kressel, Joshi, and Louie (2014) concluded was that studies using a large estimate of the fertile window resulted in larger effect sizes for conceptive risk. But most importantly, Wood et al. (2014) showed that studies using hormonal methods were not stronger than studies using self-reports in supporting conceptive risk differences. Other studies manipulating physical characteristics (e.g., WCR and hair) associated with testosterone (Dijkstra & Buunk, 2001; Singh, 1994) and dominance (Neave & Shields, 2008; Sherlock et al., 2016) have also failed to show any meaningful relationship between conceptive risk and attraction. It is important to note that these studies relied on self-report (i.e., forward-counting method) in assessing conceptive risk. We cannot reject the possibility of menstrual cyclic shifts in preferences, as we found evidence, albeit weak, for conceptive risk and attractiveness when using a Likert-type scale. Recently, Gildersleeve et al.'s (2014a) and Gildersleeve, Haselton, and Fales's (2014b) meta-analytic study found robust evidence for preferences during high-fertile days, but it was dependent on the type of relationship, where stronger preferences existed for short-term relationships (i.e., one-night stand) than long-term relationships (i.e., marriage). In this study, we did not address differences between short-term and long-term relationship preferences or if women rated these men as potential partners.

The findings from eye movements are consistent with previous research examining visual preferences in men’s somatotypes (Dixon et al., 2014). As in Dixon et al. (2014), visual attraction was mostly distributed among the upper part of the man’s body (i.e., head, chest, and midriff), which are salient characteristics in a man’s attractiveness. One particular area that did receive a considerable amount of visual attention was the midriff region of the man’s body. This notable finding was demonstrated at the initial (i.e., gaze duration) and later stages (i.e., fixation count) of visual processing. According to Dixon et al. (2014), the midriff is an important region of the man’s body when judging mate preference because it represents an accurate signal of men’s health. Too much adiposity in the midriff may signal susceptibility to particular diseases, such as diabetes, obesity, and cardiovascular-related illnesses (Dixon et al., 2014). In addition, the midriff of the man’s body is a crucial region in assessing the WCR in men, as broad shoulders will appear more salient with less adiposity in the midriff. Interestingly, the midriff is also an important area of visual attention when men make ratings of women for the same purpose (see Dixon et al., 2011; Garza et al., 2016). However, our results are in direct contrast to Rupp and Wallen’s (2007) findings, where first fixations were centered on the genitals of the man’s body. In our analysis, women first viewed the chest, and the genitals did not receive a significant amount of visual attention in the initial and late stages of visual processing. This may suggest that the groin area is not an important physical cue in attractiveness, as it does not provide information as to the health and virility of a man. One significant difference between

the present study and others (Dixon et al., 2011; B. J. Dixson et al., 2014) is that we examined the effects of conceptive risk on women’s attraction and visual attention to specific regions of the man’s body while manipulating WCR and hairiness.

There are a few limitations we would like to address in this study. One issue is the way in which conceptive risk was measured. Conceptive risk was measured by using the probability of conception with a single act of intercourse (Little et al., 2007; Wilcox et al., 2001). Although previous studies have traditionally used conceptive risk windows (i.e., low conceptive vs. high conceptive risk), previous research by Blake, Dixson, O’Dean, and Denson (2016) and Gangestad et al. (2016) have suggested that continuous measures outperform discrete measures of conceptive risk. Future studies might consider increasing the detectability of conceptive risk by utilizing Blake et al.’s (2016) recommendations where the forward counting method could be used with a luteinizing hormone test to increase accuracy. However, if using conceptive risk windows as between-subjects comparisons (i.e., low conceptive vs. high conceptive risk) in cyclic shifts, the recommendations by Gangestad et al. (2016) of using larger sample sizes should be taken into consideration. Furthermore, the use of a front pose, as opposed to B. J. Dixson et al.’s (2014) back pose image, may have inadvertently situated the face as a distraction to women viewing the image. Future work will address this possibility. However, we would like to underscore that judging from our eye movement results, the face did not appear to serve as a visual distraction. When looking at the initial stages of processing, the chest received the most first fixations, and the head and midriff were equally distributed in their first fixation duration. In late-stage visual processing, women viewed the midriff more often (i.e., fixation count) and equally regressed to the head and chest region. A front-posed image was chosen for ecological validity purposes. In our view, women are more likely to examine a potential mate when viewing him directly. In addition, women can still make adequate judgments on adiposity when viewing a front-posed image versus a back-posed image. Lastly, the main focus of the study was to examine visual differences among conceptive risk women while manipulating salient physical characteristics. In order to determine specific changes in attraction and perceptual differences, differentiating between short-term and long-term mating should be performed.

The current study adds two new findings to the field of human physical attraction. First, for men’s attractiveness, initial stages of visual processing, as measured by first fixation and gaze duration, turned out to be similar to late stages of visual processing (e.g., total time, visual regressions, and fixation count). Women’s eye movements in early stages of visual processing were predictive of their eye movement patterns in late stages of visual attraction processing. That is, in both cases, they tended to look at the upper portion of the man’s body (i.e., head, chest, and midriff). This finding stands in contrast to the results of Garza et al.’s (2016) woman’s attractiveness study, which showed that men were more likely to focus on specific areas (i.e., chest/midriff) during initial stages of attractiveness judgments but then focus on other characteristics (i.e.,
head/chest) during later stages of attractiveness judgments. Second, the present study is the first to examine WCR, hair distribution, and conceptive risk as viable visual predictors of men’s attractiveness as measured by eye movements. As shown in this study, the 0.9 WCR resulted in the longest viewing time, even though it was not considered the most attractive.

Conclusion
The current study investigated eye movement behavior of women, as they were shown men’s images and asked to rate their attractiveness. To our knowledge, this is the first study using conceptive risk to predict eye movement patterns in women’s visual perception of men’s images. The study adds to the existing literature on human physical attraction as well as to the literature concerning the use of eye movements to explore attraction in mate preferences. The findings reported here are consistent with Dixson et al.’s (2014) study, which demonstrated that women have an attentional cognitive bias toward specific areas of men’s bodies which they used in the overall assessment of mate preferences. Although these findings are novel in the field of human attractiveness and mate preferences, clearly more research needs to be done in order to fully comprehend how conceptive risk affects women’s visual processing behavior.

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