Male and Female Perception of Physical Attractiveness: An Eye Movement Study

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Abstract
Waist-to-hip ratio (WHR) and breast size are morphological traits that are associated with female attractiveness. Previous studies using line drawings of women have shown that men across cultures rate low WHRs (0.6 and 0.7) as most attractive. In this study, we used additional viewing measurements (i.e., first fixation duration and visual regressions) to measure visual attention and record how long participants first focused on the female body and whether they regressed back to an area of interest. Additionally, we manipulated skin tone to determine whether they preferred light- or dark-skinned women. In two eye tracking experiments, participants rated the attractiveness of female nude images varying in WHR (0.5–0.9), breast size, and skin tone. We measured first fixation duration, gaze duration, and total time. The overall results of both studies revealed that visual attention fell mostly on the face, the breasts, and the midriff of the female body, supporting the evolutionary view that reproductively relevant regions of the female body are important to female attractiveness. Because the stimuli varied in skin tone and the participants were mainly Hispanic of Mexican American descent, the findings from these studies also support a preference for low WHRs and reproductively relevant regions of the female body.

Keywords
visual attention, female physical attractiveness, sexual selection, waist-to-hip ratio, eye tracking

Introduction
Physical characteristics (e.g., narrow waist, long legs, and medium–large breasts) play an important role in determining attractiveness and selecting a potential mate, particularly in men’s evaluations of women (Dixson, Grimshaw, Linklater, & Dixon, 2010, 2011b; Singh, 1993; Singh & Young, 1995). One of the most explored areas of research in judging attractiveness is the waist-to-hip ratio (WHR), or the size of a woman’s waist in relation to her hips, including her buttocks. Studies show that women who have a low WHR are rated as more attractive and have advantages associated with reproductive success (Moran et al., 1999; Singh, 1993, 2002; Singh & Young, 1995; Van Hooff et al., 2000). Women with WHRs of 0.7 have been rated as being more attractive, in better health, and of higher reproductive value (Singh, 1993; Singh & Young, 1995). This article examines male and female Mexican American perceptions of attractiveness using eye movements to explore how this ethnic group might differ from others previously studied in the way it views attractiveness. Previous research (Singh, 1993; Singh & Young, 1995; Marlowe, Apicella, & Reed, 2005) has traditionally used line drawings and nonecologically valid images to assess female attractiveness. More recently, research in this domain is beginning to use technologically advanced empirical techniques, such as functional magnetic resonance imaging (fMRI) and eye tracking, to accurately and objectively measure perceived female attraction (Platek & Singh, 2010; Suschinsky, Elias, & Krupp, 2007). One advantage of using eye movements to measure attractiveness is that they provide objective and precise recordings of where and when (in ms) a particular region of interest (ROI), such as the breasts or the midriff, receives the most attention, using multiple indicators of eye movements as participants scan target pictures.
**Attraction and Mate Selection**

Humans have evolved certain cognitive strategies or mental shortcuts to aid in mate selection. These characteristics include a dependence on certain morphological traits that are associated with fertility to determine whether an individual is attractive (e.g., narrow waist). If certain morphological traits are associated with fertility and reproductive value in women, it follows that men should have cognitive mechanisms that lead them to find such features attractive. Singh and Young (1995) proposed that men judge women to be most attractive within an ideal range of WHRs. To evaluate male preference for lower WHRs, Singh (1993) utilized line drawings exhibiting a range of WHRs (0.7, 0.8, and 0.9) to determine whether there was a preference for specific waist characteristics. Findings revealed that for all body types, the lowest WHR was rated as most attractive. It is interesting to note that normal body types and low WHRs were rated high in attractiveness, sexiness, good health, and capacity for childbearing, all of which relate to fertility. In a follow-up study, Singh and Young (1995) looked at the WHR in relation to breast size and the role of both in determining personal attributes and desirability for romantic relationships. Singh and Young contend that in times of famine and food shortages, women would have needed to store surplus energy for successful reproduction, most notably in the gluteofemoral region and breast for milk production. This would have resulted in men having an evolved preference for women who exhibit lower WHRs and bigger breast size. Singh and Young found out that low, rather than high, WHR did indeed play a significant role in determining attractiveness, good health, feminine features, kindness, and understanding. Women categorized as having a high WHR were typically rated as less attractive and older looking, an attribute not consistent with reproductive success. Images that portrayed a low WHR and larger breasts were rated as most attractive and youthful looking, in keeping with attractiveness and reproductive success. Moreover, fMRI findings (e.g., Platek & Singh, 2010) have revealed that brain areas associated with reward processing and decision making (e.g., the anterior paracingulate, nucleus accumbens) become activated when men view images depicting low WHRs.

Despite playing an important role in attractiveness, it is not clear what importance breast size plays in sexual selection. Breast size may indicate reproductive capability, with small breasts being characteristic of a young, pubescent girl, and large breasts characteristic of an older, reproductively capable woman (Singh & Young, 1995). Previous research by Singh and Young found breast size to be an important contributor to female attractiveness. In their study, breast size and WHRs were used as predictors of attractiveness, health, femininity, and kindness and understanding. They concluded that images of slender women with large breasts were rated as most attractive. Additionally, images of plump women with large breasts were rated as less attractive than images of slender women with small or large breasts. In a follow-up experiment, Singh and Young reported that female figures with large breasts and narrow hips were rated as older than figures with small breasts and narrow hips. It is important to note, however, that the perception of increased age was more apparent when the figures had wide hips.

Another sexually dimorphic trait that is associated with sexual selection is skin tone. Women are lighter skinned than men in a wide range of human populations (Frost, 1988, 2007, 2008; van den Berghe & Frost, 1986), even when one controls for degree of sun exposure. Interestingly, skin tone becomes sexually dimorphic at puberty, when girls become lighter skinned than boys. According to Mesa’s (1983) study on Spanish schoolchildren, skin color darkens progressively before puberty and then lightens during adolescence, eventually forming a stable sex difference in adulthood. This sex difference is most pronounced in humans of medium skin color and seems to be constrained in very dark- and very light-skinned humans. Similar sex differences have been noted in hair color, which darkens during adolescence in both sexes but more so in boys than in girls (Leguebe & Twieselmann, 1976; Stegerdara, 1941; van den Bergh & Frost, 1986). There are two main evolutionary explanations for the sexually dimorphic nature of skin tone: (1) skin tone is used as a signal of neoteny and (2) skin tone is used as an indicator of fertility. Neotenuous traits are associated with childlike or juvenile characteristics, such as body fat, high-pitched voice, and lighter skin. In women, a lighter skin tone may be associated with what is known as infantile mimicry, that is, these physical characteristics are said to serve as an elicitor of male nurturance, similar to nurturance given to a child (Frost, 1988, 2007, 2008, 2011; van den Bergh & Frost, 1986). A childlike appearance may also reduce aggressive male feelings and hence the likelihood of aggressive behavior. Differences in skin tone are also apparent in line with hormonal changes in women. Skin tone can darken during pregnancy, during the infertile phases of the menstrual cycle, and while one is taking contraceptives (van den Bergh & Frost, 1986). Skin tone, therefore, functions as a means of determining the fecundability of women (i.e., lighter skin tone is associated with greater reproductive potential). A cross-cultural study of 51 societies found that 47 showed a preference for the lighter end of the locally represented spectrum of skin tones (van den Bergh & Frost, 1986).

