PHYSICAL ATTRACTIVENESS AND RESOURCE ACQUISITION: ATTENTIONAL CUES FOR LONG-TERM MATE SELECTION

by

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Evolutionary and sociocultural perspectives have sought to explain the process through which human mate preferences shape the current idealizations of the most desirable traits in a prospective mate. While both of these perspectives advance different logic regarding why particular mate preferences occur within a long-term context, the conclusion is the same: men prioritize a woman's physical attractiveness while women prioritize a man's current and future resource acquisition. Research has extensively focused on how men utilize physical attractiveness to select for mates with minimal research regarding how women use relevant cues when selecting for potential mates. The current study sought to expand the existing knowledge of the field to include an examination of how women use a combination of resource acquisition cues and physical attractiveness when selecting for long-term mates. A college-aged sample of male and female participants (N = 82) viewed an array of opposite-sex images while their brainwaves were recorded by an electroencephalogram (EEG) to track attention allocation to the images. The images were manipulated for physical attractiveness (high/moderate/low) and resource acquisition (high/low) to determine the cues men and women prioritize when evaluating long-term romantic interest in prospective partners. A main effect of attractiveness (p < .001) indicated both men and women prioritized their attention to the most highly attractive mates. Additional interaction effects suggested that

men and women utilized resource acquisition cues in opposite ways when considering both physical attractiveness and resource acquisition in a prospective mate.

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INTRODUCTION

The ability for humans to successfully locate and select an appropriate mate is crucial to the process of establishing a long-term relationship with a prospective other. The majority of humans participate in a defined process of mate selection aiming to obtain a mate with the highest mate value relative to their own (Buss & Schmitt, 1993; Mathes & Kozak, 2008). An individual's mate value is a conglomeration of numerous traits and qualities within a particular context which establishes his or her worth on the mating market (Fisher, Cox, Bennett, & Gavric, 2008). Differential importance is placed on the sex-specific qualities that contribute to mate value (Fisher et al., 2008). Two distinct perspectives, evolutionary and sociocultural, are typically used to explain why humans prioritize certain qualities in a mate (Buss & Barnes, 1986; Li, Bailey, Kenrick, & Linsenmeier, 2002). While much of the existing literature explains mate preferences focusing on a single perspective (Mathes & Kozak, 2008), they both distinguish the same desired qualities in a long-term mate and can provide complementary perspectives as to why sex differences exist regarding the desired qualities of a prospective mate. The current study examined how men and women specifically allocate attention toward and evaluate prospective mates based upon the mate's physical attractiveness and potential future resource acquisition. Before describing the details of the study, the general background will be described.

Evolutionary Perspective

The evolutionary theory of sexual selection described by Darwin posits that both men and women participate in intersexual and intrasexual processes when selecting for mates (Buss & Barnes, 1986). Intrasexual competition occurs within one's sex for access to members of the opposite sex, while intersexual selection refers to our sex-specific evolved mating preferences regarding the primary qualities desired in a prospective mate (Buss & Barnes, 1986). Evolutionary theory seeks to explain how sexual selection impacted subsequent mate choices regarding the perpetuation of a species, resulting in a focus on the factors necessary to successfully produce and raise healthy offspring (Buss & Barnes, 1986). The obligatory investment time in potential offspring resulting from a sexual rendezvous is quite different for men and women (Miner & Shackelford, 2010). An impregnated woman must invest nine months towards the development of a healthy newborn, while men may invest only minutes toward this same endeavor. Even though both sexes exhibit increased selection biases when seeking a long-term mate, women are often considered the choosier sex (Miner & Shackelford, 2010). Additionally, the desired time investment in a relationship can alter the qualities that are prioritized in a mate (Buss & Schmitt, 1993; Miner & Shackelford, 2010). The current research focused on mating in a long-term context only.

The distinct qualities valued by men and women seeking a long-term relationship can be understood as a sort of economical exchange of high-demand resources (Mathes & Kozak, 2008). Due to the evolutionary salience of procreation within a long-term mating context, men prioritize women in the prime of their reproductive capacity so as to maximize their potential contribution to future generations (Buss & Barnes, 1986; Buss

& Schmitt, 1993). Reproductive value is an individual's remaining expected future contribution to future generations (Buss & Schmitt, 1993). Since this value is more closely linked to current age for women than men, men are believed to have evolved a preference for women to possess characteristics reflective of youth and vitality (Buss & Schmitt, 1993). In addition to this, certain physical characteristics that are reflective of physical attractiveness, such as smooth skin, symmetry, and full lips, are also indicators of health — another trait valued by evolution (Buss & Schmitt, 1993; Shackelford & Larsen, 1999). This appearance of youth and health is the primary characteristic men prioritize in women, resulting in a woman's reproductive value as represented most clearly by her level of physical attractiveness (Buss & Barnes, 1986; Miner & Shackelford, 2010; Strahan et al., 2008).

From this same perspective, women prioritize men that possess a high reproductive value, which relates to a man's current and prospective social and economical resource acquisition, in addition to his genetic makeup (Buss & Schmitt, 1993; Howard, Blumstein, & Schwartz, 1987). Within the evolutionary perspective, this is speculated to have evolved as a preference for the most powerful man within a group; referring to his physical stature, economic possession, and social status within a hierarchy (Buss & Barnes, 1986). Men that possess this high reproductive value have access to a variety of resources that can increase chances of survival and the perpetuation of genes (Buss & Barnes, 1986). Women that can successfully attract and attain a mate willing to impart adequate resources will secure the survival of future offspring and their own presence in the gene pool (Buss & Barnes, 1986). This partnership works in favor of both sexes due to the equality of the exchange of resources (Mathes & Kozak, 2008; Miner &

Shackelford, 2010); women obtain the resources necessary to support the future care of offspring while men obtain the resources necessary to maximize their reproductive contribution (Buss & Barnes, 1986; Buss & Schmitt, 1993). These objectives result in women prioritizing a potential mate's resource acquisition and men prioritizing a woman's physical attractiveness when searching for a long-term mate (Miner & Shackelford, 2010). While these differential mate preferences are still evident in our present-day mate choices, advances in reproductive medicine, specifically the creation of contraceptives, have influenced the perspectives regarding how our behaviors may be explained.

The creation of oral birth control for women in the late 1950s revolutionized not only reproductive medicine, but challenged traditional views of interpersonal and sexual relations between adults (Tyrer, 1999). Not only were reproductive health concerns rampant when the pill was first introduced and available to the public, but potential impacts regarding social life were also voiced (Tyrer, 1999). Speculation regarding the separation of procreation from sexual activity led to beliefs that the presence of the pill would lead to irresponsible decisions regarding frequency and number of sexual partners, especially for women (Tyrer, 1999). When presented with a safe and easily reversible form of birth control, women gained more control over their fertility, leading to shifts regarding women's personal and professional pursuits (Tyrer, 1999). This reproductive advancement allowed women more freedom to select mates on the basis of more than just parental investment potential and to engage in mating of any time duration with a dramatically minimized risk of conception. Wide-spread contraceptive use has changed

the mating game, resulting in alternate explanations regarding intersexual mate preferences.

Sociocultural Perspective

The sociocultural perspective of mate preferences focuses on how current cultural norms and ideals inform the qualities and characteristics that humans seek in a prospective mate (Li et al., 2002). The evolutionary focus on the procreative goal of mating is replaced here with an increased focus on how mate selection preferences perpetuate cultural ideals (Eastwick et al., 2008). From this perspective, men and women strive to obtain the most ideal mate possible as prescribed by the current sociocultural standards (Howard et al., 1987). Even as the norms and values of a society change with the times, overall mate preferences experience only minute adjustments (Buss & Barnes, 1986; Shackelford, Schmitt & Buss, 2005). For example, in environments that exhibit ecological harshness (e.g., resources are scarce and mortality is high), the inhabitants tend to adopt a faster life history strategy, resulting in quicker physiological and sexual development (Hill, Delpriore, Rodeheffer, & Butterfield, 2014). A fast life history strategy results in a male preference for females that are more voluptuous compared to males that possess a slower life history strategy, such as inhabitants of Western societies (Hill et al., 2014). Yet, regardless of the specific preferred shape of the female body, the physical attractiveness of the woman was still the standard used to evaluate her worth in society (Hill et al., 2014; Shackelford, Schmitt, & Buss, 2005). The sociocultural preoccupation with power and status in Western cultures results in a never-ending journey to acquire more status, power, and resources, shedding light upon why men and

women are preoccupied with obtaining a mate that elevates them to a higher peg in the social status ladder.

