Social Perception of Faces and Bodies: The Relationships Among Motivational Salience, Social Perception, and Hormones

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Abstract

Social perception (i.e., the formation of impressions based on perceivable cues) of both faces and bodies is an integral part of social interaction and can influence and can be influenced by many variables, such as motivational salience (i.e., the amount of effort an individual will expend to continue viewing faces and bodies) and hormone levels of the perceiver.

The first empirical chapter (i.e., Chapter 2) investigated social perception of faces and bodies using multiple trait ratings. First, participants rated face and body stimuli on the same 13 traits as those used in the seminal article on social perception of faces. Replicating previous work, I found that social perception of faces can be summarized by the two-component pattern of valence (i.e., intent to cause harm) and dominance (i.e., ability to cause harm). Social perception of bodies, though, can be summarized by one main component. Therefore, social perception of faces and bodies followed different, distinct patterns.

The second empirical chapter (i.e., Chapter 3) investigated the relationship between the social perception components established in Chapter 2 and motivational salience. I assessed motivational salience using a standard key-press task in which participants could increase or decrease stimulus viewing time by pressing specified keys on the keyboard. Replicating previous work, valence and dominance positively and independently predicted the motivational salience of faces. Additionally, the one main social perception component of bodies positively predicted the motivational salience of bodies.

The third empirical chapter (i.e., Chapter 4) investigated the relationship among the previously established social perception component of bodies, motivational salience of bodies, and hormone levels of the perceivers. I used the passive drool method of hormone measurement to determine exact hormone levels at five weekly test sessions. Similar to studies of faces, motivational salience of bodies was greater when testosterone was higher. While the one social perception component for bodies positively predicted motivational salience separately for male and female bodies, there was no interaction between testosterone and the social perception component, failing to conceptually replicate previous interactions between testosterone and stimulus valence.

Overall, I first replicated the two-component social perception pattern of valence and dominance for faces before finding a different, one-component social perception pattern for bodies. In turn, each of these social perception components predicted motivational salience of faces and bodies. Additionally, motivational salience of bodies was greater when testosterone was high, but this effect was not qualified by the main social perception component for bodies. I conclude by discussing the similarities and differences between faces and bodies in this and other work on social perception and motivational salience.

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Author's Declaration

I declare that this thesis is comprised of my original work carried out under the supervision of Dr. Lisa DeBruine and Professor Benedict Jones.

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Chapter 1: General Introduction

1.1 Research questions

Individuals perceive and interact with a multitude of people every day, strangers and acquaintances alike. Social judgments arise from these perceptions and most work on this topic has focused on social perceptions of faces. Bodies also provide information that may be used in social perception, which leads me to the following questions: 1) What pattern of automatic perceptions do people form based on the physical features of bodies? 2) Do faces and bodies invoke similar perception patterns or are faces and bodies perceived along different components? 3) How do these perception patterns relate to the motivational salience of faces and bodies? 4) How do the hormone levels of perceivers influence the motivational salience of bodies?

1.2 Historical background of social perception

1.2.1 Physiognomy

Throughout history, people have attempted to explain personality perceptions in a multitude of ways. Before examining the modern methodologies and theories, though, one must first understand how previous generations tackled the issue. For millennia, humans have believed that personality attributes are ascertainable through merely examining one's physical features, particularly those prevalent in the face. Plato and Aristotle first officially established this concept in Ancient Greece before it morphed into the fully formed field of physiognomy (Hassin & Trope, 2000; Twine, 2002; Wegenstein & Ruck, 2011). In modern times, Johann Kaspar Lavater popularized physiognomy via widespread circulation of his essays on the topic (Graham, 1961). First published in the late 1770s, Lavater's essays were translated into multiple languages, allowing the popularity of physiognomy and its associated concepts to grow. By mixing science and religion, physiognomy claimed that one's inner beauty, meaning personality and characteristics, could be determined from one's outer beauty (Wegenstein & Ruck, 2011).

Physiognomy was commonly accepted through the 18th and 19th centuries (Hassin & Trope, 2000). In several ways, though, physiognomy continues to be popular today with many believing that personality traits can be accurately perceived from the face and studies providing some empirical support for weak correlations between personality and facial appearance (Hassin & Trope, 2000; Penton-Voak, Pound, Little, & Perrett, 2006). Numerous modern stereotypes about socially and culturally influenced attributes such as class, gender, and race continue to be guided by physiognomic concepts (Twine, 2002).

1.2.2 Phrenology

Whereas physiognomy dates back to ancient Greece, phrenology and its popularity are much more recent, with this pseudo-science dating back to the 18th and 19th centuries (Twine, 2002). Although physiognomy and phrenology are related and the latter arose from the former, the two represent distinct approaches to automatic personality perceptions. Physiognomy is the ascertaining of personality traits from faces and/or bodies whereas phrenology is the ascertaining of personality traits from specifically skull and brain size (Faigman, 2007; Hall, 1977; Hassin & Trope, 2000; Rafter, 2005; Simpson, 2005; Soreff & Bazemore, 2007).

By examining one's skull as a proxy of measuring the brain underneath, phrenologists claimed to judge personality, morality, and criminal tendencies (Hall, 1977; Rafter, 2005; Simpson, 2005). Phrenologists' belief that the skull acted as a valid proxy of one's brain was based on one of their founding tenets: the strength and ability of one's brain is expressed by its size and bulk (Faigman, 2007; Rafter, 2005; Simpson, 2005; Soreff & Bazemore, 2007). In turn, this founding tenet led to the concept that well-developed brain regions caused bulges in the skull (Faigman, 2007; Rafter, 2005; Simpson, 2005; Soreff & Bazemore, 2007). Phrenology was particularly popular during the 19th century and was used to naturalize and normalize social and societal inequalities, including racism, class disparity, euro-centrism, and patriarchy (Hassin & Trope, 2000; Twine, 2002). Belief in the field was so pervasive that people would consult supposed phrenologist experts on all types of life decisions, including employment, marriage, education, and child-rearing (Soreff & Bazemore, 2007).

Eventually, phrenology faded from popular favor when people started to acknowledge its racist overtones and scientific fallacy. Additionally, little to no evidence supported accuracy of physiognomic judgments (Hassin & Trope, 2000). However, first impressions and person perceptions continue to be formed based on physical appearance.

1.2.3 Somatotype

Just as faces were and continue to be utilized as an avenue through which people ascertain personality traits, bodily features have been assumed to indicate personality traits as well. Somatotypes are categories of bodily physiques and the identification of morphological components (Sheldon, Stevens, & Tucker, 1940). The first somatotype, endormorphy, indicates a body that is soft and round (Sheldon et al., 1940). The second somatotype, mesomorphy, indicates a body that is mainly muscle, bone, and connective tissue (Sheldon et al., 1940). The third and final somatotype, ectomorphy, indicates a body that has mainly harsh angles and fragility (Sheldon et al., 1940).

Somatotypes can also lead to perceptions of specific personality types. Phrenology and the field of somatotypes are similar in the sense that the accuracy of personality perceptions may be questionable and not empirically supported. Although the field of somatotypes is no longer commonly accepted as science, some associations between personality attributions and body types still persist in the lay population. For example, participants associated positive behavior with the mesomorph body type while associating negative social behaviors to endomorph and ectomorph body types (Lerner, 1969; Mishkind, Rodin, Silberstein, & Striegel-Moore, 2001). Specific attributions for the mesomorph somatotype included having lots of friends, being polite and happy, gregarious, brave, healthy, smart, and neat (Mishkind et al., 2001). On the other hand, participants attributed being sloppy, dirty, untrustworthy, stupid, lazy, and lonely to endomorphs (Mishkind et al., 2001). Ectomorphs were perceived as quiet, nervous, afraid, sad, weak, and sick (Mishkind et al., 2001). Furthermore, these stereotypes generalized across participant class and race (Mishkind et al., 2001).

Although mesomorphs are stereotyped positively and endomorphs negatively, male and female stereotypes of each somatotype slightly differ (Ryckman, Robbins, Kaczor, & Gold, 1989). For example, Ryckman and colleagues (1989) found that participants perceived female ectomorphs as more attractive than their male counterparts while perceiving male ectomorphs as more intelligent.

1.2.4 Moving forward with social perception

Judging personality from physical appearance, while topical, dates back to Ancient Greece. Although the practices regarding such concepts differ throughout time, the propensity for people to believe that physical appearance provides clues to personality remains. The fact that these judgments of personality are persistent leads to many questions, including questions regarding what decisions these perceptions impact.

1.3 Decisions affected by social perceptions: Key examples

First impressions and automatic social perceptions of others can influence treatment of such individuals and the decision of whether or not to spend time around specific individuals. These social perceptions, even when formed in a minute amount of time and without any actual interpersonal interaction, can influence important decisions impacting both the lives of the perceiver (i.e., the individual perceiving another person) and the perceived (i.e., the individual being perceived by another person) (Klofstad et al., 2012; Ballew & Todorov, 2007; Todorov et al., 2005; Porter, ten Brinke, & Gustaw, 2010).

Voting is one such extremely important decision influenced by social perception. Social perception can guide the perceiver to vote for a specific individual regardless of the actual quality or competence of the candidates (Klofstad, Anderson, & Peters, 2012; Todorov, Mandisodza, Goren, & Hall, 2005). Assumptions of perceived competence formed in less than two seconds even predicted election outcomes (Ballew & Todorov, 2007; Todorov et al., 2005). Even something so simple as voice pitch can shape voting decisions, as both men and women selected male and female leaders with lower voices (Klofstad et al., 2012). Voting and the subsequent social changes enacted by the elected officials can dramatically affect both the perceived and the perceiver. For example, voting for and electing one candidate over another may lead to drastically different societal reforms, such as taxation regulation, which can drastically affect the voter. These far reaching consequences highlight the importance of the influence that social perceptions can impose upon daily life.

Court verdicts are another important decision affecting the life of the perceived. If an individual appeared trustworthy, participants required more evidence to convict (Porter, et al., 2010). Moreover, when arriving at a guilty verdict for a seemingly untrustworthy individual, participants were more confident in their decision (Porter et al., 2010). Severity of crime was particularly vital to these findings, as participants needed more evidence to convict a seemingly trustworthy individual of a severe crime such as murder while not requiring a different level of evidence to convict either seemingly trustworthy or untrustworthy individuals of minor crimes (Porter et al., 2010).

Voting decisions and conviction rates are just two of the potentially large number of life-altering consequences affected by automatic social perceptions. These far-reaching implications based on automatic first impressions therefore lead to the following question: what traits are immediately ascertained that may influence decisions regarding the perceived?

1.4 Traits ascertainable via social perception

1.4.1 Faces

Previous research has demonstrated that people spontaneously judge a variety of traits from facial appearance. To test how presumed traits overlapped and to encapsulate the entire space of first impressions, Oosterhof and Todorov (2008) first asked participants to freely describe neutral faces. The researchers then grouped the unconstrained descriptions by relevance into the following trait dimensions: attractive, unhappy, sociable, emotionally stable, mean, boring, aggressive, weird, intelligent, confident, caring, egotistic, responsible, and trustworthy (Oosterhof & Todorov, 2008). Then, new participants rated the same neutral faces according to these traits in addition to dominance. With the exceptions of boring and egoistic, all trait ratings were highly reliable (Oosterhof & Todorov, 2008). After performing a Principal Component Analysis on these new trait ratings, they found that social perception of faces could be summarized by the perceiver's judgments of the valence (i.e., trustworthiness) and dominance (Oosterhof & Todorov, 2008). In other words, social perception can be summarized by the intent to cause harm (i.e., valence) and the ability to cause harm (i.e., dominance) represented within the face.

In order to better identify the specific source of first impressions, Todorov, Dotsch, Oosterhof, Porter, and Falvello (2013) even created computational models of social judgments of faces for attractiveness, competence, dominance, extraversion, likability, threat, and trustworthiness. Each model allows for the generation of faces with high and low concentrations of each listed trait, illustrating that each trait can be singly ascertained and used to form first impressions (i.e., social perceptions) of an individual.

Sutherland et al. (2013) took these analyses a step further by essentially replicating the Oosterhof and Todorov (2008) study with a more diverse set of faces. Indeed, Sutherland et al. (2013) deliberately included 1000 faces that represented a wide range of many variables and were scoured from the internet. Variance in the faces included presence or lack of facial hair, piercings, and glasses as well as a range of ages, expressions, poses, and degrees of health (Sutherland et al., 2013). Oosterhof and Todorov (2008) used much more homogeneous stimuli since all faces were neutral, had direct gaze, represented a limited age range, and lacked facial hair, earrings, glasses, and makeup. Essentially, Oosterhof and Todorov (2008) standardized their images on many of the details for which Sutherland and colleagues (2013) asserted variance should be present. Yet, Sutherland et al. (2013) found that face perception could still be summarized by trustworthiness (i.e., valence) and dominance, consistent with Oosterhof and Todorov (2008). Possibly due to their much more diverse face stimuli, Sutherland et al. (2013) also found a third component on which face perception could be summarized: youthful-attractiveness.

A further study (Wang, Hahn, DeBruine, & Jones, 2016) used even more standardized images to replicate previous findings. Wang and colleagues' (2016) stimuli were similar to that of Oosterhof and Todorov (2008) in the sense that both used faces standardized for expression, lighting, and head position. However, Wang and colleagues (2016) showed only faces and not hairstyle, clothing, or portions of bodies, as were present in Oosterhof and Todorov's (2008) stimuli. Even with the more standardized images, Wang and colleagues (2016) replicated the valance and dominance pattern and found that the valence dimension correlated strongly with both trustworthiness and attractiveness while the dominance dimension correlated strongly with aggressiveness.

Interestingly, these social perceptions arise within 100ms (Willis & Todorov, 2006). Moreover, increased deliberation time led to higher confidence in these trait judgments and more differentiated perceptions (Willis & Todorov, 2006). The formation of these judgments, even those made faster than 1 second, do not involve any interpersonal interaction between the perceiver and the perceived, merely one person attributing personality traits based on another's physical characteristics. There's even evidence that humans can form these perceptions within 39ms (Bar, Neta, & Linz, 2006). An additional layer of emotional information, such as fear displayed on faces, can be processed in 120ms (Van Heijnsbergen, Meeren, Grezes, & de Gelder, 2007).

Social perceptions, while formed in less than 100ms, remain stable and consistent, even after receiving supplemental information about the person being perceived. Previous research has shown that these first impressions are stable and consistent across perceivers (Bar et al., 2006; McAleer, Todorov, & Belin, 2014; Oosterhof & Todorov, 2008; Willis & Todorov, 2006; Zebrowitz & Collins, 1997). For example, when supposedly judging only behavior and not facial appearance, participants' personality attributions were actually best explained by explicit trait inferences based on facial appearance, not behavior inferences (Todorov & Uleman, 2003). Furthermore, the original personality attributions remained bound to the perceived individual rather than changing depending on his or her behavior (Todorov & Uleman, 2002). Therefore, spontaneously formed trait attributions based on facial appearance remain stable and consistent.

1.4.2 Voices

Just as people form first impressions of others based on facial features, they also form first impressions based on voices. Some researchers even argue that faces and voices, as well as the accompanying information, are processed in a similar manner through interactive but functionally disparate pathways that process speech, identity, and affect

(Belin, Bestelmeyer, Latinus, & Watson, 2011). Therefore, just as an impression formed via the face can be based on virtually any trait, so can an impression formed via the voice. For instance, age can be judged from both faces and voices (Drager, 2011; Linville, 1996; Rhodes, 2009; Wiese, Schweinberger, & Neumann, 2008). Attractiveness can also be judged from voices and the alteration of one's voice pitch (Fraccaro et al., 2013). People even form person attributions based on voices regarding such traits as strength, competence, and warmth (Montepare & Zebrowitz-Mcarthur, 1987). If social perception based on voices follows the same general pattern as social perception based on faces, the same traits could theoretically be ascertained via both channels.

McAleer, Todorov, and Belin (2014) replicated Oosterhof and Todorov's (2008) study with voices to test if the same pattern of social perception applied. While some previous experiments used long passages containing semantic content that could contribute to personality attribution (Montepare & Zebrowitz-Mcarthur, 1987; Zuckerman & Driver, 1989), McAleer et al. (2014) used brief utterances to test if social perception of voices occurred immediately and if such social perception was consistent across listeners. Aligning with Oosterhof and Todorov's results (2008), McAleer et al. (2014) found that the dimensions of valence and dominance, regardless of speaker gender, could summarize immediate social perception of voices. Voices rated as dominant were often of lower pitch than is typical within sex (Fraccaro et al., 2013). Furthermore, McAleer et al. (2014) found that male vocal attractiveness was positively correlated with both vocal valence and dominance. Conversely, female vocal attractiveness was mainly correlated with valence (McAleer et al., 2014).

Personality judgments based on voices also remain consistent. When forming personality judgments based on voices, Germans and Americans generally agreed (Scherer, 1972). Regardless of the speaker's nationality, ratings loaded strongly onto three factors: (1) conscientiousness and dependability, (2) sociability and dominance, and (3) anxiety (Scherer, 1972). Furthermore, speakers who rated themselves as social or dominant were rated similarly by participants of both cultures (Scherer, 1972). These results provide evidence that personality judgments specifically based on voices can also carry a degree of consistency, even cross-culturally. Combined, the results for both facial and vocal studies regarding personality attributions suggest that social perception is generally stable and consistent across raters and cultures.

1.4.3 Bodies

Social perception based on bodies could theoretically follow the same general guidelines as faces and voices, though much less research exists with regards to bodies. Trait inferences for bodies formed without any interpersonal interaction can include a variety of attributes. One of the most obvious attributes is sex. Participants were biased to categorize bodies as male and male categorizations occurred faster than female categorizations (Johnson, Iida, & Tassinary, 2012). When examining point-light displays, participants were able to accurately recognize the sex of the walker, but only when viewing dynamic videos (Kozlowski & Cutting, 1977). Additionally, accuracy of sex categorization based on point-light motion increased when viewing gender-typical gaits (Lick & Johnson, 2013).

These sex judgments can influence how individuals are perceived because social perceptions and first impressions are often formed through a filter of gender stereotypes (Koppensteiner & Grammer, 2011). For example, gender-typical body type and movement combinations were perceived as heterosexual while gender-atypical body type and movement combinations were perceived as homosexual (Johnson, Gill, Reichman, & Tassinary, 2007). Therefore, bodies can influence perception and first impressions.

Social perception specifically has yet to be examined with regards to bodies. However, people can form automatic impressions based on virtually any channel of social information (i.e., faces, voices, or bodies). As such, the empirical chapters will focus on filling this gap in the research.

When examining the social perception of bodies, it is important to keep in mind the various possibilities represented by the two-component pattern of social perception for faces and voices. This consistent pattern of social perception being organized into the components of valence and dominance for faces and voices could suggest (1) that the components of valence and dominance summarize all social perception regardless of stimulus type or (2) that the two-component pattern is specific to social perception of faces and voices, but not necessarily other types of stimuli (i.e., bodies).

1.5 Social perception component one: Valence

1.5.1 Faces

The component of valence includes judgments of both trustworthiness and attractiveness. Evolutionarily, the ability to rapidly ascertain trustworthiness and threat-ability would have been adaptive. Trustworthiness relates to the perception of strong leadership with trustworthy faces being more valued during times of peace (Little, Roberts, Jones, & DeBruine, 2012). Trustworthiness could indicate a higher presence of prosociality, which may be beneficial during peacetime (Little et al., 2012). Trustworthy individuals may be more prone to perpetuating or even establishing peace through prosociality, which may be why trustworthy faces are valued more during times of peace.

Attractiveness is one of the most commonly recognized traits utilized in immediate judgments. Generally, raters agree on who is attractive, even across cultures (Fink & Penton-Voak, 2002; Langlois et al., 2000). In particular, sexually dimorphic traits, averageness, and symmetry of facial features are deemed attractive cross-culturally (Rhodes, 2006). With regards to first impressions, those who are physically attractive are perceived both more positively and more accurately in terms of personality traits (Lorenzo, Biesanz, & Human, 2010). Judgments of attractiveness reach beyond simple physical appeal to form a halo effect, which can occur immediately as part of a first impression. This halo effect encompasses the practice of people generally forming more positive social perceptions and treating attractive children and adults more positively, regardless of whether or not the attractive individuals are strangers or friends (Langlois et al., 2000). Therefore, the halo effect is highly relevant to first impressions.

Judgments of altruism and intelligence particularly supported the concept that unattractiveness is bad while judgments of sociability supported both the concepts that unattractiveness is bad and beauty is good (Griffin & Langlois, 2006). Overall, faces that are rated low on attractiveness are less sex-prototypical, less average, older, or less symmetrical and lead to impressions of lower intelligence, health, and social competence (Zebrowitz & Montepare, 2008). In point of fact, less attractive faces were associated with negative traits based on first impressions (Miller, 1970). However, the negative effects of unattractiveness may be more consistent than those of attractiveness, even though attractive individuals are perceived to possess more positive traits (Griffin & Langlois, 2006). Indeed, a meta-analysis (Eagly, Ashmore, Makhijani, & Longo, 1991) found that the actual size of the beauty-is-good effect was only moderate. Moreover, facial attractiveness, averageness, symmetry, and male face masculinity offer intelligence and/or health cues but only for those on the lower end of the attractiveness scale (Zebrowitz & Rhodes, 2004). This discrepancy could mean that the differences in automatic personality perceptions based on attractiveness are more founded on a tendency to attribute negative traits to less attractive individuals, even while a halo effect occurs for attractive individuals.

1.5.2 Voices

While facial information may carry more weight than voices when the two channels are perceived in conjunction (Tsankova et al., 2012), voices can influence the impression of trustworthiness as well. Furthermore, the combination of (un)trustworthy faces and voices does not alter confidence in overall trustworthiness ratings of individuals (Tsankova et al., 2012). However, both men and women perceived lower-pitched female voices as having higher levels of trustworthiness (Klofstad et al., 2012; Tsantani, Belin, & McAleer, 2016).

Perceived vocal trustworthiness also relates to how people select their superiors. Men and women chose lower-pitched male and female voices as leaders (Klofstad et al., 2012), probably because of the association between lower pitch and higher ratings of trustworthiness, competence, strength, and dominance (Klofstad et al., 2012; Tsantani et al., 2016). This association between low voice pitch and higher trustworthiness ratings could, in turn, shed some light on why fewer women are elected as leaders.

