VARIATION IN MALE GAZE PATTERNS: DO GAZE PATTERNS GENERALIZE BETWEEN SEXUALLY RELEVANT AND NON-RELEVANT STIMULI?

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ABSTRACT

VARIATION IN MALE GAZE PATTERNS: DO GAZE PATTERNS GENERALIZE BETWEEN SEXUALLY RELEVANT AND NON-RELEVANT STIMULI?

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Preliminary eye-tracking studies have identified two distinct gazing strategies which males employ when assessing the attractiveness of female images (Melnyk, McCord, & Vaske, 2014). It has been hypothesized that differences in male gazing strategy reflect differences in their mating strategy. Conversely it is possible that differences in gazing strategy simply reflect a difference in cognitive processing style. To explore these possibilities the current study examined the degree to which gaze patterns did or did not generalize between assessing the attractiveness of sexually relevant images, (females) and sexually irrelevant images (pre-pubescent or post menarche females, males, chimps, and neutral images). The model was partially supported as latent class analyses revealed a two class solution existed for one of the sexually relevant females, but for all other images gazing behaviors were best represented by single class solutions. For the female with two distinct groups of gazers a MANOVA was used to determine differences on gazing variables. Results revealed significant differences in the amount of time spent on the face $F\ (1,75) = 7.191$, $p = .009$; $n2 = .087$, and hair $(1, 75) = 157.328$, $p = .000$; $n2 = .677$. Priming effects and the implications for future studies are explored.

CHAPTER I – INTRODUCTION

Preliminary studies from eye-tracking research suggest that each male has a gaze pattern that is unique to the individual. This serendipitous finding was noted early in initial data collection, leading to re-analysis of the data, and has been replicated subsequently (Melnyk, Dillard, & McCord, 2014; Melnyk, & McCord, 2013; Melnyk, McCord, & Vaske, 2014). The original study (Melnyk & McCord, 2012) manipulated hair color across four models. Each model was presented an equal number of times with blonde, black, brown, and red hair. It was hypothesized when a model was shown with blonde hair she would be seen as younger, and therefore more attractive. It was also predicted that a greater proportion of total gaze time would be spent on blonde hair, and that overall assessment time would be shorter when blonde hair was present as a cue.

Early into data collection researchers noted that each male used a gazing strategy that appeared unique to the individual. Subjects also displayed relative consistency across models. The gaze pattern used for the first model looked similar to the gaze pattern used for each subsequent model shown. It soon became apparent the influence of the independent variable (i.e., hair color) was outweighed by the breadth of varied and unique individual gaze patterns. None of the predicted hypotheses reached a significant level.

Data were post analyzed using latent class analysis to see if subjects could be meaningfully placed into groups based on emerging patterns. Results showed the 60 male subjects could be meaningfully placed into two distinct groups with 70% falling into the first category and the remaining 30% falling into the second. The two-class solution was statistically superior to a one-class solution, and a three-class solution was not statistically more meaningful than a two-class solution.

The first latent class was labeled “face,” characterized by gaze patterns fixated predominantly on the face of female models. The second latent class also looked at face more than any other body region; however, class two spent significantly less time fixating on faces than the “face” class. The second class was also categorized by spending significantly more time looking at the breast, waist, and hip regions. Based upon their broader gaze pattern, yet still showing a predominant interest in the face of the model, class two was labeled “face plus.” While two distinct groups could be formed, no other differences between the groups could be explored given the nature of post analysis.

Some literature exists to suggest that while viewing sexually relevant stimuli male gaze pattern is governed by the type of mating strategy currently being employed. In a recent study males were shown a woman with a box covering her body, and another box covering her face. Subjects were told they could remove one of the two boxes, and asked which they would like removed. Researchers found that when focused on short term mating men would prefer seeing a woman’s body to her face, however, in the case of a long term relationship men were more concerned with the attractiveness of the woman’s’ face (Confer, Perilloux, & Buss, 2010). Based upon the similarities between Confer, Perilloux, and Buss’s data, and the face and face plus categories of the current area of research, a second experiment was set up. The second study allowed researchers to shift focus from hair color to the differences in gaze types. Particularly, does mating strategy influence gaze behavior, and by extension predict group placement? Researchers predicted there would be a difference between latent classes, in long and short term mating strategies. Specifically that “face” would score higher in cues of commitment, and long term mating strategy. While “face plus” would score higher in cues to a short term mating strategy and lower in cues of commitment This follow up study also tested the reliability of the latent two class construct.

In order to assess short-term versus long-term mating strategy, subjects completed the Revised Socio-sexual Inventory (SOI-R), which factors the overall number of sexual partners, number of sexual partners within the past year, the subject’s attitude towards promiscuous behavior, and their desires for future sexual experiences. The SOI-R ranks responses on three subscales Attitude, Behavior, and Intent (Penke & Asendorpf, 2008). Subjects also completed the Commitment Scale, with subscales of Intent to Persist, Attachment, and Long-term Orientation (Rusbult, Kumashiro, Kubacka, & Finkel, 2009). Subjects were also asked to complete the M5-120 Personality Questionnaire (Johnson, 2011; McCord, 2011), a five-factor personality test, to see if any personality differences occurred between groups. For the eye-tracking portion of the study the subjects were asked to rate the attractiveness of a female model from 1 (lowest) to 10 (highest). Immediately afterwards a follow up question came on screen asking subjects if they would rather have sex with or marry the model they were viewing.

Once again subjects could be placed into two distinct classes at greater statistical significance than a one class or three class solution. The two-class solution replicated previous categorizations of gaze types with “face” and “face plus” classes emerging. Based upon latent classes, no differences occurred between groups on the SOI-R, the Commitment Scale, or personality factors. The scales used in this experiment had all been established as valid and reliable measurements in previous research. Furthermore, when subjects were grouped based on a preference to sleep with or marry the model, rather than latent class assignment, significant differences could be seen on both the SOI-R and the Commitment Scale. This suggests the scales used were reliable in predicting long-term verses short-term mating strategies. These combined findings raise the possibility that the two classes formed by gaze pattern may not be related specifically to mating preferences but instead might reflect a more general perceptual style.

The current study is designed to address this issue. Are the differences between classes exclusive to sexually relevant content, or due to a more underlying cognitive mechanism? When shown an image of a male model, or a monkey, or a tree, will the face and face plus classes use a similar pattern to the one they use when viewing female models?

CHAPTER II – REVIEW OF THE LITERATURE

Principles of Mate Selection in Humans

While evolutionary theory had already begun to make its way into scientific community, *The Origin of Species* (Darwin, 1859) served as a catalyst introducing evolution to the world. Darwin argued adaptations accounted for the variation within a species due to natural selection, an idea central to modern evolutionary theory.