**Ethnic Differences**

Although previous studies have primarily focused on European and European American men, research on other ethnic minorities, such as Hispanics, who are the focus of this study, has not been well documented. The ideal female body of Western cultures (Singh & Luis, 1995) differs in some respects from that of other cultures, particularly hunter gatherers. In examining ethnic differences in WHR, Singh’s (1994) operating assumption was that every culture has distinct characteristics in terms of what they look for in the opposite sex. Marlowe, Apicella, and Reed (2005) looked into WHR preferences among the Hadza hunter gatherers of Tanzania using a frontal 2-D WHR and a profile WHR, which is a 2-D photo showing the side view of an
image where the waist and buttocks are more visible. The results showed that Hazda men’s WHR preferences for the frontal images were similar to the choices made by European American men. However, preference for higher WHRs was seen in images that portrayed profile images. European American men preferred profile images with a 0.7 WHR, while Hazda men preferred profile images with a 0.9 WHR (Marlowe et al., 2005). In an extension of Marlowe et al.’s study, Swami, Jones, Einon, and Furnham (2009) used British men who were classified as being European Caucasian or of African descent. They also used a sample of African men from Cape Town, South Africa. The images used in this study were of women of both ethnicities in a profile pose (side view). Swami et al. (2009) found that South African men preferred high WHR Black women with large breasts and high WHR White women with small breasts. The British sample, on the other hand, preferred high WHR Black women with small breasts and high WHR women with large breasts. Thus, this pattern of results seems to argue against low WHR preferences and suggests cross-cultural differences. As for Hispanics, little is known about their WHR preferences. By better understanding the preferences of a Hispanic population, we may better understand how selection pressures have created cognitive strategies or mental shortcuts for assessment of WHR.

**Eye Movements and Attractiveness**

Recently, researchers have been utilizing eye movements to measure which features are used to assess attractiveness. Eye movements or eye tracking methodology is a sensitive gaze-contingency technique that measures real-time visual processing. It provides a precise measurement of when and where participants look without evoking a conscious response (i.e., without relying on the participant’s explicit awareness). In a typical eye movement study, participants are simply asked to inspect a picture/image to determine whether it is attractive (yes/no type of answer). For example, researchers might be interested in the number of eye fixations or the amount of time a person spends looking at a particular area of a target image. Eye movements show that differences in the duration and number of fixations indicate interest in a specific region of the target image (Balcetis & Dunning, 2006; Henderson, 2003; Issacowitz, 2006; Rayner, 1998; Rizzo, Hurrig, & Damasio, 1987). Eye movements are important visual attention measurements because where a person looks or fixates on indicates the initial stage before the stimulus is processed and encoded (Yantis, 2005). Moreover, attractiveness is a strong factor in determining visual attention, as demonstrated in previous research showing that (1) people focus more attention on relevant versus irrelevant information (Suschnisky et al., 2007), (2) infants gaze longer at attractive or familiar adults (Langlois et al., 1987), and (3) men stare longer at attractive female faces (Fink et al., 2008; Maner, DeWall, & Gailliot, 2008). Specifically, eye tracking studies show that people look longer at images that portray the opposite sex and limit their viewing of the face when the image contains erotic content (Lykins, Meana, & Kambe, 2006; see also Rupp & Wallen, 2007). These studies are consistent with eye tracking research, which shows differences in visual attention to the female body and to specific ROIs.

What is the relationship between eye movements and WHR research? In one of the first studies to use eye movements, Suschnisky, Elias, and Krupp (2007) examined visual attention to images of different female WHRs (0.68–0.85), and the participants were asked to rate the women’s attractiveness. The results showed that men directed most of their visual attention (i.e., fixations) to regions that were reproductively significant, such as the breasts, the waist, and the hips. More importantly, women with lower WHRs received the most visual attention, indicating male interest in that particular region of the body. Moreover, women with lower WHRs were also rated as the most attractive.

In a related study, Hewig, Trippe, Hecht, Straube, and Miltner (2008) explored gender differences and gaze patterns of participants who were looking at a male or female body. Participants were exposed to images of fully clothed men and women. Each image had the same posture, a similar clothing style, and a similar size of body regions. Overall, findings indicated that, when exposed to images of the opposite sex, participants were more likely to rate them as attractive and spent longer time viewing them. Men spent significantly more time focusing on the breast area. Indeed, these patterns of results are consistent with evolutionary strategies of mate selection (Hewig, Trippe, Hecht, Straube, & Miltner, 2008) and suggest that longer viewing time is associated with attraction.

Dural, Cetinkaya, and Guibertekin (2008) presented male and female participants with female images with altered overall weight, which included underweight, normal-weight, and overweight individuals as well as varying WHRs (0.7, 0.8, 0.9, and 1.0). The attractiveness of each image was rated by measuring eye fixations. The body was divided into three ROIs: the upper trunk (e.g., the breasts), below the breasts to the waist, and the hips to the feet. Analysis of eye fixations revealed significant sex differences in attention to the region from below the breasts to the waist and including the overall waist-to-hip area. Male participants rated this region more attractive than the other ROIs and spent more time looking at it. Dural et al. concluded that WHR importance must be an evolved cognitive mechanism in mate selection due to the overall gender differences, that is, male participants rated the region from the breasts to the waist as the most attractive region and gave it the most visual attention.

In a more recent study, Dixon, Grimshaw, Linklater, & Dixon (2010) investigated how individuals viewed nude female images as a function of WHR. The images were graphically manipulated to represent WHRs of 0.7, 0.8, and 0.9. The nude image was divided into six anatomical ROIs: face, breasts, waist, hips and thighs, genitals, and legs for the frontal pose. The back pose was divided into the head, upper back, waist, buttocks, rear thighs, and rear legs. Results showed that, regardless of the frontal or rear poses, the midriff received the most eye fixations and total time; that is, participants made more visual fixations and spent the most time looking at the waist area. Moreover, the images with the lowest WHR (0.7)
were the ones that received the most first fixations on the breasts. In other words, when shown a woman who exhibited the lowest WHR, individuals first fixated on the breasts. It has been argued that first fixations reflect automaticity, in that individuals look at a specific area first without awareness, before consciously focusing on other areas. For higher WHRs (0.8 and 0.9), individuals fixated on the midriff more. Accordingly, men will employ the WHR as a cognitive mechanism filter in order to identify women who do not meet the perceiver’s expectations of attractiveness and fertility. Men in the Dixson et al.’s (2010) study may have automatically focused on the woman’s breast, as seen with WHRs of 0.7 and 0.9, because the WHR preference was already met. This propensity for men to look at the 0.7 WHR is known as the “first pass filter,” and it tends to exclude women who are unhealthy or have low reproductive value (Singh, 1993). Once WHRs higher than 0.7 are filtered out, men will use other characteristics of the female body (i.e., head, breasts, and skin tone) to determine a final mate selection (Singh, 1993). Unfortunately, Dixson et al. (2010) measured first fixations but not first fixation duration. By including this second measurement, we wish to find out not only whether individuals look for a 0.7 WHR first but also whether they are more interested in the breasts and the midriff than in other regions of the body.