Additionally, just as facial attractiveness leads to a halo effect, so does vocal attractiveness. Speakers with more attractive faces and voices were rated more favorably than their less attractive counterparts when participants were exposed to the individual's face, voice, or both (Zuckerman & Driver, 1989). Speakers with attractive voices were also rated more positively when participants only heard the speaker's voice as well as when they heard and saw the speaker's face and voice (Zuckerman & Driver, 1989). The same positive ratings held true for individuals with attractive faces when judged based on face alone or face and voice together (Zuckerman & Driver, 1989). This suggests that both an attractive face and voice can potentially improve basic personality assumptions and how one is treated, even based on first impressions.

Attractiveness ratings based on faces and voices strongly agree. For example, men who rated women's faces and voices strongly agreed on who was attractive (Collins & Missing, 2003). Women with attractive faces also had attractive voices (Collins & Missing, 2003). Sexually dimorphic voices were considered attractive, but deliberately exaggerating sex-typical voice pitch did not increase vocal attractiveness (Fraccaro et al., 2013). Interestingly, deliberately altering one's voice pitch altered immediate judgments of dominance but not of attractiveness (Fraccaro et al., 2013).

1.6 Social perception component two: Dominance

1.6.1 Faces

Dominance and related strength and threat assumptions can also be ascertained through quick examinations of an individual. When creating models representing attractiveness, competence, dominance, extraversion, likability, threat, and trustworthiness, the threat model strongly correlated with the dominance model (Todorov et al., 2013). While the models of strength and dominance were highly similar, participants distinguished between the highly dominant-physically weak and highly dominant-physically strong faces (Toscano, Schubert, Dotsch, Falvello, & Todorov, 2016). However, participants could not do the same for physically strong-low dominance and physically strong-high dominance faces (Toscano et al., 2016). Therefore Toscano and colleagues (2016) concluded that although both dominance and strength of an individual are perceived via the face, strength is used as a cue for dominance more so than dominance is used as a cue for strength.

Cross-culturally, people consistently sort and rate facial images by a dominance dimension (Keating, Mazur, & Segall, 1981). For candidates at West Point, a military university in the United States of America, cadets who were perceived to be dominant based on facial features were promoted to significantly higher rankings in their last two years at West Point than their seemingly submissive counterparts (Mazur, Mazur, & Keating, 1984). Cadets' facial dominance even predicted their military rankings over 20 years later (Mueller & Mazur, 1996). These results suggest that social perceptions of dominance could influence various aspects of life, including military and civilian promotions.

1.6.2 Voices

Voices, similar to faces, possess indicators of perceived dominance. Fundamental and formant frequencies are two aspects that shape voices and influence voice perceptions. Fundamental frequencies are the main correlate of pitch while formant frequencies influence timbre perceptions (Puts, Hodges, Cárdenas, & Gaulin, 2007). Participants perceived recordings with lower fundamental and format frequencies as belonging to more dominant men (Puts et al., 2007). Formant frequencies had a stronger effect on dominance perceptions and influenced physical dominance perceptions more than social dominance (Puts et al., 2007). Puts, Gaulin, and Verdolini (2006) provide further evidence for this conclusion by finding that masculine, low-pitch voices are associated with higher ratings of perceived male physical and social dominance.

Additionally, this ratings increase was stronger for perceptions of physical rather than social dominance (Puts et al., 2006). Interestingly, Puts and colleagues (2006) also found that men who believed they were more physically dominant than their counterpart lowered their voice pitch in conversation. Conversely, men who believed they were less physically dominant than their counterpart followed the opposite pattern by raising their voice pitch in conversation (Puts et al., 2006). A separate study also found that low fundamental frequency in men correlated with more physical aggressiveness (Puts, Apicella, & Cárdenas, 2011). Collectively, these findings suggest that voices as well as faces can indicate dominance.

1.7 Accuracy of social perception, health inferences, and mate quality inferences

1.7.1 Brief evolutionary background: Ecological theory

Automatically forming personality and social impressions based on physical features would only be efficient and useful if the impressions carried accuracy. For that reason, many assert that these immediate social perceptions have some level of accuracy in current and/or past ecologies (Montepare & Zebrowitz-Mcarthur, 1987; Shackelford & Larsen, 1999; Zebrowitz & Montepare, 2006; Zebrowitz & Montepare, 2008; Zebrowitz, Fellous, Mignault, & Andreoletti, 2003). Ecological theory in particular purports that social impressions are adaptive because they provide humans with information about their surroundings and potential interpersonal interactions. Ecological theory also states that these social perceptions are based on accurate perceptions ascertained by learning associations between personality and physical features (Montepare & Dobish, 2003; Zebrowitz & Montepare, 2006; Zebrowitz & Montepare, 2008). For ecological theory to be correct, trait perceptions must carry some level of accuracy.

1.7.2 Accuracy of social perception

While many studies show that individuals automatically form social perceptions based on physical characteristics, this occurrence does not necessarily require the judgments to be accurate. As evidenced by physiognomy, phrenology, and somatotypes, personality judgments that are based on purely physical features or appearance and are consistent within and between observers can be inaccurate. However, some researchers assert that immediate first impressions form because of the adaptive and evolutionary benefit of automatically recognizing personality traits (Montepare & Zebrowitz-Mcarthur, 1987; Shackelford & Larsen, 1999; Zebrowitz & Montepare, 2006; Zebrowitz & Montepare, 2008; Zebrowitz et al., 2003). Additionally, inaccurate social perceptions made in strictly controlled laboratory environments could reflect processes that would normally generate accurate perceptions in more relevant or ecologically valid circumstances (Funder, 1987).

In fact, some researchers have found a relationship between these automatically formed social impressions and self-reported personality attributes. Participants accurately rated male faces on emotional stability and openness to experience, based on self-reported levels for each face (Penton-Voak et al., 2006). For both male and female faces, participants accurately surmised levels of extraversion (Penton-Voak et al., 2006). Even when judging composite faces representing high or low agreeableness and extraversion, participants rated these personality traits accurately. However, Penton-Voak and colleagues (2006) also admit that while these accuracy results are significant, the correlations are still quite low with none surpassing $r = 0.255$.

Additionally, Zebrowitz, Hall, Murphy, and Rhodes (2002) also found limited support for accuracy of intelligence judgments. Trustworthiness judgments of faces evaluated via trait ratings are also minimally supported, with higher accuracy for judgments of trustworthy rather than untrustworthy faces (Porter, England, Juodis, ten Brinke, & Wilson, 2008). Overall, while the evidence may be limited, studies do suggest that initial impressions based on facial appearance may actually possess a certain level of accuracy across multiple traits.

1.7.3 Basis for inaccurate social perception: Overgeneralization

Although limited evidence suggests some personality perceptions based on physical features are accurate, this may not always be the case. For example, overgeneralization of physical features to various attributes, such as age and emotional expressions, may lead to inaccurate social perception.

1.7.3.1 Threat potential

Purportedly, the first social perception component (i.e., valence) is sensitive to approach and avoidance features while the second social perception component (i.e., dominance) is sensitive to features regarding physical strength or weakness (Oosterhof & Todorov, 2008; Todorov, Said, Engell, & Oosterhof, 2008). Physical features that imply approach or avoidance, such as neutral facial displays perceived as happy or angry due to overgeneralization of emotion, could imply that the perceived individual poses potential assistance or threat, depending on the person and situation. For example, facial displays of anger may strongly suggest a threat. In turn, observers may decide to avoid such an individual. If overgeneralizing a neutral face as happy, observers may then decided that approaching the individual is safe. Dominance and physical strength could also represent potential threat to oneself or the community. In this sense, the two social perception components of valence and dominance could have been evolutionarily helpful. Oosterhof and Todorov (2008) even state that face evaluation could involve an overgeneralization of adaptive mechanisms that infer ability or intent to cause harm. Being able to gauge ability or intent to cause harm immediately and from a distance would have been helpful in primitive times, as people had virtually no other way to judge the potential safety posed by a stranger.

1.7.3.2 Emotion indicators

In addition, people can also form social judgments based on other overgeneralizations, specifically the overgeneralization of emotion indicators. For example, neutral faces that are perceived to have certain personality traits actually do resemble certain emotional expressions (Said, Sebe, & Todorov, 2009). Neutral faces rated negatively represented disgust and fear while faces rated high for threat-ability resembled anger (Said et al., 2009). Neutral faces resembling anger or happiness can also lead to the perceiver assuming low or high affiliative traits, respectively (Zebrowitz & Montepare, 2008). When perceived individuals actually did express happiness and surprise, they were perceived as high in dominance and affiliation while perceived individuals expressing anger were perceived as high in dominance but low in affiliation (Montepare & Dobish, 2003). These trait attributions engrained deeply enough that they carried over even when the perceived individuals were not expressing any emotion (Montepare & Dobish, 2003).

The perception of faces as possessing certain traits can even exaggerate the perception of displayed emotions. More specifically, trustworthy faces displaying happiness were rated as happier than untrustworthy faces showing the same degree of happiness (Todorov, Baron, & Oosterhof, 2008). The opposite was true for faces displaying anger – untrustworthy faces were rated as angrier than trustworthy faces displaying the same degree of anger (Todorov et al., 2008). Therefore, emotional expressions can exacerbate existing social perceptions.

1.7.3.3 Infantile or juvenile features

This overgeneralization of information and subsequent formation of social perceptions goes beyond the areas of emotion and social perception components of valence and dominance. Even adults with childlike facial features are consistently perceived to be warmer, more submissive, more honest, less competent, weaker, and more naïve (Berry & McArthur, 1986; Montepare & Zebrowitz-Mcarthur, 1987; Zebrowitz & Montepare, 2008). Some evidence suggests that individuals with multiple baby-faced features are perceived as being more intellectually childlike than those with just one baby-faced feature (Zebrowitz & Montepare, 2008). These impressions are consistent across multiple perceivers and cultures, leading others to treat these baby-faced individuals more like children and to expect more child-like behavior from them (Montepare & Zebrowitz-Mcarthur, 1987; Zebrowitz & Montepare, 2008).

Similar to personality perception based on faces, voice perception can also be influenced by perceived age. Participants believed voices belonged to younger individuals when paired with images of younger faces (Drager, 2011). In turn, these results could suggest that voices perceived as belonging to younger individuals could also potentially be associated with the same personality traits that are associated with individuals who possess childlike facial features, such as warmth, honesty, and submissiveness.

1.7.3.4 Familiarity

Overgeneralization of familiarity can also lead someone to form a more positive first impression of an individual. Termed the familiar face overgeneralization hypothesis, people can unconsciously recognize that a face is similar to that of another person and attribute the second person's personality traits to the first (Zebrowitz & Collins, 1997; Zebrowitz & Montepare, 2008). However, this effect can also have a negative impact on impressions. If an individual appears physically similar to one with genetic anomalies, he or she may be perceived as having characteristics that coincide with those genetic anomalies (Zebrowitz et al., 2003).

General familiarity of faces can also influence how much someone likes a face. Subliminal exposure to faces of another race increased Caucasian participants' liking for a separate set of faces of the same race (Zebrowitz, White, & Wieneke, 2008). This suggests that prejudice and its associated negative social perceptions could at least partially derive from overgeneralizing unfamiliar faces even when the faces are mainly unfamiliar because of race.

1.7.4 Health and mate quality inferences

Taking the concept of accurate trait perceptions based on physical features a step further, the evolutionary one-ornament theory posits that attractiveness could be an honest signal of health and potential mate quality (i.e., attractiveness represents one-ornament of health and mate quality) (reviewed in Hahn & Perrett, 2014; Henss, 1995; Shackelford & Larsen, 1999; reviewed in Weeden & Sabini, 2005; Zebrowitz & Montepare, 2006; Zebrowitz et al., 2003). Additionally, the halo effect of attractiveness, which leads people to rate attractive individuals higher overall, could be based on physical fitness qualities (Zebrowitz & Collins, 1997). For this to be true, attractive individuals, who are perceived as healthier due to their attractiveness, would also have to actually be healthier than their unattractive counterparts.

Indeed, Shackelford and Larsen (1999) did find limited evidence for this assertion that facial attractiveness related to better physical health as measured by daily physical symptom reports. Another study (Rhodes, Chan, Zebrowitz, & Simmons, 2003) also found that masculinity judgments of men's faces were related to their long-term health. While Kalick, Zebrowitz, Langlois, and Johnson (1998) found that facially attractive individuals were rated as healthier, they also found that facial attractiveness was not related to actual health. However, using attractiveness and perceived health ratings of high school yearbook pictures in conjunction with lifespan data, Henderson and Anglin (2003) found that facial attractiveness, but not perceived health, predicted longevity (i.e., lifespan). Therefore, certain evidence supports the concept that attractiveness represents an honest signal of health.

Another reason attractiveness could signal overall health quality is because attractiveness could serve as a proxy measure of developmental stability (Fink & Penton-Voak, 2002; Rhodes, 2006). Symmetrical faces are perceived as attractive and average faces are more symmetrical than non-average faces (Grammer & Thornhill, 1994; Little, Jones, & DeBruine, 2011). On the other hand, asymmetry implies developmental instability or an inability to fight off disease (Rhodes, 2006). Therefore, symmetry could signal developmental stability and a stronger ability to fight off disease (Little et al., 2011). However, the evidence linking attractiveness and health is substantially weaker than that linking asymmetry and non-averageness of facial features to poor health (Rhodes, 2006).

Jones and colleagues (2001) found that the negative correlation between ratings of apparent health and measured facial asymmetry remained even when controlling for attractiveness. This same study (Jones et al., 2001) found that the positive correlation between attractiveness and apparent health remained when controlling for asymmetry. Furthermore, the association between asymmetry and attractiveness disappeared when controlling for apparent health (Jones et al., 2001). Together, the results of this study suggest that the relationship between attractiveness and symmetry is mediated by judgments of apparent health (Jones et al., 2001). Fink, Neave, Manning, and Grammer (2006) found that highly symmetrical faces were rated higher on attractiveness, health, and some personality traits, leading them to conclude that facial symmetry is considered attractive because it probably reflects health quality.

Additionally, women accurately estimated men's physical strength from separate photos of their faces and bodies (Sell et al., 2009). Toscano, Schubert, and Sell (2014) found that facial judgments of dominance relied at least partially on strength judgments when using both real and computer-generated male faces. Even the shoulder-to-hip ratio (SHR) correlated with facial attractiveness, as males judged to have attractive faces had significantly more triangle-shaped SHRs, which is seen as more appealing (Shoup & Gallup, 2008). These same men with attractive faces also had higher grip strength and more sexual partners, leading the authors to conclude that facial features contain crucial information regarding fitness and hormonal status (Shoup & Gallup, 2008). In a separate study, handgrip strength correlated with face ratings of dominance, masculinity, and attractiveness (Fink, Neave, & Seydel, 2007). Therefore, the attributes of dominance and masculinity, which also suggest strength and are perceived by women as attractive, could represent honest signals of mate quality (Fink et al., 2007).

In terms of female voices, health risk factors are negatively correlated with attractiveness (Fraccaro et al., 2013). Since attractiveness and voice pitch in women are positively correlated, this could suggest that attractive voices are negatively related to poor health (Fraccaro et al., 2013). Furthermore, men with lower voices experience more reproductive success than their counterparts with higher voices (Feinberg, 2008). Given the link between male vocal attractiveness and lower voice pitch (Collins, 2000; Feinberg, Jones, Little, Burt, & Perrett, 2005) and that reproductive success can represent mate quality, Feinberg's (2008) findings suggest a link between low male voice pitch, attractiveness, and mate quality.

Body mass index (BMI), waist-to-hip ratio (WHR) in women, and waist-to-chest ratio (WCR) in men are crucial to bodily attractiveness. Lower BMIs, WHRs, and WCRs are viewed as attractive (Coy, Green, & Price, 2014; Furnham, Tan, & McManus, 1997; Han, Hahn, Fisher, DeBruine, & Jones, 2015; Henss, 1995; Singh, 1993a, 1993b; Singh, 1994; Streeter & McBurney, 2003; Tovée, Maisey, Vale, & Cornelissen, 1999b; van Anders & Hampson, 2005). However, BMI more strongly correlated with attractiveness than WHR (Tovée, Maisey, Emery, & Cornelissen, 1999a). Reproductive value, as measured by apparent youth and low number of offspring, even mediated the relationship between female body features (i.e., BMI and WHR) and attractiveness ratings (Andrews, Lukaszewski, Simmons, & Bleske-Rechek, 2017). Changes to BMI and higher BMI levels can impact reproductive abilities and health, including increasing health risks related to various diseases (Calle, Thun, Petrelli, Rodriguez, & Heath Jr, 1999; Lake, Power, & Cole, 1997; Manson et al., 1995; Tovée et al., 1999a). Higher WHRs, which are perceived as unattractive, are specifically linked to decreased fertility, more cardiovascular disease risk factors, increased stress, and increased general long term health risks (Henss, 1995; Tovée et al., 1999a; van Anders & Hampson, 2005). Men with low WCRs are perceived as being in better physical shape (Coy et al., 2014), which is an indicator of health. Thus, perceived attractiveness is furthermore linked to reproductive value for women and perceived and actual health for both men and women through BMI, WHR, and WCR.

If attractiveness truly does signal reproductive quality and health, then attractiveness ratings of faces and bodies for the same individual should correlate. In fact, this face and body correlation is precisely what many researchers found (Fink, Taschner, Neave, Hugill, & Dane, 2010; Hönekopp, Rudolph, Beier, Liebert, & Müller, 2007; Thornhill & Grammer, 1999), leading to the assertion that attractive faces signal mate quality (Aharon et al., 2001). Specifically, ratings of attractiveness, masculinity, and dominance for male faces and bodies significantly and positively correlated (Fink et al., 2010), as did ratings of strength (Sell et al., 2009). Thornhill and Grammer (1999) found that attractiveness ratings of female faces and bodies also significantly and positively correlated. Even attractiveness ratings for faces and voices strongly correlated (Collins & Missing, 2003). These consistent correlations led researchers to conclude that attractiveness indicators suggest similar qualities and represent an honest signal of mate quality (Collins & Missing, 2003; Fink et al., 2010; Thornhill & Grammer, 1999).

1.8 Comparing findings about faces, voices, and bodies

Although aforementioned evidence suggests that the attractiveness of faces and bodies represents one ornament of health and mate quality, other studies imply otherwise. Furthermore, the different channels of faces, voices, and bodies could provide different information with regards to various traits and attributes.

Some conflicting results have arisen regarding attractiveness representing health and quality of mate value. For example, a composite measure of physical fitness correlated with bodily attractiveness, but not facial attractiveness (Hönekopp et al., 2007). This composite measure of physical fitness also positively correlated with mating success as measured by self-report (Hönekopp et al., 2007), suggesting that perhaps bodily rather than facial attractiveness relates more to mating success. Hönekopp and colleagues (2007) therefore concluded that men's faces and bodies signal different aspects of mate quality from each other. Furthermore, Peters, Rhodes, and Simmons (2007) found that face and body attractiveness made significant and independent contributions to overall ratings of attractiveness. Additionally, facial and bodily attractiveness did not interact when forming overall attractiveness judgments (Peters et al., 2007). Therefore, the researchers concluded that faces and bodies convey different information (Peters et al., 2007). Weeden and Sabini (2005) also reviewed numerous studies and found that, among many variables, only female WHR and weight predicted attractiveness and health, providing evidence contradicting the one-ornament theory.

An additional theory, the multiple motives hypothesis, states that women will find men most attractive when they possesses physical characteristics indicating sexual maturity, dominance, sociability, high social status, and youth (Cunningham, Barbee, & Pike, 1990). Supporting this theory, Cunningham and colleagues (1990) found that women rated men as most attractive when they had a mix of neotenous (i.e., large eyes) and mature features (i.e., prominent cheekbones and large chin), were expressive in a positive way (i.e., smiling), and were wearing high status clothing (i.e., suits). All of these cues provided different information and combined to form an overall level of attractiveness. Therefore, the multiple motives hypothesis opposes the one-ornament theory.

Men and women also showed different associations between type of relationship and attractiveness ratings. First, Currie and Little (2009) found that face attractiveness ratings best predicted the ratings of combined images (i.e., face and body) regardless of sex and relationship type. They thus concluded that faces were more important for overall attractiveness ratings. When examining sex and type of relationship, Currie and Little (2009) found that men's attractiveness ratings of female bodies were more important for short-term relationships. However, women's attractiveness ratings of male faces and bodies were equally important for both short- and long-term relationships (Currie & Little, 2009). While attractiveness of faces and bodies may signal health and quality, this evidence supports the theory that faces and bodies signal different information about potential mates.

Combining facial and vocal channels can also influence the overall social perception of the perceived. Such a combination of facial and vocal channels significantly affected trustworthiness ratings, with faces carrying more weight for these trustworthiness ratings (Tsankova et al., 2012). For the same participants, even though trait ratings did significantly differ depending on if the participant perceived a face, a voice, or both combined, confidence in trait ratings was not significantly affected when perceiving a face and voice in combination (Tsankova et al., 2012). Therefore, perceivers alter their trait attributions, but not confidence in these trait attributions, depending on if they perceive a face, a voice, or both together. Additionally, high dominance was rated higher on attractiveness when expressed via the face rather than the voice (Raines, Hechtman, &

Rosenthal, 1990). However, low dominance was rated higher on attractiveness when expressed via the voice rather than the face (Raines et al., 1990). Therefore, while faces and voices both provide vital information for person perception, the information may be different in content or may be perceived differently according to channel (i.e., face or voice).

Competing information between faces and voices can also influence attractiveness ratings. Extremely attractive individuals were rated as less attractive when paired with unattractive voices, showing that ratings from distinct channels can further influence overall perception of the individual (Surawski & Ossoff, 2006). This effect of unattractive voices remained when paired with attractive faces even though the halo effect (i.e., rating attractive individuals higher overall) of physical attractiveness was stronger than that of vocal attractiveness (Surawski & Ossoff, 2006).