Darwin noted a few striking inconsistencies with his theory of natural selection. The first problem Darwin found was with the feathers of a male peacock, which appear to draw unnecessary attention. Why would a trait which increases the likelihood of attracting predators be adaptive? The second anomaly noted was the variation between sexes in a number of species. Given a shared environment and facing similar adaptive challenges, why did dramatic differences between sexes occur? To answer both of these inconsistencies Darwin devised a second evolutionary theory, which focused on sexual selection through intra-sexual and intersexual competition. Intra-sexual competition is characterized by same-sex rivals pitting against one another to gain sexual access to a desirable member of the opposite sex, whereas in intersexual competition qualities deemed attractive by the opposite sex will be given access to more mating opportunities and more desirable mates, and as a result these qualities will increase in a species over time.

The evolutionary model was significantly influenced by the contributions of Gregor Mendel who demonstrated genetic inheritance through a series of experiments on a variety of pea plants (Mendel, 1866). Unfortunately, Mendel’s discovery went largely unnoticed for some time. Once researchers realized the significance of Mendel’s discovery, his genetic model was combined with Darwin's theory of natural selection forming what is known in biology as "the modern synthesis" (Dobzhansky, 1937; Huxley, 1942; Mayr, 1942; Simpson, 1944).

While evolutionary theory stems from biology, it has been increasingly implemented in other sciences and cross-disciplinary studies. By 1921 Westermarck had proposed a link between attractive features and evolutionary functionality (Westermarck, 1921). Westermarck argued sexually attractive traits are species-typical, evolving as a result of natural selection. Similar conclusions were made by Ellis (1926) who expounded that while attraction has been observed to be species–typical, marked differences still occur between males and females in sexual selection, and in displays of mating behavior. These differences were directly addressed by the parental investment theory proposed by Robert Trivers (1972), whose work expounded on the inclusive fitness model proposed by W. D. Hamilton (1964). Hamilton noted classical fitness was a too narrow of a view as it did not take genes passing through other sources into consideration. For example, on average siblings share 50% of the same genetic makeup; as a result, increasing the fitness of a sibling increases the fitness of the mutual genes shared with them. Building upon the framework of inclusive fitness Trivers expanded on Hamilton's work with three major papers, the second of which, describing parental investment theory, is particularly relevant to the current area of study.

Parental Investment Theory

A primary difference between men and women is the size of their gametes. Females have large gametes with relatively low mobility, whereas males have small gametes with rather high mobility, produced in much greater number. A female is born with roughly 400 ova which serve as her eggs over her lifetime. Males on the other hand produce 12 million sperm per hour (Marshall, 1893; Yeung, Anapolski, Depenbusch, Zitzmann, & Cooper, 2003). Not only is there an offset in gametes but females must gestate the egg. The (human) female must then carry the child for 9 months, consuming considerable energy and resources, and closing all other mating opportunities until after the child is born. The initial male contribution is considerably less, taking only a matter of minutes in some cases. Initial investment in offspring tends to weigh far more heavily on females, with the exception of a few anomalies noted in nature (Trivers, 1985). Trivers's theory predicts in any given species whichever sex has the greater investment will be the more discriminating of the two. In the case of all mammals the female undergoes internal fertilization and gestation, making them the more discriminating sex. The initial parental investment of women makes them a valuable resource (Trivers, 1972). As a result of women being choosy as to which males they will mate with, men to a greater degree must compete for access to females.

Women's Mate Preferences

Traditionally females have had to choose from a wide variety of desirable traits in males. There are concerns with financial prospects and resource acquisition, as well as how willing a particular male is to invest those resources in her and her children. Furthermore symmetry and physical fitness are important as they serve as cues to genetic quality.

A preference for financial resources is contingent on two things. First a man must not only have resources but have a way of ensuring they will not be taken away, and secondly he must be willing to invest those resources. Some men prefer to mate with a large number of women, investing as little as possible in each, while other men focus all of their resources towards one woman and her children (Belsky, Steinberg & Draper, 1991).

An American study found women value economic resources to a much greater amount than men do. In 1939 women valued financial resources twice as much as men did on a survey, and this finding was replicated in 1956 and again in 1967 (Buss, Shackleford, Kirkpatrick, & Larsen, 2001). These findings remained consistent past the sexual revolution of the 1960's and 1970's with data replicating yet again in the mid-80's,with women showing nearly twice the preference men show for financial prospects (Buss, 1989). Another study examined desired earning percentiles of a hypothetical partner. Women indicated a desire for their hypothetical partner to at least be in the 70th percentile, whereas men indicated a preference for at least the 40th percentile (Kenrick, Sadalla, Groth, & Trost, 1990). In personal ads it was found women tend to seek financial resources roughly 11 times as often as males do (Wiederman, 1993). In the landmark 37-culture study of David Buss (1985), across all cultures women not only rated financial prospects as more important than men did, it was nearly twice as important.

A preference for social status goes close to hand in hand with resources as typically the men who control society control the resources. Betzig (1986) studied 186 societies and found high status men had greater wealth, more wives, and were able to provide higher quality food for their children. Preference for social status was another factor with significant differences in Buss's 37-culture study; women in Taiwan valued social status 63 percent more than men did, 40 percent more in Brazil, and 38 percent more in West Germany, just to cite a few (Buss, 1989). Age also plays a factor. An older male has had more time and opportunity to accrue resources. As a result older men are often more established and able to invest resources in offspring. Throughout the 37-culture study women universally preferred men who were older than them, averaging 3½ years of preferred difference. Although age preferences range from just under 2 years apart in French Canadian women to Iranian women who seek husbands over 5 years older than themselves (Buss, 1989).

Ambition and industriousness are other factors for which women show a greater preference. Eight hundred fifty-two single American women and 100 married American women unanimously rated ambition and industriousness as important or indispensible (Buss, 1989). Where women see men who lack ambition to be extremely undesirable, men tend to see a lack of ambition in women to be of little to no consequence in their desirability (Buss & Schmitt, 1993). Dependability and stability are two factors on which both males and females place high value in a mate; in the 37-culture study the only trait on which both sexes placed more value was love (Buss et al., 1990). Of course both traits are tremendously important. A dependable man will not only give resources but will reliably do so over a long period of time. An unreliable man will provide erratically and inflict emotional cost and other damage to partners (Buss, 1991).