Women in present-day Western societies are pervasively bombarded with idealizations of the female body resulting in an internalization of the thin-body ideal (Cafri, Yamamiya, Brannick, & Thompson, 2005). This internalization, along with the pervasive pressures exhibited by society to achieve this (mostly unobtainable) body type, results in lower body image satisfaction as women are socialized to attribute their social worth almost entirely to their physical attractiveness (Cafri et al., 2005; Strahan et al., 2008). In combination with the obstacles that a woman faces when seeking to elevate her social position, sociocultural norms influence the pathways women have available to achieve increased status, power, and resources (Li et al., 2002). Since a woman's worth is inextricably tied to her physical attractiveness, this is the commodity that woman have available to trade for upward social mobility (Mathes & Kozak, 2008; Li et al., 2002). This economical exchange of resources between men and women results in men assigning high importance and value to the commodity women are most-commonly valued for: physical attractiveness (Buss & Barnes, 1986; Howard et al., 1987; Li et al., 2002; Cafri et al., 2005).

The typical dispersion of power within a society suggests that men are initially granted with higher social status, power, and resources than women, resulting in the value placed upon a women's exchange object as proportional to a man's current status (Mathes & Kozak, 2008). Simply put, women seek to obtain a mate of a higher socioeconomic status to increase their position in society by marrying upward, and men want to obtain the most physically attractive mate possible to reflect their own worth

(Buss & Barnes, 1986; Howard et al., 1987; Li et al., 2002). Yet, even as women prioritize resource acquisition, the physical attractiveness of a potential mate still impacts women's mate choices (Miner & Shackelford, 2010) resulting in a trade-off between resource acquisition and physical attractiveness when surveying potential mates (Mathes & Kozak, 2008). While men and women weight the importance of a pretty face differently, other than sexual dimorphism, the physical qualities that make a face attractive are very similar for men and women (Peters et al., 2006).

Physical Attractiveness

There are many factors that contribute to an individual's attractiveness, and while the body plays a role in this evaluation (Confer, Perilloux, & Buss, 2010; Peters et al., 2006), the primary indicator of physical attractiveness is found in the face (Grammer & Thornhill, 1994; Riggio, Widaman, Tucker, & Salinas, 1991; Peters et al., 2006; Currie & Little, 2009). Research has consistently shown that faces that are symmetrical (Perrett et al., 1999), average (Alley & Cunningham, 1991), and sexually dimorphic (Little, Jones, & DeBruine, 2011) are perceived as most attractive by both sexes. These same indicators of attractiveness have also been positively correlated to health (Shackelford & Larsen, 1999) supporting the evolutionary view that facial attractiveness cues health and fertility (Buss & Schmitt, 1993).

Due to the sociocultural and evolutionary salience of attractive faces, humans tend to pay attention to attractive faces in their environment (Maner, Galliot, & DeWall, 2007; Marzi & Viggiano, 2010; Morgan & Kisley, 2014). The attentional resources humans have at their disposal are limited, forcing a prioritization of the most relevant and important stimuli within a given context and environment (Jung, Ruthruff, Tybur,

Gaspelin, & Miller, 2012). Due to the relative importance of obtaining a mate (Buss & Barnes, 1986), the most attractive faces in an environment are prioritized attention compared to less attractive faces (Marzi & Viggiano, 2010; Morgan & Kisley, 2014). Maner et al. (2007) examined how the presence of an average or attractive face influenced a participant's ability to quickly shift their attentional set. Participants completed a modified dot-probe task: a face (average or attractive) appeared in one of four possible quadrants and after the face disappeared a shape appeared in either the same quadrant (filler trial) or an alternate quadrant (attentional shift trial); participants had to classify the shape as quickly as possible. Reaction times demonstrated that attractive female faces "captured" the attention of participants resulting in slower reaction times on attentional shift trials. This attentional capture effect demonstrates that processing facial information requires cognitive resources that could otherwise be devoted to other tasks (Jung et al., 2012) resulting in slower reaction times to the primary task (Maner et al., 2007). These findings indirectly indicate that processing faces requires the use of cognitive resources which can also be tracked more directly utilizing event-related potentials (ERPs).

Attractiveness and Attentional Resource Allocation

The measurement of the amount of attentional resources allocated to salient stimuli in the environment can be tracked utilizing real-time recordings of the electromagnetic emissions generated by the firing of neurons. This is accomplished through recording the electric impulses of the brain over selected portions of the scalp with an electroencephalogram (EEG). These electrical impulses are known as event-related potentials (ERPs) since they occur in response to stimuli that a participant has just

viewed. ERP recordings track the overall brain activity produced pre and post-stimulus in milliseconds, which allows viewing of the real-time allocation of resources to the stimuli. Specific brainwave components are examined to evaluate how the brain is responding to stimuli presentation (Ibanez et al., 2014). The late-positive potential (LPP) is a specific brainwave component shown to be sensitive to motivationally salient stimuli, including emotional images (Ibanez et al., 2014; Schupp et al., 2004) and facial attractiveness (Johnston & Oliver-Rodriguez, 1997; Marzi & Viggiano, 2010; Morgan & Kisley, 2014; van Hooff, Crawford, & van Vugt, 2011; Werheid, Schacht, & Sommer, 2007). This increased allocation of resources results in biases regarding attractive faces that can influence the behaviors and judgments of people (Marzi & Viggiano, 2010).

Faces are allocated attentional resources in a manner that is proportional to the attractiveness of the face; more attractive faces are allocated more attentional resources in comparison to less attractive faces. This effect is most pronounced for men gazing at attractive female faces (Johnston & Oliver-Johnston, 1997; Morgan & Kisley, 2014; van Hooff et al., 2011), but women have also demonstrated a heightened allocation to more attractive faces (Marzi & Viggiano, 2010; Werheid et al., 2007). Additionally, Marzi and Viggiano (2010) demonstrated that not only are attractive faces allocated the largest amount of cognitive resources compared to other faces (indicating their motivational salience), but attractive faces are more memorable than less attractive faces. While both sexes appear to similarly allocate an increased amount of resources to attractive faces, this line of research has more extensively focused on how men allocate resources to female faces.

Morgan and Kisley (2014) examined how the allocation of cognitive resources to female faces of varying attractiveness was impacted by mating market value. While mating market value is comprised of a variety of traits within specific contexts that affect mating choices (Fisher et al., 2008), it was operationalized in this study as facial attractiveness only. Men in the study were told to imagine that the women in the images they were instructed to rate for attractiveness had previously rated the participant's physical attractiveness. The participants were rated either high or low by the women placing them into either a high or low mating market value condition, respectively. When men were placed in a low mating market value condition, they allocated significantly more resources to unattractive target images than when the men were placed in a high mating market value condition. This distinction can be seen as the separation between the solid and dashed red curves in Figure 1. This pattern of activity speaks to the establishment of a lower limit of attractiveness that the participants would be willing to pursue as a suitable potential mate. Men that have a lower mating market value will not have as many options when seeking a mate compared to men that possess a higher market value (Morgan & Kisley, 2014). While facial attractiveness is a vital component of an individual's mate value, this is not the only factor that influences one's worth on the mating market, yet other potentially impactful factors have not been extensively researched to date.

Current Study

Mating value is commonly described as "the total sum of characteristics an individual possesses at a given moment and within a particular context that impacts on their ability to successfully find, attract, and retain a mate" (Fisher et al., 2008, p. 14).

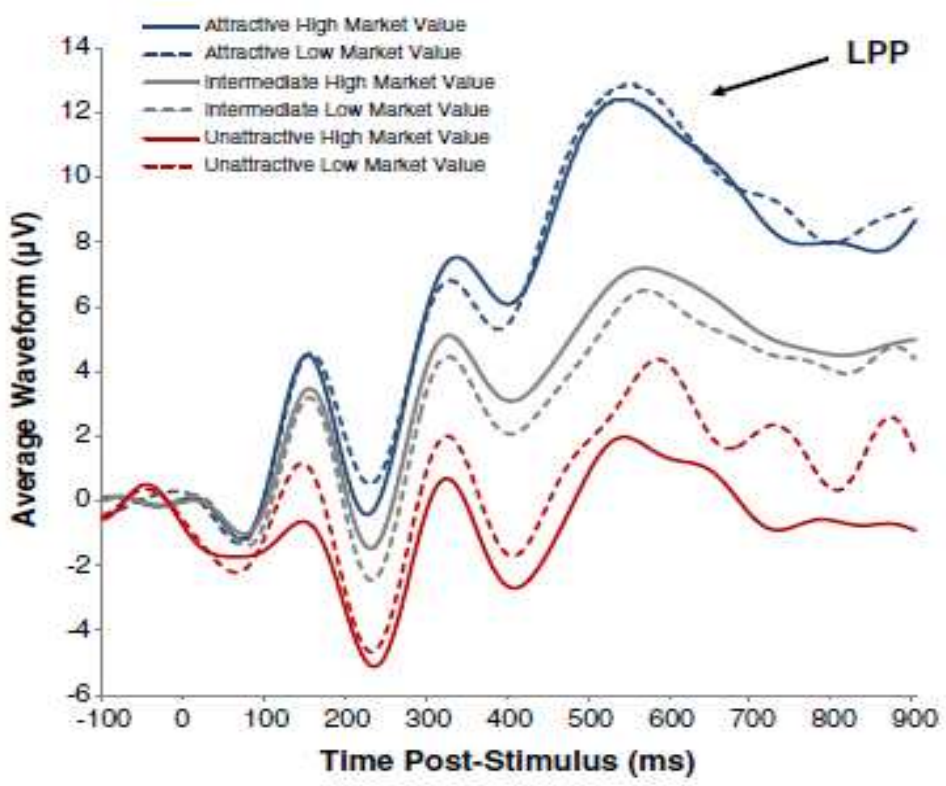

Figure 1. LPP response amplitudes to images of female faces of varying levels of attractiveness relative to the participant's mating market value condition. (From Morgan & Kisley, 2014).