Two of the main channels of person perception are the perceived individual's face and voice. These channels can work in collusion, providing a more coherent, solid person perception. However, they can also portray conflicting information, which creates a problem for the perceiver. The impression of virtually any trait, including perceptions of trustworthiness and attractiveness, can be altered depending on information perceived via the face and the voice. Given the amount of research performed regarding how faces and voices influence person perception, bodies could also come into play. Whether bodies provide similar, different, or conflicting information than faces and voices is yet to be fully determined. Furthermore, social perception of both faces and bodies could relate to motivational salience, which is the amount of effort an individual will expend to continue looking at a face or body.

1.9 Motivational salience

While many variables can influence social perception, social perception can in turn influence motivational salience (i.e., the amount of effort an individual will expend to continue looking at an image). For example, attractiveness could be inherently rewarding (Cloutier, Heatherton, Whalen, & Kelley, 2008; Elman et al., 2005; reviewed in Hahn & Perrett, 2014). The presence of the halo effect for attractive individuals strongly suggests inherent reward value, as the halo effect leads to associations between attractiveness and positive attributions. Thus, people will expend more effort in order to continue viewing attractive people or images (Wang, Hahn, Fisher, DeBruine, & Jones, 2014). This concept of attractive stimuli possessing more motivational salience is supported by the finding that attractive people are judged more accurately due to the heightened effort to properly perceive attractive individuals according to personality (Lorenzo et al., 2010). Experiments based on this concept of motivational salience often use key-press tasks in which participants must expend more effort in order to continue viewing rewarding, attractive, or motivationally salient stimuli (Elman et al., 2005; reviewed in Hahn & Perrett, 2014; Hahn, Fisher, DeBruine, & Jones, 2016; Levy et al., 2008).

In one such experiment, men expended more effort to extend the viewing time of attractive female faces (Levy et al., 2008). Although heterosexual male participants rated images of males and females as equivalently attractive, only the attractive female images possessed motivational salience (Aharon et al., 2001). This discrepancy in motivational salience for equally attractive male and female faces allows for the conceptual and empirical separation of 'liking' versus 'wanting' with regards to attractive stimuli (Aharon et al., 2001). Women, on the other hand, displayed similar increased efforts for both attractive male and female faces (Hahn, Xiao, Sprengelmeyer, & Perrett, 2013; Levy et al., 2008). Others, though, have found that only the variable of preferred-sex matters for extending viewing time (Hahn et al., 2016). More specifically, images of preferred-sex individuals were seen as more rewarding than images of an individual's non-preferred sex regardless of the participant's own sex (Hahn et al., 2016). Although the more detailed findings of these papers differ, they both suggest that attractive faces are rewarding and that more attractive faces are more rewarding.

Depending on the sex of the perceiver, faces and bodies of the same individuals can inherently and contextually possess different levels of motivational salience. For both sexes, attractive opposite-sex faces inspired higher motivational salience in the high mate competition condition, in which the sex ratio of stimuli was weighted 2:1 for faces of the opposite sex (Hahn, Fisher, DeBruine, & Jones, 2014). For women, relationship context (i.e., short- or long-term relationship) did not change the preference for men's faces or bodies (Wagstaff, Sulikowski, & Burke, 2015). For men, though, the preference for bodies increased in the short-term relationship context while the preference for faces increased in the long-term relationship context (Wagstaff et al., 2015). Therefore, mate competition, relationship context, and sex of the perceiver can all influence motivational salience.

Additionally, Wang et al. (2016) found that, independently of each other, both the valence and dominance components that summarized social perception for faces were also positively related to the motivational salience of faces. Therefore, motivational salience could potentially encompass such attributes as reward value, valence, and dominance. Furthermore, if motivational salience and social perception are associated, regardless of the specific social perception components, the social perception pattern for bodies may also positively relate to motivational salience of bodies.

1.10 The influence of hormones on social perception and motivational salience

While a multitude of variables can influence how people form social perceptions, hormones are also an important aspect, especially for motivational salience. Due to their involvement in the menstrual cycle and sexual desire, three hormones in particular can drastically affect perception of other individuals: progesterone, estradiol, and testosterone.

1.10.1 Progesterone

Hormone levels of the perceiver can potentially influence the motivational salience of stimuli. For example, progesterone levels positively correlated with women's preference for self-resembling faces (DeBruine, Jones, & Perrett, 2005). This preference for and increased motivational salience of self-resembling faces could, in turn, show a desire to seek family during pregnancy since progesterone levels increase during pregnancy (DeBruine et al., 2005).

Progesterone can also influence perception of possible threat and contagion. When progesterone was relatively high, women more often perceived both fearful or disgusted expressions as more intense when paired with averted rather than direct gaze (Conway et al., 2007). This raised awareness to potential physical threat could be related to protecting one's children, as higher progesterone levels prepare a woman's body for pregnancy (Conway et al., 2007). Therefore, raised progesterone levels could potentially increase the motivational salience of, but not preference for, potentially dangerous expressions displayed on others' faces.

1.10.2 Estradiol

When participants' ratios of estradiol-to-progesterone were high, the motivational salience of sexually dimorphic faces increased (Wang et al., 2014). In another study, when the progesterone-to-estradiol ratio was low and testosterone was low-to-normal, symmetrical faces were rated higher on attractiveness (Hernández-López, García-Granados, Chavira-Ramírez, & Mondragón-Ceballos, 2017). This second study also found that when the progesterone-to-estradiol ratio was high, symmetrical faces were rated lower on attractiveness (Hernández-López et al., 2017). These results all suggest that high estradiol-to-progesterone ratios correlate with increased motivational salience and attractiveness ratings. Furthermore, the estradiol-to-progesterone ratio is associated with conception risk (Landgren, Uden, & Diczfalusy, 1980; Baird et al., 1991). Therefore, conception risk as measured by the estradiol-to-progesterone ratio may influence the attractiveness ratings and motivational salience of male faces and bodies.

Higher estradiol levels in women also correlated with a preference for faces of men who had higher testosterone levels (Roney & Simmons, 2008). Furthermore, estradiol levels in women over time predicted their preferences for the testosterone levels of men whose faces they were judging (i.e., women's estradiol levels predicted their testosterone preferences of male faces) (Roney & Simmons, 2008). Even when tested across multiple sessions, women's estradiol levels consistently correlated with their preferences for faces of men who had higher testosterone levels (Roney, Simmons, & Gray, 2011). However, estradiol levels showed no relationship with preferences for facial masculinity as opposed to other attributes, such as testosterone levels (Marcinkowska et al., 2016), suggesting that facial indicators of masculinity and testosterone levels differ. Estradiol levels also best predicted how women's preferences for vocal masculinity changed over the menstrual cycle (Pisanski et al., 2014). Overall, this evidence regarding estradiol and testosterone levels suggests that hormone levels in women may affect motivational salience of faces via influencing perceptions of and preferences for features that may signal hormone levels in men (Roney & Simmons, 2008).

1.10.3 Testosterone

Along with progesterone and estradiol, raters' testosterone levels can also increase motivational salience of attractive or rewarding images. While low testosterone decreases sexual desire and fantasies in men (Bagatell, Heiman, Rivier, & Bremner, 1994) and testosterone levels are associated with solitary sexual desire (i.e., desire to engage in sexual activity by oneself) in women (van Anders, 2012), women may be more sensitive to testosterone overall (Bancroft, 2002; van Anders, 2012). For women in particular, high perceiver testosterone levels related to increased motivational salience of attractive faces (Wang et al., 2014) and increased preference for facial masculinity (Welling et al., 2007). However, women's increased testosterone levels did not correlate with preferences for faces of men with higher testosterone levels (Roney et al., 2011). Some evidence suggests that testosterone generally relates to an increase in motivational salience of stimuli, but particularly for attractive or rewarding faces (Hahn, DeBruine, Fisher, & Jones, 2015b; Wang et al., 2014).

For men, preferences for feminine characteristics increased when testosterone was high (Little et al., 2011; Welling et al., 2008). Furthermore, this preference for feminine characteristics was found only for female faces, indicating that the influence of men's testosterone levels does not drive a general response bias (Welling et al., 2008). Instead, the influence of men's testosterone levels on preferences for feminine characteristics was sex-specific and could modulate sexual interest (Welling et al., 2008).

High testosterone also suppresses the immune system (Fink & Penton-Voak, 2002). Therefore, a high level of testosterone paired with an attractive male face could indicate an ability to defend against disease (Fink & Penton-Voak, 2002). Masculine traits and other testosterone-dependent secondary sexual characteristics also imply greater immunocompetence (Jones et al., 2008; Perrett et al., 1998). As such, attractiveness in men could indicate good health.

Interestingly, prenatal and circulating testosterone levels could also differentially influence social perception and motivational salience of male faces. For example, Neave, Laing, Fink, and Manning (2003) found that the length ratio of the second to fourth fingers, which indicates prenatal testosterone levels, negatively related to perceived dominance and masculinity of male faces. Thus, they concluded that dominance and masculinity as represented via male facial features were prepared by high prenatal testosterone levels and assumedly activated during puberty (Neave et al., 2003). Prenatal testosterone levels were not related to attractiveness (Neave et al., 2003). However, circulating testosterone levels were not related to perceived dominance, masculinity, or attractiveness (Neave et al., 2003). Furthermore, Schaefer, Fink, Mitteroecker, Neave, and Bookstein (2005) found that prenatal and circulating testosterone levels affected male facial shape in different ways with the former relating to a prominent lower face and the latter relating to an elongation of the face.

Testosterone levels also affect voice pitch and attractiveness. Lower male voice pitch (i.e., fundamental frequency), which is associated with higher testosterone levels (Evans, Neave, Wakelin, & Hamilton, 2008), is viewed as more attractive. Since higher testosterone levels, when associated with good health, represent stronger immune systems, lower and more attractive voice pitch in men could also signal good health (Feinberg, 2008).

1.10.4 Overview

Combined, the aforementioned results demonstrate the wide influence of hormones on the subjective assessment of facial stimuli in particular. Together and independently, the specific hormones of progesterone, estradiol, and testosterone help guide motivational salience and social perception of others.

1.11 Current studies and unanswered questions

While much research on faces and some on voices has examined social perception and/or its relationship to motivational salience and hormone levels of perceivers, little work examines the same relationships with regards to bodies. In this thesis I examine the relationships between automatic social perceptions and motivational salience of bodies as well as how hormone levels of perceivers influence these relationships.

In the first empirical chapter (i.e., Chapter 2), I specifically investigate the social perception of both bodies and faces to determine if body perception follows the same pattern as face and voice perception. Previous work has shown that social perception of faces can be summarized by the components of valence and dominance (Oosterhof & Todorov, 2008; Wang et al., 2016). In such research, valence was defined as an individual's intent to cause harm and dominance was defined as the ability to cause harm. Subsequent work (McAleer et al., 2014) extends this research to another channel of social perception: voices. Again, the researchers found that social perception, this time of voices, could be summarized by the two components of valence and dominance. This leads to the question of whether or not social perception of bodies may follow the same pattern.

Furthermore, just as individuals can judge attributes from faces and voices (McAleer et al., 2014; Oosterhof & Todorov, 2008; Sutherland et al., 2013; Tsankova et al., 2012; Wang et al., 2016), attributes can also be judged from bodies (de Gelder, 2006a; Fink et al., 2007; H. Meeren, Heijnsbergen, & de Gelder, 2005; Sell et al., 2009; Shoup & Gallup, 2008; Zhan, Hortensius, & de Gelder, 2015). For example, attributes like strength can be ascertained from both faces and bodies (Sell et al., 2009). Waist-to-chest ratio and handgrip strength are even related to men's facial attractiveness, dominance, and masculinity (Fink et al., 2007; Shoup & Gallup, 2008). Moreover, BMI and waist-to-hip ratio are negatively associated with women's bodily and facial attractiveness (Furnham et al., 1997; Han et al., 2015; Singh, 1993a, 1993b). Given that similar information can be gathered from faces and bodies, social perception could follow a similar pattern as well.

Social perception as a whole could follow a two-component pattern of valence and dominance or each channel could be perceived according to a unique pattern. The similar valence and dominance pattern of social perception for faces and voices suggests that perhaps social perception as a whole follows one distinct pattern with two components. However, the specific social perception pattern of bodies has yet to be established. Therefore, I investigate the social perception of both bodies and faces in the first empirical chapter. The data also allow me to address the question of how social perceptions of faces and bodies of the same individuals correlate.

In the second empirical chapter (i.e., Chapter 3), I focus on motivational salience of faces and bodies in conjunction with the social perception pattern established in the first empirical chapter. Attractive faces in particular can be rewarding and, thus, motivationally salient (Bzdok et al., 2011; Hahn & Perrett, 2014; Mende-Siedlecki, Said, & Todorov, 2013). Many studies use key-press tasks in order to evidence the motivational salience discrepancy between different stimuli, particularly that of attractive and less attractive faces (Hahn et al., 2014; Hahn et al., 2016; Levy et al., 2008; Wang et al., 2014). In some instances, preferred-sex stimuli show an even stronger effect of motivational salience, particularly for men (Hahn et al., 2016; Levy et al., 2008). Findings from key-press studies align with those of brain imaging, as attractive faces activate reward-related areas of the brain (Bzdok et al., 2011; Mende-Siedlecki et al., 2013; Rhodes, 2006) and that activation in these areas increases as attractiveness increases (Cloutier et al., 2008). This evidence suggests that attractive body images could possess more motivational salience than less attractive bodies and that female bodies viewed by heterosexual male participants could possess even more motivational salience than simply attractive bodies of either sex.

Previous work also shows that the social perception components independently predict motivational salience of faces (Wang et al., 2016). Even non-human animals show an effect of social perception on motivational salience, as dominant male macaque faces are more motivationally salient than less dominant male macaque faces (Deaner, Khera, & Platt, 2005). If social perception plays a part in overall motivational salience, then perhaps the social perception components of bodies also predict the motivational salience of bodies. As such, Chapter 3 investigates the relationship between the social perception components established in Chapter 2 and motivational salience of faces and bodies.

In the third and final empirical chapter (i.e., Chapter 4), I expand the second empirical chapter (i.e., Chapter 3) by examining steroid hormones (progesterone, estradiol, and testosterone) with regards to motivational salience and social perception of bodies. Some evidence suggests that testosterone in particular may be important for motivational salience of faces. For example, testosterone related to increased motivational salience in general (Hahn et al., 2015b; Wang et al., 2014). Furthermore, motivational salience of attractive male and female faces was greater when women's testosterone was high (Wang et al., 2014), suggesting that the same effect of testosterone might be larger for bodies with higher valence. Combined, this evidence strongly suggests that hormone levels of the perceiver could potentially influence motivational salience and social perception of bodies. Therefore, in Chapter 4, I build upon the relationships between social perception and motivational salience established in Chapter 3 by investigating how hormones relate to motivational salience and whether any relationship between testosterone and motivational salience is greater for bodies with higher valence (as measured by the social perception component).

1.12 General methodology

1.12.1 Rating task

In order to investigate social perception of faces and bodies in Chapter 2, I use the same methodology as Oosterhof and Todorov's (2008) seminal paper that I am replicating and extending. Namely, I use 7-point Likert scales for trait rating tasks of 13 traits (i.e., aggressiveness, attractiveness, caringness, confidence, dominance, emotional stability, intelligence, meanness, responsibility, sociability, trustworthiness, happiness, and weirdness). These were the same traits derived from free description and used in the seminal paper (Oosterhof & Todorov, 2008). Participants are asked to "Please rate how [trait] this [face/body] is on a scale from 1 (much less [trait] than average) to 7 (much more [trait] than average)." Each stimulus remains on screen until the rating is completed. Trials are all self-paced and trial order is randomized for each participant. Furthermore, each participant views only male or female stimuli and only faces or bodies.

Following Oosterhof and Todorov (2008), I average the trait ratings across participants for each stimulus within each trait. I then perform Principal Component Analyses for male body stimuli, female body stimuli, male face stimuli, and female face stimuli. Thus, I derive the social perception components for male bodies, female bodies, male faces, and female faces by following the same procedures as Oosterhof and Todorov (2008).

1.12.2 Key-press task

To investigate the motivational salience of faces and bodies in Chapter 3, I use a standard key-press task previously used by many others (Aharon et al., 2001; Elman et al., 2005; Hahn, DeBruine, & Jones, 2015a; Hahn et al., 2016; Hahn et al., 2013; Levy et al., 2008;

Wang et al., 2016). Participants initiate the trial by pressing the space bar and then control the viewing time of each stimulus by pressing specific keys on the keyboard. By alternately pressing keys 7 and 8, participants can increase the default viewing time of 4 seconds. Participants can decrease the viewing time by alternately pressing keys 1 and 2. Each key-press alters the viewing time by 100 milliseconds.

Following the procedure of previous studies (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016), the key-press score for each trial is calculated by subtracting the number of key presses made to decrease the viewing time from those made to increase the viewing time. Therefore, higher key-press scores indicate higher motivational salience (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016).

Each participant completed a block of practice trials before beginning the experimental trials. Stimuli were shown in four blocks (i.e., male faces, female faces, male bodies, and female bodies), the order of which was randomized for each participant. Trial order within block was also randomized for each participant.

In order to examine the relationship between social perception components and motivational salience and to follow practices regarding similar work (Hahn et al., 2015b; Wang et al., 2014), I use separate linear mixed models for male faces, female faces, male bodies, and female bodies. Following recommendations from Barr, Levy, Scheepers, and Tily (2013), I maximally specify random effects within each model.

1.12.3 Hormone measurement

To investigate the relationship among the social perception of bodies, motivational salience of bodies, and hormones of the perceiver in Chapter 4, I use both the standard key-press task from Chapter 3 and the passive drool method of hormone measurement.

I use the passive drool method of saliva and hormone collection rather than having participants chew gum or provide urine or blood samples because of the improved simplicity and practicality. Chewing gum can affect hormone assays with both men and women having higher testosterone and estradiol after chewing gum (Anders, 2010). For hormone collection via urine, participants must provide a urine sample from their first urination on the day of testing (Feinberg et al., 2006), which may be forgotten by some participants. Regarding hormone collection via blood samples, such a process requires specific medical training. Thus, passive drool is the most efficient and practical method of saliva collection for my study.

Other methods of hormone measurement exist, such as counting methods. However, the passive drool method allows for an actual measurement of hormones rather than relying on inference of hormone levels. Counting methods involve women recording the onset and duration of menstruation and researchers then counting days forwards or backwards to establish high and low fertility phases (Gangestad et al., 2016). Therefore, counting methods only allow for the inference of hormone levels and have modest validity (Gangestad et al., 2016). The passive drool method, though, allows for direct measurement of hormone levels. Therefore, I use the passive drool method in Chapter 4.

Saliva samples collected via passive drool (Papacosta & Nassis, 2011) are immediately frozen and stored at -32°C until shipped to the Salimetrics Lab in Suffolk, UK for analysis of hormone levels, matching the procedure from previous research (Hahn et al., 2015b; Wang et al., 2014). Estradiol, progesterone, and testosterone levels are tested using the Salivary 17β-Estradiol Enzyme Immunoassay Kit 1-3702, Salivary Progesterone Enzyme Immunoassay Kit 1-1502, and Salivary Testosterone Enzyme Immunoassay Kit 1-2402. Additionally, the estradiol-to-progesterone ratio is calculated from the estradiol and progesterone data. All hormone assays meet Salimetrics' quality control.

1.12.4 Ethics

All experiments contained within this thesis follow British Psychological Society (BPS) ethical guidelines and are approved by the University of Glasgow School of Psychology ethics committee (ethics application number: 300150008).

Chapter 2: Social perception of faces and bodies

Abstract

The social perception of faces shows a consistent two-component pattern of valence and dominance. This pattern also arises in the social perception of voices, suggesting that assessment of valence and dominance could be a fundamental aspect of social perception. To test this, 958 participants rated 50 male or 50 female faces or bodies on the 13 traits used in Oosterhof and Todorov (2008). We replicated the two-component pattern of valence and dominance for faces, but not for bodies. For both male and female bodies, traits associated with both valence and dominance loaded onto the first principal component, while the second principal component mainly correlated with the traits that had low inter-rater reliability and disappeared when these traits were removed from the analysis. Overall, our findings provide evidence against the idea that the two-component pattern is a fundamental aspect of social perception.

2.1 Introduction

Social perception, the formation of impressions based on perceivable cues, is an integral part of social interaction. Faces in particular are vital for social perception, providing cues to important information, such as age, gender, emotion, and health (Belin et al., 2011; Hill, Bruce, & Akamatsu, 1995; Massaro & Egan, 1996; Tovée, Edmonds, & Vuong, 2012). Individuals also make social judgments, such as dominance and trustworthiness, from facial appearance (Berry & McArthur, 1986; Penton-Voak et al., 2006; Todorov et al., 2008; Tsankova et al., 2012). The judgments based on such cues can be very fast, with stable impressions being formed from facial morphology within

100ms (Willis & Todorov, 2006). Such inferences can make the social world, often comprised of numerous quick interactions, much easier to navigate. For example, perceiving threat from a potentially dangerous individual may lead the perceiver to avoid this individual, which could in turn save the perceiver from harm. Indeed, first impressions and social perceptions, such as attractiveness, can greatly affect important decisions, ranging from mate choice to selection of leaders (Ballew & Todorov, 2007; Langlois et al., 2000; Todorov et al., 2005).

With specific regards to faces, after classifying unconstrained descriptions into 13 traits, Oosterhof and Todorov (2008) found that face perception could essentially be encapsulated by judgments of valence and dominance. In other words, while faces can be judged on many aspects and traits, the majority of variance in these perceptions can be summarized by judgments of valence and dominance. Wang, Hahn, DeBruine, and Jones (2016) and Sutherland et al. (2013) replicated this finding that social perceptions of faces are mostly explained by valence and dominance, although the latter used highly variable stimuli and also found that a third dimension of youthfulness emerges when using stimuli with a very wide range.