Women must also take factors of physical and athletic prowess into account. Sexual domination is a recurrent theme among primates. Barbara Smuts (1985) found that female baboons frequently formed “special friendships” with males who offered physical protection against other males and predators that would do her or her children harm. In return the female baboon gives the male sexual access during estrus. Likewise women have developed a preference for men who appear physically fit and able to protect them and their offspring. A study on desirability of physical traits women judged short men to be undesirable as a short-term or long-term partner (Buss & Schmitt, 1993). Another study found tall men (roughly, 5’ 11”) were seen as an ideal marriage partner. Tall men are also seen as more desirable mates and dates than short men (Ellis, 1992). When women place personal ads that mention height, 80 percent say they want a man who is 6 feet or taller (Cameron, Oskamp, & Sparks, 1978). It was also found that personal ads placed by taller men received more responses than those placed by short men (Lynn & Shurgot, 1984).

Men's Mate Preferences

While females tend to be the more selective sex, considerable competition still occurs between females competing for accesses and retention of mates (Fink, Klappauf, Brewer, & Shackelford, 2014). In Buss's 37-culture study he found universally men place significantly more value on features of physical attractiveness and youth than women do (Buss, 1989). Youth and beauty have been linked with numerous biological markers of fertility, health, and reproductive value (Evans, Hoffmann, Kalkhoff, & Kissebah, 1983; Wass, Waldenstrom, Rossner, & Hellberg, 1997; Zaadstra, et al. 1993; Ziomkiewicz, Ellison, Lipson, Thune, & Jasienska, 2008).

Preference for youth. Multiple cross-cultural studies have shown that to a near universal degree men show a preference for women who are younger than themselves (Buss, 1994; Symons, 1995). Further exploration led to a more precise prediction that men prefer women close to peak levels of fertility and reproductive fitness. Teenage boys showed a preference towards women in their early to mid 20's even in cases where such preference resulted in a 7-year age gap (Kenrick, Keefe, Gabrielidis, & Cornelius, 1996).

Preference for beauty. With regard to beauty, multiple predictor variables have been examined, including body dimensions (shape and structure), hair quality and length, skin tone and clarity, facial symmetry, and femininity. The following sections will review each of these predictor variables in greater depth, as each is pertinent to the current field of study.

Waist-to-hip ratio (WHR). Devendra Singh was the first to link waist-to-hip ratio (WHR) and perceptions of attractiveness. He suggests optimal attractiveness is reached when the waist is 70% the size of the hips. Singh demonstrated this finding in a landmark study (1993a) analyzing the body dimensions of Miss America winners and Playboy centerfolds. These samples were selected in particular as both groups are widely viewed as pinnacles of beauty within American society. Results came back showing there was a slight trend for females to get thinner over time; however, the WHR of winners and centerfolds tended to stay between .68 and .71 on average. A preference for a .7 waist-hip ratio has been replicated across a variety of studies (Singh, 1993b; Singh, 1994; Singh & Young, 1995; Singh, 1995; Singh & Randall, 2007). Physiological studies examining the effects of body fat distribution offer confirmation of WHR as a biological cue to personal and reproductive fitness. Healthy waist to hip ratios tend to reflect fat distribution (more so than actual amount of fat) and have been linked to lower risks of diabetes, hypertension, heart attack, stroke, and gallbladder disorders (Evans, Hoffmann, Kalkhoff, &Kissebah, 1983; Hartz, Rupley, & Rimm 1984). Beyond personal health benefits WHR has been empirically linked to factors of fertility. One study found women with a low WHR (indicated by a smaller waist) and relatively larger breasts on average had levels of estradiol that were 26 percent higher than the rest of the female sample. This is significant as estradiol is an ovarian hormone, which serves as a good predictor of fertility (Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004). Another study found increasing WHR is negatively correlated with fertility. In-fact, distribution of body fat seems to have more influence over fertility than age or obesity (Zaadstra et al., 1993). Cross cultural studies have demonstrated the preference for a .7 WHR is not culturally bound but appears to be a near universal trait (Dixon, Dixon, Bishop, & Parish, 2010; Dixon, Dixon, Li, & Anderson, 2006; Singh, Dixson, Jessop, Morgan, & Dixson, 2010; Singh & Luis, 1995).While many cross-cultural studies have rendered results suggesting a .7 WHR preference to be a universal trait, there are marked exceptions. Among Yomybato and Shipertiari males located in indigenous regions of Peru, weight, but not waist-to-hip ratio, was a strong predictor of perceived attractiveness, as well as health, and desirability as a wife (Douglas & Shepard, 1998). Further studies found the Hadza men of Tanzania always preferred images of heavier females, whereas U.S. men found thin images most attractive and medium images as healthiest and most desirable as a wife. Further WHR was not a significant predictor of response in Hadza men, whereas U.S. samples show a preference for the .7 WHR (Westman & Marlowe, 1999). Skeptics of WHR propose body mass index (BMI) may be a stronger and more reliable predictor of attractiveness.

Body mass index (BMI). One study found WHR and BMI to be positively correlated, with WHR going up as BMI goes up; however, when researchers statistically controlled for BMI, WHR was not a significant determinant of attractiveness (Cornelissen, Tovee, & Bateson, 2009). This suggests WHR is only an important factor as to the degree to which it correlates with BMI. Supporting evidence can be seen in an eye-tracking study which found gaze patterns for perceiving body attractiveness correlated with gaze patterns used to estimate BMI, and not with gaze patterns used to estimate WHR; attractiveness scans focused primarily on the waist and breasts but not the hips or pelvis (Cornelissen, Hancock, Kiviniemi, George, & Tovee, 2009). Other studies have demonstrated BMI to be a greater predictor of perceived attractiveness, health, and fertility than WHR (Mo et al., 2013). In another study BMI was roughly twice as powerful a predictor of attractiveness compared to WHR (Koscinski, 2013). Overall BMI appears to be a very significant predictor of attractiveness in Western societies (Fan, Liu, Wu, & Dai, 2004; Puhl & Boland, 2001; Tovée, Edmonds, & Vuong, 2012; Tovée, Hancock, Mahmoodi, Singleton, & Cornelissen, 2002; Tovée, Maisey, Emery, & Cornelissen, 1999; Tovée, Reinhardt, Emery, & Cornelissen, 1998). Just as WHR has been linked to cues of reproductive fitness, there have been studies showing a relationship between BMI and reproductive fitness. Women must have a certain amount of fat in order to be able to reproduce

(Frisch, 1988). Another study found women who are overweight or obese in early adulthood show greater risks of menstrual problems, hypertension during pregnancy, and sub-fertility (Lake, Power, & Cole, 1997). High or low BMI's were associated with a reduced probability of successful reproduction treatment, particularly in the obese category. Regression analysis revealed once controlling for other variables pregnancy rates for obese women in assisted reproduction treatment were half that of women receiving treatment with moderate BMI's (Wang, Davies, & Norman, 2000). BMI also serves as a good indicator of health. One study followed 115,195 females enrolled in the Prospective Nurses Health Study. Researchers found women with a BMI over 29 were more than twice as likely to die in comparison to the leanest women in the study. Once BMI was above 27 mortality rates were substantially higher. Mildly overweight women were at an increased risk of coronary heart disease and cancer (Evans & Frank, 1997). While the number of BMI studies has greatly increased in the literature over the past few years, they are not without some methodological flaws. An argument has been made that social science datasets should use more accurate measures of fatness, as BMI does not account for fat free mass such as muscle and bone (Burkhauser, & Cawley, 2008). Another study found that when compared to a body fat percentage count determined via BOD POD, BMI failed to accurately predict overweightness in both college student and college athlete samples (Ode, Pivarnik, Reeves, & Knous, 2007).