Due to the influence evolutionary and sociocultural factors have upon the mate selection process, the characteristics that compose the mate value of men and women are weighed differently. When seeking a long-term relationship, people prioritize the most important traits that a potential partner possesses (Fisher et al., 2008). Men prioritize their mate's level of physical attractiveness (Li et al., 2002) while women prioritize their mate's current and potential future resource acquisition (Mathes & Kozak, 2008). While other factors such as personality and intelligence do impact mate value assessments, the specific qualities prioritized during initial mate identification and selection within a long-term context are attractiveness and resource acquisition (Li et al., 2002).

The current literature regarding mate choice has extensively focused on how men select mates, especially in regard to selection based on facial attractiveness (Li et al., 2002; Mathes & Kozak, 2008; Morgan & Kisley, 2014; van Hooff et al., 2011; Werheid et al., 2007). While studies have reliably shown that men are susceptible to an attentional "capture" effect toward attractive female faces (Johnston & Oliver-Rodriguez, 1997; Maner et al., 2007), the literature has not examined how females may prioritize their attention allocation. While physical attractiveness is certainly an important factor when women are selecting mates (Escasa, Gray, & Patton, 2010; Miner & Shackelford, 2010), within a long-term context women should be more sensitive to cues of potential resource acquisition and prioritize attention toward potential mates possessing a high amount of resources (Li et al., 2002; Mathes & Kozak, 2008).

The current study examined the impact facial attractiveness and potential resource acquisition had upon how males and females allocated their limited cognitive resources to the target. The independent variables were attractiveness (high/moderate/low), resource acquisition (high/low), and gender (male/female). Resource acquisition was operationalized as the target image's potential income 10 years from now. The amounts ranged from $25,000 - $115,000 with the low resource acquisition amounts ranging from $25,000 - $65,000 and the high resource acquisition amounts ranging from $75,000 - $115,000. These amounts were chosen based upon the average amount of household income in the United States that is projected to impact life satisfaction and/or emotional well-being. Kahneman and Deaton's (2010) study indicated that once a household has attained an income of ~$75,000, further increases in income do not have a notable impact on an individual's rating of their emotional well-being (e.g., happiness). The primary

dependant variable was the ERP amplitudes in response to viewing the images. The predictions for this study were informed by the literature on mate selection. Men were expected to prioritize a female's physical attractiveness, regardless of her resource acquisition. Women were expected to prioritize a man's resource acquisition while still taking his facial attractiveness into consideration, resulting in a trade-off of attractiveness for resources. This study expected to expand the understanding of how people select long-term mates, especially regarding female choices, and the inclusion of LPP amplitudes is expected to help clarify how men and women allocate their limited resources to prospective mates based upon facial attractiveness (for both sexes) and resource acquisition cues for women.

CHAPTER 2

METHOD

Participants

The participants for this study were recruited from the undergraduate population at the University of Colorado Colorado Springs (UCCS) through the use of an internal research system at UCCS called SONA. A total of 82 participants were recruited, 41 males and 41 females. The ages of the participants ranged from 18 - 40 (M = 23.00, SD = 5.76). All participants were right-handed and tested 20/40 or better with natural or corrected-to-normal vision. Participants self-identified as European American (68.3%), Hispanic/Latino (14.6%), Asian American or Pacific Islander (7.3%), African American (1.2%), or identified with more than one ethnicity (8.5%). The sexual orientation of the participants was primarily heterosexual (n = 76) with additional participants identifying as bisexual (n = 4), homosexual (n = 1), or asexual (n = 1). Corrupted brainwave data for four female participants resulted in sample sizes of 41 males and 37 females.

Participants were almost evenly split when it came to relationship status with 45 individuals indicating they were not currently in a romantic relationship or were divorced (n = 2) while the other participants were currently involved in romantic relationship (n = 21), engaged (n = 2), or married/partnered (n = 12). Of the 35 people that indicated they were currently in some sort of relationship, 32 of those people indicated they were involved in a monogamous relationship. The majority of participants did not have

children (n = 71) while the remaining participants had 1 or more children (n = 11). Of the female participants, just over half (53.7%) were currently taking a hormonal form of birth control.

Materials

The study was described to participants as a two-part study with the first portion being online and the second portion being in lab. Informed consent and demographic information including age, gender, sexual orientation, relationship status (and duration, if applicable), and number of children was collected online. Women were asked to self-report use of hormonal birth control, the first day of their last cycle, and the accuracy of this information. Participants also completed the 7-item Sociosexual Orientation Inventory (SOI), which gauges how willing an individual is to engage in uncommitted sexual relations (Simpson & Gangestad, 1991). Cronbach's alpha for this measure is .73.

Electroencephalogram (EEG) was used to record the electromagnetic amplitudes on the scalp that resulted from brain activity to the stimuli. A 74-electrode sintered Ag/AgCl cap (Electrode Arrays, El Paso, TX) recorded each participant's brainwaves in real-time as they viewed the stimuli. The electrode cap was attached to an amplifier under the control of data acquisition software (Sensorium, Inc., Charlotte, VT). Following the recording, the EEG data was converted into ERPs by EMSE software (Source Signal Imaging, Inc. La Mesa, CA). A photosensitive diode was attached to the presentation screen ensuring that exact timing of the stimuli presentation relative to the ERP activity was monitored.

Black and white images of high attractive (HA), moderate attractive (MA), and low attractive (LA) males and females were used as the stimuli. A separate group of male

and female participants (*N* = 211) rated 92 images of men and 94 images of women for their physical attractiveness on an 8-point scale, (1 = *very unattractive*, 4 = *neither attractive nor unattractive*, 8 = *very attractive*). The 120 images used in the current study were sorted into categories of high attractiveness, moderate attractiveness, and low attractiveness using the collected ratings. Paired samples *t*-tests indicated that the average rating for each set of images was not different for male and female images. High attractive male and female images were rated 5.48 and 5.57, respectively. Moderate attractive male and female images were rated 4.10 and 4.35, respectively. Low attractive male and female images were rated 2.57 and 2.74, respectively.

Each participant only viewed opposite-sex images, consisting of 20 images of each attractiveness level (HA/MA/LA). Images were presented in blocks of 12, with 4 images of each attractiveness level paired equally with either a high or low resource acquisition level (described above). Images were presented 3 times coupled with the same resource level so as to establish reliable recordings from the EEG (detailed below).

Procedure

After signing up for the study on the SONA system, participants were directed to an external website (Qualtrics) for data collection of the demographic information and the SOI. Once this portion of data collection was complete, participants could sign up for the in-lab portion of the study. After arriving in the lab, participants were asked to indicate which hand was dominant and completed a brief eye exam administered using a Snellen chart. Once the participant was ready, two research assistants prepared the participant for the EEG recording.

A stiff bristle brush was used to brush the scalp to remove dead skin cells, allowing for a more accurate recording due to increased electrical conductivity between the scalp and the electrodes in the cap. The lateral and horizontal center of the participant's head was determined with a tape measure and a small mark was made on the head with an Expo marker. The central electrode (Cz) was fitted to this position as the rest of the cap was carefully placed onto the head. NuPrep gel was used to abrade the skin above and lateral to each eye, and behind each ear (mastoid) and an alcohol swab was used to remove any excess gel. Double-sided sticky electrode collars were used to attach an electrode to each of these spots on the participant's skin. The chin strap was secured and EGel, an electrically conductive gel, was inserted into every electrode using a blunt-tipped needle. All electrical impedances were checked for an acceptable level (below 10 kΩ) before continuing. Placing the cap took approximately 45 min.

After completion of this procedure, the participant completed the paradigm as their brainwaves were recorded. Before the manipulation began, participants viewed three black screens of instructions regarding the paradigm completion: "The images you are about to view were generously provided by students at community colleges, 4-year Universities, and trade schools around the United States (screen 1). Please imagine your life 10 years from now. Imagine that you are single and you are seeking a long-term romantic partner. You are about to view an array of images. You will see a dollar amount indicating that person's annual potential income 10 years from now, followed by their face (screen 2). Please use all of the information provided to indicate on the following 5-point scale how interested you would be in being involved in a long-term romantic relationship with each person pictured. Press any key to continue (screen 3)" Once

participants clicked past the final instruction screen, the paradigm began. See Figure 2 for a visual description of the presentation order within the paradigm.