As social perception extends to the entire person being observed rather than merely his or her face, McAleer, Todorov, and Belin (2014) examined whether or not voices were judged along the same dimensions as faces. Not only did they find that voices were judged using the same valence and dominance dimensional space as faces, they found that these judgments, which were based on short phrases from unfamiliar individuals, were stable across perceivers (McAleer et al., 2014). The researchers also found that the perceived attractiveness of men's voices was positively related to both valence and dominance, while the perceived attractiveness of women's voices was mainly related to valence (McAleer et al., 2014). Previous researchers also found that voices were judged along similar dimensions, such as warmth, strength, and dominance (Montepare & Zebrowitz-Mcarthur, 1987; Scherer, 1972; Zuckerman & Driver, 1989), even when using different traits than Oosterhof and Todorov (2008). Furthermore, researchers also found that such voice ratings were consistent across cultures (Montepare & Zebrowitz-Mcarthur, 1987; Scherer, 1972).

In addition to voices, social judgments of faces are related to social judgments of bodies and various body attributes. Indeed, strength can be accurately judged from faces and bodies separately (Sell et al., 2009). Many other body measurements relate to social judgments of faces as well. Body measurements like shoulder-to-hip ratio and handgrip strength have been related to men's facial attractiveness, dominance, and masculinity (Fink et al., 2007; Shoup & Gallup, 2008). Both body mass index (BMI) and waist-to-hip ratio (WHR) are negatively linked to women's attractiveness (Furnham et al., 1997; Han et al., 2015; Singh, 1993a, 1993b), although BMI is a stronger correlate than WHR (Tovée et al., 1999a).

Research on social perception of physical characteristics has mainly focused on faces (de Gelder, 2006b; de Gelder & Van den Stock, 2011; de Gelder et al., 2010; Kret & de Gelder, 2013) and voices (McAleer et al., 2014; Fraccaro et al., 2013; Collins & Missing, 2003; Klofstad et al., 2012). However, evidence suggests that social perceptions of faces and voices may be affected by social perception of bodies (Kret & de Gelder, 2013; Mondloch, Nelson, & Horner, 2013; Van den Stock, Righart, & de Gelder, 2007). Evidence from facial and vocal research showing that social perception as a whole can be summarized by valence and dominance suggests that body perception may also follow the same pattern. No research, though, has yet explored this issue. Such a consistent social perception pattern could suggest that overgeneralization from cues such as age and sexual dimorphism leads to social perceptions.

The current chapter aims first to determine if static body ratings are consistent across participants. Secondly, we aim to investigate the social perception pattern of bodies. Given that both faces and voices follow the same social perception pattern of valence and dominance, we expect bodies to follow a similar pattern. Thirdly, we aim to determine the relationship between social perceptions of faces and bodies of the same individuals. Given previous research showing that attractiveness ratings of faces and bodies correlate (Fink et al., 2010; Hönekopp et al., 2007; Sell et al., 2009; Thornhill & Grammer, 1999), we expect social perceptions of corresponding faces and bodies to correlate. Fourthly, we aim to determine how body measures of stimuli, such as BMI, dimorphic shape, and age, are related to social perceptions of bodies. To do so, we will examine ratings of the same 13 personality traits as Oosterhof and Todorov (2008), but with corresponding face and body stimuli instead of only face stimuli.

2.2 Method

2.2.1 Stimuli

Stimuli were created from images of 50 white men and 50 white women between the ages of 19 and 30 years. These images and associated data were sourced from 3d.sk, a website that provides high-quality body images for 3D gaming development and other uses. All individuals gave their consent for their images to be used commercially and publicly. See Supplemental Materials Table S1 for age, height, weight, BMI, chest circumference, waist circumference, and hip circumference for each person.

Face images were taken against neutral backgrounds and all individuals posed facing the camera with direct gazes and neutral expressions. Images were masked to show only the face and ears. Face images were aligned on the center of the pupils so that interpupillary distance was 26.4% of image width. Using Graphic Converter 9, facial piercings and/or hair clips were removed from 8 face images. Face images were displayed at a size of 300x400 pixels (interpupillary distance was 79 pixels). See Figure 2.1 for the average of all male and female face stimuli.

Figure 2.1. Averaged Male and Female Face Stimuli. The images depict the average of all male and the average of all female face stimuli.

Body images were also taken against neutral backgrounds and individuals posed directly facing the camera with their legs shoulder width apart and arms at 45-degree-angles. According to the World Health Organization standards, 1 male and 19 female stimuli had low BMIs, 37 male and 31 female stimuli had normal BMIs, and 12 male and 0 female stimuli had overweight BMIs. Bodies were sized relative to actual height (1000px/m), the background was deleted, and placed on an 1800x2400 pixel neutral background. Faces and genitals were obscured with grey circles in order to mitigate potential rating confounds and for ethical reasons, respectively. Using Graphic Converter 9, tattoos, belly-button rings, and/or bracelets were removed from 21 body images. Body images were displayed at a size of 300x400 pixels (166.7px/m). See Figure 2.2 for the average of all male and female body stimuli.

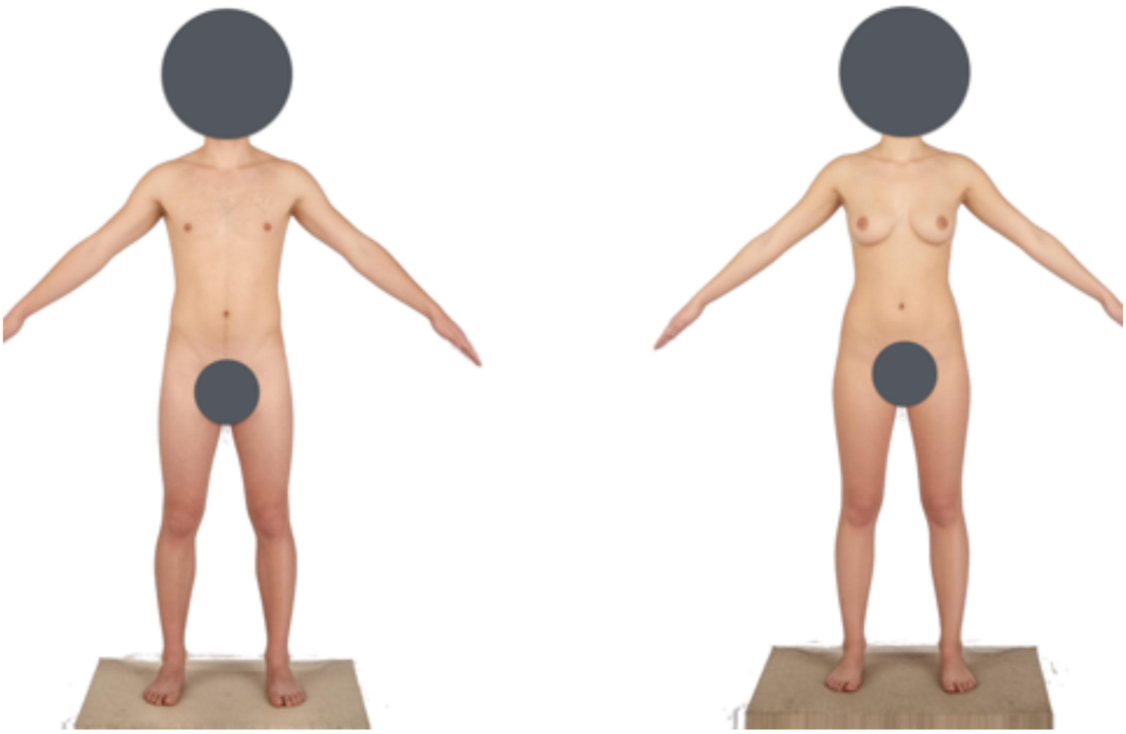

Figure 2.2. Averaged Male and Female Body Stimuli. The images depict the average of all male and the average of all female body stimuli.

2.2.2 Participants

Participants were 449 men aged 18.0 to 90.1 years (mean = 30.0 years, SD = 11.0) and 509 women aged 18.0 to 71.0 years (mean = 26.1 years, SD = 9.2). Every individual was randomly assigned to judge either male or female faces or bodies on one of the 13 traits previously investigated by Oosterhof and Todorov (2008). While 75 completed 2 to 8 different ratings, 883 completed only one rating. Ratings were done online, following previous research establishing validity and reliability of online versus in-lab tasks (Buchanan & Smith, 1999; Miller et al., 2002; Pare & Cree, 2009). See Supplemental Materials Table S2 for the number of male and female participants per rating task.

2.2.3 Rating Tasks

The procedure for ratings of the 13 traits (i.e., aggressiveness, attractiveness, caringness, confidence, dominance, emotional stability, intelligence, meanness, responsibility, sociability, trustworthiness, happiness, and weirdness) was based on that used by Oosterhof and Todorov (2008). While the original research used the trait *unhappiness*, our pilot studies suggest that this rating has very low reliability due to some participants misunderstanding the direction of the rating. We therefore replaced this rating with *happiness*, as specified in our pre-registration (Morrison, Jones, & DeBruine, 2015, September 21b). Participants were asked to "Please rate how [trait] this [face/body] is on a scale from 1 (much less [trait] than average) to 7 (much more [trait] than average)." The image remained onscreen during the rating. Trial order was randomized for each participant and trials were self-paced. Similar to previous related designs, the researchers did not provide definitions of traits to the participants (McAleer et al., 2014; Oosterhof &

Todorov, 2008). The experiment followed British Psychological Society (BPS) ethical guidelines and was approved by the University of Glasgow School of Psychology ethics committee.

2.2.4 Procedure

Similar to the procedure from Oosterhof and Todorov (2008), we initially collected ratings from 5 men and 5 women for each trait, and then assessed inter-rater reliability. The reliability of many traits as assessed via Cronbach's alpha was lower than 0.80, so we collected further ratings and reassessed reliability after at least 10 men and 10 women rated each trait, as specified in our pre-registered analysis plan (Morrison et al., 2015, September 21b). Each trait and stimulus combination was rated by 10 to 14 women and 10 to 14 men.

2.3 Results

2.3.1 Consistency of Ratings

Following Oosterhof and Todorov (2008), we calculated Cronbach's alpha for each trait for male and female faces and bodies (see Table 2.1). All alphas for face traits were above 0.71, while 4 traits for female bodies (aggressive = 0.63, intelligent = 0.56, mean = 0.53, trustworthy = 0.60) and 2 traits for male bodies (trustworthy = 0.35, weird = 0.48) had alphas below 0.70. However, the 95% confidence intervals for all alphas excluded 0, so all traits were included in analyses.

Table 2.1. Inter-rater Reliability for Stimuli. Inter-rater reliability (Cronbach's alpha) and the accompanying confidence intervals for each trait and type of stimuli.

Trait	Male Face	Female Face	Male Body	Female Body
aggressive	0.86 [0.81-0.90]	0.76 [0.63-0.84]	0.87 [0.74-0.89]	0.63 [0.38-0.74]
attractive	0.82 [0.65-0.88]	0.84 [0.72-0.87]	0.91 [0.85-0.93]	0.88 [0.81-0.91]
caring	0.89 [0.79-0.90]	0.90 [0.86-0.93]	0.81 [0.71-0.85]	0.70 [0.53-0.79]
confident	0.84 [0.75-0.88]	0.82 [0.67-0.84]	0.94 [0.90-0.95]	0.87 [0.79-0.91]
dominant	0.82 [0.69-0.85]	0.72 [0.56-0.78]	0.93 [0.90-0.95]	0.80 [0.67-0.86]
emotionally stable	0.85 [0.73-0.89]	0.82 [0.69-0.86]	0.74 [0.59-0.79]	0.73 [0.45-0.80]
happy	0.94 [0.88-0.95]	0.93 [0.89-0.95]	0.85 [0.75-0.88]	0.81 [0.70-0.85]
intelligent	0.78 [0.54-0.84]	0.71 [0.46-0.78]	0.72 [0.64-0.82]	0.56 [0.36-0.71]
mean	0.82 [0.78-0.88]	0.78 [0.70-0.85]	0.78 [0.67-0.84]	0.53 [0.17-0.65]
responsible	0.80 [0.61-0.86]	0.79 [0.63-0.86]	0.78 [0.68-0.85]	0.70 [0.61-0.80]
sociable	0.81 [0.71-0.85]	0.82 [0.73-0.86]	0.87 [0.82-0.91]	0.85 [0.77-0.89]
trustworthy	0.82 [0.72-0.84]	0.80 [0.65-0.85]	0.35 [0.20-0.61]	0.60 [0.30-0.76]
weird	0.91 [0.83-0.93]	0.87 [0.77-0.91]	0.48 [0.16-0.61]	0.77 [0.64-0.83]

We then calculated the average ratings across participants for each stimulus within each trait and used this information for further analyses. All means and standard deviations for male body, male face, female body, and female face stimuli by trait can be seen in Table S3 in Supplemental Materials.

2.3.2 Principal Components of Face and Body Ratings

We performed Principal Component Analyses (PCA) for male body stimuli, female body stimuli, male face stimuli, and female face stimuli ratings (Table 2.2).

Table 2.2. PCA Output for Each Condition. For each of the four PCAs, the table shows the loadings for each trait onto each PC.

Trait	Male Face PC1	Male Face PC2	Female Face PC1	Female Face PC2	Female Face PC3	Male Body PC1	Male Body PC2	Female Body PC1	Female Body PC2
aggressive	-0.578	0.741	-0.636	0.655	0.004	0.830	0.417	0.657	0.640
attractive	0.771	0.413	0.724	0.438	-0.403	0.943	0.056	0.913	-0.258
caring	0.889	-0.307	0.852	-0.336	0.035	0.870	-0.230	0.855	0.026
confident	0.678	0.507	0.590	0.642	0.273	0.968	0.058	0.939	-0.054
dominant	0.086	0.867	-0.235	0.860	0.186	0.889	0.249	0.904	0.035
emotionally stable	0.901	-0.061	0.763	0.476	0.082	0.928	0.140	0.862	-0.018
happy	0.772	-0.243	0.874	0.088	0.145	0.909	-0.137	0.904	-0.088
intelligent	0.705	0.154	0.668	0.121	0.464	0.891	-0.195	0.722	-0.560
mean	-0.580	0.745	-0.566	0.751	-0.005	0.830	0.387	0.725	0.398
responsible	0.734	0.170	0.791	-0.019	0.351	0.894	-0.097	0.790	-0.140
sociable	0.837	0.138	0.780	0.318	-0.380	0.943	0.104	0.935	-0.101
trustworthy	0.875	-0.072	0.848	-0.339	-0.031	0.623	-0.629	0.789	0.375
weird	-0.676	-0.523	-0.614	-0.273	0.503	-0.515	0.486	-0.873	0.077

For male face stimuli, the first two Principal Components (PCs) accounted for 53% and 21% of the variance, respectively. All traits that strongly correlated with the first PC are related to valence (e.g., *attractive*, *caring*) and all traits that strongly correlated with the second PC are related to dominance (i.e., *aggressive*, *dominant*, and *mean*). *Emotionally stable* (0.90) and *dominant* (0.87) had the strongest loadings for the first and second PCs, respectively.

For female face stimuli, the first three PCs accounted for 50%, 23%, and 8% of the variance, respectively. All traits that strongly correlated with the first PC are related to valence (e.g., *happy*, *trustworthy*) and all traits that strongly correlated with the second PC are related to dominance (i.e., *dominant* and *mean*). No trait had a loading stronger than 0.50 for the third PC. *Happy* (0.87), *dominant* (0.86), and *weird* (0.50) had the strongest loadings for the first, second, and third PCs, respectively.

For male body stimuli, the first two PCs accounted for 74% and 9% of the variance, respectively. All traits except *weird* and *trustworthy* strongly and positively loaded onto the first PC. The two highest factor loadings for the second PC were *trustworthy* (-0.63) and *weird* (0.49), which were also the factors that had the lowest inter-rater reliability (< 0.7).

For female body stimuli, the first two PCs accounted for 71% and 9% of the variance, respectively. All traits except *aggressive* strongly loaded onto the first PC. The highest factor loadings for the second PC were *aggressive* (0.64), *intelligent* (-0.56), *mean* (0.40), and *trustworthy* (0.38), which were also the factors that had the lowest inter-rater reliability (< 0.7).

We also ran a PCA excluding any trait with an alpha below 0.7. All face loadings remained identical because all face trait alphas were above 0.7. *Trustworthy* and *weird* for male bodies and *aggressive*, *intelligent*, *mean*, and *trustworthy* for female bodies were excluded from analysis. The analyses for male and female bodies each produced a single PC, explaining 82% and 80% of the variance, respectively. All traits loaded strongly onto this first PC for both male and female bodies (see Table S4 in Supplemental Materials). The first PCs in the original and this new PCA correlated strongly for both male bodies ($r = 0.9999$, $p < .001$) and female bodies ($r = 0.9999$, $p < .001$). In order to adhere to guidelines of strict inter-rater reliability and to closely follow Oosterhof and Todorov (2008), all subsequent analyses will include this second, stricter PCA excluding any trait with an alpha below 0.7.

Following Oosterhof and Todorov (2008), we ran another PCA after removing the traits *trustworthy* and *dominant* to determine whether these traits were significantly correlated with the first and second PC, respectively. For male faces, *trustworthy* judgments were strongly correlated with the first PC ($r = 0.840$, $p < .001$), but not with the second PC ($r = -0.063$, $p = 0.662$), while *dominant* judgments were strongly correlated with the second PC ($r = 0.733$, $p < .001$), but not the first PC ($r = 0.079$, $p = 0.586$). For female faces, *trustworthy* judgments were strongly correlated with the first PC ($r = 0.773$, $p < .001$), but not the second PC ($r = -0.395$, $p = 0.005$), while *dominant* judgments were strongly correlated with the second PC ($r = 0.766$, $p < .001$), but not the first PC ($r = -0.118$, $p = 0.416$). For male bodies, *trustworthy* judgments correlated moderately with the only PC ($r = 0.583$, $p < .001$), while *dominant* judgments correlated strongly ($r = 0.875$, $p < .001$) with this same PC. For female bodies, *trustworthy* judgments correlated strongly with the only PC ($r = 0.737$, $p < .001$), while *dominant* judgments also correlated strongly with the same PC ($r = 0.873$, $p < .001$).

2.3.3 Trait Correlations

We correlated the average body ratings with the average face ratings by trait, separately for male and female stimuli. Of the matching trait correlations, only two were significant: male confidence ($r = 0.34$, $p = 0.017$) and male dominance ($r = 0.37$, $p = 0.009$). No correlations between female face and body ratings were significant (uncorrected for multiple comparisons). Of particular note, facial attractiveness ratings did not predict body attractiveness ratings for either men ($r = 0.26$, $p = 0.071$) or women ($r = -0.05$, $p = 0.732$). See Figures S1 and S2 in Supplemental Materials for all of the trait correlations.

We also correlated face and body PC scores, separately for men and women. No correlations were significant (all male $r < 0.19$, $p > 0.18$; all female $r < 0.10$, $p > 0.48$).

2.3.4 Body Measures

We used regression to examine the relationships between each PC and stimulus age, BMI, BMI^2, waist-to-chest ratio (WCR) if male, and waist-to-hip ratio (WHR) if female. BMI^2 was included in the analyses because both low and overweight BMIs could be considered less attractive or rewarding than normal BMIs, creating a quadratic rather than simply linear relationship between BMI and each PC.

For the first male face PC, the model was not significant ($R^2 = 0.088$, $F(4,45) = 1.08$, $p = 0.376$). For the second male face PC, the model was not significant ($R^2 = 0.058$, $F(4,45) = 690$, $p = 0.603$). For the first female face PC, the model was not significant ($R^2 = 0.013$, $F(4,45) = 151$, $p = 0.961$). For the second female face PC, the model was not significant ($R^2 = 0.108$, $F(4,45) = 1.36$, $p = 0.262$). For the third female face PC, the model was not significant ($R^2 = 0.156$, $F(4,45) = 2.07$, $p = 0.101$). For the only male body PC, the model was significant ($R^2 = 0.310$, $F(4,45) = 5.06$, $p = 0.002$). For the only female body PC, the model neared significance ($R^2 = 0.181$, $F(4,45) = 2.50$, $p = 0.056$).

WCR significantly predicted the only PC for male bodies (beta = 6.397, s.e. = 2.085, $t = 3.069$, $p = 0.004$). BMI^2 significantly predicted the only PC for both male and female bodies (male: beta = -2.750, s.e. = 0.880, $t = -3.126$, $p = 0.003$; female: beta = -2.671, s.e. = 0.969, $t = -2.757$, $p = 0.008$). Age significantly predicted the third PC for female faces (beta = 0.133, s.e. = 0.048, $t = 2.763$, $p = 0.008$). Additionally, stimulus age, WCR, and

WHR did not significantly predict the first PC for female bodies or faces, nor did they significantly predict the second PC for male faces.

2.4 Discussion

Our first aim was to determine whether social judgments were consistent across observers for male and female bodies and faces. Ratings were reliable for all face traits and most body traits. All traits for faces had strong inter-rater reliabilities (alpha > 0.7). Two traits for male bodies (*trustworthy* and *weird*) and four traits for female bodies (*aggressive*, *intelligent*, *mean*, and *trustworthy*) had alphas less than 0.7. However, none of the confidence intervals for any trait included 0 (see Table 2.1).

Our second aim was to determine if social judgments of bodies followed the same two-component pattern (valence and dominance) as faces and voices (McAleer et al., 2014; Oosterhof & Todorov, 2008). The face data generally replicated the two-component pattern of valence and dominance, with a first PC that correlated most strongly with traits like *sociable* and *trustworthy* and a second PC that correlated most strongly with traits like *dominant* and *mean* (see Table 2.2). Overall, *trustworthy* and *dominant* correlated strongly with the first and second PCs, respectively. Female face judgments also produced a third PC, which was most strongly positively correlated with *intelligent* and *weird*, and negatively correlated with *attractive* (a ‘geekiness’ component).

While our face data generally replicated the two-component pattern of valence and dominance, our body data did not. As opposed to faces, most traits loaded quite strongly onto the first PC for male and female bodies, with only *trustworthy* and *weird* for male bodies and *aggressive* for female bodies having loadings below 0.7. Furthermore, trustworthiness and dominance both correlated with the first PC. For both male and female bodies, the second PC loaded most strongly onto the least reliable judgments. After removing the traits with alphas below 0.7, the first PCs remained nearly identical, and this new analysis did not include a second PC for male or female bodies.