WHR/BMI interaction studies. The argument has been made that sexual selection operates on whole phenotypes, not the relative proportions of a single body part (Brooks, Shelly, Fan, Zhai, & Chau, 2010). As a result, in recent years many researchers are opting to measure BMI and WHR, along with other body regions, concurrently rather than independently. In a recent study researchers examined the effects of BMI and WHR as well as the girth of limbs on perceptions of female attractiveness. Results showed BMI and WHR to be interdependent factors, leading the authors to conclude the two factors should be studied in unison rather than isolation (Funham, Petrides, & Constantinides, 2005). Furnham conducted a follow up study and found an interaction between WHR and breast size. Evidence suggests results and conclusions of WHR studies are dependent on selected stimulus materials and data analysis employed (Furnham, Swami, & Shah, 2006). Along those lines researchers at Emory University and Yerkes National Primate Research Center ran a study on the effects of BMI and WHR as interdependent variables in predicting attractiveness. Results showed BMI and WHR were both significant predictors of attractiveness; however, in their study waist circumference proved to be an even greater predictor of attractiveness (Rilling, Kaufman, Smith, Patel, & Worthman, 2009). A comprehensive study of body proportions found age, BMI, and WHR, were all correlated with ratings of attractiveness; however, findings implicate youth and abdominal fat proportion and placement are not the sole determinants of body attractiveness. Other body dimensions such as a larger bust, smaller waist, narrow ankles, longer limbs, and a shorter distance between waist and hips play a significant role in attractiveness (Brooks, et al., 2010).

Hair quality. Another cue of health and attractiveness is quality and length of hair. Two hundred thirty women were interviewed in a variety of public locations. Interviewers collected data on age, subjective health, and relationship status. Additionally, hair length and quality were measured (Hinsz, Matz, & Patience, 2001). Hair length and quality were both strong predictors of youth. Younger women tended to have longer hair when compared to older women; furthermore, observers' judgments as to the quality of interviewees' hair were positively correlated with the women's own subjective judgments of their health. Another study examined the role hairstyle plays in facial attractiveness. Results showed only long and medium length hair significantly effected ratings of attractiveness. These two hairstyles also greatly increased perceived health. Long hair particularly boosted perceived health in women with lower scores of attractiveness (Norbert & Bereczkei, 2004). Another study yielded similar results, with long hair compared to short being correlated with higher scores of attractiveness (Bereczkei & Mesko, 2007). Fink, Neuser, Deloux, Roder, & Matts (2013) also replicated manipulation of hair as a means to significantly increase or alter female facial attractiveness. Additionally they found healthy hair was perceived as looking younger, healthier, and more attractive than damaged hair.

Skin quality. Skin quality is an important factor as it gives an indication of both current health, along with a part time record of previous health (Sugiyama, 2005). Clear skin free of blemishes boasts an absence of parasites, skin damaging disease, and the possibility of good genes able to heal without infection (Singh & Bronstad, 1997). Multiple studies have found homogeneous skin to be perceived as younger and more attractive than splotchy skin (Fink et al., 2008; Fink, Grammer, & Thornhill, 2001; Fink, Grammer, & Matts, 2006). A more precise study found perceptions of age, attractiveness, health, and youth were all influenced by the distribution of melanin and hemoglobin on the skin (Matts, Fink, Grammer, & Burquest, 2007). In another study a small group of subjects were shown 118 images of Japanese women ranging in age from 13 to 80. Subjects were asked to give age estimates for each image; however, images were cropped so subjects only saw a patch of skin from the cheek. Results showed age estimation was highly correlated with actual chronological age, suggesting skin tone is a reliable and accurate means for estimating age (Lopera, Igarashi, Nakao, & Okajima, 2013). Another interesting finding is the role of skin coloration on perceived health. When subjects were allowed to alter skin coloration to create what they perceived to be optimal looking healthy skin, skin redness was increased, providing support that skin blood color enhances healthy appearances. Subjects also increased yellowness and lightness of skin, suggesting a ratio of high carotenoid and low melanin coloration are present in healthy faces (Stephen, Law-Smith, Stirrat, & Perrett, 2009). Further research into skin coloration has found increased carotenoid coloration significantly improved ratings of attractiveness (Lefevre, Ewbank, Calder, von dem Hagen, & Perrett, 2013). Previous studies have also linked other aspects of skin quality to facial attractiveness (Fink & Neave, 2005). This is of particular importance as research suggests males gaze at the face more than any other body region when making assessments of female attractiveness (Melnyk & McCord, 2013; Melnyk, McCord, & Vaske, 2014; Melnyk, Dillard, & McCord, 2014).

Facial femininity and symmetry. With face being gazed at more than any other region it stands to reason the face figures very prominently in determinants of attractiveness. Typically males find more feminine faces to be particularly attractive. Femininity is defined as having features such as full lips, relatively larger eyes, a small chin, thin jaw, high cheek bones and having a relatively short distance between the mouth and jaw (Gangestad & Scheyd, 2005). It is hypothesized that feminine faces are likely to be determinants of attractiveness for two reasons. First, as women age there is a tendency for facial features to become less feminine; thus, facial femininity offers cues to youth. Secondly, facial femininity is linked to higher levels of estrogen, one of the primary ovarian hormones linked to fertility (Schaefer et al., 2006). In fact in a biological analysis women who reported a desire for many children were rated as more feminine looking than those who desired fewer children (Law Smith et al., 2010). A meta-analysis revealed that facial femininity is one of the most powerful predictors in regards to female attractiveness (Rhodes, 2006). In another study researchers found a male preference for feminine faces remained significant, although reduced when health was controlled for, and remained significant when age was controlled for (Moore, Law Smith, Taylor, & Perrett, 2011).

Symmetry is another factor that holds a great deal of influence over attractiveness. It is hypothesized that symmetry is an indicator of developmental stability, showing ability to withstand environmental stressors, and a signal of good genes (Thornhill, & Gangestad, 1993). Symmetrical faces have been positively correlated with ratings of attractiveness, compared to non-symmetrical faces (Fink, Neave, Manning & Grammer, 2006). Cross cultural studies suggest preferences for symmetry may be a universal trait (Rhodes, et al., 2001; Rhodes, 2006).