Present Study

The present study expands on Dixson et al. (2010) in three important ways. (1) It includes first fixation duration, gaze duration, and visual regressions. These additional visual measurements will further explore the first pass filter by recording automatic processing time (i.e., number of first fixations and first fixation duration), time spent on an ROI (i.e., gaze duration), and whether individuals regress back to a specific ROI (i.e., visual regressions). (2) This study measures attractiveness ratings by using yes/no responses immediately after the image is presented. This will give us an insight into the intuitive judgments individuals make when looking at a female image without having to spend a considerable amount of time using a rating system that is time consuming and might discourage “intuitive” responses. (3) Furthermore, the experiment described here looks at an understudied population and determines the extent to which previous findings can be generalized to the Hispanic population. Additionally, the study examines the gender differences that exist in visual attention. Previous studies have primarily focused on male populations; therefore, by using both men and women, we can provide further insights into the question of whether visual attraction is a gender or a general preference. The possibility that males spend a considerable amount of time attending to specific areas of the body when compared to females would further support the mate (i.e., male) selection preferences hypothesis. A finding that a low WHR ratio is preferred, and that individuals focus on reproductively relevant regions, would further support the possibility that cognitive strategies are used to assess the physical characteristics that are sought for in women, primarily by male participants. Therefore, in this study, we hypothesized the following: (1) as has been shown by Dixson et al. (2010, 2011b), Singh (1993), Singh and Young (1995), and Suschinsky et al. (2007), the areas of the breast and midriff will receive more visual attention than other areas; (2) the lower the WHR, the more attractive ratings it will receive; and (3) there will be gender differences in the amount of visual attention displayed, that is, men will spend longer time viewing the images than will women.

Experiment 1

Material and Method

Participants

Participants were 54 (men = 16 and women = 38) Hispanic students of Mexican American descent, ranging from 18–40 (M = 23.70, SD = 4.98) years of age recruited from the Texas A and M International University (TAMIU) undergraduate population. Participants received class credit for their participation.

Materials

A color photograph taken from Dixson et al.’s (2010) study of a nude woman facing forward was used and altered to meet the required dimensions. Using Adobe Photoshop CS6, version 13.0.1.1, the image’s waist and breast size were manipulated by making either the waist or the breasts appear small, medium, or large. A professional artist and expert in the Photoshop software application performed the image alterations. A low WHR image was made by digitally reducing the waist and a high WHR image by expanding the waist. WHRs were operationally defined by a numerical ratio of 0.7, 0.8, and 0.9, by dividing the waist of the image with the hips. As in Dixson et al. (2011a) and Brown et al. (1999), breast sizes were operationally defined as small (80% of the original image), medium (original breasts of the image), or large (120% of the original image). In total, nine images exhibited different combinations of waist and breast sizes, so that one image could have a small waist-small breast, small waist-medium breast, or small waist-large breast, and the sequence was continued for all of the images. The ROIs were the six anatomical regions used in Dixson et al.’s (2011) study, which included the following: (1) the face and neck, from the top of the head to the clavicle; (2) the breasts, as measured from the clavicle to the border of the bottom of the breasts; (3) the midriff, which included the waist and extended from the bottom of the breasts to the widest part of the hips; (4) the groin, which encompassed the area showing pubic hair; (5) the thighs, beginning at the end of the midriff border to the knee; and (6) the legs and feet, which were the remaining portion of the female body. All images were input into SR-Experiment Builder and modified to meet the size requirements, so that they could be viewed clearly. Each image in SR-Experiment Builder was 783 × 1,599 pixels, and the bit depth was set at 24. Additionally, we set ROIs for all of
the images, so as to know specifically which part of the body participants fixated on more.

Procedure

Upon arrival at the laboratory, participants completed a consent form. They were then instructed to sit comfortably, so that they were able to position their chin on a chinrest and maintain stability. Visual calibrations were conducted to ensure that the eye tracker was accurately recording the participants’ eye movements. The visual recording was monocular, that is, the eye tracker recorded the movements of the right eye. The distance between the chinrest and the eye tracker was 55 cm. Experimental stimuli were presented using SR-Experiment Builder running on Windows OS 7, and the EyeLink 1000 eye tracker was connected to a dedicated host computer running on disk operating system.

Experimental instructions were presented on the computer screen, and participants familiarized themselves with a Microsoft Sidewinder Plug and Play Gamepad used to rate image attractiveness. Participants were instructed to use the left trigger for “not attractive” and the right trigger for “attractive.” In rating the images, participants were instructed to make an intuitive judgment. No time limit was set for the images. Before the experimental images were shown, participants rated six pictures as part of the practice block. A total of nine experimental images were shown in each individual session, and the order of the images was randomized for each experimental session.

In recording eye measurements, first eye fixation was determined by the first area (ROI) participants viewed. First fixation duration was the amount of time participants focused first on a specific ROI (head, breasts, midriff, groin, thighs, and legs/feet). Gaze duration time was the entire time participants focused on a specific ROI throughout the trial. The participant’s total time was measured by how long they viewed each image (i.e., the overall duration of the trial). This was primarily done to measure the effect that breast size and WHR manipulations had on viewing the entire image. Fixation count was determined by how many visual fixations were recorded for a specific ROI. Finally, regressions were operationalized as the number of times participants returned to an ROI throughout a trial.

Results

Data from three participants were excluded because the eye tracker camera was unable to record their eye movements due to the type of corrective lenses they were using.

Attractiveness

WHR and breast size have both been used to determine a woman’s attractiveness. As in Singh (1993), Suchinsksy et al. (2007), and Dixson et al. (2010), we first attempted to find a relationship between breast size and attractiveness and between WHR and attractiveness. Breast size, particularly large breasts, has often been used as an indicator of female attractiveness (Singh & Young, 1995). Previous research has also indicated that a low WHR is considered more attractive and a preferred characteristic in mate selection. A logistic regression using WHRs (0.7, 0.8, and 0.9) and breast size (small, medium, and large) was performed to determine whether these dummy-coded predictor variables would increase the likelihood of rating a female figure as more attractive (i.e., no/yes ratings and dummy coded). Participants made intuitive judgments while being visually recorded. Since past research has found that a low WHR is associated with attractiveness, the highest WHR (0.9) was used as a reference category. Because large breasts are generally preferred, we used small breasts as a reference category. The logistic regression was statistically significant, $\chi^2(4) = 186.555, p < .001$. When the images portrayed a WHR of 0.7 or 0.8, they were 4 times more likely to be rated as attractive (see Table 1). When the images portrayed medium or large breasts, they were more likely to be rated as attractive.

First Fixations

For all WHR images (0.7, 0.8, and 0.9), breasts received the greatest number of first fixations, $\chi^2 = 649.40, p < .001$ (see Table 2). We further examined whether the head, breasts, and midriff ROIs were influenced by WHRs. Significant differences were revealed, in which the lower the WHR, the more first fixations were noted on the head, $\chi^2 = 27.81, p < .002$. The midriff also revealed differences, that is, first fixations were recorded more on the midriff for the 0.9 WHR, $\chi^2 = 32.07, p < .001$ than the 0.7 and 0.8 WHRs. The breasts did not reveal significant differences in first fixations across

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

|           | $\beta$ | SE $\beta$ | Wald | df | Exp($\beta$) |
|-----------|---------|------------|------|----|--------------|
| Intercept | -0.70   | 0.12       | 33.52| 1  | 1.00         |
| WHRs      |         |            |      |    |              |
| 0.7       | 1.42**  | 0.13       | 120.08| 1  | 4.15         |
| 0.8       | 1.46**  | 0.13       | 116.21| 1  | 4.40         |
| 0.9       | 0*      |            |      |    |              |
| Breast size |        |            |      |    |              |
| Small     | 0*      |            |      |    |              |
| Medium    | 0.42    | 0.12       | 11.32| 1  | 1.52         |
| Large     | 0.42    | 0.13       | 23.89| 1  | 1.14         |

Note. Model $\chi^2(4) = 186.555, p < .001$, $R^2 = .14$ (Nagelkerke). 0* = reference category; WHR = waist-to-hip ratio. **p < .001.