Our third aim was to determine the relationship between social perceptions of faces and bodies of the same individuals. For men, only *confidence* and *dominance* correlated significantly between faces and bodies. No female face ratings significantly correlated with their corresponding body ratings.

Our fourth aim was to determine how body measurements are related to social perceptions. We investigated age, BMI, BMI^2, waist-to-chest ratio for men (WCR) and waist-to-hip ratio for women (WHR). For men, the only body PC was significantly and linearly predicted by WCR and BMI^2. Men with a higher, more muscular WCR scored higher on this PC, which was strongly correlated with all trait judgments except *trustworthy* and *weird*. Men with either lower or higher BMIs scored lower on this PC, hence the quadratic relationship between BMI and the only body PC. For women, the only body PC was significantly predicted by BMI^2. Women with either lower or higher BMIs scored lower on this PC. For men's faces, the first PC (i.e., valence) was non-significantly and positively correlated with age, while the second PC (i.e., dominance) was not predicted by any body measurements. For women's faces, the first PC (i.e., valence) was not predicted by any body measurements, the second PC (i.e., dominance) was negatively (but not significantly) related to WHR, and the third PC (i.e., geekiness) was positively related to age.

Our findings for social judgments of faces generally replicate previous research (McAleer et al., 2014; Oosterhof & Todorov, 2008; Sutherland et al., 2013). Interestingly, the trait loadings for the first two PCs were very similar for male and female faces, suggesting that the social perception of faces works similarly regardless of the face's sex. We additionally found a third PC for female faces. Although Oosterhof and Todorov (2008) did not find this third PC for female faces, Sutherland et al. (2013) did find a third component of youthfulness based on a stimuli set with a wider age range. In particular, Sutherland et al. (2013) included stimuli ages ranging from young adult to senior citizen, whereas the Oosterhof and Todorov (2008) face models were all relatively homogeneous with regards to age. Our stimuli age range (i.e., 19-30 years old) is similar to that of Oosterhof and Todorov (2008) and is considerably smaller than that of Sutherland et al (2013). Even so, we found that age predicted the third PC for female faces in our data. Therefore, male and female faces could potentially be perceived by a three-component pattern (valence, dominance, and age) of social perception, but this third component may be of little importance when judging faces of similar ages.

Our findings for social judgments of bodies did not follow this two-component pattern, however. Traits associated with both valence and dominance loaded onto the only PC for both male and female bodies. This finding provides clear evidence against the idea that social perception is universally organized into a two-component model corresponding to valence and dominance.

Furthermore, future research could replicate this study but start with free descriptions of bodies, like Oosterhof and Todorov (2008) did with faces, rather than using the same traits as faces. Starting with free descriptions, which would then be grouped into specific traits, would allow a more nuanced analysis of the social perception pattern specific to bodies in addition to the current analyses which show that the social perception patterns of faces and bodies differ.

The positive correlations between male bodies and faces for *confidence* and *dominance* suggest that these judgments may rely on a common underlying trait, such as muscularity. Among ancestral humans, strength for fighting (i.e., upper body strength) was very important with regards to inflicting costs as well as gathering and maintaining resources (Sell et al., 2009). Since this physical strength sustained the ability to cause harm and gather and maintain resources, strength could directly influence perceptions of dominance and confidence. However, the lack of corresponding correlations between faces and bodies for all other judgments suggests that most social judgments of faces and bodies do not rely on common underlying traits visible in both faces and bodies, such as BMI or skin condition. Previous papers have found that face and body attractiveness ratings correlate for both men and women, but only moderately with significant correlations between 0.3 and 0.49 (Fink et al., 2010; Hönekopp et al., 2007; Thornhill & Grammer, 1999).

Others, though, have found that an assortment of physical features within faces and bodies supply different information regarding youth, maturity, sociability, approachability, and social status (Cunningham et al., 1990). According to this multiple motives hypothesis, all of these features, which provide various cues to information, combine to form an overall measure of attractiveness (Cunningham et al., 1990). Thus, this multiple motives hypothesis directly opposes the previously mentioned studies which claim that facial and bodily attractiveness represent one ornament of mate and/or health quality. In our sample, men's facial and bodily attractiveness were positively related ($r = 0.26$, $p = 0.071$), although this was not significant in a two-tailed test. However, women's facial and body attractiveness were entirely uncorrelated in this sample ($r = -0.05$, $p = 0.732$).

While this thesis and previous papers provide useful information regarding how people perceive others, more accurate and generalizable results could potentially be obtained by using a more varied stimuli set. While Sutherland et al. (2013) tried to expand upon the relatively uniform stimuli used by Oosterhof and Todorov (2008), more can be done to broaden the ages, ethnicities, and physical attributes of stimuli. Moreover, even though our data show that the social perception of bodies is not identical to the social perception of faces (and voices), individuals see and hear faces and voices hundreds of times every single day, but see naked bodies only rarely. This discrepancy in exposure may cause a difference in ability to form social judgments for different types of stimuli. In addition to a more extensive stimulus set, replicating the experiment in a society which has near equal exposure to unadorned bodies and faces would help determine if our finding that bodies are perceived differently than faces is due to lack of stimuli exposure, if the two-component pattern of social dominance only applies to faces and voices, or due to another explanation altogether.

The results of this study replicate that of Wang and colleagues (2016) in that social perception of faces follows the two-component pattern of valence and dominance. The current study also extends this research by showing that social perception of bodies follows a one-component pattern. Wang and colleagues (2016) also found that the social perception components for faces positively predict motivational salience. However, no study examines if social perception possesses a similar relationship for bodies. Therefore, the next chapter will investigate the relationship between motivational salience and social perception components for faces and bodies.

Chapter 3: Social perception predicts motivational salience of faces and bodies

Abstract

Previous research indicates that social perception of faces and voices shows a consistent two-component pattern of valence and dominance, while social perception of bodies consists of a one-component pattern where both valence and dominance correlate (see previous chapter). Valence and dominance have been shown to independently predict the motivational salience of faces; participants used key-presses to increase viewing time more for faces that scored higher on valence and/or dominance. To test the relationship between motivational salience and the social perception of bodies, 56 participants (28 men) performed the same key-press task on 50 male and 50 female faces and bodies. Valence and dominance significantly, positively, and independently predicted the motivational salience of male and female faces, replicating earlier work. The main social perception component for bodies significantly and positively predicted motivational salience for both male and female bodies. BMI and dimorphic shape (i.e., WCR for men and WHR for women) predicted motivational salience, but these effects were qualified by sex of stimulus and type of stimulus (i.e., faces versus bodies).

3.1 Introduction

Social interaction requires social perception, which is the creation of impressions and attributions based on ascertainable cues. Faces are particularly useful for forming impressions and the establishment of social perception, as they are usually the first stimulus viewed and perceived. Faces provide important information about an individual, including age, gender, emotion, and health (Belin et al., 2011; Hill et al., 1995; Massaro & Egan, 1996; Tovée et al., 2012). Furthermore, people automatically form personality-based social judgments, such as dominance and trustworthiness, based on one's facial features (Berry & McArthur, 1986; Penton-Voak et al., 2006; Todorov et al., 2008; Tsankova et al., 2012). Rather than forming over extended periods of time, social perceptions and first impressions based on facial morphology are formed automatically and within 100ms (Willis & Todorov, 2006). While these automatic judgments may or may not be accurate to the individual's actual personality, forming social perceptions at such a quick rate could help perceivers avoid potentially dangerous or threatening individuals. These immediate judgments can have substantial social consequences, including influencing voting decisions (Todorov et al., 2005).

In order to examine social perception with regards to faces, Oosterhof and Todorov (2008) first asked participants to freely describe face stimuli. After classifying these descriptions into 13 traits, Oosterhof and Todorov (2008) established that the many aspects of social perception could be summarized by evaluations of valence and dominance. Wang, Hahn, DeBruine, and Jones (2016) and Sutherland et al. (2013) replicated this result of valence and dominance components encapsulating social perception judgments. However, Sutherland et al. (2013) used much more heterogeneous stimuli and, consequently, found an additional summarizing component of youthfulness.

While faces significantly influence impressions, social perception as a whole involves observing and integrating information about the entire person. To test if social perception followed a similar pattern when based on a different aspect of person perception, McAleer, Todorov, and Belin (2014) examined social perception of voices. Valence and dominance components again summarized social perception, but for voices rather than faces (2014). Furthermore, these social perception judgments made from voices were stable across perceivers (2014).

Based on the results from face and voice studies, body perception could also theoretically be encapsulated by judgments of valence and dominance. For example, strength can be ascertained from faces and bodies (Sell et al., 2009). Measurements such as shoulder-to-hip ratio (SHR) and handgrip strength are related to facial dominance, masculinity, and attractiveness in men (Fink et al., 2007; Shoup & Gallup, 2008). Additionally, women's body mass index (BMI) and waist-to-hip ratio (WHR) are negatively related to attractiveness (Furnham et al., 1997; Han et al., 2015; Singh, 1993a, 1993b), with BMI as a stronger correlate (Tovée et al., 1999a). Therefore, Chapter 2 reproduced Oosterhof and Todorov's (2008) original study using both face and body stimuli. We first replicated the social perception pattern of valence and dominance components for faces. However, the same pattern did not apply to body perception. Instead, both valence- and dominance-related traits loaded strongly onto the first social perception component for both male and female bodies, suggesting that social perception is not fundamentally encapsulated by the two-component pattern of valence and dominance.

Research also shows that viewing attractive faces can be rewarding (Bzdok et al., 2011; Hahn & Perrett, 2014; Mende-Siedlecki et al., 2013). Many studies have used key-press tasks to evidence the idea that participants will expend more effort to continue looking at attractive and, therefore, rewarding or motivationally salient faces (Hahn et al., 2014; Hahn et al., 2016; Levy et al., 2008; Wang et al., 2014). Some studies even show that this effect is stronger for preferred-sex faces, particularly for men (Hahn et al., 2016; Levy et al., 2008). Wang, Hahn, DeBruine, and Jones (2016) found that the social perception components of valence and dominance significantly and independently related to the motivational salience of faces. Furthermore, dominance even carries weight for social perceptions in non-human animals, as dominant male macaque faces possess more motivational salience (Deaner et al., 2005).

The current study examines the relationship between the motivational salience and social perception components for faces and bodies. Thus, the current study furthers the findings of Wang, Hahn, DeBruine, and Jones (2016) by expanding the research to bodies. Firstly, we aim to determine how the social perception components and participant sex relate to motivational salience for male and female face and body stimuli separately. Based on previous research (Wang et al., 2016), we expect that motivational salience will be correlated with each social perception component. Secondly, we aim to determine how the motivational salience of corresponding faces and bodies are related. Based on the one-ornament literature which claims that face and body attractiveness represent one mate or health quality (Thornhill & Grammer, 1999), we expect a positive relationship between motivational salience of corresponding faces and bodies. Lastly, the current study aims to determine how the motivational salience of male and female faces and bodies for male and female participants relates to body measures (i.e., age, BMI, WHR, and WCR) of stimuli. We expect body measures such as WCR, WHR, and BMI to negatively relate to motivational salience, as lower WCRs, WHRs, and BMIs are considered more attractive (Coy et al., 2014; Furnham et al., 1997; Han et al., 2015;

Henss, 1995; Singh, 1993a, 1993b; Singh, 1994; Streeter & McBurney, 2003; Tovée et al., 1999b; van Anders & Hampson, 2005).

3.2 Method

3.2.1 Stimuli

Stimuli were identical to that used in the first empirical chapter (i.e., Chapter 2). Stimuli were created from images of 50 white men and 50 white women between the ages of 19 and 30 years. These images and associated data were sourced from 3d.sk, a website that provides high-quality body images for 3D gaming development and other uses. All individuals gave their consent for their images to be used commercially and publicly. See Supplemental Materials Table S1 for age, height, weight, BMI, chest circumference, waist circumference, and hip circumference for each person.

Face images were taken against neutral backgrounds and all individuals posed facing the camera with direct gazes and neutral expressions. Images were masked to show only the face and ears. Face images were aligned on the center of the pupils so that interpupillary distance was 26.4% of image width. Using Graphic Converter 9, facial piercings and/or hair clips were removed from 8 face images. Face images were displayed at a size of 300x400 pixels (interpupillary distance was 79 pixels). See Chapter 2, Figure 2.1 for the average of all male and female face stimuli.

Body images were also taken against neutral backgrounds and individuals posed directly facing the camera with their legs shoulder width apart and arms at 45-degree-angles. Bodies were sized relative to actual height (1000px/m), the background was deleted, and placed on an 1800x2400 pixel neutral background. Faces and genitals were obscured with grey circles in order to mitigate potential rating confounds and for ethical reasons, respectively. Using Graphic Converter 9, tattoos, belly-button rings, and/or bracelets were removed from 21 body images. Body images were displayed at a size of 300x400 pixels (166.7px/m). See Chapter 2, Figure 2.2 for the average of all male and female body stimuli.

3.2.2 Participants

Participants were 82 men and women. Twenty-four individuals who did not identify as heterosexual were excluded (11 homosexual; 7 bisexual; 3 asexual; 3 did not provide their sexual orientation). Individuals who did not make any responses during the task were also excluded (2). The final sample included 28 men aged 18.2 to 37.1 years (mean = 23.086, SD = 4.743) and 28 women aged 18.5 to 52.2 years (mean = 26.446, SD = 10.070).

3.2.3 Procedure

3.2.3.1 Key-Pressing Task

The participants completed a standard key-press task, similar to previous studies, which assesses motivational salience of faces (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016). For the key-press task, participants controlled the viewing duration of each stimulus by pressing specified keyboard keys after initiating the trial by pressing the space bar. Participants could increase the default viewing duration of 4s by alternately pressing keys 7 and 8 and/or decrease the viewing duration by alternately pressing keys 1 and 2. Each key press increased or decreased the viewing time by 100ms. Participants completed a block of practice trials before beginning the experimental trials. Stimuli were shown in four separate conditions (male bodies, male faces, female bodies, and female faces). The order of conditions was randomized for each participant and trial order was randomized for each condition for each participant. The key-press tasks were run in-lab at the University of Glasgow's Institute of Neuroscience and Psychology. The experiment followed British Psychological Society (BPS) ethical guidelines and was approved by the University of Glasgow School of Psychology ethics committee.

Following previous studies (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016), we subtracted the number of key presses made to decrease viewing time from those made to increase viewing time in order to calculate the key-press scores for each trial. Higher key-press scores indicate higher motivational salience (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016). Because the key-press scores were right-skewed, we log transformed the result after adding an optimal constant to make all values positive and then scaled the scores.

3.2.3.2 Social Perception Components

Principal Component (PC) scores were taken from Chapter 2 and followed the same procedure as Oosterhof and Todorov (2008). The PC scores were calculated using trait ratings of the same face and body stimuli used here. Each stimulus was rated by at least 10 men and 10 women on 13 traits (i.e., aggressiveness, attractiveness, caringness, confidence, dominance, emotional stability, intelligence, meanness, responsibility, sociability, trustworthiness, happiness, and weirdness). Participants were asked to "Please rate how [trait] this [face/body] is on a scale from 1 (much less [trait] than average) to 7 (much more [trait] than average)." The image remained onscreen during the rating. Trial order was randomized for each participant and trials were self-paced.

Ratings from Chapter 2 of male and female face stimuli each produced a first principal component that correlated strongly with traits such as trustworthiness and attractiveness (labeled 'Valence PC') and a second PC that correlated strongly with traits such as aggressiveness and meanness (labeled 'Dominance PC'). Female face stimuli produced a third PC that correlated strongly with traits such as intelligence and weirdness (labeled 'Geekiness PC'). These results are consistent with the findings of Oosterhof and Todorov (2008) and Sutherland et al. (2013).

Ratings of male and female body stimuli each produced a first PC that correlated strongly with traits related to both valence and dominance (labeled 'Main PC') and a second PC that mainly correlated with traits that had low (alpha < .70) inter-participant reliability (labeled 'unreliable PC'). However, these second PCs disappeared in a subsequent principal component analysis that removed the low-reliability traits. For all motivational salience analyses, only the data from the second, more stringent principal component analysis from Chapter 2 (i.e., one PC for bodies) will be used.

3.3 Results

3.3.1 Social Perception Components and Motivational Salience of Faces and Bodies

First, we investigated the relationship between social perception components and key-press scores. Because the number and meaning of the PCs differed among conditions, we conducted separate linear mixed models for each condition. For each analysis, we tested the effects of the social perception PCs, participant sex, and all their interactions. Random effects were maximally specified. Random intercepts were specified for each stimulus and participant. Random slopes by stimulus were specified for participant sex. Random slopes by participant were specified for each social perception PC and all of their interactions. The dependent variable in each model was key-press score, which was right-skewed. Following recommendations by Emerson (1983) and Emerson and Soto (1983), we therefore log transformed key-press scores after adding an optimal constant to make all values positive and scaling the resulting scores.

For male faces, the model was significantly better than the null model ($\chi^2(7) = 39.08$, $p < 0.001$). For female faces, the model was significantly better than the null model ($\chi^2(15) = 67.54$, $p < 0.001$). For male bodies, the model was significantly better than the null model ($\chi^2(3) = 44.28$, $p < 0.001$). For female bodies, the model was significantly better than the null model ($\chi^2(3) = 36.02$, $p < 0.001$).

Analyses of both male and female face stimuli showed that key-press scores were positively and significantly related to the Valence PC (male: beta = 0.135, $p < .001$; female: beta = 0.156, $p < .001$) and the Dominance PC (male: beta = 0.054, $p = 0.012$; female: beta = 0.071, $p = 0.003$). This effect of the Dominance PC for male faces was qualified by participant sex (beta = 0.073, $p = 0.037$), whereby the effect of key-press scores increasing as dominance increased was greater for women. Key-press scores for female face stimuli were also significantly and negatively related to the Geekiness PC (beta = -0.104, $p < .001$). No other predictors or interactions were significant in either analysis. Corresponding analyses for male and female body stimuli showed that key-press scores were positively and significantly related to only the Main PC (male: beta = 0.239, p < .001; female: beta = 0.226, p < .001). No other predictors or interactions were significant in either analysis. See Tables 3.1 - 3.4 and Figures 3.1 - 3.2 for full statistics on these analyses.

Table 3.1. Male Face Key-Press Regression Output. Regression output for the key-press scores of male face stimuli. The Valence PC and the Dominance PC significantly predicted the key-press scores of male face stimuli. The effect of the Dominance PC was qualified by participant sex.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.139	0.095	57.970	-1.461	0.149
PC_{val}	0.135	0.025	67.784	5.409	< .001
PC_{dom}	0.054	0.021	54.475	2.611	0.012
Participant Sex	0.301	0.189	56.459	1.596	0.116
PC_{val} x PC_{dom}	0.006	0.018	48.767	0.336	0.738
PC_{val} x Participant Sex	0.071	0.044	55.974	1.608	0.114
PC_{dom} x Participant Sex	0.073	0.034	46.052	2.142	0.037
PC_{val} x PC_{dom} x Participant Sex	0.038	0.027	48.542	1.372	0.176

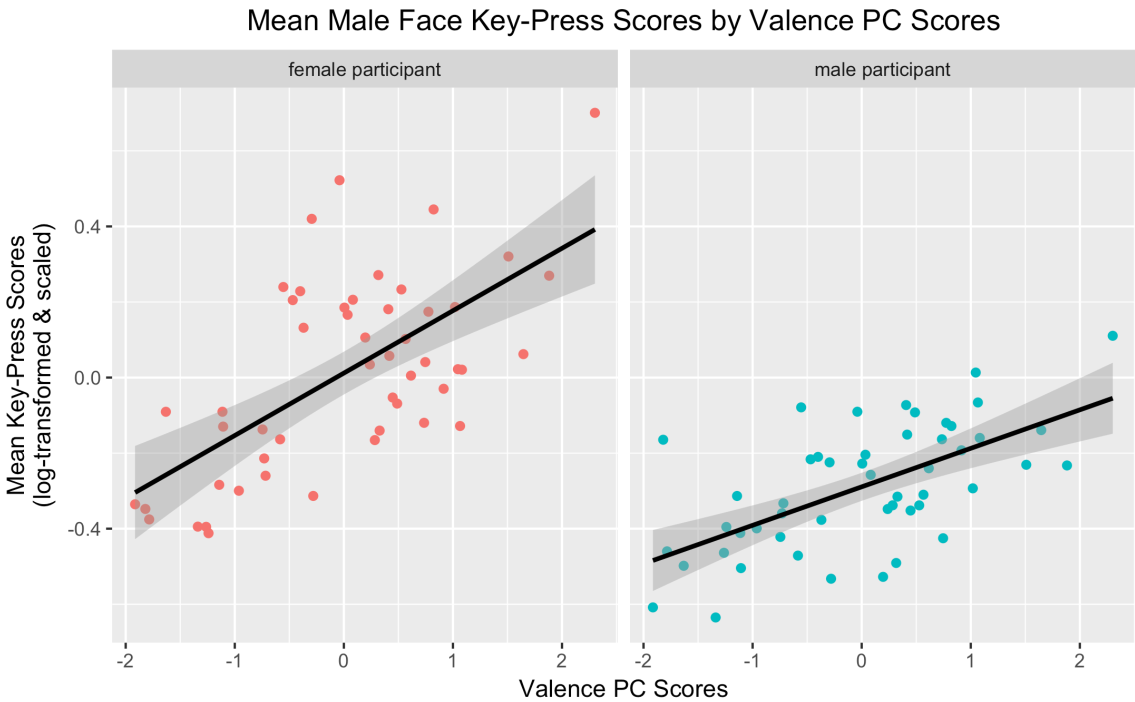

Figure 3.1. Mean Male Face Key-Press Scores by Valence PC Scores. There was a main effect of the Valence PC, whereby key-press scores increased as loadings onto the Valence PC increased.