Another study showed symmetrical faces that were close to average and characterized by feminine features such as prominent cheek bones, full lips, thin eyebrows and a small nose and chin were most attractive. Overall averageness was the best predictor of female attractiveness; however, feminine features were still enhancing (Baudouin & Tiberghien, 2004).

While a great deal of the literature supports the concept of the importance of facial symmetry, not all researchers agree on the subject matter. Derek Hodgson (2009) proposes that while an attraction to symmetry is present, it is not sexually motivated. Rather he suggests it is a perceptual bias, based upon human history and craft making. Further, he does not believe symmetry to be a reliable cue to an individual's actual quality of health.

Eye-Tracker Technology and Research

Machinery such as eye-trackers are becoming increasingly available to researchers, in part due to the rapid growth of technology. Access to such technology now allows evolutionary predictions to be tested in new and precise measures. Eye-tracking technology has in fact been present in some shape or form for over 100 years. Only in the past decade has technology of this nature been implemented in evolutionary psychology.

One such example is a study aimed to further expand the literature of WHR by using eye tracking technology. Men viewed the same female over the trials, but, her body was "morphed" by a computer to vary her breast size (small, medium, large) and her WHR (.7 or .9). They found breasts and hips received more attention than any other body region. Men gazed predominantly on breasts; however, consistent with previous WHR literature, the .7 WHR was always preferred to the .9 WHR, regardless of breast size (Dixson, Grimshaw, Linklater, & Dixson, 2011). In contrast, other eye-tracking studies contend these results. Previously mentioned in the review of BMI literature above is an eye tracking study conducted by Cornelissen et al. (2009). This study used an eye-tracker to gauge similarities and differences in gaze patterns when assessing for WHR, BMI, or attractiveness. As noted previously, the fixation patterns used by the attractiveness condition were similar to the patterns used to assess BMI, with predominant focus on the bust and stomach. Gaze patterns used to assess WHR did not relate to gaze patterns used for assessing attractiveness and focused predominately on the hip and pelvic area. Another study found fixation count and duration were significantly higher when viewing faces with homogeneous skin color, typical of younger people, than when faces were shown less homogeneous skin colors (Fink et al., 2008).

Baseline studies in eye-tracking studies focused on gaze patterns involving sexually relevant stimuli have established that both men and women have a greater number of fixations while viewing erotic stimuli, compared to neutral non-erotic stimuli (Lykins, Meana, & Kambe, 2006). Similarly, researchers found heterosexual males paid greater visual attention to adult females than to adult males or children of either sex (Fromberger et al., 2012). In another study male subjects viewed images of females ranging in age from birth to 60. Results showed men had a greater number of fixations, with overall longer gaze times, when viewing 20-year-old females compared to any other age group. These findings are consistent with evolutionary predictions in regards to peak fertility (Hall, Hogue, & Guo, 2011).

A significant amount of evidence is present showing the importance of the face in attraction; in fact, studies suggest both males and females gaze at the face more so than any other region (Hewig, Trippe, Hecht, Straube, & Miltner, 2008; Melnyk, & McCord, 2013; Melnyk, McCord, & Vaske, 2014; Melnyk, Dillard, & McCord, 2014). While Hewig et al. (2008) report that both sexes primarily gaze at the face, they also noted differences between the sexes. After the initial scan of the face, men spent significant time looking at women's breasts, whereas women gazed longer at the legs of both men and women. Rupp and Wallen (2007) found similar results, with marked sex differences in gaze span between males and females while looking at sexually arousing visual stimuli. Expanding on this literature Tsujimura et al. (2009) found that while marked differences occur between sexes while viewing sexually arousing stimuli, these differences dissipate when presented with stimuli depicting explicit intercourse.

In previous research Melnyk and McCord (2012) examined the role of hair color as a determinant of attractiveness. Based on the assumption that in all cultures blonde hair darkens with age (Symons, 1995), it was predicted that models with blonde hair would be viewed as younger and therefore more attractive. Additionally it was proposed that proportionally more gaze time would be devoted examining blonde hair, and a shorter assessment time would be needed to estimate age and attractiveness when blonde hair was present as a cue. Of the four hypotheses, none reached significance; however, researchers had made a serendipitous finding early into data collection based upon the individual differences in gazing strategies noted in subjects. Data were post analyzed to meaningfully place subjects into groups based on gazing strategies. Latent class analysis revealed subjects could meaningfully be place into two distinct groups. The first group, labeled "face," gazed at the face more than any other region. The second group was labeled "face plus," and they too were categorized by looking at the face more than any other body region; however, they looked significantly less than the “face” group. Furthermore the “face plus” group gazed at the breast, waist, and hip regions significantly longer than the “face” group (Melnyk, McCord, & Vaske, 2014). A tendency to predominantly gaze at the face is consistent with other findings in the literature of eye-tracking and human sexuality (Hewig, Trippe, Hecht, Straube, & Miltner, 2008; Rupp & Wallen, 2007; Tsujimura et al., 2009). A follow up study replicated the two-class solution. Groups were once again categorized by a “face” and “face plus” category (Melnyk, Dillard, & McCord, 2014). Potential predictor variables of socio-sexuality, commitment levels, and personality factors were explored but yielded no significant results between the face and face plus classes. One possible explanation could be in personal preference of various body regions. Dagnino, Navajas, and Sigman (2012) ran a series of studies finding that males display a dichotomous difference in preferences for breasts or buttocks; rarely did males believe these body regions equally contributed to attractiveness. A follow up experiment within the same study had males express their preference for either breasts or buttocks. Subjects were then calibrated to an eye tracker and simultaneously presented with two images; a pair of breasts, and another image of a buttock. Subjects were asked to compare the body features and decide which image they found more attractive. Results showed first and last fixations were both directed towards the body region the subject had indicated a preference for.

Statement of the Problem

While males can be meaningfully placed into distinct groups based upon their unique gaze patterns, researchers have failed to identify the determining variable(s). The current study aims to see if male gaze patterns remain relatively consistent between sexually relevant and non relevant stimuli. If gaze patterns do generalize, it provides evidence for a more underlying cognitive mechanism. However, if gaze patterns vary between sexual and non-sexual stimuli, it provides evidence that the diversity in gaze patterns is sexually driven. Based upon the work of Dagnino, Navajas, and Sigman (2012) it is also possible that gaze patterns are determined by personal preferences, which may or may not be evolutionarily driven. The hypothesis in question predicts: Gazing patterns used to determine female attractiveness will not generalize from sexually relevant stimuli to sexually non-relevant stimuli.