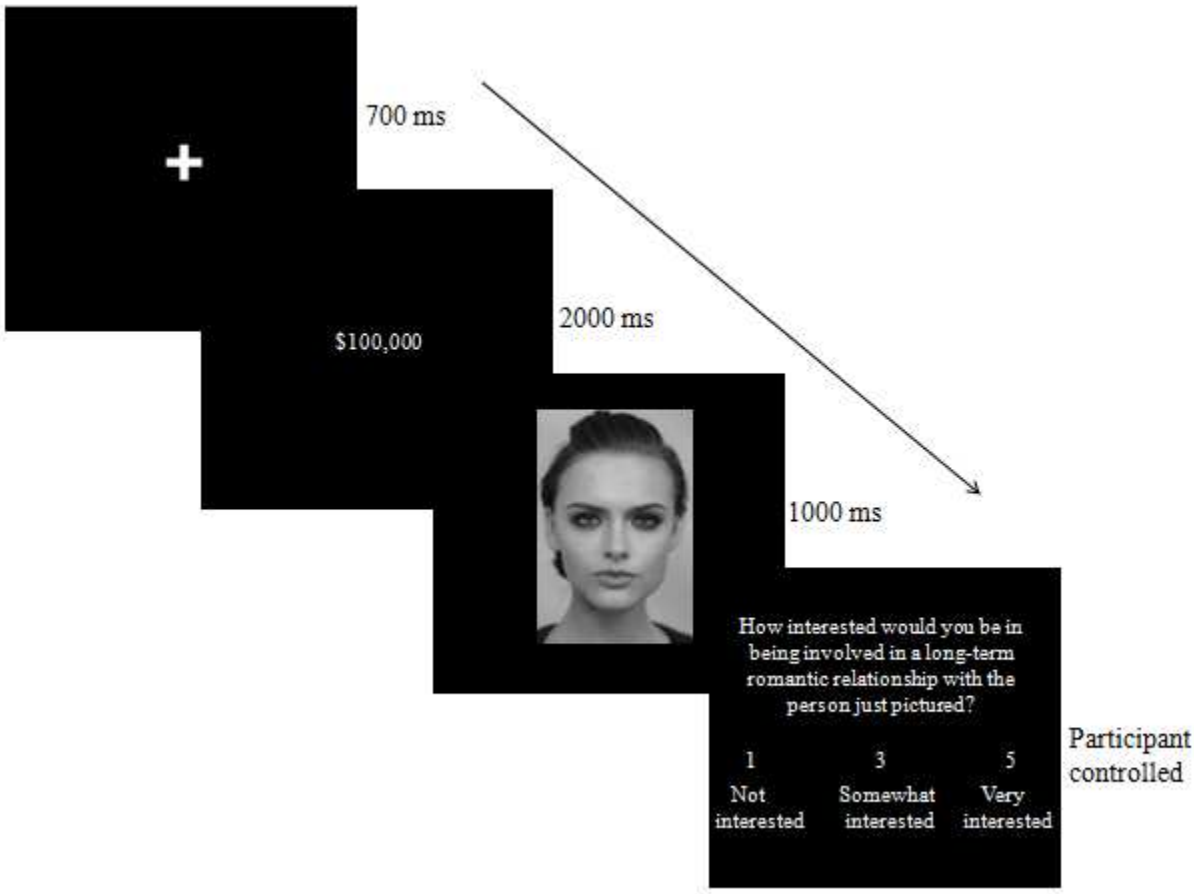

Figure 2. Paradigm slide presentation order.

Each trial began with a white fixation cross centered on a black screen for 700 ms followed by a black screen with white text for 2000 ms indicating the pictured individual's annual future earning potential. The target image appeared for 1000 ms followed by a black screen with white text "How interested would you be in being involved in a long-term romantic relationship with the person just pictured?" Participants responded to each image on a 5-point Likert scale reflecting the degree of interest the participant had to be in a romantic relationship with the pictured individual, (1 = *not*

interested, 3 = *somewhat interested*, 5 = *very interested*). The paradigm would not advance to the next trial without input of a response from the participant on the number pad. Trials occurred in blocks of 12 and a participant controlled pause occurred between blocks. There were 10 blocks total with each image presented three times to increase the reliability of the EEG recording. The paradigm took approximately 20 mins. Upon completion of the paradigm, participants were assisted with the cap removal and clean-up, debriefed and dismissed.

ERP Analysis

For the ERP analysis, six separate average waveforms were computed for each participant based on attractiveness level and resource acquisition condition. Trials with excessive movement or blink artifact (exceeding ±150 μV) were excluded from the average waveform computation. Each image was presented 3 times for a total of 180 image presentations resulting in 30 presentations for each of the six image types. These presentations were used to compute the average LPP amplitude in response to each image type for each gender. The LPP peak amplitude was measured as the highest waveform amplitude occurring between 300 and 700 ms post-stimulus presentation. This was calculated as the average amplitude across the five electrodes (Pz, P2, P1, POz, and CPz) recording from the central parietal location (Pz) on the cap. This time window and collection of electrodes has been shown to exhibit maximal LPP amplitudes to faces of varying attractiveness (Johnston & Oliver-Johnston, 1997; Marzi & Viggiano, 2010; Morgan & Kisley, 2014; van Hooff et al., 2011; Werheid et al., 2007).

CHAPTER 3

RESULTS

A mixed design was used to examine how attractiveness and resource acquisition differently impacted initial interest in a potential long-term mate for men and women. The independent variables of interest included attractiveness (high/moderate/low: within subjects), resource acquisition (high/low: within subjects), and gender (male/female: between subjects). The dependent variables included the early and late LPP amplitudes in response to the image stimuli. Participants were exposed to 6 conditions resulting from the combination of the attractiveness and resource acquisition variables. Using an alpha level of .05, 3x2x2 mixed factorial ANOVAs were conducted to examine the pattern of results for the dependent variables.

Upon completion of the data collection, average waveforms were computed for an initial examination of the timeframe of the maximal peak of the LPP for the central parietal electrode (Pz). These preliminary waveforms were collapsed across gender so as to reduce any experimenter bias during the timeframe selection and can be seen in Figure 3. This first look indicated that participants were exhibiting distinct peaks of early and late aspects of the LPP, which is typical for this component. The selected timeframes of interest include 300ms – 400ms (identified as the early LPP) and 500ms – 700ms (identified as the late LPP). This identification of the early LPP and late LPP resulted in the computation of 6 average amplitudes in accordance with the 6 conditions that

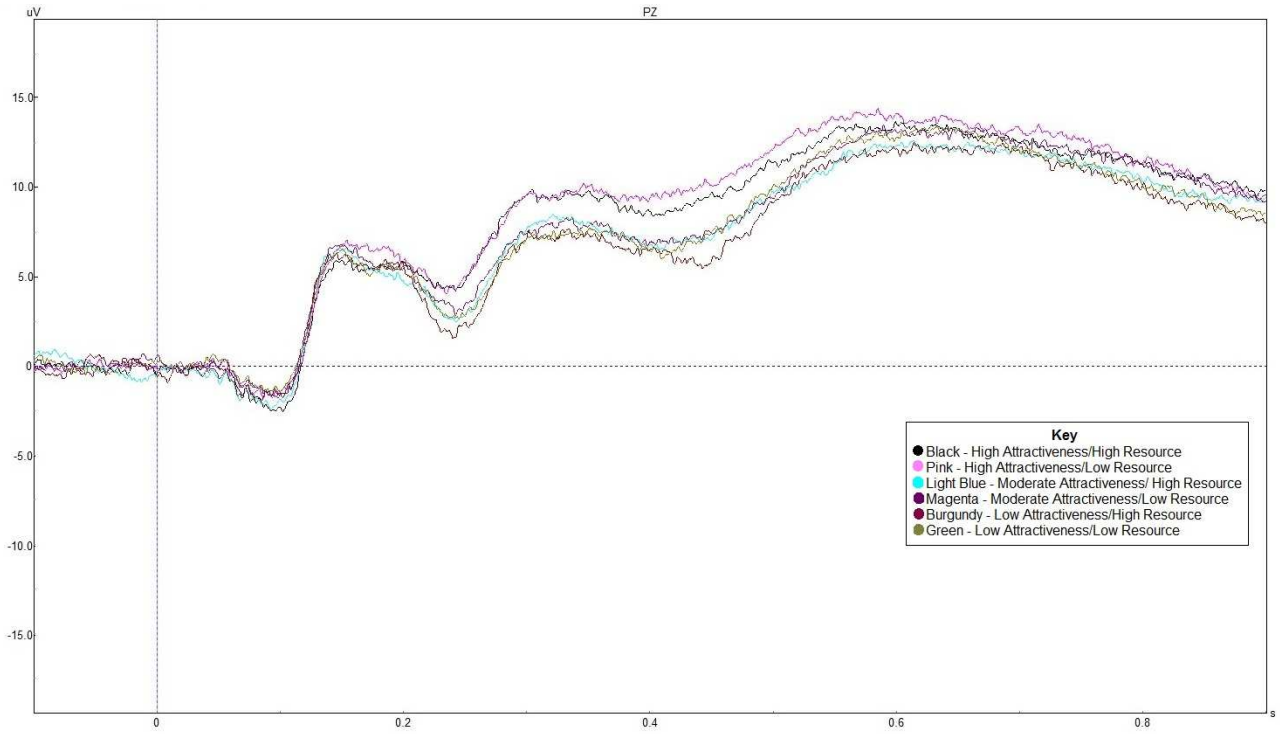

Figure 3. Grand average preliminary waveform collapsed across gender for all conditions for the central parietal electrode (Pz) for peak LPP time frame selection.