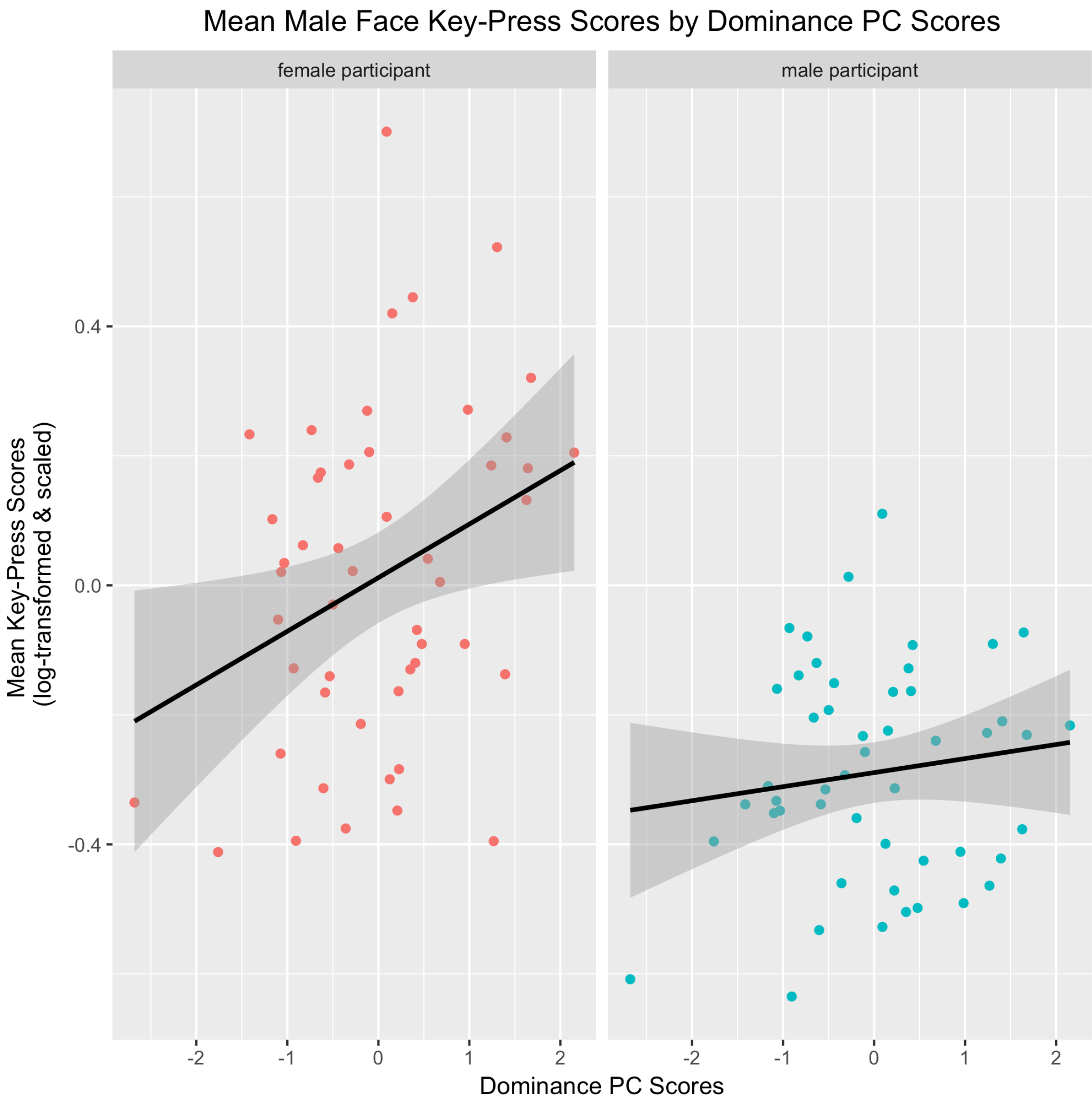

Figure 3.2. Mean Male Face Key-Press Scores by Dominance PC Scores. There was a positive main effect of the Dominance PC. This main effect was qualified by participant sex, whereby the effect was greater for female participants.

Table 3.2. Female Face Key-Press Regression Output. Regression output for the key-press scores of female face stimuli. The Valence PC, the Dominance PC, and the Geekiness PC significantly predicted the key-press scores of female face stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.015	0.107	57.444	-0.143	0.887
PC_{val}	0.156	0.021	55.349	7.428	< .001
PC_{dom}	0.071	0.023	58.649	3.124	0.003
PC_{geek}	-0.104	0.021	55.727	-4.857	< .001
Participant Sex	0.204	0.213	56.164	0.961	0.341
PC_{val} x PC_{dom}	0.015	0.023	48.645	0.636	0.527
PC_{val} x PC_{geek}	-0.018	0.025	49.289	-0.710	0.481
PC_{dom} x PC_{geek}	-0.004	0.020	48.645	-0.205	0.838
PC_{val} x Participant Sex	-0.006	0.035	60.154	-0.167	0.868
PC_{dom} x Participant Sex	0.023	0.038	74.935	0.598	0.552
PC_{geek} x Participant Sex	0.032	0.036	63.740	0.902	0.37
PC_{val} x PC_{dom} x PC_{geek}	-0.009	0.028	44.498	-0.314	0.755
PC_{val} x PC_{dom} x Participant Sex	0.046	0.035	2426.459	1.316	0.188
PC_{val} x PC_{geek} x Participant Sex	-0.005	0.039	69.793	-0.135	0.893
PC_{dom} x PC_{geek} x Participant Sex	0.006	0.031	2426.459	0.189	0.85
PC_{val} x PC_{dom} x PC_{geek} x Participant Sex	0.033	0.042	114.190	0.785	0.434

Table 3.3. Male Body Key-Press Regression Output. Regression output for the key-press scores of male body stimuli. The Main PC significantly predicted the key-press scores of male body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.056	0.085	58.322	-0.662	0.511
PC_{main}	0.239	0.033	68.287	7.332	< .001
Participant Sex	0.320	0.168	55.999	1.906	0.062
PC_{main} x Participant Sex	0.092	0.060	55.977	1.536	0.13

Table 3.4. Female Body Key-Press Regression Output. Regression output for the key-press scores of female body stimuli. The Main PC significantly predicted the key-press scores of female body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	0.208	0.076	58.962	2.757	0.008
PC_{main}	0.226	0.033	65.926	6.807	< .001
Participant Sex	-0.120	0.150	57.265	-0.799	0.427
PC_{main} x Participant Sex	-0.033	0.063	59.269	-0.514	0.609

3.3.2 Relationship Between Motivational Salience of Faces and Bodies

Next, to investigate whether motivational salience of individuals' faces and bodies were related, we used two additional linear mixed models. The first model examined if male face stimuli key-press scores were predicted by participant sex and male body stimuli key-press scores. The second model examined the same relationship for female face and body stimuli key-press scores. Random intercepts were specified for each stimulus and participant. Random slopes by stimulus were specified for participant sex, body key-press scores, and their interaction. Random slopes by participant were specified for body key-press scores.

For male face and body motivational salience, the model was significantly better than the null model ($\chi^2(3) = 7.93$, $p = 0.047$). For female face and body motivational salience, the model was not significantly better than the null model ($\chi^2(3) = 2.40$, $p = 0.493$).

Key-press scores for male face stimuli were significantly and positively related to key-press scores for male body stimuli (beta = 0.044, p = 0.045). No other predictors or interactions were significant regarding male stimuli. Key-press scores for female face stimuli were not significantly related to key-press scores for female body stimuli (beta = 0.011, $p = 0.610$) or any other predictor or interaction. See Figures 3.3 - 3.4 for (fe)male face and body key-press score relationships.

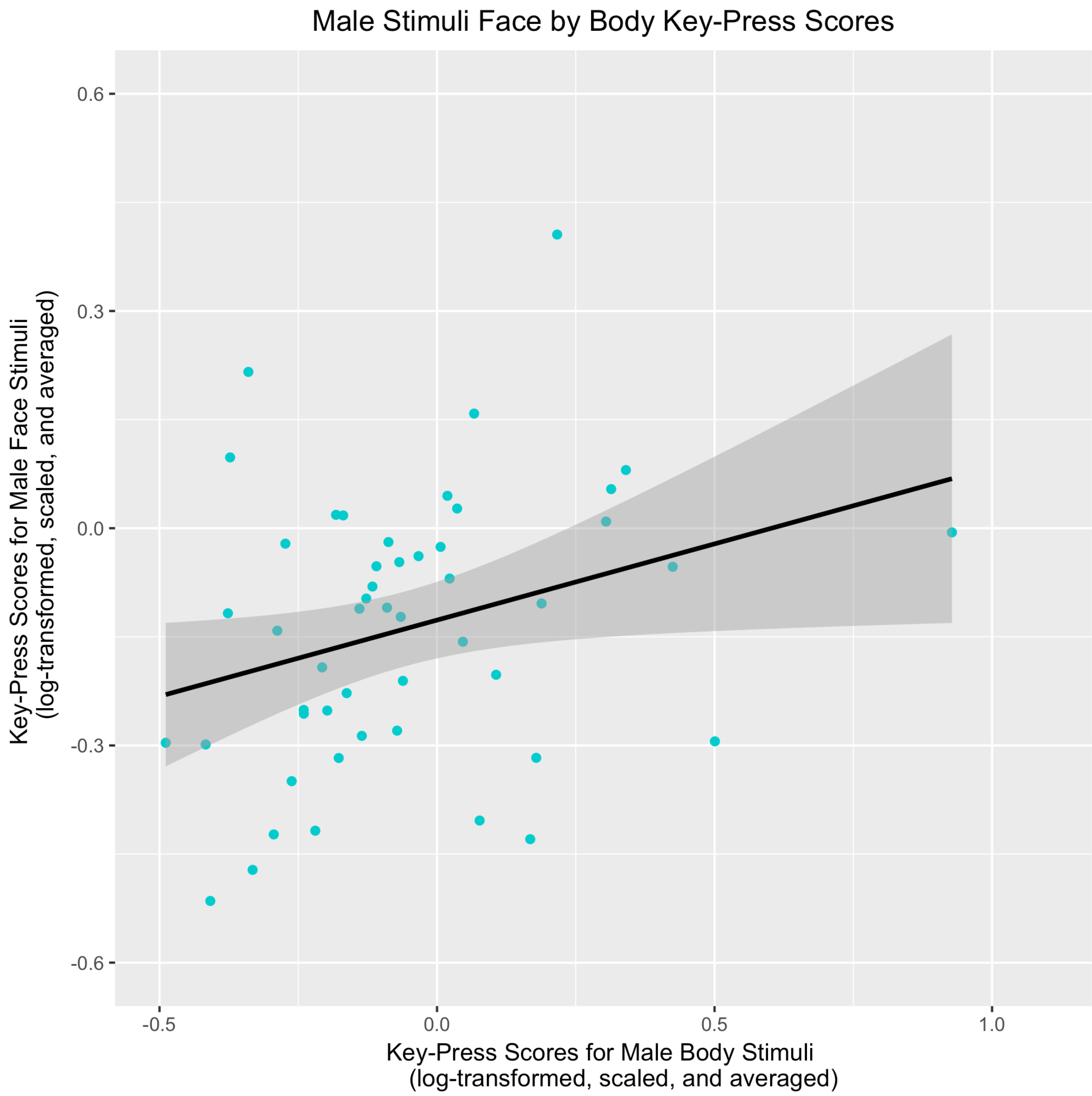

Figure 3.3. Male Face Key-Press Scores Predicted by Male Body Key-Press Scores. Average key-press scores for male face stimuli were significantly related to average key-press scores for male body stimuli.

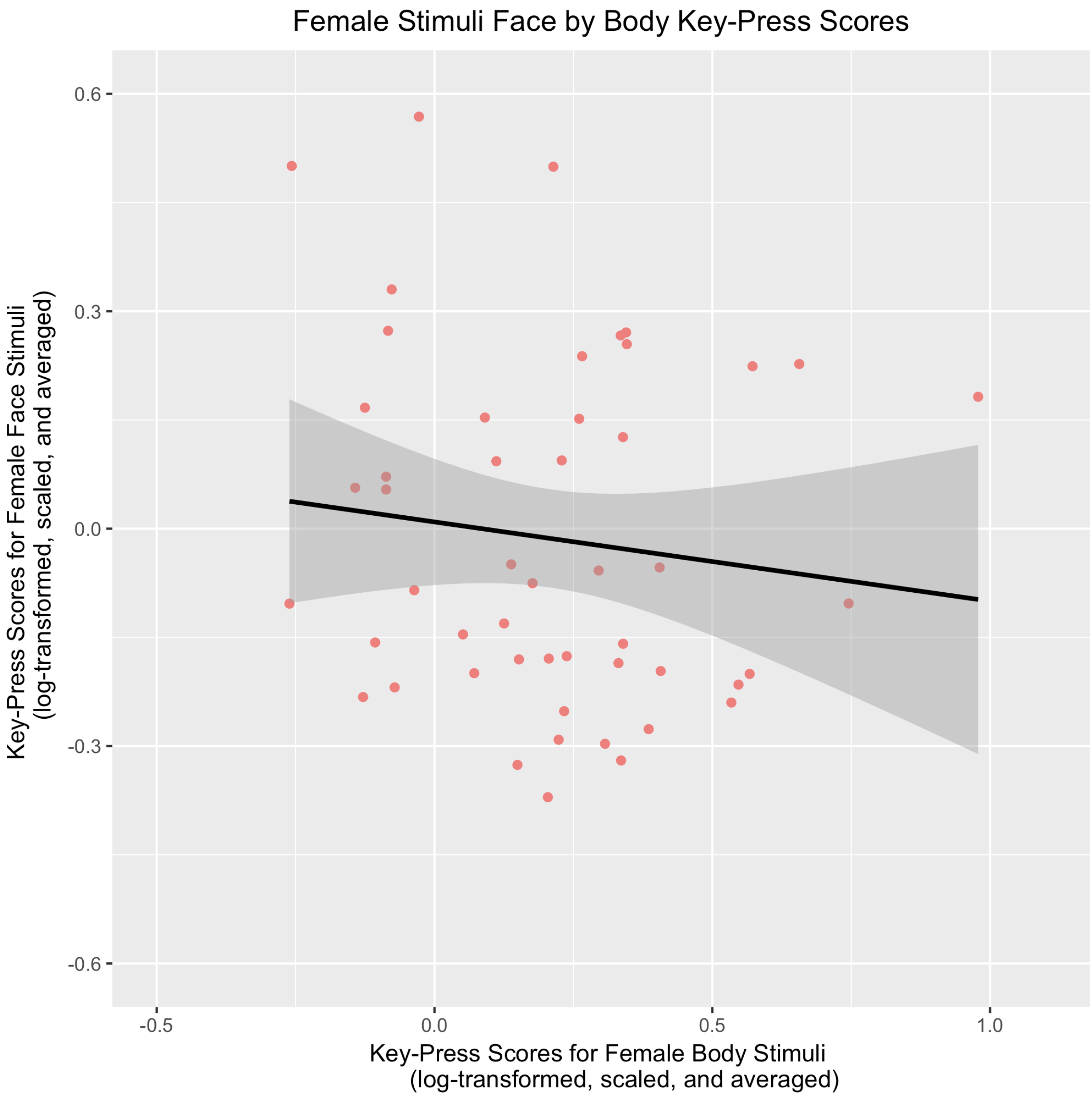

Figure 3.4. Female Face Key-Press Scores Predicted by Female Body Key-Press Scores. Key-press scores for female face stimuli were not significantly related to key-press scores for female body stimuli.

3.3.3 Body Measures and Motivational Salience of Faces and Bodies

Next, we used an additional linear mixed model to investigate whether motivational salience of individuals' faces and bodies were related to their ages, BMIs, BMI^2, and waist-to-hip ratios (WHR; if female) or waist-to-chest ratios (WCR; if male). For this and subsequent analyses BMI, BMI^2, dimorphic shape (WHR or WCR), and age were scaled within sex and dimorphic shape was reversed so that high numbers represent more sexually dimorphic shapes. BMI was centered before squaring to prevent collinearity. The first model examined if all stimuli key-press scores were predicted by participant sex, stimulus sex, stimulus type, BMI, BMI^2, stimulus age, and dimorphic shape (i.e., WHR or WCR). Random intercepts were specified for each stimulus and participant. Random slopes by stimulus were specified for participant sex, stimulus type, and their interaction. Random slopes by participant were specified for stimulus sex, stimulus type, BMI, BMI^2, stimulus age, dimorphic shape and their interactions. For all stimuli, the model was significantly better than the null model ($\chi^2(32) = 359.57$, $p < 0.001$).

Key-press scores for all stimuli were significantly and positively related to stimulus sex (beta = 0.195, $p < .001$), whereby female stimuli had higher key press scores than male stimuli. This effect of stimulus sex was qualified by participant sex (beta = -0.272, $p < .001$), whereby men had higher key-press scores for female stimuli. Key-press scores for all stimuli were significantly and positively related to stimulus type (beta = 0.152, $p < .001$), whereby body stimuli had higher key-press scores than face stimuli. This effect of stimulus type was qualified by participant sex (beta = -0.149, $p < .001$), whereby male participants had higher key-press scores for body stimuli. The effect of stimulus type was also qualified by stimulus sex (beta = 0.139, $p < .001$), whereby key-press scores were higher for female and body stimuli. The interaction among stimulus sex, participant sex, and stimulus type (beta = -0.337, $p < .001$) indicated that key-press scores were highest for male participants viewing female body stimuli.

Key-press scores for all stimuli were significantly and negatively related to BMI^2 (beta = -0.041, p = 0.022). This effect of BMI^2 was qualified by stimulus type (beta = -0.054, p = 0.001), whereby the effect was greater for body stimuli than face stimuli. The effect of BMI was qualified by stimulus type (beta = 0.042, p = 0.01), whereby the relationship between BMI and key-press scores was more negative for face stimuli than body stimuli. Key-press scores were also significantly and positively related to dimorphic shape (beta = 0.043, p = 0.016). This effect of dimorphic shape was qualified by stimulus type (beta = 0.047, p = 0.002), whereby the effect was greater for body stimuli than face stimuli. The interaction among dimorphic shape, stimulus sex, and stimulus type (beta = -0.092, p = 0.005) indicated that the effect of dimorphic shape was greater for male body stimuli. See Table S5 in the Supplemental Materials for full statistics on these analyses. See Figures 3.5 - 3.7 for interaction effects.

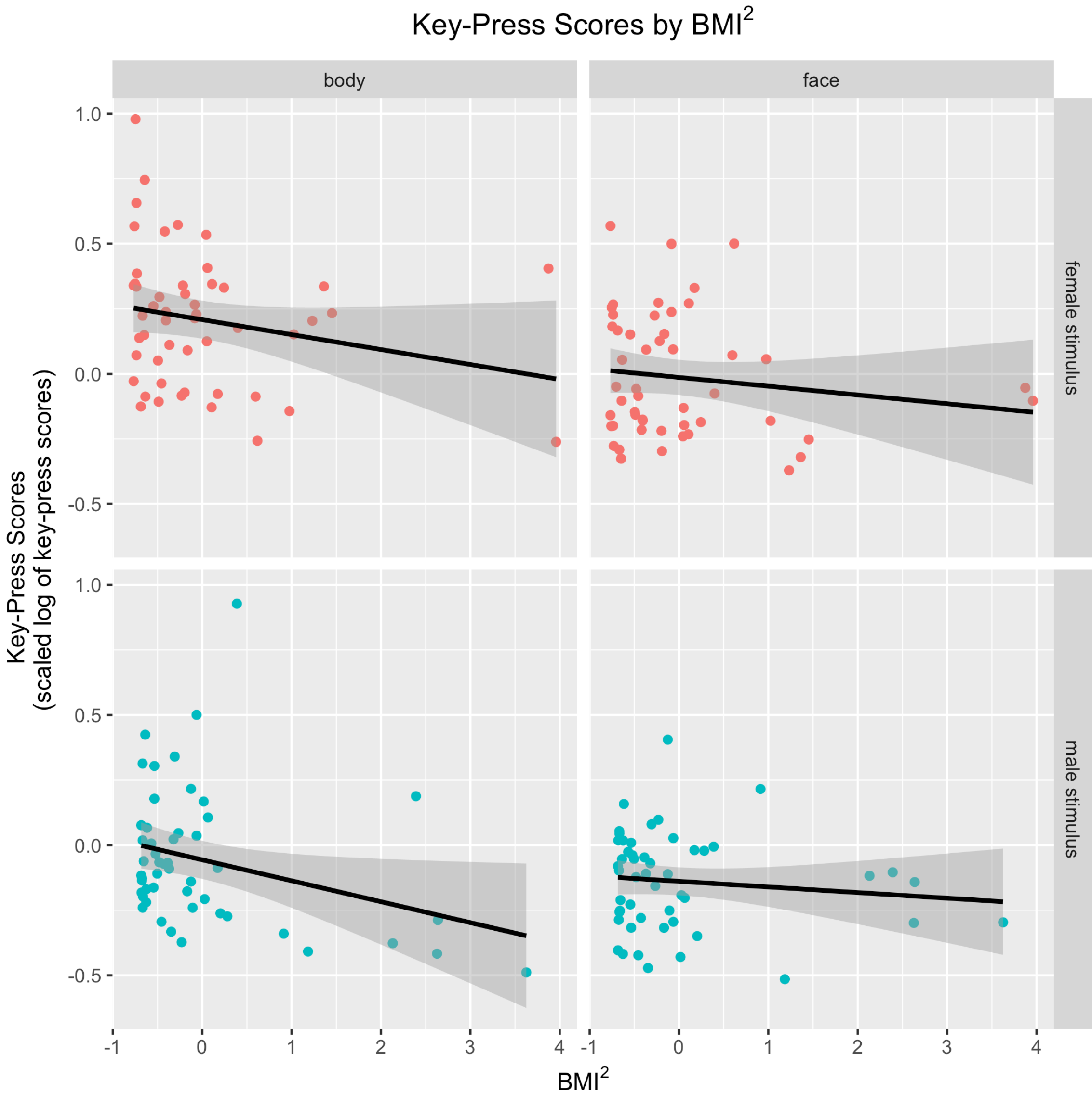

Figure 3.5. Key-Press Scores by BMI^2. There was a main effect of BMI^2, whereby key-press scores decreased as BMI^2 increased. This effect was qualified by stimulus type, whereby the effect of BMI^2 was greater for body stimuli than face stimuli.