CHAPTER III – METHOD

Participants

Male subjects were recruited via the “psychology participant pool” at Western Carolina University. Subjects were given a “subject number” upon arrival to ensure eye tracking data could be paired with demographic data while maintaining anonymity. In the demographics survey subjects were asked to reveal sexual orientation. Individuals who did not indicate a sexual preference for females were excluded from analysis. Upon completion subjects received .5 class research credits uploaded online to SONA Systems. Students had the option of taking part in other experiments for class credits, or alternatively, could have written a supplemental research paper in lieu of participating in any study. Since equivalent and alternative options were provided to students no subject was coerced into participating in this or any study.

Measures

Eye tracking technology collected information on fixation durations, and fixation counts, in predefined Areas Of Interest (AOI’s). All images contained an AOI which encompassed the entire image allowing researchers to record the total amount of time spent gazing at each image. For the humanoid images additional AOI regions were mapped out including hair, face, chest, waist, and hips. For the neutral stimuli additional AOI’s included background, foreground, skyline, and focal point. Subjects also filled out a demographic survey inquiring about sexual orientation, age, ethnicity, current relationship status, favorite physical trait in the opposite sex, and ranking of body regions.

Procedures

Subjects signed up for a testing date via SONA Systems online. Upon arriving at the Neuro-cognitive lab students were asked to sign in on a form ensuring they received credit for attending the experimentation session. After signing in subjects were given an informed consent form with details of the study and their role, if they chose to participate. Upon turning in the informed consent form subjects were taken back to the eye tracker one at a time to view all 8 images presented in a completely randomized order. Before each image was shown participants were instructed to rate the following image from 1 least attractive to 10 most attractive. Participants were allowed to look at each image as long as they felt necessary to make their assessment, once a decision was made the participant would press the space bar on a keyboard in front of them to continue with the experiment. Images shown included two pictures of women around peak fertility, two women at evolutionarily inappropriate ages (one prepubescent, one post menarche), two non-relevant humanoids (male, ape), and two neutral images (tree, tower). All humanoid images were full frontal shots of fully clothed models with the exception of the chimp who was depicted in a naturalistic form (not clothed). Once each image had been individually rated for attractiveness subjects were brought out of the eye-tracking room back into the lobby where they completed the demographics survey mentioned above.

Data Analyses

1, 2, and where necessary 3-class analyses were tested for best model fit (see table 1). Model fit was determined by comparing the sample size adjusted Bayesian Information Criterion (BIC) scores, and Lo-Mendell-Rubin LR test (LRT) values and significance scores for each image. For images with multiple classes Multivariate Analyses Of Variance (MANOVAs) were run to explore differences between groups.

CHAPTER IV – RESULTS

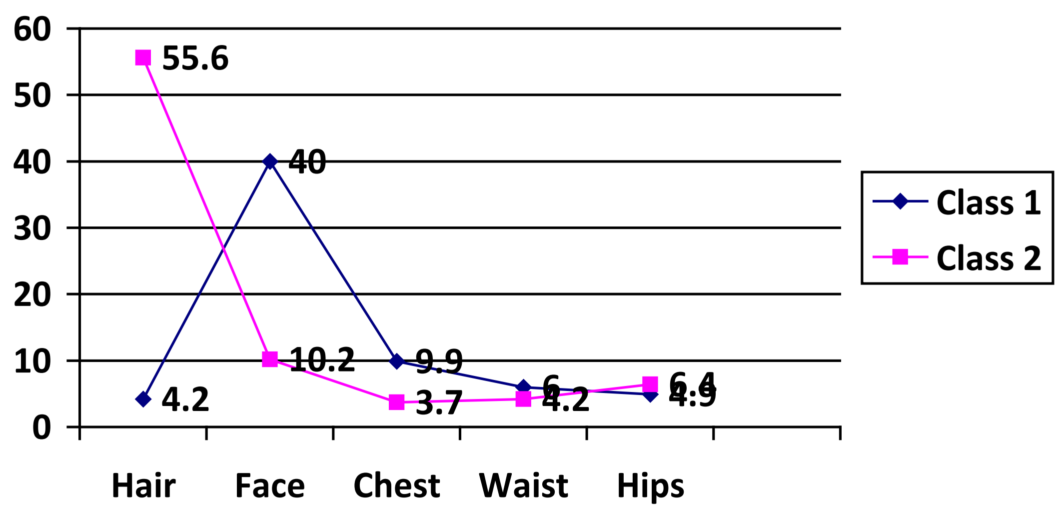
Fixation durations within each of the predefined AOI regions were extracted from the eye-tracker for analyses. Data were converted to percentage scores by dividing the total fixation duration of each AOI by the total time spent viewing each image. Converted percentage scores were first analyzed in Mplus (Muthén, & Muthén, 1998-2011) through a series latent class analyses to explore naturally occurring groups within the dataset. One-class, and two-class-solutions were subsequently run to explore the best model fit for each image. For all images other than "Female 2" 2-class solutions did not reach significance, in the case of "Female 2" a 3-class solution was also run.

Table 1

Stimuli	Class Solution	Sample Size Adjusted BIC	LO-MENDELL-RUBIN ADJUSTED LRT TEST	P	Entropy
Chimp	1 class	-574.144			
	2 class	-708.471	136.247	0.1108	1.000
Man	1 class	-673.543			
	2 class	-815.092	143.203	0.6009	1.000
Girl	1 class	-670.418			
	2 class	-830.03	160.598	0.2046	1.000
Elderly Lady	1 class	-597.718			
	2 class	-754.205	157.589	0.5759	1.000
Tower	1 class	-695.479			
	2 class	-751.197	62.018	0.2729	0.967
Tree	1 class	-1063.39			
	2 class	-471.008	94.41	0.5075	0.920
Female 1	1 class	-503.379			
	2 class	-640.876	139.301	0.1275	0.999
Female 2	1 class	-527.204			
	2 class	-601.973	78.891	**0.0353***	0.995
	3 class	-632.450	36.235	0.1868	0.985

As shown in Table 1, The first hypothesis was partially supported, with one of the two sexually relevant images displaying a two-class solution as the best fit for the data, indicated by a Lo-Mendell-Rubin LR test (LRT) = 78.89; $p = .03$ For the two class solution 89% of males were placed in class 1, and 11% were placed into class 2. The latent classes found were plotted for the average proportion of time spent gazing at each AOI to illustrate differences in gazing strategies between the two groups (see figure 1). All other images including female 1, male, chimp, girl, elderly lady, tower, and tree were best represented by single-class solutions suggesting males did not differ from one another in gazing at these images

Figure 1 (Female 2)



For illustrative purposes line graphs of other humanoid stimuli were plotted to depict the differences in gazing strategies of class 1 and class 2 individuals. Class 1 individuals tended to use a similar strategy when gazing at all target images (see figure 2). Class 2 individuals showed much greater variation in gazing patterns across all images however, images of sexually relevant females show the greatest deviation from the standard gazing strategy (see figure 3).