participants were exposed to (attractiveness (3) x resource acquisition (2)). Using the pre-specified cluster of electrodes (Pz, POz, CPz, P1 and P2), average amplitudes were calculated for each distinct peak (early and late LPP) for each participant. The results will be presented first for the early LPP, followed by the late LPP, and the behavioral data.

Early LPP

Prior to analysis, the data were examined for any violations of assumptions. Normality was investigated using normal Q-Q plots, skewness values, kurtosis values, and the Kolmogorov-Smirnov test. A visual examination of the Q-Q plots showed that the data were approximately normally distributed along the diagonal of the plots. There were no notable skewness or kurtosis values that were higher than a value of 1 indicating that the data were normally distributed. Additionally, the Kolmogorov-Smirnov test

indicated that all of the data were not significantly different from a normal distribution $D(78) = .07$, $p = .20$, fulfilling the assumption of normality.

The assumption of homogeneity of variance was examined with Levene's test of the equality of error variances. Levene's test indicated that all of the conditions met the assumption of homogeneity of variance (*p*'s range from .06 - .92). The assumption of sphericity was examined using Mauchly's test of sphericity. Mauchly's test indicated that the variable of attractiveness and the interaction of attractiveness x resource acquisition met the assumption of sphericity, $X^2(2) = 5.84$, $p = .054$ and $X^2(2) = 2.32$, $p = .31$, respectively. Adequately meeting the assumptions, the data were analyzed.

As expected, the data showed a main effect of attractiveness, $F(2,152) = 38.27$, $p < .001$, partial $\eta^2 = .34$, indicating that faces were allocated cognitive resources based on how attractive the face was, regardless of the level of resource acquisition or the gender of the participant. Planned contrasts indicated that highly attractive faces ($M = 9.00$) were significantly different from moderately attractive ($M = 7.30$), $F(1,76) = 35.51$, $p < .001$, and low attractive faces ($M = 6.71$), $F(1,76) = 60.78$, $p < .001$. Moderately and low attractive faces were also significantly different from one another, $F(1,76) = 6.42$, $p = .01$. The average waveforms for the main effect of attractiveness collapsed across participants can be seen in Figure 4. Main effects of resource acquisition and gender were not found for this component, $F(1,76) = 0.01$, $p = .91$ and $F(1,76) = 0.00$, $p = .99$, respectively.

Interestingly, the early LPP demonstrated a significant 2-way interaction between the variables. A significant disordinal interaction between resource acquisition x gender indicated that men prioritized attention to the lower resource acquisition levels ($M_{(low)} =$

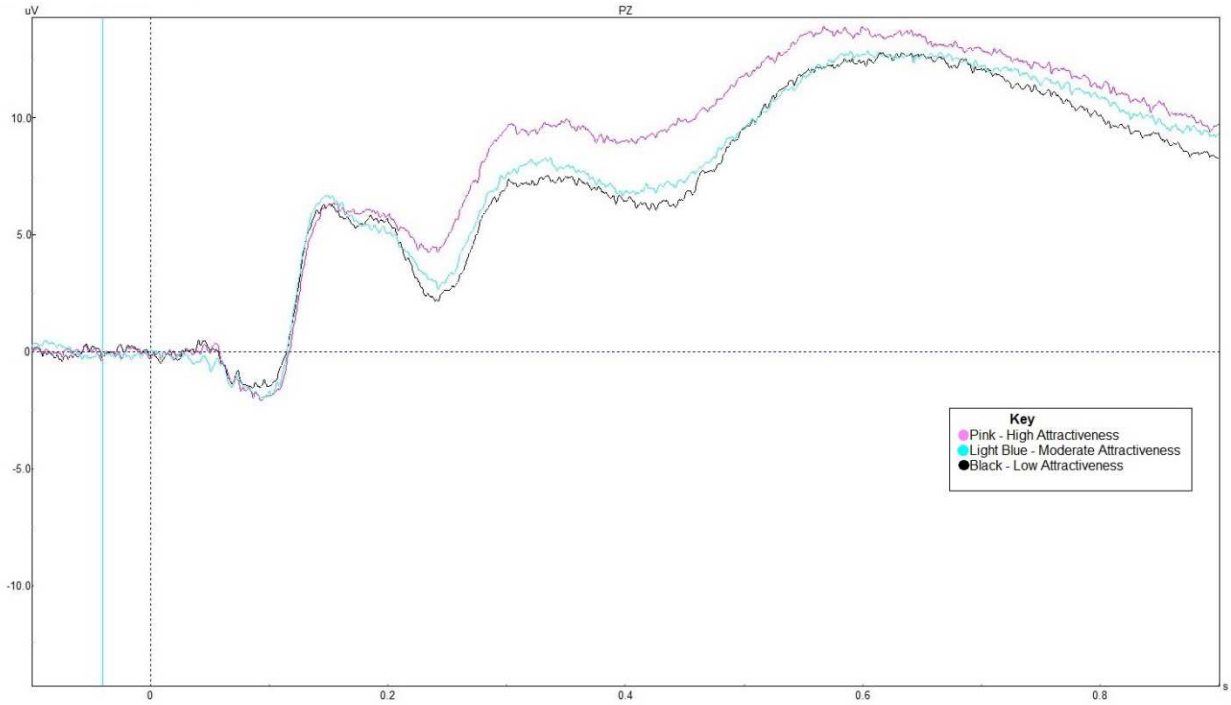

Figure 4. The main effect of attractiveness collapsed across all participants for the Pz electrode.

8.00, $M_{(high)}$ = 7.34) while women prioritized attention to the higher resource acquisition levels ($M_{(low)}$ = 7.36, $M_{(high)}$ = 7.98), $F(1,76) = 9.20$, $p = .003$, partial $\eta^2 = .11$. Refer to Figure 5 for a visual display of this effect and Figure 6 to view the average waveforms. The other possible interactions were non-significant: attractiveness x gender ($p = .25$) and attractiveness x resource acquisition ($p = .77$).

As predicted, a significant 3-way interaction was found for the early LPP, $F(2,152) = 4.43$, $p = .01$, partial $\eta^2 = .06$. Paired samples *t*-tests were used to examine the 3-way interaction; three pairwise comparisons were made for each gender. A Bonferroni corrected alpha was calculated using a total of 6 comparisons for a new alpha level of .008. The results of the *t*-tests indicated that for males, a significant difference was found for the interaction of moderate level of attractiveness x resource acquisition, $t(40) = -3.61$, $p = .001$. The pattern of mean ERP amplitudes indicates that males allocated a

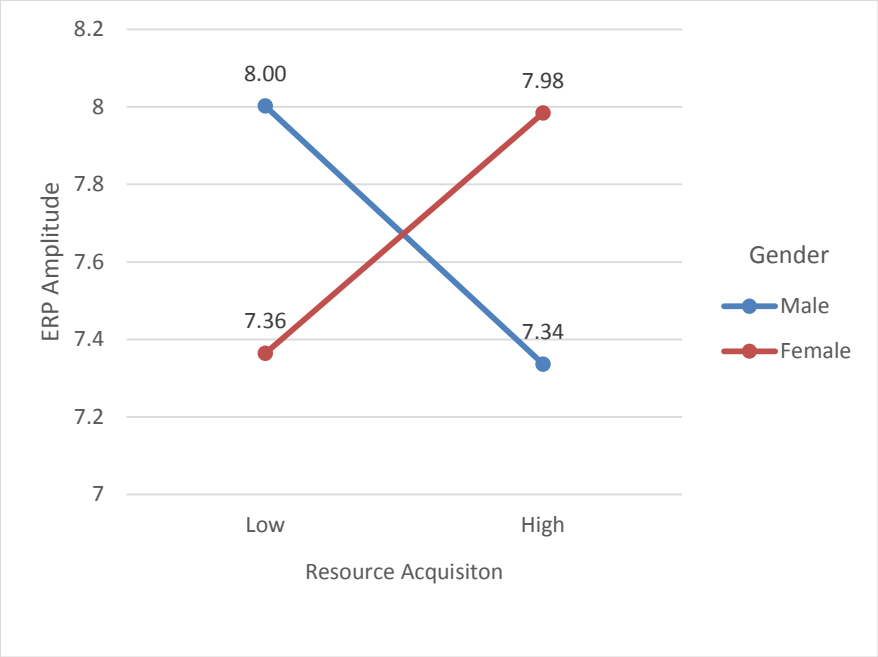

Figure 5. The interaction of gender x resource acquisition level for ERP amplitudes for the early LPP waveform.