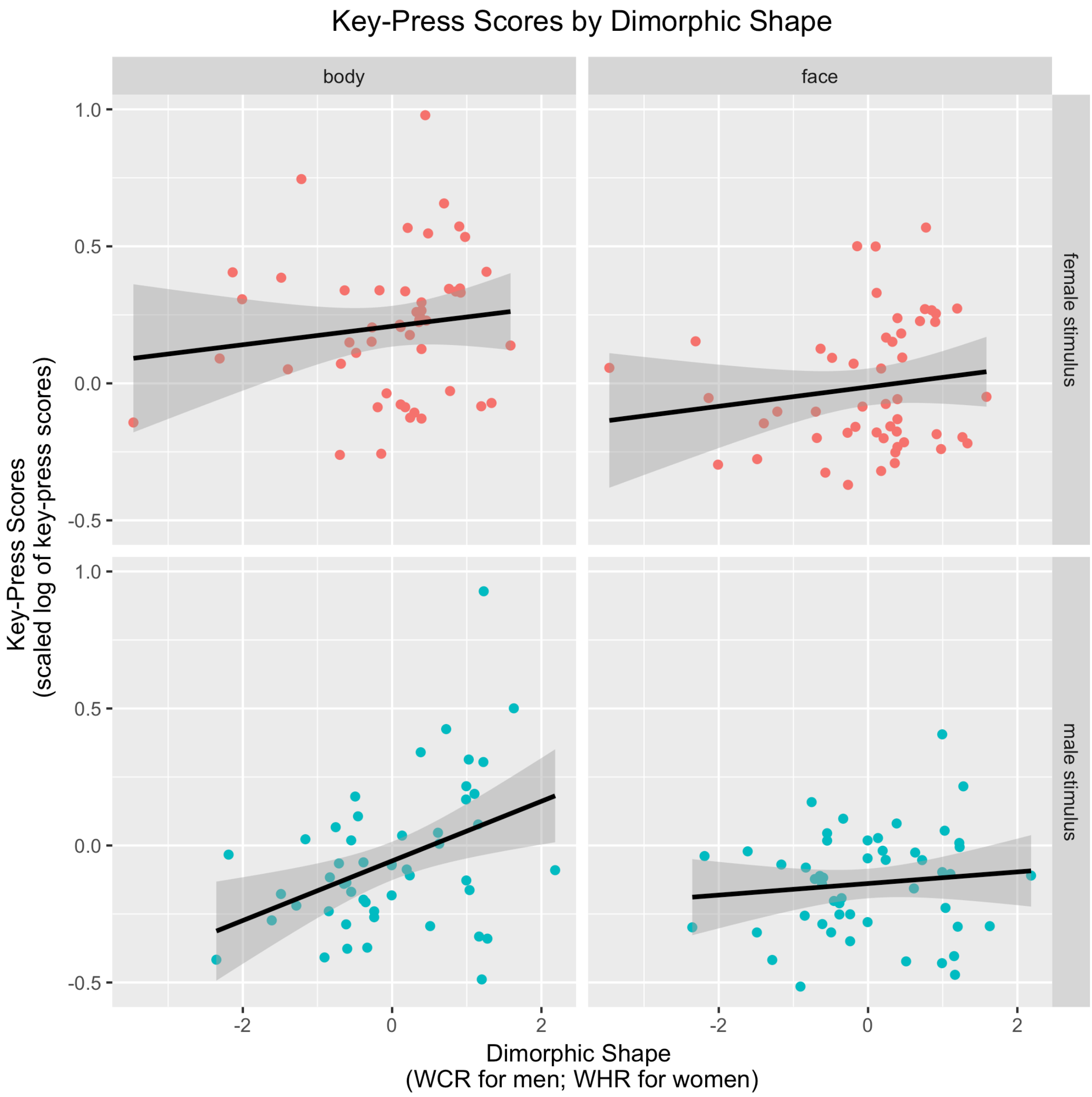

Figure 3.6. Key-Press Scores by Dimorphic Shape. There was a main effect of dimorphic shape (i.e., WCR for men and WHR for women), whereby key-press scores increased as dimorphic shape increased. This effect was qualified by stimulus type, whereby the effect of dimorphic shape was greater for body stimuli than for face stimuli. The three-way interaction among stimulus sex, stimulus type, and dimorphic shape indicated that the effect of dimorphic shape was greater for male body stimuli.

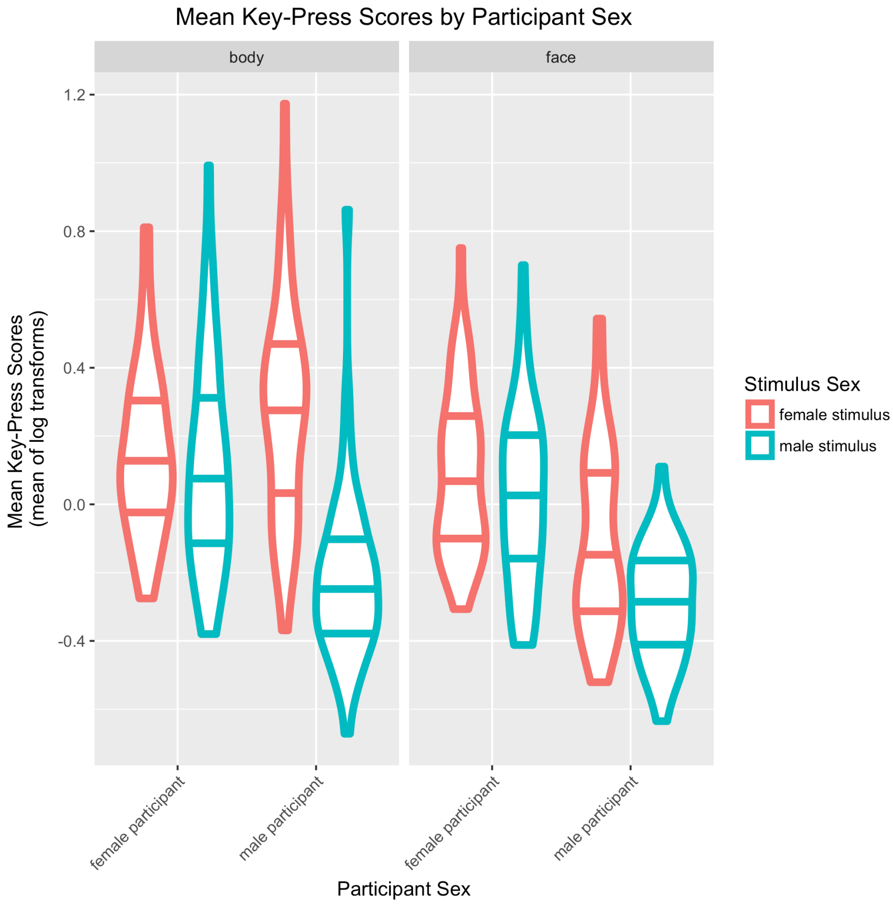

Figure 3.7. Mean Key-Press Scores by Participant Sex Split by Stimulus Sex and Stimulus Type. The violin plot displays the entire distribution of data. Broader sections of each shape indicate that a higher number of participants had key-press scores at the corresponding value. For example, few male participants had key-press scores over 0.2 for male body stimuli while the majority of participants had key-press scores from -0.6 to 0.0. Within each shape, the center line represents the mean and the two outer lines represent the inter-quartile range. There was a main effect of stimulus type, whereby body stimuli had higher key-press scores than face stimuli. This main effect of stimulus type was qualified by participant sex, whereby the effect was greater for male participants. There was also a main effect of stimulus sex, whereby female stimuli had higher key press scores than male stimuli. The effect of stimulus type was also qualified by stimulus sex, whereby key-press scores were higher for female and body stimuli. The interaction among stimulus sex, participant sex, and stimulus type indicated that key-press scores were highest for male participants viewing female body stimuli.

To investigate the main effects of stimulus sex and stimulus type, we ran another four models exploring whether motivational salience of individuals' faces and bodies were related to their ages, BMIs, BMI^2, and waist-to-hip ratios (WHR; if female) or waist-to-chest ratios (WCR; if male) for male face, female face, male body, and female body stimuli separately. The first model examined if male face stimuli key-press scores were predicted by participant sex, BMI, BMI^2, dimorphic shape, stimulus age, and their interactions. Random intercepts were specified for each stimulus and participant. Random slopes by stimulus were specified for participant sex. Random slopes by participant were specified by BMI, BMI^2, dimorphic shape, and stimulus age. The following three models examined the same relationships, but for female face, male body, and female body stimuli, respectively.

For male faces, the model neared being significantly better than the null model ($\chi^2(8) = 14.55$, $p = 0.068$). For female faces, the model was not significantly better than the null model ($\chi^2(8) = 4.18$, $p = 0.840$). For male bodies, the model was significantly better than the null model ($\chi^2(8) = 19.02$, $p = 0.015$). For female bodies, the model was not significantly better than the null model ($\chi^2(8) = 7.46$, $p = 0.488$).

Key-press scores for male body stimuli were significantly related to BMI^2 (beta = -0.081, $p = 0.03$), and dimorphic shape (i.e., WCR; beta = 0.116, $p = 0.004$). No other predictors were significant for male body stimuli. For male face stimuli, the effect of BMI was qualified by participant sex (beta = -0.071, $p = 0.021$), whereby the effect of key-press scores decreasing as BMI increased was greater for female participants. No other predictors were significant for male face stimuli. Key-press scores for female face stimuli and female body stimuli were not significantly related to any predictor. See Figure 3.8

below and Tables S6 - S9 in the Supplemental Materials for full statistics on these analyses.

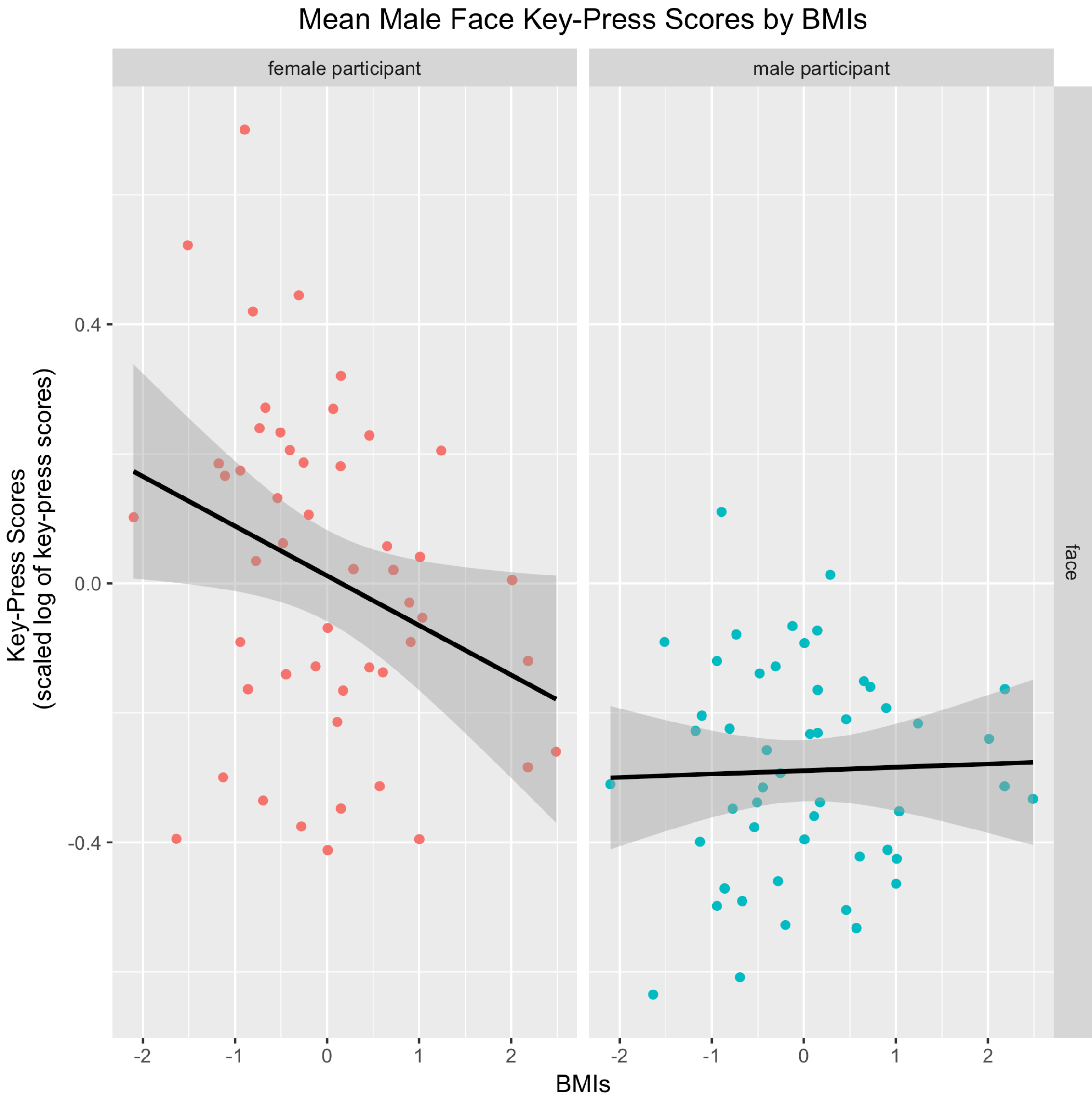

Figure 3.8. Male Face Key-Press Scores by BMIs for Male Face Stimuli. The effect of BMI was qualified by participant sex, whereby the effect of key-press scores decreasing as BMI increased was greater for female participants.

3.4 Discussion

Our first aim was to determine how the social perception components and participant sex related to the motivational salience of male face, female face, male body, and female body stimuli. For both male and female body stimuli, the Main PC positively and significantly predicted motivational salience. For male face stimuli, both the Valence PC and Dominance PC positively, significantly, and independently predicted motivational salience; this effect of the Dominance PC was qualified by participant sex, being greater for female than male participants. For female face stimuli, both the Valence PC and the Dominance PC positively, significantly, and independently predicted motivational salience, while the Geekiness PC negatively, significantly, and independently predicted motivational salience. Combined, the results show that every social perception PC significantly and independently predicted motivational salience of male faces, female faces, male bodies, and female bodies.

The findings that the Valence PCs and Dominance PCs for both male and female face stimuli significantly and independently predicted motivational salience replicates previous research (Wang et al., 2016). However, Wang and colleagues (2016) did not find that the effect of the Dominance PC on the motivational salience of male faces was qualified by participant sex. This interaction could suggest that dominance may be more important for women to assess from men's facial appearance. For instance, dominant male faces may pose more risk, but also more potential gain for women as opposed to less dominant male faces.

Our second aim was to determine the relationship between the motivational salience of corresponding face and body stimuli. Motivational salience of male body stimuli significantly and positively correlated with motivational salience of male face stimuli. Motivational salience of female body stimuli did not significantly correlate with motivational salience of female face stimuli. Just as our findings show mixed results regarding the correlation between motivational salience of corresponding faces and bodies, so does the literature. Certain studies find that attractiveness ratings of faces and bodies correlate (Fink et al., 2010; Sell et al., 2009; Thornhill & Grammer, 1999) and, therefore, suggest that faces and bodies represent one ornament of health and/or reproductive quality.

In contrast, Hönekopp and colleagues (2007) found that a composite measure of physical fitness only correlated with bodily attractiveness and not facial attractiveness, which opposes the one ornament theory. Peters, Rhodes, and Simmons (2007) also purport that faces and bodies provide different information, as they found that face and body attractiveness made independent and significant contributions to overall attractiveness ratings. Furthermore, evidence supporting the multiple motives hypothesis suggests that various physical features within the face and body represent cues to youth, maturity, sociability, approachability, and social status (Cunningham et al., 1990). However, no one feature can represent multiple cues simultaneously. Therefore, these various physical features and the accompanying multiple messages combine to form overall attractiveness, which directly opposes the one-ornament literature.

Currie and Little (2009) also found that face and body attractiveness are more or less important depending on relationship type (i.e., long- or short-term), providing further evidence suggesting that face and body attractiveness may signal different information. For example, Currie and Little (2009) found that for men in particular, female body attractiveness was more important for short-term relationships. Interestingly, face and body attractiveness ratings of men were equally important across short- and long-term relationship contexts for women (Currie & Little, 2009). This evidence could suggest that men in particular gather different information from female faces and bodies.

Our third and final aim was to determine how motivational salience was related to stimulus type, stimulus sex, participant sex, and stimulus body measures (i.e., age, BMI, WHR, and WCR). For all stimuli combined in one analysis, stimulus sex significantly predicted motivational salience, whereby female stimuli had higher motivational salience. This effect of stimulus sex was qualified by participant sex, whereby female stimuli had higher motivational salience for male participants. Stimulus type also significantly predicted motivational salience of all combined stimuli, whereby body stimuli had higher motivational salience than face stimuli. This effect of stimulus type was qualified by participant sex, whereby the effect was greater for male participants. The main effect of stimulus type was also qualified by stimulus sex, whereby female and body stimuli possessed the most motivational salience. The interaction among participant sex, stimulus sex, and stimulus type indicated that female body stimuli possessed particularly strong motivational salience for male participants.

These results of stimulus sex, stimulus type, and the interaction between participant sex and stimulus sex are consistent with previous research. For example, Levy and colleagues (2008) found that female stimuli possess more motivational salience for men than male stimuli do for women. Additionally, Hahn, Xiao, Sprengelmeyer, and Perrett (2013) found that men exerted more effort than women did to view adult female faces. The significant result of stimulus type (i.e., bodies possess more motivational salience than faces) may result from the relative novelty of unadorned body images relative to face images.

The effect of BMI was qualified by stimulus type, whereby the relationship between BMI and motivational salience was more negative for face stimuli than body stimuli. BMI^2 significantly predicted motivational salience of combined stimuli, whereby motivational salience decreased as BMI^2 increased. This effect of BMI^2 was qualified by stimulus type, whereby the effect was greater for body stimuli. Dimorphic shape (e.g., femininity for female stimuli and masculinity for male stimuli) also significantly predicted motivational salience of all combined stimuli, whereby motivational salience increased as dimorphic shape increased. However, this effect of dimorphic shape was qualified by stimulus sex and stimulus type.

Therefore, we interpreted these interactions by performing the same body measures analyses separately for male faces, female faces, male bodies, and female bodies. No predictors were significant regarding motivational salience of female faces or bodies. For male face stimuli, the non-significant effect of BMI was qualified by participant sex, whereby the relationship between BMI and motivational salience was more negative for female participants. BMI^2 negatively and significantly predicted motivational salience for male body stimuli. Dimorphic shape (i.e., WCR) positively and significantly predicted motivational salience for male body stimuli. These separate analyses show that the aforementioned three-way interaction between dimorphic shape, stimulus sex, and stimulus type indicated that the main effect of dimorphic shape was present only for male body stimuli.

The finding that BMI^2 negatively and dimorphic shape positively predicted motivational salience for all combined stimuli as well as specifically male bodies aligns with the established concept that higher BMIs and less dimorphic shapes are perceived as less attractive (Coy et al., 2014; Furnham et al., 1997; Han et al., 2015; Henss, 1995; Singh, 1993a, 1993b; Singh, 1994; Streeter & McBurney, 2003; Tovée et al., 1999b; van Anders & Hampson, 2005). However, it is surprising that the current data do not replicate such findings for specifically female faces and bodies. Perhaps a stimulus set with a wider female BMI range would show a stronger relationship between BMI and motivational salience for female bodies.

The current chapter replicated the work of Wang, Hahn, DeBruine, and Jones (2016) with the finding that the Valence and Dominance PCs significantly and independently predicted motivational salience of male and female faces. Additionally, the present study went a step further to examine bodies with regards to social perception PCs and found that the single Main PC for both male and female bodies also significantly predicts motivational salience. Therefore, even though faces and bodies may be perceived along different dimensions, each of these dimensions is important for motivational salience. While the different dimensions of social perception, BMI^2, and dimorphic shape all relate to motivational salience, other variables may also be important. For instance, hormone levels of the perceiver could potentially affect the motivational salience of faces and bodies and could illuminate the relationships between social perception dimensions, body measures, and motivational salience even further.

This study examined the relationship between motivational salience and social perception components for faces and bodies, finding that each PC independently related to motivational salience. Previous work, though, suggests that hormones can also influence motivational salience of faces both independently and as they interact with social perception components (Hahn et al., 2015b; Wang et al., 2014). Therefore, Chapter 4 will investigate the relationship among motivational salience of bodies, social perception components, and hormones.

Chapter 4: Influence of hormones and social perception on motivational salience of bodies

Abstract

Motivational salience (i.e., how hard someone will work to continue viewing an image) is related to measures of valence, including attractiveness, cuteness, and neural correlates of reward sensitivity. The components summarizing social perception of faces (i.e., valence and dominance) and bodies (i.e., general social perception component) positively predict motivational salience of stimuli. Although only one component summarizes social perception of bodies, the component may be a proxy measure of valence and correlates strongly with attractiveness (PCA loadings: males = 0.948, females = 0.938). Previous studies of face images show that testosterone positively predicts motivational salience, especially for high-valence faces. In order to investigate the relationship among valence, hormones, and motivational salience of bodies, 121 female participants used a standard key-press task to control the viewing time of stimuli after providing saliva samples via passive drool. The motivational salience of all bodies was greater when testosterone was high and estradiol was low. The main social perception component positively predicted the motivational salience of both male and female bodies, although the effect was greater for male bodies. However, the main social perception component did not qualify any main effects, including the effect of testosterone.

4.1 Introduction

Faces are particularly important for social interaction and attractiveness in faces can be especially influential. For example, individuals with attractive faces are judged and treated more positively than their unattractive counterparts (Langlois et al., 2000). Furthermore, attractive faces and attractive stimuli in general are rewarding (Bzdok et al., 2011; Hahn & Perrett, 2014) and can modify activation in brain areas related to reward (Mende-Siedlecki et al., 2013). Even cute infant faces are more rewarding than less cute infant faces. For example, compared to viewing low-cuteness manipulations, viewing high-cuteness manipulations of infant faces led to an increase in brain activity specifically in areas associated with reward (Bzdok et al., 2011; Glocker et al., 2009; Mende-Siedlecki et al., 2013). Using both attractiveness ratings and a key-press task that allowed participants to control the viewing time of each face, researchers found that participants liked and wanted cute infant faces more than less cute infant faces (Parsons, Young, Kumari, Stein, & Kringelbach, 2011; R. Sprengelmeyer, Lewis, Hahn, & Perrett, 2013).