Figure 2 (class 1)

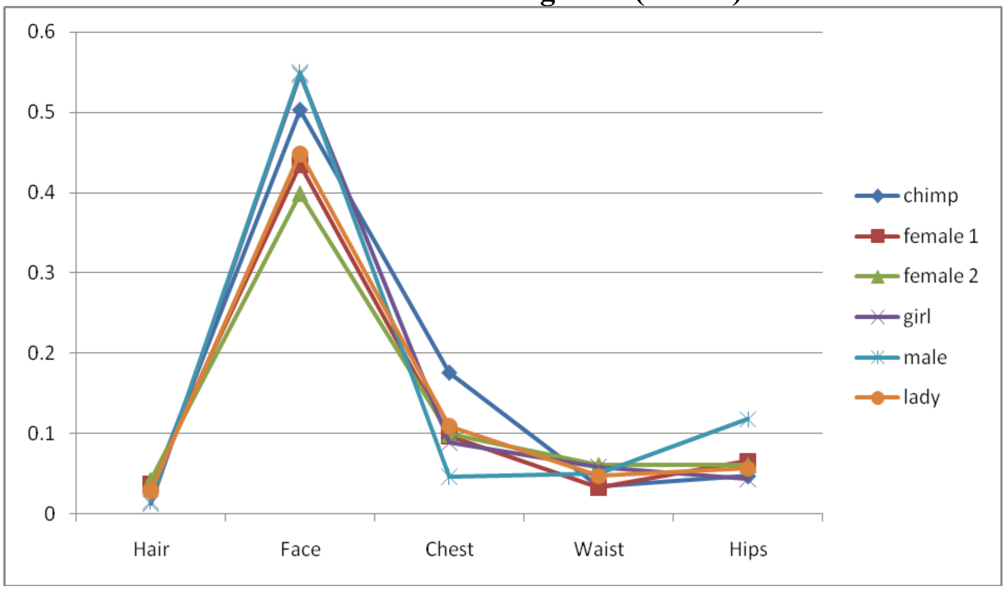
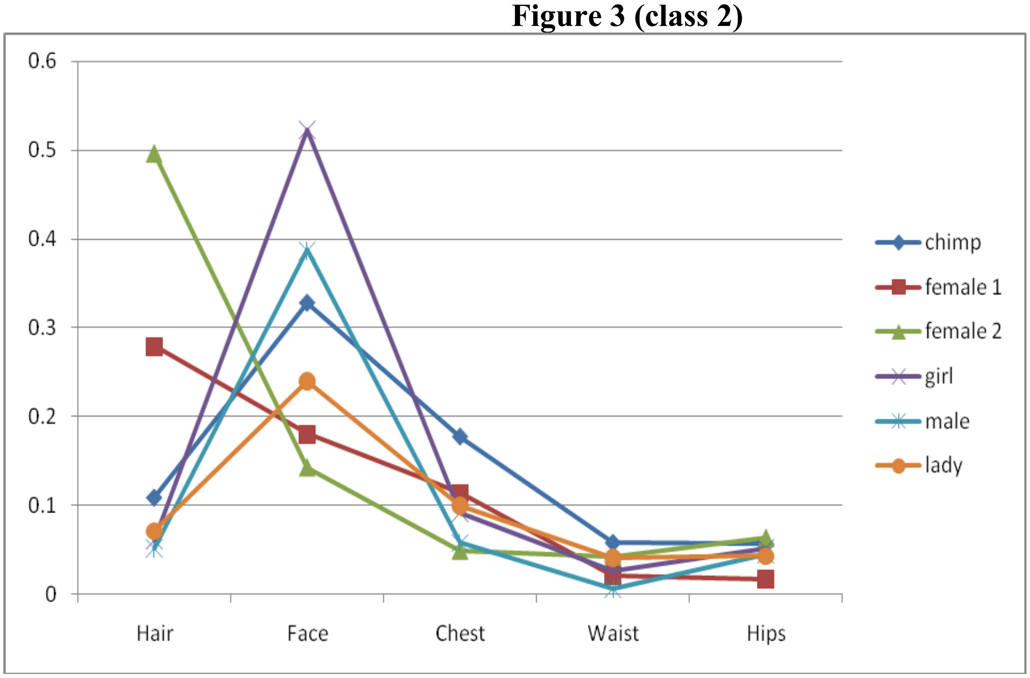


Figure 3 (class 2)



For the female model with a two-class solution, A MANOVA was conducted to examine group differences on all five dependent variables as a group, followed by univariate analyses for each AOI. The multivariate test was significant after correcting for non-normal distribution (Wilks' *Λ* (5, 71) = 31.244, *p* = .000; *n2* = .885; power = 1.0) indicating there were rather large differences between the two groups overall in regard to the dive dependant variables (see table 2)

Table 2								
Test	**Value**	**F**	**Hypo-thesis df**	**Error df**	**Sig.**	**Parital Eta Squared**	**Noncent. Paramet er**	**Obs. Power**
Pillai's Trace	.688	31.244	5.000	71.000	.000	.688	156.218	1.000
Wilks' Lambda	.312	31.244	5.000	71.000	.000	.688	156.218	1.000
Hotellin g's Trace	2.200	31.244	5.000	71.000	.000	.688	156.218	1.000
Roy's Largest Root	2.200	31.244	5.000	71.000	.000	.688	156.218	1.000

Univariate analysis shown in Table 3 revealed participants greatly differed in the amount of time they spent on hair *F* (1, 75) = 157.328, p = .000; *n2* = .677, with class 2 spending significantly more time *M = .49, sd* = .23 than class 1 *M* = .04, *sd* = .07. The groups also significantly differed in the amount of time spent on face *F* (1,75) = 7.191, p = .009; *n*2 = .087; with class 1 spending more time *M* = .39*, sd = .25* than class *2 M* = .14, *sd* = .19.