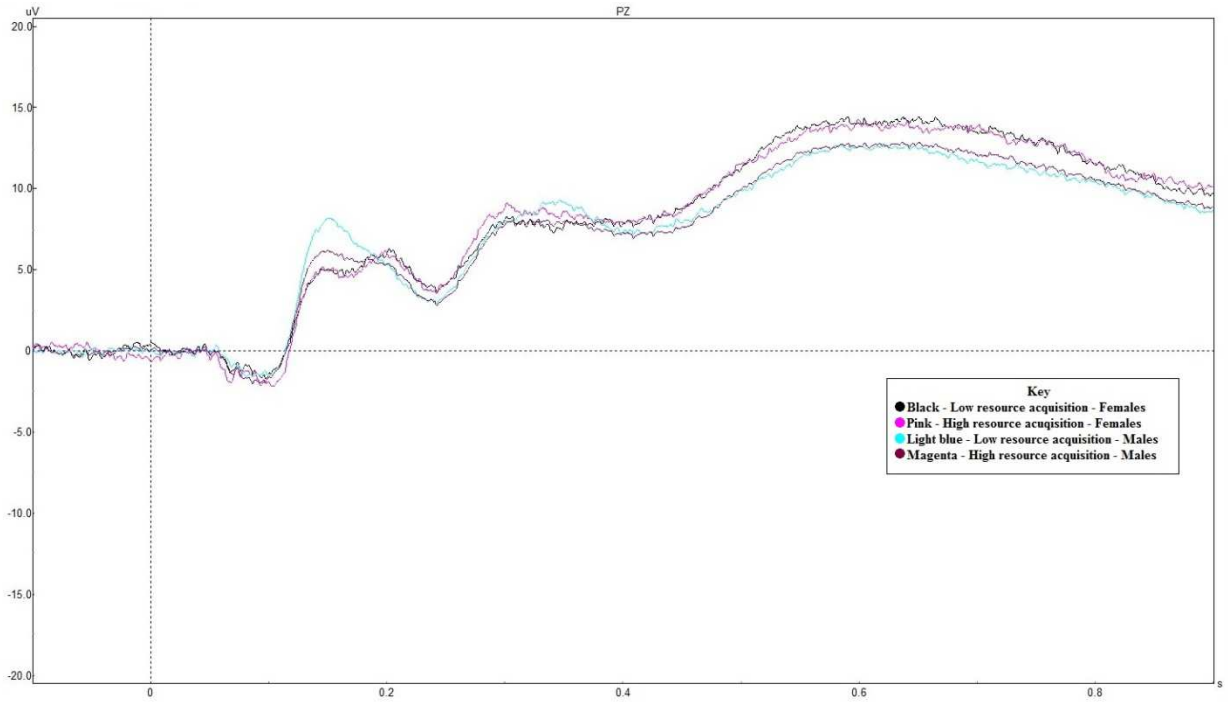

Figure 6. The average waveforms for the 2-way interaction of gender x resource acquisition.

significantly higher portion of their cognitive resources to female stimuli in the low resource acquisition condition (M = 8.16) than the high resource acquisition level (M = 6.88) when the attractiveness level was moderate. The results for females did not reach the Bonferroni corrected p level for significance; however, there were notable differences for females in the moderate attractiveness condition (p = .03). This interaction is visually depicted in Figure 7.

Late LPP

Assumption checks for the late LPP were performed prior to the inferential analysis. The data were checked for normality through normal Q-Q plots, kurtosis values, skewness values, and the Kolmogorov-Smirnov test. Q-Q plots indicated the data were approximately normally distributed along the diagonal reference line. Kurtosis and skewness values were not notably higher than a value of 1 suggesting a normal distribution of the data. The Kolmogorov-Smirnov test showed that the data met the normality assumption adequately, $D(78) = .07$, $p = .20$.

Levene's test showed that the data also met the assumption of homogeneity of variance (p's range from .05 - .94) with the exception of the low attractiveness/ high resource condition. Due to the tendency of large sample sizes to distort the results of Levene's test (Field, 2009), the violation of this assumption was not further examined and homogeneity of variance was assumed. The assumption of sphericity was met for both the variable of attractiveness and the interaction of attractiveness x resource acquisition with Mauchly's test of sphericity, $X^2(2) = 2.09$, $p = .35$ and $X^2(2) = 1.60$, $p = .45$, respectively. Inferential analyses were performed upon meeting the assumption checks.

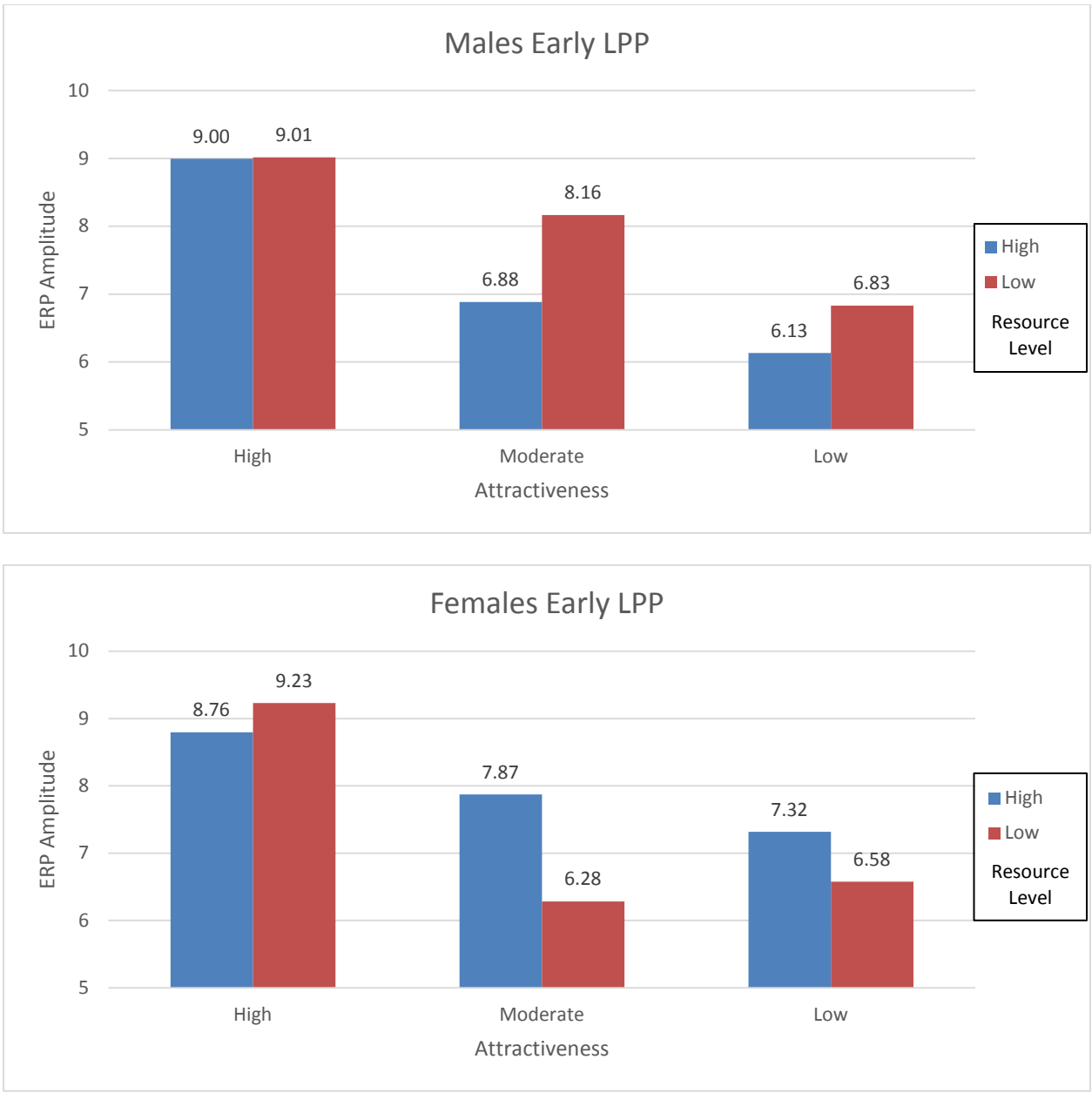

Figure 7. The 3-way interaction between gender, resource acquisition, and attractiveness for ERP amplitudes for the early LPP for males and females.