### Table 2. Number of First Fixations on One of the Six ROI Body Regions.

| WHR | Head | Breasts | Midriff | Groin | Thighs | Legs/Feet |
|-----|------|---------|---------|-------|--------|-----------|
| 0.7 | 37   | 76      | 36      | 4     | 14     | 2         |
| 0.8 | 31   | 72      | 43      | 5     | 16     | 1         |
| 0.9 | 18   | 69      | 68      | 5     | 9      | 1         |

Note. WHR = waist-to-hip ratio; ROI = region of interest.
WHRs, $\chi^2 = 12.68, p = .24$. However, the breasts and the midriff received the highest number of first fixations.

Data were submitted to a linear mixed-effects analysis using IBM SPSS (Version 22), with items (images) and subjects (participants) as random effects and gender, WHR, and ROIs as fixed effects. The overall model conformed to a 2 (gender: male vs. female) x 3 (WHR: 0.7, 0.8, 0.9) x 3 (breasts: small, medium, large) x 6 (regions of interest: head, breasts, midriff, groin, legs/feet) mixed design. This basic design was used throughout Experiments 1 and 2 to analyze the different eye movement indexes.

**First Fixation Duration**

The results revealed a main effect of ROI, $F(5, 1614.76) = 2.70, p < .01$. As can be seen from Figure 1, participants’ first fixation duration was longer on the midriff than on the head, $t(658.31) = 3.10, p = .002$, and the thighs, $t(579.85) = 2.35, p = .01$. There were no significant differences between the midriff and the breasts, $t(689.13) = 1.28, p = .20$; the groin, $t(526.67) = .98, p = .32$; and the legs/feet, $t(397.33) = .87, p = .38$. This suggests that participants focused more of their first fixation time on the midriff than on other regions of the body. There was an interaction between ROI and gender, $F(5, 1613.47) = 2.31, p < .05$, suggesting that males spent longer first fixation time duration on all ROIs, with the exception of the head region.

**Gaze Duration**

Gaze duration was measured by recording the average time participants focused on a specific area throughout each trial. There was a main effect for ROI, $F(5, 1606.86) = 38.58, p < .001$. Significant differences were noted between the breasts and the midriff, $t(690.60) = 2.98, p < .01$; the thighs, $t(625.01) = 7.82, p < .001$; the groin, $t(543.88) = 9.83, p < .001$; and the legs/feet, $t(451.75) = 5.08, p < .001$. There was no significant difference between the breasts and the head, $t(700.30) = .58, p = .56$. There was an interaction between ROI and gender, $F(5, 1605.56) = 3.50, p < .01$. Follow-up multiple comparisons showed that men focused their visual attention on the breasts, $t(92.58) = 3.51, p < .001$, and the head, $t(106.15) = 2.60, p < .01$, more so than did women (see Figure 2). The other ROIs followed the same pattern, with the exception of the legs; however, these ROIs did not reach significance.

**Total Time**

Total time was the time spent on each image per trial. The only significant main effect involved gender, $F(1, 62.97) = 10.76, p < .01$. The main effect revealed that men spent significantly more time viewing the images than women, $t(62) = 3.24, p < .001$. Additionally, there was a three-way interaction between WHR, breast size, and gender, $F(10, 1597.51) = 20.43, p < .001$. The interaction (see Figure 3) showed that men spent...
more time looking at small breasts when the WHR was 0.7 or 0.8. In general, low to medium WHRs predicted longer total times spent viewing small breasts.

**Fixation Count**

Fixation count was defined as the average number of fixations made in each trial. There was a main effect for ROI, \( F(5, 1605.99) = 44.81, p < .01 \), and an interaction between ROI and gender, \( F(5, 1604.76) = 2.97, p = .01 \). Participants made more fixations on the breasts than on the midriff, \( t(691.31) = 4.62, p < .001 \); the head, \( t(697.88) = 2.62, p < .01 \); the thighs, \( t(634.04) = 7.53, p < .001 \); the groin, \( t(545.96) = 10.72, p < .001 \); and the legs/feet, \( t(452.42) = 5.27, p < .001 \). The interaction showed that, for all of the ROIs, men made more fixations than women on all of the areas, with the exception of the legs/feet. There was an additional interaction between WHR and ROI, \( F(10, 1591.80) = 2.91, p = .01 \). For the 0.7 WHR, the breasts received the highest number of fixations, significantly more than the midriff, \( t(1584.78) = 5.56, p < .001 \); the groin, \( t(1588.19) = 8.96, p < .001 \); the thighs, \( t(1591.42) = 5.76, p < .001 \); and the legs/feet, \( t(1589.24) = 4.68, p < .001 \). The breasts were not significantly fixated on more than the head, \( t(1583.98) = 1.80, p = .07 \). For the 0.8 WHR, the breasts received the highest number of fixations, significantly more than the head, \( t(1586.51) = 3.19, p < .01 \); the midriff, \( t(1587.23) = 4.19, p < .001 \); the groin, \( t(1592.94) = 7.96, p < .001 \); the thighs, \( t(1590.55) = 5.96, p < .001 \); and the legs/feet, \( t(1596.79) = 3.87, p < .001 \). The 0.9 WHR produced the highest number of fixations on the breasts, significantly more than on the groin, \( t(1591.80) = 7.24, p < .001 \); the thighs, \( t(1588.40) = 6.00, p < .001 \); and the legs/feet \( t(1596.55) = 2.67, p < .01 \). The breasts were not significantly fixated on more than the head, \( t(1588.40) = 1.48, p = .07 \), and the midriff \( t(1589.09) = .50, p = .62 \). Table 3 shows the overall fixation counts by ROI and by WHR. Consistent with Dixson et al.’s (2010), most of the visual fixations were centered on the upper female body (head, breasts, and midriff), more specifically on the breasts.

**Visual Regressions**

For eye regressions, the results yielded a significant main effect for ROI, \( F(5, 1613) = 8.95, p < .001 \). Participants tended to regress back to an ROI associated with the upper body, such as the head, the breasts, and the midriff. Participants made more regressions toward the upper body than toward the lower body. There was a significant three-way interaction between ROI, WHR, and gender, \( F(25, 1587.03) = 2.083, p = .001 \). The interaction showed that the lower the WHR (0.7), the more visual regressions men made toward the upper body, as seen in Figure 4.

**Discussion**

According to previous studies (Moran et al., 1999; Singh, 1993; Singh & Young, 1995; 2002; Van Hooff et al., 2000), the lower the WHR, the more attractive a woman will be rated. One purpose of the present study was to investigate whether participants would rate the lowest WHR as more attractive than higher WHRs while viewing images that vary not only in WHR.
but also in breast size. Past studies (e.g., Moran et al., 1999; Singh, 2002; Van Hooff et al., 2000) utilized a rating scale with multiple numerical options for the level of attractiveness. In this experiment, the focus was on how intuitive these responses would be while participants viewed images. This is why a binary response (i.e., yes/no) was used to prevent participants from spending too much time considering different possibilities and instead encourage them to provide a fast and intuitive judgment.

As predicted, the lowest WHR (0.7) increased the likelihood of rating the image as attractive, more so than the higher WHRs. This was also seen with the 0.9 WHR. Breast size was varied as well, with the medium and large breasts slightly increasing the likelihood of rating the image as attractive. As with Dixson et al. (2010), Suschinsky et al. (2007), and Brase and Walker (2004), the lower the WHR, the higher was the attractiveness rating. These results support the importance of the WHR in ratings of attractiveness and extend this importance to a Hispanic population of Mexican American descent, hence indicating that WHRs are cross-culturally used to assess attractiveness.