Table 3									
Dependant Variable		**Sum of Squares**	**Df**	**Mean square**	**F**	**Sig.**	**Partial Eta Sq.**	**Noncent. Pararmeter**	**Observed Power**
Chest	Contrast	.027	1	.027	1.948	.167	.25	1.948	.281
	Error	1.056	75	.014					
Face	Contrast	.421	1	.421	7.191	.009	.087	7.191	.745
	Error	4.394	75	.059					
Hair	Contrast	1.473	1	1.473	157.32	.000	.677	157.328	1.00
	Error	.702	75	.009					
Hips	Contrast	.002	1	.002	.224	.623	.003	.244	.078
	Error	.483	75	.006					
Waist	Contrast	.003	1	.003	.506	.479	.007	.506	.108
	Error	.450	75	.006					

CHAPTER V – DISCUSSION

The current study aimed to replicate previous findings of males employing two distinct gazing strategies while assessing female attractiveness (Melnyk, McCord, & Vaske, 2014; Melnyk, Dillard, & McCord, 2014, Melnyk & McCord 2013). Further, this study explored whether the differences in male gazing patterns previously noted were specific to assessing sexually relevant images, or if the differences observed were due to a more underlying cognitive mechanism. If the latter were true it would stand to reason that male gaze patterns would remain consistent across a variety of target images, with some individuals being more prone to a narrow gazing pattern, while others would show a tendency to employ a broad gazing strategy (Pettigrew, 1958). A two-class solution emerged as predicted for one of the sexually relevant female images; however, a single-class solution was the best fit for the other sexually relevant image. Consistent with our second prediction, all other image categories (irrelevant ages, irrelevant stimuli, and neutral images) were best represented by single-class solutions (see table 1). These findings partially replicate previous results of two-class solutions occurring when males assess female images for attractiveness. The overall findings suggest that a default gazing strategy may be used when gazing at stimuli; however, some males (class 2 males) deviate from this strategy, but only when gazing at sexually relevant stimuli. If that is the case it is possible that within this group attention is being diverted to regions signaling short term mate value. The current study does not support the suggestion of a broad verses narrow processing style as only one of the sexual images elicited distinct differences in gazing strategy, where no other stimuli did. If the broad verses narrow processing style had held true one would expect to have found two distinct gazing categories across a number of images. An evolutionary model was not fully supported either with only one of the two sexually relevant images producing a significant two class solution, however as figure 3 depicts the other sexually relevant image arguably varied in gaze pattern to a greater degree than did any other stimuli. Third variables and a lack of priming may in part explain why only one but not both of the sexually relevant images were gazed at differently Further, the two-class solution which did emerge does not precisely mirror previous findings. The larger of the two groups accounted for the majority of participants at 89%, and reflected the "face" class in previous studies. This group was slightly larger than previous studies which found roughly 70% of males falling into the face class (Melnyk, Mccord, & Vaske, 2014). The second group consisted of the remaining 11%, somewhat smaller than the second classes noted in previous studies. Further, this group does not reflect the "face plus" class which has previously been found and instead is best categorized as a "hair" class. This group may still however, be attending to cues of short term mate value. Much of the research on hair quality has linked length and health of hair to current physical health (Hinsz, Matz, & Patience, 2001; Neuser, Deloux, Roder, & Matts, 2013; Norbert & Bereczkei, 2004), which along with fertility status are two of the primary traits males take interest in while using a short term mating strategy (Li & Chang 2012). In contrast the face shows signs of genetic quality, which is of greater importance for males in a long term mating strategy (Li & Chang 2012).

An issue with the current methodology may have been exploring short and long term mating strategies as traits, relatively constant within the individual. It is becoming increasingly apparent, however, that mating strategy and by extension gazing strategy is better represented as a malleable state, offering a certain degree of fluidity between short and long term mating strategies. Arguably individuals must be capable of executing both long term and short term mating strategies simultaneously or events such as cheating would likely not occur. A growing body of behavioral data suggests that priming a male for either a short term or long term partner may be the distinguishing factor in the variations of gaze patterns (Cornelissen, Hancock, Kiviniemi, George, & Tovee, 2009; Lu, & Chang,2012; Maner, Gailliot, Rouby, & Miller, 2007; Maner, et al., 2003). The level of ambiguity in the current study may be due to a lack of priming. Previous studies attempted to identify predictor variables based off of a trait approach. If mating strategy is more of a state in nature than a lack of priming may account for weak or inconclusive results.

Beyond eye tracking studies there is a fair amount of support to suggest that placing particular interest in the face or the body of a female depends on the type of mating strategy currently being used by a male. Attractiveness ratings of female faces have been correlated with the attractiveness ratings of female bodies, however, only to a certain degree, suggesting that cues provided by the body and face are not entirely redundant with one another (Peters, Rhodes, & Simmons, 2007). Moreover overall female attractiveness is independently influenced by ratings of both the face and the body (Currie & Little, 2009; Peters et al., 2007). The face may be the best physical indicator of age (Thornhill & Gangestad, 1999), which has been argued to be the most important aspect of female mate value in the context of a long term mating strategy (Li & Chang, 2012). As previously noted in chapter two's section on men's mate preferences facial features offer many cues to a female's reproductive value (Moore, Law Smith, Taylor, & Perrett, 2011; Law Smith et al., 2010; Fink, Neave, Manning & Grammer, 2006; Rhodes, 2006; Schaefer et al., 2006; Gangestad & Scheyd, 2005; Baudouin & Tiberghien, 2004; Rhodes, et al., 2001; Thornhill, & Gangestad, 1993) Even subtle information such as sexual attitudes can be picked up by women's faces and bodies (Kramer, Gottwald, Dixon, & Ward, 2012). In the same manner that Li and Chang (2012) argue the face offers more relevant cues for males using long term mating strategies, they suggest the body offers more relevant cues for males using a short term mating strategy. Particularly, males in a short term mating strategy should less concerned about genetic quality and more concerned with current fertility status, which can be readily assessed through quick and honest displays of the body (Confer, et al., 2010). It stands to reason that if both the face and body send signals of reproductive value, and fertility, both regions will receive some level of visual attention. In a recent study Bleske-Rechek, Kolb, Stern, Quigley, & Nelson (2014) found that the face and body were both strong predictors of full body attractiveness ratings. Further analyses demonstrated that body attractiveness accounted for more variance in ratings of women's full body attractiveness when wearing a swimsuit than when wearing normal clothes. Such findings suggest that outside of priming, the gazing strategy (and by extension sexual strategy) used by males may be partially influenced by contextual signals sent from females.

Future studies will aim to examine differences in male gazing patterns from a state rather than trait lens. Priming may be factored into future analyses as a predictor variable of differences in male gazing patterns when assessing female attractiveness. Another line of future research could explore the relationship between cues and signals sent by females and the natural priming which may occur within males. It has been documented that females tend to vary in how revealing their outfits are in relation to their ovulatory cycle, whereas the most revealing outfits are worn closest to ovulation (Durante, Li, & Haselton, 2008). If male gazing strategy is infact influenced by the degree to which cues from the body are available to be read as shown by Bleske-Rechek et al. (2014), then it stands to reason ovulating females may foster short term mating strategies within males by extenuating their own short term mate value. Future studies can further explore priming as a predictor of male gaze patterns, as well as the influence of female ovulation as a natural primer of male sexual strategy.

Figure 4: Aggregate Heat Map Class 1(Face)

Figure 5: Aggregate Heat Map Class 2 (Hair)

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