Similar to the early LPP, the late LPP also demonstrated a significant main effect of attractiveness, $F(2,152) = 8.74$, $p < .001$, partial $\eta^2 = .10$. Planned contrasts indicated that high attractive faces garnered the largest ERP amplitudes ($M = 12.69$) compared to both moderate attractive faces ($M = 11.63$, $p = .001$) and low attractive faces ($M = 11.47$, $p = .001$). Moderate attractive faces and low attractive faces were not significantly

different from one another (p = .58). A significant main effect of resource acquisition indicated that the low resource acquisition condition (M = 12.22) had higher ERP amplitudes compared to the high resource acquisition condition (M = 11.64), $F(1,76)$ = 7.37, p = .008, partial η^2 = .09. The main effect of gender was trending toward significance, $F(1,76)$ = 3.13, p = .08, partial η^2 = .04. While none of interaction effects for the late LPP reached significance (attractiveness x resource acquisition p = .97, 3-way interaction p = .21), some trending effects emerged for the interaction of attractiveness x gender (p = .09) and resource acquisition x gender (p = .06). All of the inferential values for the early and late LPP are displayed in Table 1 while the average ERP amplitudes for each waveform for each gender are listed in Table 2.[1]

Table 1

Summary of the 3x2x2 mixed ANOVAs for the early and late LPP waveforms

	Early LPP			Late LPP		
Effect	F	p	partial η^2	F	p	partial η^2
Attractiveness	38.27	.000*	.34	8.73	.000*	.10
Resource Acquisition	0.01	.91	.00	7.37	.008*	.09
Gender	0.00	.99	.00	3.13	.08	.04
Attractiveness x Gender	1.41	.25	.02	2.49	.09	.03
Attractiveness x Resource Acquisition	0.26	.77	.00	0.03	.97	.00
Resource Acquisition x Gender	9.20	.003*	.11	3.69	.06	.05
Attractiveness x Resource Acquisition x Gender	4.43	.01*	.06	1.56	.21	.02

*Indicates significant at p = .05

1All of the listed ERP analyses were also performed with the central parietal electrode Pz for both the early and late LPP. This resulted in a similar pattern of results for all of the stated main and interaction effects for the analyses involving the cluster of the 5 electrodes (Pz, POz, CPz, P1 and P2). Early LPP: Main effect of attractiveness (p < .001), 2-way interaction of resource acquisition x gender (p = .005), 3-way interaction (p = .03). Late LPP: Main effect of attractiveness (p = .001), main effect of resource acquisition (p = .004).

Table 2

Mean ERP amplitudes for male and female participants for the early and late LPP

	Early LPP			Late LPP		
Resource Acquisition	Attractiveness *M*(*SD*)			Attractiveness *M*(*SD*)		
Males	High	Moderate	Low	High	Moderate	Low
High	9.00 (5.20)	6.88 (5.20)	6.13 (4.56)	11.65 (4.71)	10.18 (4.76)	9.42 (4.91)
Low	9.01 (5.58)	8.16 (5.19)	6.83 (5.45)	11.96 (5.75)	11.59 (5.77)	10.69 (4.95)
Females	High	Moderate	Low	High	Moderate	Low
High	8.76 (6.12)	7.87 (6.58)	7.32 (6.07)	13.20 (5.59)	12.40 (6.46)	12.96 (7.17)
Low	9.23 (5.56)	6.28 (5.89)	6.58 (5.93)	13.95 (5.88)	12.34 (5.77)	12.80 (6.37)

Behavioral Data

An examination of the behavioral data revealed that the behavioral response selections were unfortunately not recorded for the majority of participants (n = 77). The behavioral response to each image was not logged by the computer due to a programming error in the initial set-up of the paradigm. All participants completed the paradigm within the expected timeframe (~20 min) and the design of the paradigm was such that it would not advance without the participant selecting a response to the image. Based upon this paradigm design, expected time completion, and experimenter observation, all participants are assumed to have viewed and responded to the paradigm as intended. Although not the desired outcome, a preliminary analysis of data for the five participants that was recorded will be presented. The minimal amount of data includes 180 total data points for each participant in response to viewing and rating each image 3 times.

The appropriate assumptions were checked and as expected, the minimal amount of data did not meet the assumptions of normality, homogeneity of variance, or sphericity. As a transformation of the data was unlikely to help with such a small *n,* an

exploratory analysis was performed with the robustness of the *F* test in mind. The *p* values reported here are with sphericity assumed, but this same pattern of results also emerged for the Greenhouse-Geisser and Huynh-Feldt values. While caution should be used in interpreting any of these results, the pattern of results appears to be similar to the LPP. The inferential results from this sample only consisted of 4 males and 1 female, making any results including gender as a variable not reliably interpretable, thus only main effects of attractiveness and resource acquisition were tested. A main effect of attractiveness ($p < .001$) emerged, indicating that participants were most interested in initiating a long-term romantic relationship with the most highly attractive stimuli.

CHAPTER 4

DISCUSSION

The results of the current study support the idea that men and women are impacted by both attractiveness and resource acquisition cues when evaluating initial romantic interest in a prospective mate. The predicted main effect of attractiveness indicated that both sexes prioritized their attention to the most physically attractive faces in the environment. This pattern of brain activity substantiates past literature indicating that physical attractiveness is a reliable marker of prospective interest in a mate due to its motivational relevance in this context (Johnston & Oliver-Rodriguez, 1997; Marzi & Viggiano, 2010; Morgan & Kisley, 2014; van Hooff et al., 2011; Werheid et al., 2007). The current study's results are also in accordance with research demonstrating that men prioritize their limited resources toward the most highly attractive faces in the environment (Johnston & Oliver-Rodriguez, 1997; Maner et al., 2007; Morgan & Kisley, 2014; van Hooff et al., 2011) and provides more evidence that women also allocate their attention towards the most physically attractive, and thus motivationally salient, faces in the environment (Marzi & Viggiano, 2010; Werheid et al., 2007). Other than the main effect of attractiveness, the early and late LPP demonstrated some alternate patterns of activity and will be discussed separately.

Early LPP

While the main effect of resource acquisition was not significant here (p = .91), a significant interaction between the variables of resource acquisition x gender (p = .003) suggested that men and women were allocating attention to the monetary manipulation in opposite ways; females allocated more attention towards higher resource acquisition conditions while males allocated their attention to lower resource acquisition. The latter was not a predicted effect for the current study and the interpretation of this effect is viewed as a preliminary step to the 3-way interaction (discussed below). Females were expected to allocate their attention to prospective mates in the higher resource acquisition condition in light of previous findings that women are motivated to seek a prospective long-term mate that can provide adequate resources (Buss & Schmitt, 1993; Miner & Shackelford, 2010). Curiously, males allocated attention in the opposite pattern, perhaps suggesting that an observation of traditional gender roles had an additional influence on mate selection. Eastwick et al. (2006) suggests that traditional gender ideologies designate the division of labor within a household according to a patriarchal system in which men are considered the financial provider and women are considered the social caretaker. The dualism of this provision of labor inspired an interpretation of the finding in the current study. Women, as indicated by the literature, were more focused on a mate with higher resources while men followed the opposite pattern of attending to lower earning women. In support of this, a correlational study examining the mate preferences among a college-aged sample of students showed that male participants not only endorsed a traditional female gender role to a stronger extent than female participants, but these male students also exhibited more sex-typed mate preferences (Johannesen-Schmidt

& Eagly, 2002). Additionally, Eastwick et al. (2006) suggests that as women acquire more financial security, they may be less willing to commit to an entirely domestic role, and this is reflected in men's mate preferences. Further evidence for this explanation is supported by the fact that the 3-way interaction was driven by a significant effect of male preference rather than female preference.

The 3-way interaction of attractiveness x resource acquisition x gender demonstrated that men allocated significantly higher attention to women in the low resource acquisition condition when her attractiveness level was moderate. When the attractiveness level was high, there was not a notable difference for the amount of attention that was paid to the image. This suggests that men allocated the most attention to women with the highest reproductive value (i.e., high physical attractiveness), yet when presented with women of a lower reproductive value, men may have evaluated the potential mate for her "homemaker potential" instead. The opposite of this pattern of responses, while not reaching significance, was displayed by the female participants for the moderate attractiveness level, suggesting that females use resource acquisition cues in direct opposition to how males use them.