Another purpose of the present study was to determine which regions of the female body received the most visual attention. By using eye movements, we were able to determine which areas were most important. During first fixations, participants directed their attention toward the upper parts of the body (i.e., head, breasts, and midriff), which are typically considered more reproductively relevant to male participants. There were more first fixations directed toward the breasts than toward the midriff, and these differences were significant for WHRs of 0.7 and 0.8 but not for the 0.9 WHR. In short, the present results replicated Dixson et al.’s (2010) findings when the WHR was 0.7. Thus, based on first fixation counts, it appears that the small and medium breasts attract the most attention for all WHRs, except for the 0.9 WHR.

In addition, we measured first fixation duration, that is, the length of time participants focused on the first area they viewed. This measurement was not included in Dixson et al. (2010). The results revealed that the midriff was the region of the body that participants focused on the longest. To the best of our knowledge, this measurement has never been utilized before in this area of research. Although the breasts received the most first fixations, the midriff received a longer duration of first fixations. It can be argued that the number of first fixations merely represents participants’ scanning of the image, while the duration of first fixations indicates the degree of interest in a particular region. Thus, it may very well be the case that first fixation duration is a reasonable indicator of the first pass filter, or mental module, proposed by Singh (1993) as a major determinant of preferences for low female WHRs.

To measure gaze duration, we recorded the amount of time participants spent looking at a WHR image. As with Dixson et al. (2010) and Suschinsky et al. (2007), participants viewed the upper part of the female body longer than the lower parts. This is consistent with evolutionary thinking that the upper parts of the body are key to males in mate selection and attractiveness (Suschinsky et al., 2007). More specifically, the breasts received the longest gaze duration and also showed the greatest gender differences. Men spent significantly longer time viewing each ROI, except for the feet. Other than the effect of gender, these differences in gaze duration are consistent with Dixson et al. (2010) for the ROIs. Overall, male viewing times were more directed toward ROIs, whereas women were more evenly distributed in their viewing times.

We wanted to determine whether manipulation of the WHR would affect the total time spent viewing female images. Overall, male participants viewed the lowest WHR (0.7) longer than the 0.8 and 0.9 WHRs. Moreover, in male participants, the 0.7 and 0.8 WHRs received the longest total time when paired with small breasts. When the image had a 0.9 WHR, male participants viewed the one with the largest breasts the longest. This is an additional finding that, to the best of our knowledge, has not been reported in the literature. Previous research has looked mostly into overall ratings of attractiveness as a function of WHR and breast size, and the eye tracking literature has focused mostly on gaze duration and fixation count. These findings may imply that WHR and breast size can be conflicting signals of phenotypic quality, the outcome being longer decision times.

With regard to visual regressions or the likelihood of participants returning to a viewed ROI, the ROIs in the upper body received the highest number of visual regressions for all three WHRs. In particular, the lowest WHR produced the highest number of regressions. This is a new finding, and the first time that visual regressions have been considered in sexual attraction research. More importantly, the visual regressions are consistent with the importance of the upper body, which encompasses the more reproductively relevant regions. Male participants looked back the most at the upper body, most notably, the head and the breasts, when the woman had a low WHR (0.7).

Low WHRs were rated as most attractive, and breast size did not play a role in the attractiveness ratings. Overall, it was apparent that participants focused most of their visual attention on the upper female body. This is highlighted by our findings from first fixations, first fixation duration, gaze duration, fixation count, and visual regressions. For measurements of total time, fixation count, and visual regressions, the results indicate the importance of low WHRs (0.7). Although participants did look first at the breasts (i.e., first fixation), we believe that first fixation duration should be considered more important because it signifies degree of attention, instead of a visual scan. To summarize the findings of Experiment 1, the lower the WHR, the more attractive the female image seemed. We were also able to confirm our hypothesis that visual attention would be directed toward the breasts and the midriff, which are reproductively relevant regions. Finally, gender differences were observed as well, that is, men spent more time than did women viewing images and viewing the ROIs.

**Experiment 2**

Experiment 2 further manipulated WHR (0.5 and 0.6) and skin tone (dark vs. light). This was done to further explore whether using lower WHRs than what has been commonly used so far (0.7, 0.8, 0.9, and 1.0) would significantly affect attractiveness.
ratings. In previous studies (e.g., Frost, 1988, 2007, 2008, 2011; Swami, Furnham, & Joshi, 2008; van den Bergh & Frost, 1986), participants found lighter-skinned women to be more attractive. If skin tone plays a role in attractiveness, we would expect dark and light complexions to be assessed differently, as shown by eye movements and attractiveness ratings. Overall, we expected Experiment 2 to replicate and further corroborate the results of Experiment 1. That is, the breasts and the midriff should receive more visual attention than other regions (e.g., thighs and feet).

**Material and Method**

**Participants**

Ninety-eight Hispanic students from Mexican American descent (males = 29 and females = 69) ranging from 18-40 (M = 22.40, SD = 4.54) years of age participated in the experiment. Participants were recruited from the TAMU undergraduate population. None of the participants from Experiment 2 took part in Experiment 1.

**Materials**

Experimental materials were the same as in Experiment 1, with the exception that the female image was modified to include 0.5 and 0.6 WHRs. In addition, skin tone was manipulated to create a set of dark skin and light skin tone images. A total of 15 images for each skin tone (i.e., dark vs. light) were created with five different WHRs (i.e., 0.5, 0.6, 0.7, 0.8, and 0.9) and three different breast sizes (i.e., small, medium, and large). A total of 30 images were used in the experiment. The attractiveness scale was identical to the one used in Dixon et al. (2010). Attractiveness was measured on a 6-point Likert-type scale (1 = unattractive, 2 = slightly attractive, 3 = moderately attractive, 4 = attractive, 5 = very attractive, and 6 = extremely attractive).

**Procedure**

The eye tracking sessions followed the same procedure as in Experiment 1. Immediately after completion of the experimental session, participants proceeded to a second computer station to rate the attractiveness of the female images they were exposed to. Image presentation for the attractiveness-rating task was performed on an Apple iMac computer, using PsyScope and ioLab Systems USB Button Box. This task was randomly assigned, so that participants received a set of 15 images that were either dark skinned or light skinned. They were first given a practice trial of three pictures to familiarize them with the task.

**Results**

**Attractiveness**

As in Experiment 1, attractiveness ratings using a dichotomous variable were made as a function of WHR and breast size. Ratings were performed as participants made intuitive judgments while being visually recorded. The variables were dummy coded for WHR (i.e., 0.5, 0.6, 0.7, 0.8, and 0.9), breast size (i.e., small, medium, and large), and skin tone (i.e., dark and light). Attractiveness ratings were dummy coded as well. The logistic regression was significant, $\chi^2(6) = 2,258.62$. $p < .001$. Using the highest WHR (0.9) as a reference category, participants who viewed the 0.6 WHR were 15 times more likely to rate the image as attractive. This was followed by the lowest WHR (0.5), for which participants were 10 times more likely to rate the image as attractive, then the 0.7 WHR (7 times more likely), and lastly the 0.8 WHR (2 times more likely). If we use the smallest breast size as the reference category, medium breasts were almost 2 times more likely to be rated as attractive (see Table 4).

| Breast size | β | SE β | Wald | df | Exp(β) |
|-------------|----|------|------|----|--------|
| Small       | 0  | .0  | 1.10 | 1  | .32    |
| Medium      | .67**| .05 | 161.44| 1  | 1.97   |
| Large       | .10*| .05 | 3.87 | 1  | 1.10   |

Note. Model $\chi^2(6) = 2,258.62$. $p < .001$. $R^2 = .25$ (Nagelkerke). 0* = reference category; WHR = waist-to-hip ratio. *p < .05. **p < .01.

Using the 6-point attractiveness Likert-type scale, a 2 (gender: male vs. female) × 2 (skin tone: dark vs. light) × 3 (breasts: small, medium, and large) × 5 (WHR: 0.5, 0.6, 0.7, 0.8, and 0.9) mixed design revealed a significant main effect for WHR, $F(4, 1337.91) = 269.09$, $p < .001$. The lowest WHR (0.5) received the highest rating of attractiveness; significantly higher than the 0.7 WHR, $t(1337.90) = 4.08$, $p < .001$. The lowest WHR (0.5) was not significantly different from the 0.6 WHR, $t(1337.90) = .87$, $p = .39$. The main effect for breast size was also significant, $F(2, 1337.95) = 19.82$, $p < .001$. Images with medium breast size were rated as more attractive than images with small breast size, $t(1337.98) = 6.54$, $p < .001$, and large breast size, $t(1337.93) = 2.89$, $p < .01$. There was a main effect for gender, $F(1, 80.96) = 6.06$, $p = .01$. The images seemed more attractive to men than to women, $t(80.89) = 2.46$, $p = .01$. There was an interaction between gender and skin tone, $F(1, 1459) = 5.25$, $p < .05$. The dark-skinned images seemed more attractive to men ($M = 3.31$, $SD = 1.55$ vs. $M = 2.62$, $SD = 1.57$) than to women, $t(79.87) = 2.55$, $p < .05$. Finally, the results indicated that skin tone did not play a significant role in the overall ratings of attractiveness, $t(1457) = .32$, $p = .74$. Overall, we found that the lowest WHR (0.5) and the images with medium breasts received the highest ratings of attractiveness. Table 5 shows the mean ratings of attractiveness on a Likert-type scale.
Table 5. Means (SD) of the Attractiveness Rating Scale.

| WHRs       | Breast Size |
|------------|-------------|
|            | Small       | Medium     | Large      |
| Light skin tone | 3.77 (1.48) | 4.12 (1.38) | 3.47 (1.68) |
| .5 (WHR, light) |           |            |            |
| .6 (WHR, light) |           |            |            |
| .7 (WHR, light) |           |            |            |
| .8 (WHR, light) |           |            |            |
| .9 (WHR, light) |           |            |            |
| Dark skin tone | 3.74 (1.65) | 4.08 (1.52) | 3.52 (1.70) |
| .5 (WHR, dark) |           |            |            |
| .6 (WHR, dark) |           |            |            |
| .7 (WHR, dark) |           |            |            |
| .8 (WHR, dark) |           |            |            |
| .9 (WHR, dark) |           |            |            |

Note. WHR = waist-to-hip ratio.

Table 6. Number of First Fixations on One of Six Body Regions.

| WHR | Head | Breasts | Midriff | Groin | Thighs | Legs/Feet |
|-----|------|--------|--------|-------|--------|-----------|
| .5  | 1    | 6      | 41     | 297   | 402    | 0         |
| .6  | 0    | 10     | 41     | 294   | 399    | 0         |
| .7  | 1    | 6      | 30     | 296   | 413    | 0         |
| .8  | 0    | 10     | 37     | 287   | 403    | 0         |
| .9  | 0    | 12     | 31     | 284   | 406    | 0         |

Note. WHR = waist-to-hip ratio.

First Fixations

For all of the images (0.5, 0.6, 0.7, 0.8, and 0.9), significant differences were observed for the first region fixated, χ² = 10,219.02, p < .001 (see Table 6). The thighs were the region participants first looked at, but the duration of first fixation on the thighs was not affected by WHR, χ² = 21.71, p = .15. The second region that received the most first fixations was the groin. There were no significant differences between the remaining ROIs and WHR, χ² = 25.28, p = .19. That is, regardless of WHR, regions such as the head, the breasts, the midriff, and the legs/feet received similar first fixations. For all subsequent analyses, a 2 (gender) × 2 (skin tone) × 3 (breasts) × 5 (WHR) × 6 (ROI) mixed design was used to analyze the participant’s eye movements.

First Fixation Duration

The analysis revealed a significant main effect for ROI, F(5, 10882.19) = 190.05, p < .01. The ROIs that received the longest first fixation duration were the upper portion of the female image, most notably the head, the breasts, and the midriff, as seen in Figure 5. The breasts received longer first fixation duration than did the midriff, t(4160.79) = 4.88, p < .001; the head, t(3987.04) = 6.13, p < .001; the groin, t(4355.58) = 11.18, p < .001; the thighs, t(4959.06) = 9.93, p < .001; and the legs/feet, t(2563.10) = 4.97, p < .001. There was a significant interaction between ROI and gender, F(5, 10882.21) = 5.89, p < .01. This indicated that men in general spent more time than did women on all the ROIs, with the exception of the legs/feet (see Figure 6). Moreover, the head and the breasts received the longest gaze duration. These findings replicate the gaze duration time and differences recorded in Experiment 1.

Gaze Duration

In the gaze duration analysis, there was a main effect for ROIs, F(5, 10882.19) = 190.05, p < .01. Overall, fixations were longer for ROIs on the upper body than for those on the lower body. Individuals fixated longer on the breasts than on the midriff, t(4155.29) = 5.80, p < .001; the head, t(3974.92) = 2.54, p < .01; the groin, t(4355.58) = 11.18, p < .001; the thighs, t(4959.06) = 9.93, p < .001; and the legs/feet, t(2563.10) = 4.97, p < .001. There was a significant interaction between ROI and gender, F(5, 10882.21) = 5.89, p < .01. This indicated that men in general spent more time than did women on all the ROIs, with the exception of the legs/feet (see Figure 6). Moreover, the head and the breasts received the longest gaze duration. These findings replicate the gaze duration time and differences recorded in Experiment 1.

Total Time

For total time, there were three main effects, gender, F(1, 95.44) = 6.80, p < .01; breast size, F(2, 21.75) = 9.03, p < .01; and skin tone, F(1, 21.75) = 19.91, p < .01. The main effect for gender revealed that males spent longer total time on the images than females, t(95.44) = 2.61, p = .01. The main effect for breast size showed that large breasts received longer total time than medium, t(89.95) = 3.68, p < .01, and small breasts, t(84.12) = 3.52, p < .01. The main effect for skin tone showed that light skin tone images received longer total time than dark skin tone images, t(14.23) = 4.38, p < .001. The main effect for skin tone showed that, although attractiveness ratings of skin tone have been reported in past studies (e.g., Frost, 1988, 2007, 2008, 2011; van den Berghe & Frost, 1986), visual attention has not. This is a new finding that provides insight into the amount of interest people may show when scanning.
visual images. The images with the light skin tone were viewed longer than the images with the dark skin tone, \( t(6.93) = 4.46, p < .001 \). There was a three-way interaction between WHR, breast size, and gender, \( F(2, 64.31) = 5.33, p < .01 \). Men viewed the images with the 0.7 WHR and small breasts longer than women, as depicted in Figure 7. Female visual attention was consistent across all WHRs and breast size, where males showed the most difference in WHRs and breast size. Overall, findings for total time were similar to those reported for Experiment 1, in which men spent more time looking at all WHRs, including the additional 0.5 and 0.6 WHRs.