Late LPP

In addition to the main effect of attractiveness mentioned above, a significant main effect of resource acquisition was found, indicating that the lower level of resource acquisition (M = 12.22) was allocated significantly higher ERP amplitudes compared to the higher level of resource acquisition (M = 11.64). This effect is speculated to also be driven by the male participant's responses and indeed, a 2-way interaction of gender x resource acquisition was trending for this component (p = .06) with the ERP amplitudes

for males following the same pattern of a higher allocation to the low resource acquisition condition (M = 11.41) than the high (M = 10.42). Additionally, a trending effect of attractiveness x gender (p = .09) suggests that females may be employing evaluations of the physical attractiveness of a potential mate to a larger extent than past literature usually indicates (Li et al, 2002) by allocating a larger portion of their attention (as estimated by the overall mean amplitude of the ERP for all attractiveness levels) to the physical attractiveness of a prospective mate compared to male ERP amplitudes ($M_{(\text{Female})}$ = 12.94, $M_{(\text{Male})}$ = 10.92). Further research is needed to clarify how or why females are exhibiting larger ERP amplitudes in responses to the attractiveness of a face for the late LPP.

When evaluating the potential of a long-term mate, males are speculated to use physical attractiveness to a larger extent than females, while females are depicted as focusing their attention primarily on acquiring resources from a potential mate (Li et al., 2002; Miner & Shackelford, 2010). Due to the implication that men prioritize markers of reproductive value such as physical attractiveness in their assessments of a potential mate, perhaps men are capable of categorizing a potential mate's attractiveness quicker than women and the lack of a significant 3-way interaction for this component may be indicative of the speed of facial attractiveness judgments. Previous research has shown that reliable judgments of physical attractiveness can be made in less than 100 ms (Locher, Unger, Sociedade, & Wahl, 1993; Olson & Marshuetz, 2005). Important to note is that Locher at al. (1993) and Olson and Marshuetz (2005) both used male and female participants in their research; however, their participants were only instructed to evaluate

the physical attractiveness of the stimuli and were not evaluating the target's mate potential.

In order for the 3-way interaction to have been significant for this later occurring timeframe, the evaluations of the interaction of attractiveness and resource acquisition would need to be occurring almost instantaneously for men and women. As physical attractiveness information is speculated to be of a greater priority to men than women, perhaps men were able to categorize the target stimuli's level of attractiveness so quickly that this evaluation had dissipated by 400ms after the target was presented. The higher ERP amplitudes for women for the 2-way interaction of attractiveness x gender (discussed above) suggest that women were motivated to allocate a larger portion of attention to the attractiveness of the target for a longer portion of time as they evaluated the mate for their prospective value. Additionally, a glance at the mean ERP amplitudes for the gender x resource acquisition 2-way interaction also indicated that females were allocating more attention to the resource acquisition information for a longer period of time compared to males ($M_{(\text{Female})} = 12.94$, $M_{(\text{Male})} = 10.92$). The results of the current study may indicate that while men and women use the cues of physical attractiveness and resource acquisition in different ways, they are equally aware of these cues in their environment. In support of this, the interaction effect of attractiveness x resource acquisition was not significant ($p = .96$), indicating that gender is obviously an important factor to consider when examining mate preferences.

Limitations and Future Directions

Limitations of the current research include a lack of behavioral responses to analyze in comparison to the brainwave responses. This information would have been

valuable in discerning if male or females exhibited a noticeable pattern of responses in the behavioral data, lending support to the 3-way interaction hypothesis. Even as the relationship between agreement with traditional gender roles and prospective mate preferences was uncovered after data collection was complete, a measure evaluating the extent to which participants held a traditional gender role ideology could have helped explain if adhering to this belief impacted participants' allocation of attention to the differing resource acquisition conditions. Collection of physical attractiveness ratings of the target stimuli following the conclusion of the paradigm would have also been interesting to analyze in combination with the brainwave data to evaluate if the economic manipulation of resource acquisition could potentially impact perceptions of physical attractiveness. It also would have been preferable to have collected data from more participants so that in the case of corrupted data, the integrity of the sample sizes was not compromised.

The current study demonstrates that males also appear to be susceptible to mate-relevant cues regarding resource acquisition and future research is needed to fully understand this phenomenon. The unexpected 2-way interactions of gender x resource acquisition and gender x attractiveness are difficult to fully interpret for the design of the current study and a more focused study to further interpret the pattern of these effects would be interesting in the future. The current pattern of male responses begs the question of how adherence to a traditional gender role ideology may influence and potentially explain initial mate preference for both sexes. While the focus of this study was motivated attention to the images, it would also be interesting in future studies to

have participants rate the image for overall physical attractiveness to examine if non-physical mate cues may have an impact on physical evaluations.

Romantic relationship status was recorded in this study, yet post hoc analyses with relationship status as a dichotomous variable (in a relationship/ not in a relationship) indicated no unique connection between relationship status and the pattern of allocated attention. The current study does not appear to have been sensitive enough to detect differences based on relationship status; however, past literature has indicated that persons in committed relationships are likely to derogate the attractiveness of a prospective mate (Meyer, Berkman, Karremans, & Liberman, 2011; Ritter, Karremans, & Schie, 2010; Simpson, Gangestead, & Lerma, 1990). Perhaps it is not enough to merely be involved in a relationship with another individual and commitment is the vital element that may inspire this derogation (Johnson & Rusbult, 1989). With this in mind, the mean ERP amplitudes for engaged and married individuals were examined and were observed to be much lower than participants that were single, in a relationship (but not engaged or married), or divorced. Future studies should examine if involvement in a committed relationship may impact not only behavioral evaluations of a prospective mate, but also the pattern of brain activity resulting from these evaluations. Perhaps a study design forcing committed participants to compare a potential mate to their current romantic mate would inspire participants to use relationship maintenance strategies and demonstrate this derogation effect. A focus on relationship status as a measured variable could lend some insight into how people in relationships protect their relationship from prospective mates possessing a higher mate value, resulting from higher physical attractiveness or other traits compared to one’s current mate.

Conclusion

The results of the current study provide support to the previous literature indicating that physical attractiveness is an important cue for both men and women seeking prospective romantic mates (Buss & Barnes, 1986; Escasa et al., 2010; Miner & Shackelford, 2010). Additionally, this line of research provides new evidence to demonstrate that potential resource acquisition is an important consideration for mate selection, for men as well as women. While women are typically alleged to be the choosier sex (Miner & Shackelford, 2010), it appears that in the current study men utilized resource acquisition information to a larger extent than women. It is interesting to note that while both sexes prioritized their attention to the most attractive faces in their environment, men and women may differ in the time it takes to complete these evaluations concerning prospective romantic mates. Even as the lack of behavioral responses is disappointing, the pattern of responses in the brain activity is promising in showing that mate-relevant cues of physical attractiveness and potential resource acquisition impacted how both sexes allocated their limited supply of attention to the targets. Male and female mate preferences remain indubitably complicated, yet the current study illustrations that both sexes are in tune with a variety of cues related to a potential mate's value, even when those cues are speculated to be of higher importance to the opposite sex.

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APPENDIX

University of Colorado Colorado Springs

Institutional Review Board (IRB) for the Protection of Human Subjects

Date: 1/27/2016

IRB Review **APPROVED**

IRB PROTOCOL NO.: 15-116
Protocol Title: Brainwaves and Attractiveness
Principal Investigator: Laura Morgan
Faculty Advisor if Applicable: Michael Kisley
Application: Renewal
Type of Review: Expedited 4
Risk Level: No more than Minimal Risk
Renewal Review Level (If changed from original approval) if Applicable: N/A No Change
This Protocol involves a Vulnerable Population: N/A (No Vulnerable Population)
Expires: 1 February 2017
*Note, if exempt: If there are no major changes in the research, protocol does not require review on a continuing basis by the IRB. In addition, the protocol may match more than one review category not listed.
Externally funded: ☒ No ☐ Yes
OSP #: Sponsor:

Thank you for submitting your Request for IRB Review for renewal of an approved protocol. The protocol identified above has been reviewed according to the policies of this institution and the provisions of applicable federal regulations. The review category is noted above, along with the expiration date, if applicable.

Once human participant research has been approved, it is the Principal Investigator's (PI) responsibility to report any changes in research activity related to the project:

- The PI must provide the IRB with all protocol and consent form amendments and revisions.
  - The IRB must approve these changes prior to implementation.
- All advertisements recruiting study subjects must also receive prior approval by the IRB.
- The PI must promptly inform the IRB of all unanticipated serious adverse (within 24 hours). All unanticipated adverse events must be reported to the IRB within 1 week (see 45CFR46.103(b)(5). Failure to comply with these federally mandated responsibilities may result in suspension or termination of the project.
- Renew study with the IRB ***prior to expiration***.
- Notify the IRB when the study is complete

If you have any questions, please contact Research Compliance Specialist in the Office of Sponsored Programs at 719-255-3903 or irb@uccs.edu

Thank you for your concern about human subject protection issues, and good luck with your research.

Sincerely yours,

Melissa J. Benton
Melissa Benton, PhD
IRB Committee Member