**Fixation Count**

For fixation count, there was a main effect for ROIs, \( F(5, 10874.94) = 255.63, p < .01 \). The breasts received a higher number of fixations than the midriff, \( t(4151.68) = 11.38, p < .001 \); the head, \( t(3945.40) = 5.63, p < .001 \); the groin, \( t(4355.56) = 20.98, p < .001 \); the thighs, \( t(4960.44) = 15.94, p < .001 \); and the legs/feet, \( t(2957.64) = 12.30, p < .001 \). There were interactions between ROI and gender, \( F(5, 10870.24) = 8.44, p < .01 \), and between ROI and WHR, \( F(20, 10832.40) = 2.82, p < .01 \). Men focused more than women on the breasts than on the midriff, \( t(106.07) = 2.29, p = .02 \); the head, \( t(115.42) = 5.62, p < .001 \); the groin, \( t(110.59) = 21.02, p < .001 \); the thighs, \( t(105.58) = 15.97, p < .001 \); and the legs/feet, \( t(290.89) = 12.20, p < .001 \). Table 7 shows mean fixation counts for the interaction between WHR and ROI. Fixation counts for WHRs and ROIs replicated findings from Experiment 1.

**Visual Regressions**

Visual regressions yielded a significant main effect for ROIs, \( F(5, 10890.47) = 100.32, p < .01 \). Participants made most of their visual regressions toward the upper body and the thighs. Most notably, the head and the breasts received the highest number of visual regressions for all WHRs, as seen in Figure 8. These differences were all significantly different from each other (\( p < .01 \)). In line with Experiment 1, most visual regressions focused on the upper female body (i.e., head, breasts, and midriff).

A separate post hoc analysis was conducted in order to determine differences between ratings of attractiveness and visual measurements. The YES/NO responses were dummy coded and entered as a predictor variable in the model. Subsequently, first fixation duration, gaze duration, total time, and fixation count were analyzed in a 2 (gender: male vs. female) \( \times 2 \) (skin tone: dark vs. light) \( \times 2 \) (attractive: yes vs. no) \( \times 3 \) (breasts: small, medium, large) \( \times 5 \) (WHR: 0.5, 0.6, 0.7, 0.8, 0.9) \( \times 6 \) (ROIs) mixed design. First fixation duration showed no significant interaction between ROI and attractiveness, \( F(5, 10809.82) = 1.46, p = .20 \). Gaze duration showed a significant interaction between ROI and attractiveness, \( F(6, 10852.39) = 2.20, p < .05 \). Pairwise comparisons revealed that images rated as attractive had longer gaze duration. In the total time analysis, there was an interaction between WHR and attractiveness, \( F(4, 10994.38) = 37.14, p < .001 \). Pairwise comparisons showed that, for 0.5, 0.8, and 0.9 WHRs, individuals who rated pictures as attractive spent more time viewing the image. This pattern was reversed for the 0.6 WHR. When participants rated the image as
unattractive, their viewing time was longer than when they rated the image as attractive. For the 0.7 WHR, total viewing time did not differ significantly between participants who rated the image as attractive and those who did not (p = .78). Additionally, there was a significant three-way interaction between WHR, skin tone, and attractiveness rating, F(2, 10815.28) = 5.44, p < .01. Light skin tone images that were rated as attractive were looked at longer (see Figure 9).

Discussion

In Experiment 2, our main goal was to determine whether lower WHRs (0.5 and 0.6) than in Experiment 1 would produce similar findings. Previous studies (Dixson et al., 2010; Henss, 2000; Singh, 1993, 2002; Singh & Young, 1995; Suschinsky et al., 2007) typically used 0.7, 0.8, and 0.9 WHRs and found that the lower the WHR, the more attractive the women would be rated. Additionally, we altered the image’s skin tone to determine whether skin tone played any role in attractiveness and in visual attention.

As in Experiment 1, we found that participants’ intuitive judgments of attractiveness were inversely related to WHR. That is, the lower the WHR, the more likely participants rated the image as attractive. As a methodological issue, we wanted to compare the YES/NO scale used in the experiment with the more commonly used 6-point Likert-type scale of attractiveness. Our results showed that the YES/NO responses were identical to those produced with the attractiveness scale used by Dixson et al. (2010).

Using the attractiveness scale, we also wanted to determine whether waist size, breast size, and skin tone were associated with attractiveness. For waist size, the image with the lowest WHR (0.5) received the highest rating of attractiveness. This study is one of the first to indicate that the 0.5 WHR is rated highly on the attractiveness scale. For breast size, the image with medium breasts received the highest rating of attractiveness. In contrast to Singh (1993), large breasts did not receive

### Table 7. Mean Numbers of Visual Fixations and Standard Deviations (SDs) for the ROIs as a Function of WHRs.

| WHR | Head (SD) | Breasts | Midriff | Groin | Thighs | Legs/Feet |
|-----|-----------|---------|---------|-------|--------|-----------|
| .5  | 2.47 (2.26) | 3.63 (1.13) | 2.45 (2.35) | 1.35 (1.69) | 1.78 (1.26) | 1.28 (.69) |
| .6  | 2.57 (2.38) | 3.16 (2.28) | 2.10 (1.82) | 1.43 (1.82) | 1.88 (1.32) | 1.15 (.82) |
| .7  | 2.48 (2.63) | 3.16 (2.47) | 2.27 (2.49) | 1.39 (1.75) | 1.82 (1.52) | 1.45 (1.75) |
| .8  | 2.43 (2.25) | 2.87 (2.52) | 2.87 (1.48) | 1.28 (1.60) | 1.70 (1.15) | 1.13 (.60) |
| .9  | 2.18 (1.55) | 2.66 (2.10) | 1.76 (1.34) | 1.24 (.56) | 1.56 (0.98) | 1.40 (.60) |

Note. WHR = waist-to-hip ratio; ROI = region of interest.

### Figure 8. Mean amount of regressions in waist-to-hip ratios as a function of region of interests.

### Figure 9. Mean total time (in ms) for skin tone as a function of gender and attractiveness rating.
the highest rating of attractiveness. Moreover, men were more likely than women to give female images higher ratings of attractiveness. Another important finding was that, unlike other findings (e.g., Swami et al., 2008), we did not find an overall significant relationship between attractiveness ratings and skin tone. However, when breaking the results down by gender, we found that darker-skinned women seemed more attractive to men than to women.

The eye movement results of Experiment 2 replicated those of Experiment 1, with the exception of the first fixation results. First fixations were directed toward the thighs, as opposed to the breasts (as in Experiment 1). This could be accounted for by the different WHRs that were used, the thighs (including the buttocks) being more noticeable. However, first fixation duration was identical in the two experiments. As in the first experiment, participants spent more time viewing the breasts and the midriff. This finding supports Singh (1993) in his notion of a first pass filter, that is, unconsciously, men will use the waist area as a measure of attractiveness. Gaze duration revealed similar patterns. The ROIs that received the most visual attention were the reproductively relevant ones, most notably the head, the breasts, and the midriff. This difference was more pronounced in men. This same pattern was reported in the first experiment. Specifically, men showed more interest in all the areas of the female body, with the exception of the feet. The upper parts of the body are often physical cues for mate selection; therefore, the time spent looking at the upper body differed significantly from the time spent looking at the lower body.

Total time data replicated the results found in Experiment 1 when looking at gender differences. Men spent more time viewing the breasts of the female when the WHR was 0.7. Total time results also showed that men spent significantly more time viewing the image than did women. Although participants did not rate the light skin tone as more attractive than the dark one on the Likert-type scale, they spent significantly greater time viewing the light-skinned images than the dark-skinned ones when making the intuitive attractiveness response (i.e., YES/NO). This suggests greater visual interest in the images with lighter skin. Previous research (Frost, 1988, 2007, 2008, 2011; van den Berghe & Frost, 1986) has suggested that lighter skin is a preferred attribute of women in many societies, and female skin tone changes in many ways that may explain this increase in attention. First, girls lighten in skin tone during adolescence much more than do boys, at a time of increasing reproductive capability. Also, skin tone is a neotenous trait, that is, lighter skin is one of several childlike characteristics that the female body seems to mimic, possibly to foster male nurturance and to decrease male aggressiveness (Frost, 1988, 2007, 2008, 2011; van den Berghe & Frost, 1986).

Finally, as in Experiment 1, fixation count and regressions were similar. Participants made more visual fixations on the upper body, most notably the breasts, the head, and the midriff. In terms of visual regressions, participants regressed to the upper body after first viewing the images. These visual regressions are consistent with the data from Experiment 1 and highlight the postautomatic response of visual interest, suggesting that the reproductively relevant regions are given a higher rating of attractiveness. In a separate post hoc analysis, we used attractiveness as a predictor to determine whether participants would spend more time viewing the female image rated as more attractive. We found significant interactions between attractiveness and gaze duration, in the sense that participants who rated the image as attractive had longer gaze duration time for all ROIs. Additionally, attractiveness was related to longer total time spent viewing images with WHRs of 0.5, 0.8, and 0.9. Interestingly, the image that was rated as attractive had more fixation counts for all ROIs. With this analysis, we can specifically show that eye movements differ as a function of attractiveness.

General Discussion

The purpose of the two experiments reported here was to explore attractiveness by measuring eye movements while participants viewed nude female images with different WHRs, breast sizes, and skin tones. To our knowledge, this is one of the most complete studies of attractiveness with a predominantly Hispanic population. By using eye movements, we could specifically measure visual attention in relation to WHR, ROI, gender, and skin tone.

Both experiments revealed similar findings and, in addition, replicated previous studies (e.g., Dixson et al., 2010, 2011b; Hewig et al., 2008; Suschinsky et al., 2007). When we measured first fixation duration, gaze duration, total time, fixation count, and visual regressions, participants were more likely to focus most of their visual attention on the upper part of the woman’s body. This is in line with what Suschinsky et al. (2007) referred to as the reproductively relevant regions, particularly for men. This study also supported the theoretical notion, which Singh (1993) referred to as the first pass filter, that visual attention should focus on the waist (i.e., the midriff). Also related to Singh’s research, we found that breast size did play a minor role in judging whether a female figure is attractive; however, waist size contributed a more significant role. Additionally, when looking at skin tone, we find that our results corroborate Frost’s extensive work on skin tone and attractiveness. Participants were more likely to view a female image longer if the skin tone was light, rather than dark.

The results of both experiments add to the existing literature on attractiveness, eye tracking, and ethnic differences. In this study, we did not see any major differences from previous research that focused primarily on European American populations. It appears that Hispanics of Mexican American descent prefer low WHRs, as do other ethnicities. In addition, our results indicate the importance of a more diverse selection of WHRs (0.5, 0.6, 0.7, 0.8, and 0.9) as a means to examine the differences that may exist with lower WHRs. In this study, images with lower WHRs (0.5, 0.6, and 0.7) had identical attractiveness ratings and total gaze time. We also found that breast size was not necessarily a consistent variable in attractiveness and visual measurements. Breast size slightly
increased the likelihood of rating the female image as attractive, and yet breasts overall received most of the visual attention. Participants focused most of their attention on smaller breasts in the first experiment and on large breasts in the second. Therefore, we cannot conclude that breast size directly affects either the attractiveness ratings or visual attention measures. This is in contrast to Dixson et al.’s (2011a) study, where the amount of visual attention did not differ with breast size.

To summarize, the results of both studies contribute three new findings to the field of human attractiveness. First, attractiveness varies over a short period of time, while one is viewing an image of a woman. This may indicate that the upper female body is considered more attractive than the lower female body, as was shown in both experiments. A mental algorithm seems to focus attention on one physical characteristic and then on another. In this sequence of events, evaluation of one characteristic has an impact on evaluation of succeeding characteristics. Interest in the midriff, as measured by first fixation duration, seems to function as a first pass filter that precedes evaluation of other characteristics, or specific regions of the female body that have been considered important in sexual selection. Moreover, when individuals focused on specific regions of the body, they tended to return to the ones they focused on the most. Second, this study shows the importance of additional measurements (e.g., first fixation duration and regressions) to accurately and precisely measure attractiveness. Eye movements provide a “true” measure because they reflect ongoing mental processes in real time, whereas ratings are typically “post hoc” processes that rely more on problem-solving strategies. The rating process may misrepresent what participants actually prefer or wish, since it requires additional mental processes. By using eye tracking, we can specifically measure what participants are most interested in. This was apparent in measurement of skin tone preferences: Attractiveness ratings did not differ overall, with the exception of gender differences, yet light-skinned images were viewed longer than dark-skinned images. Lastly, the results of the present study suggest gender differences in terms of attraction when viewing a female’s physical structure. The overall results provide further evidence that males favor certain regions (e.g., breasts and midriff) and spend significantly more time viewing the female body. Therefore, the way one views the female body is specifically determined by the physical characteristics that aid in mate selection.

These findings have led to a number of suggestions for future research. Studies of WHRs and attractiveness using eye tracking methodology might consider a wider array of measurements, such as those employed in the experiments described here. In previous studies, first fixation count was used to measure automatic processing and thus immediate interest in a specific body region. The present study shows that, in addition to first fixation count, first fixation duration should be used as an index of immediate visual interest. In both experiments, first fixation duration was a more consistent measurement than first fixation count. First fixation duration can provide greater insight into the amount of attention people devote to a specific body region. In contrast, first fixation count could indicate visual scanning, rather than degree of interest. We also suggest using attractiveness as a predictor variable to determine whether people spend longer times looking at images they rate as attractive than at those they rate as unattractive. This study is the first to look at these perceived differences between viewing times and attractiveness ratings. Future research might also consider whether eye tracking and image rating measure different levels of attraction. It may be that rating of images or figures on the traditional Likert-type scale would tap into erotic attraction, whereas eye tracking would measure attraction in general.

To conclude, we would like to address the following methodological issues that might be improved for future research. In both studies, there were more women than men in our sample size. The reason for using both genders in the study was to primarily focus on visual attention and attraction. Since the image was nude, and there were differences in gender visual attention, it can be argued that male visual attention was focused more on sexual attraction. That is, although there were similarities in visual patterns (i.e., first fixation duration, gaze duration, fixation count, and regressions), overall men spent more time on those areas than females, supporting the evolutionary theory of mate selection. Any reference to mate selection and reproductive relevance was distinctively associated with our male sample size. Even when using more males, as in the second experiment, the results were similar to the first, and it was shown that men spent more time on images and specific areas (e.g., breasts and midriff) of the body than women. Future research exploring mate selection or reproductive relevance could focus specifically on a male population. Another limitation of the present study was the stimuli that were used. The image taken from Dixson et al. (2010) may not capture a representative cross section of women’s torsos (i.e., include more than one image exhibiting various poses). Research in this field could benefit from using different photos of females, such as nude versus clothed females to compare whether the pattern of visual attention is solely for nude females, or for females in general, and to experimentally manipulate visual attraction versus sexual attraction, where clothed may represent visual attraction and nude sexual attraction. Additionally, the experimental image used exhibited pubic hair in the groin area of the body. Since it has become fashionable for women to remove pubic hair, it might have served as a distracting stimulus. However, our results did not reveal significant fixation or attention displayed to this ROI. Future research using similar stimuli might wish to consider removing potentially distracting stimulus.

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