Many researchers have used key-press tasks in which participants can choose to continue or stop viewing an image (Aharon et al., 2001; Hahn et al., 2014; Hahn et al., 2016; Levy et al., 2008; Wang et al., 2014) in order to demonstrate that individuals will expend more effort to continue looking at attractive faces rather than unattractive faces. This willingness to exert effort in order to continue viewing an image represents *motivational salience*. The positive relationship between attractiveness and motivational salience may be more pronounced for preferred-sex images, especially for men (Hahn et al., 2016; Levy et al., 2008). Hahn and colleagues (2016) additionally found that the motivational salience difference between preferred-sex and non-preferred-sex images is even stronger for attractive faces.

Hormone levels of the perceiver can also influence the motivational salience of stimuli. For example, two studies find a positive effect of testosterone on the motivational salience of adult and infant faces (Hahn et al., 2015b; Wang et al., 2014). Wang and colleagues (2014) found that adult faces had more motivational salience when women had higher levels of testosterone. Hahn and colleagues (2015b) also found this positive main effect of women's testosterone, but in the specific context of infant faces. Furthermore, the main effect of testosterone was greater for both physically attractive adult faces (Wang et al., 2014) and cute infant faces (Hahn et al., 2015b). Therefore, both studies suggest that the main effect of testosterone is greater for more motivationally salient faces. These findings complement research showing that an increase in testosterone leads to an increase in reward sensitivity (van Honk et al., 2004) and activation of reward areas of the brain (de Macks et al., 2011; Morris et al., 2015).

In addition to adult attractiveness and infant cuteness, motivational salience has been related to the social perception components of faces. Social perception is the creation of impressions based on perceivable cues and is an integral aspect of social interaction. Faces are particularly important regarding social perception with individuals ascertaining age, gender, emotion, and health (Belin et al., 2011; Hill et al., 1995; Massaro & Egan, 1996; Tovée et al., 2012) as well as forming trait attributions (Berry & McArthur, 1986; Penton-Voak et al., 2006; Todorov et al., 2008; Tsankova et al., 2012) within 100ms (Willis & Todorov, 2006) based on facial features. Oosterhof and Todorov (2008) examined facial social perception by asking participants to first freely describe faces.

These free descriptions were then grouped into 13 traits and the faces were rated accordingly. Analyses on these ratings of 13 traits then showed that social perception of faces could be summarized by the two components of valence (i.e., intent to cause harm) and dominance (i.e., ability to cause harm). Wang and colleagues (2016) later replicated that the social perception of faces could be summarized by the two principal components of valence and dominance. Additionally, they found that both valence and dominance independently and positively predicted the motivational salience of faces (Wang et al., 2016). Therefore, motivational salience may rely on more than simple attractiveness.

Although much research has investigated various influences on the motivational salience of faces, the same has not yet been investigated for bodies. Therefore, the current study examines the relationship among hormones of perceivers, the general social perception component of bodies, and the motivational salience of bodies. We examine the relationships between the motivational salience of bodies and women's testosterone, progesterone, estradiol, and estradiol-to-progesterone ratio and whether any of these potential relationships are qualified by the sex of the bodies or the general social perception component of the bodies. Following previous studies of hormones and the motivational salience of faces (Hahn et al., 2015b; Wang et al., 2014), we expect (1) that the motivational salience of bodies will be greater when testosterone is high and (2) that this main effect of testosterone will be qualified by the general social perception component for bodies, whereby the effect of testosterone will be greater as the social perception component increases.

4.2 Method

4.2.1 Stimuli

Stimuli were created from images of 50 white men and 50 white women between the ages of 19 and 30 years. These images and associated data were sourced from 3d.sk, a website that provides high-quality body images for 3D gaming development and other uses. All individuals gave their consent for their images to be used commercially and publicly. See Supplemental Materials Table S1 for age, height, weight, BMI, chest circumference, waist circumference, and hip circumference for each person.

Body images were taken against neutral backgrounds and individuals posed directly facing the camera with their legs shoulder width apart and arms at 45-degree-angles. Bodies were sized relative to actual height (1000px/m), the background was deleted, and placed on an 1800x2400 pixel neutral background. Faces and genitals were obscured with grey circles in order to mitigate potential rating confounds and for ethical reasons, respectively. Using Graphic Converter 9, tattoos, belly-button rings, and/or bracelets were removed from 21 body images. Body images were displayed at a size of 300x400 pixels (166.7px/m).

Stimuli were identical to the body stimuli used in the first and second empirical chapters (i.e., Chapters 2 and 3). See Chapter 2, Figure 2.2 for the average of all male and female body stimuli.

4.2.2 Participants

Participants were 154 women. Fifteen individuals who did not identify as heterosexual were excluded (0 homosexual; 14 bisexual; 0 asexual; 1 did not provide her sexual orientation). Individuals who did not make any responses during the task were also excluded (3). Those who did not provide hormone data or whose hormones were below the assay sensitivity level (13) were excluded, as well as those who only completed one session (2). The final sample included 121 women aged 17.8 to 34.4 years (mean = 21.418, SD = 3.361).

4.2.3 Procedure

Matching the procedure from Hahn et al. (2015b), each participant completed five weekly test sessions, during which they provided a saliva sample via passive drool (Papacosta & Nassis, 2011). Every test session occurred at the same time of day in order to control for potential effects of diurnal hormone level changes (Bao et al., 2003; Veldhuis et al., 1988). The experiment followed British Psychological Society (BPS) ethical guidelines and was approved by the University of Glasgow School of Psychology ethics committee.

4.2.3.1 Key-Pressing Task

The participants completed the same standard key-press task as in Chapter 3, which assesses motivational salience of stimuli (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016). For the key-press task, participants decreased or increased the viewing duration of each stimulus by pressing specified keyboard keys after initiating the trial by pressing the space bar. Each key press increased or decreased the viewing time by 100ms. Participants completed a block of practice trials before beginning the experimental trials. Stimuli were shown in two separate conditions (male bodies and female bodies). The order of conditions was randomized for each participant and trial order was randomized for each condition for each participant. The key-press tasks were run in-lab at the University of Glasgow's Institute of Neuroscience and Psychology.

Following previous studies (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016) and Chapter 3, we subtracted the number of key presses made to decrease viewing time from those made to increase viewing time in order to calculate the key-press scores for each trial. Higher key-press scores indicate higher motivational salience (Aharon et al., 2001; Elman et al., 2005; Hahn et al., 2015a, 2016; Hahn et al., 2013; Levy et al., 2008; Wang et al., 2016). Because the key-press scores were right-skewed, we log transformed the result after adding an optimal constant to make all values positive and then scaled the scores.

4.2.3.2 Social Perception Components

Principal Component (PC) scores were taken from Chapter 2 and followed the same procedure as Oosterhof and Todorov (2008). The PC scores were calculated using trait ratings of the same body stimuli used here. Each stimulus was rated by at least 10 men and 10 women on 13 traits (i.e., aggressiveness, attractiveness, caringness, confidence, dominance, emotional stability, intelligence, meanness, responsibility, sociability, trustworthiness, happiness, and weirdness). Participants were asked to "Please rate how [trait] this [face/body] is on a scale from 1 (much less [trait] than average) to 7 (much more [trait] than average)." The image remained onscreen during the rating. Trial order was randomized for each participant and trials were self-paced.

Ratings of male and female body stimuli each produced a first PC that correlated strongly with traits related to both valence and dominance (labeled 'Main PC' in earlier chapters and referred to here as 'general social perception component') and a second PC that mainly correlated with traits that had low (alpha < .70) inter-participant reliability (labeled 'unreliable PC'). However, these second PCs disappeared in a subsequent principal component analysis that removed the low-reliability traits. For all hormone analyses, only the data from the second, more stringent principal component analysis in Chapter 2 (i.e., one PC for bodies) will be used.

4.2.3.3 Hormone Measurements

Matching the procedure from Hahn et al. (2015b), saliva samples were collected via passive drool (Papacosta & Nassis, 2011), meaning that participants directed their spit into a test tube to later be analyzed for exact hormone levels. Saliva samples were immediately frozen and stored at -32°C until they were shipped to the Salimetrics Lab (Suffolk, UK) for analysis. Samples were tested by Salimetrics using the Salivary 17β-Estradiol Enzyme Immunoassay Kit 1-3702 (mean = 2.797 pg/mL, SD = 1.013 pg/mL), Salivary Progesterone Enzyme Immunoassay Kit 1-1502 (mean = 157.453 pg/mL, SD = 110.442 pg/mL), and Salivary Testosterone Enzyme Immunoassay Kit 1-2402 (mean = 86.409 pg/mL, SD = 29.125 pg/mL). We also calculated the estradiol-to-progesterone (e-to-p) ratio (mean = 0.026 pg/mL, SD = 0.018 pg/mL) from the estradiol and progesterone data. All assays passed Salimetrics' quality control. Data for which hormone levels were more than 3 standard deviations from the mean or below testing level were excluded from analyses. Hormone values were centered on their subject-specific means in order to focus on within-subject changes and scaled to similar ranges (i.e., progesterone divided by 400, estradiol divided by 5, testosterone divided by 100, and estradiol-to-progesterone ratio divided by 0.075) following Jones and colleagues (2017). Therefore, the distributions for each hormone mainly varied from -0.5 to 0.5, which better enabled calculations within the various linear mixed models.

4.3 Results

4.3.1 Hormone Predictors of Motivational Salience

We used a linear mixed model to investigate whether motivational salience (i.e., key-press score) was related to each hormone (i.e., progesterone, estradiol, testosterone, and estradiol-to-progesterone ratio) and whether these potential effects were qualified by stimulus sex and the general social perception component. The dependent variable was the log-transformed and scaled key-press score. The predictor variables were stimulus sex (effect-coded: male = -0.5, female = +0.5), the general social perception component from Chapter 2 and subject-mean-centered and scaled progesterone, estradiol, testosterone, and the estradiol-to-progesterone ratio. This analysis follows our pre-registered analysis plan (Morrison, Jones, & DeBruine, 2015, September 21a) with two exceptions: we centered hormones on subject-specific means instead of on grand means and log-transformed key press scores to mitigate skew.

Following recommendations from Barr, Levy, Scheepers, and Tily (2013), we analyzed maximal models by including random intercepts and slopes. Random effects were maximally specified. Random intercepts were specified for each participant, stimulus, and participant session. Random slopes by participant were specified for the interaction among each hormone, stimulus sex, and social perception component. Random slopes by stimulus were specified for each hormone. Random slopes by participant session were specified for the interaction between stimulus sex and social perception component. For all stimuli, the model was significantly better than the null model ($\chi^2(19) = 330.62$, $p < 0.001$).

Key-press scores were positively and significantly related to testosterone (beta = 0.223, p = 0.013). Key-press scores were negatively and significantly related to estradiol (beta = -0.292, p = 0.022). Key-press scores were positively but non-significantly related to progesterone (beta = 0.201, p = 0.063) and unrelated to estradiol-to-progesterone ratio (beta = 0.062, p = 0.589). There was also a significant main effect of stimulus sex (beta = -0.101, p = < .001), whereby male stimuli had higher key-press scores than female stimuli. Additionally, there was a positive main effect of the social perception PC (beta = 0.230, p = < .001).

This main effect of the social perception PC was qualified by stimulus sex (beta = -0.106, p = < .001), whereby the effect was greater for male stimuli. We did not replicate the finding from previous research that a measure of valence (e.g., attractiveness (Wang et al., 2014) or cuteness (Hahn et al., 2015b)) qualified the main effect of testosterone (beta = 0.001, p = 0.965). The social perception PC also did not qualify any other effects of hormones.

Stimulus sex qualified the main effects of two hormones: estradiol (beta = 0.188, p = < .001), and estradiol-to-progesterone ratio (beta = -0.087, p = 0.048). The social perception PC did not qualify any of the interactions between hormones and stimulus sex. See Table 4.1 and Figures 4.1 - 4.4 for full statistics on these analyses.

Table 4.1. Hormones and Social Perception PC Key-Press Regression Output for All Stimuli. Regression output for the key-press scores of all stimuli with regards to hormones and the social perception component.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.041	0.055	122.998	-0.746	0.457
Stimulus Sex	-0.101	0.014	99.142	-7.372	< .001
Social Perception PC	0.230	0.007	99.065	33.456	< .001
Estradiol	-0.292	0.127	517.500	-2.290	0.022
Progesterone	0.201	0.108	515.259	1.862	0.063
Testosterone	0.223	0.090	514.037	2.487	0.013
E-to-P Ratio	0.062	0.115	514.591	0.540	0.589
Social Perception PC x Stimulus Sex	-0.106	0.016	155.565	-6.827	< .001
Estradiol x Stimulus Sex	0.188	0.048	61948.448	3.890	< .001
Progesterone x Stimulus Sex	0.056	0.041	61943.789	1.363	0.173
Testosterone x Stimulus Sex	0.017	0.034	61961.064	0.489	0.625
E-to-P Ratio x Stimulus Sex	-0.087	0.044	61963.685	-1.980	0.048
Estradiol x Social Perception PC	0.046	0.024	62051.638	1.903	0.057
Progesterone x Social Perception PC	-0.002	0.021	62019.259	-0.117	0.907
Testosterone x Social Perception PC	0.001	0.017	62119.839	0.043	0.965
E-to-P Ratio x Social Perception PC	0.006	0.022	62143.156	0.290	0.772
Progesterone x Social Perception PC x Stimulus Sex	0.042	0.068	633.626	0.615	0.539
Estradiol x Social Perception PC x Stimulus Sex	-0.042	0.080	633.983	-0.522	0.602
Testosterone x Social Perception PC x Stimulus Sex	-0.088	0.056	634.804	-1.554	0.121
E-to-P Ratio x Social Perception PC x Stimulus Sex	-0.054	0.072	635.101	-0.756	0.450

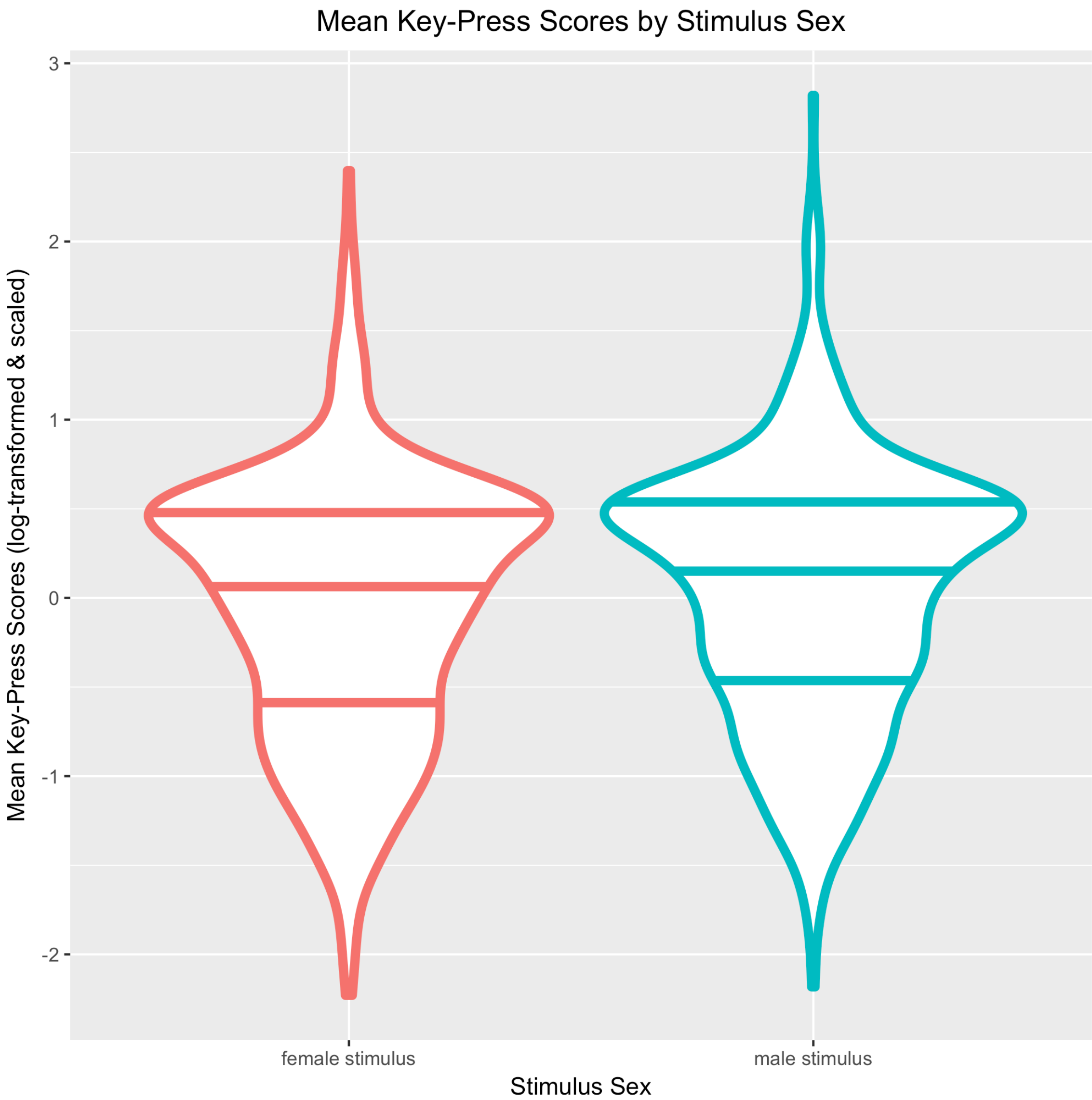

Figure 4.1. Mean Key-Press Scores by Stimulus Sex. There was a main effect of stimulus sex, whereby male stimuli had higher key-press scores. The violin plot displays the entire distribution of data. Broader sections of each shape indicate that a higher number of stimuli had key-press scores at the corresponding value. For example, few male stimuli had key-press scores over 1.5 while the majority of male stimuli had key-press scores from -1.5 to 1.0. Within each shape, the center line represents the mean and the two outer lines represent the inter-quartile range.

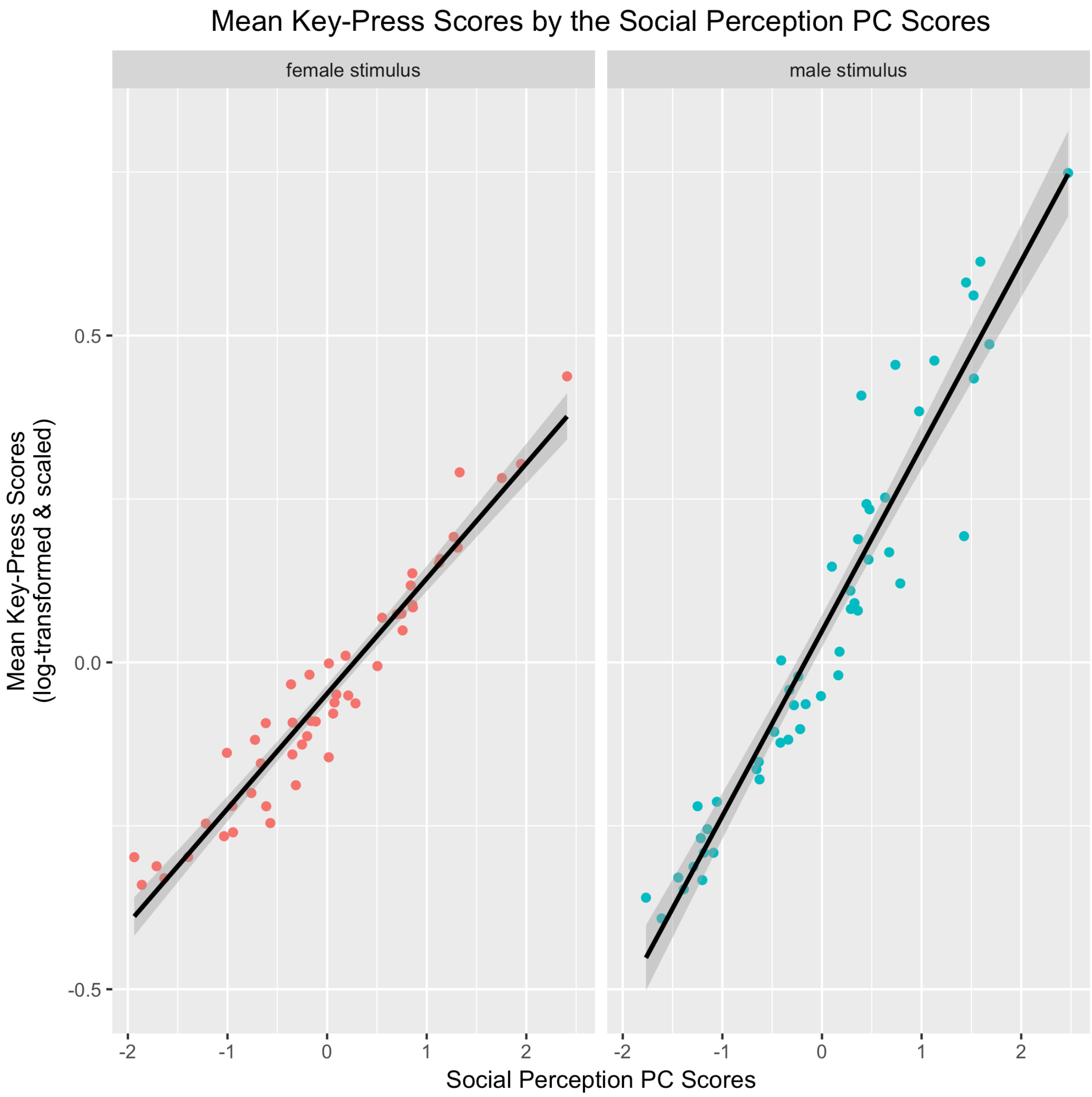

Figure 4.2. Mean Key-Press Scores by the Social Perception PC Scores. Stimulus sex qualified the main effect of the social perception PC, whereby the effect was greater for male stimuli.

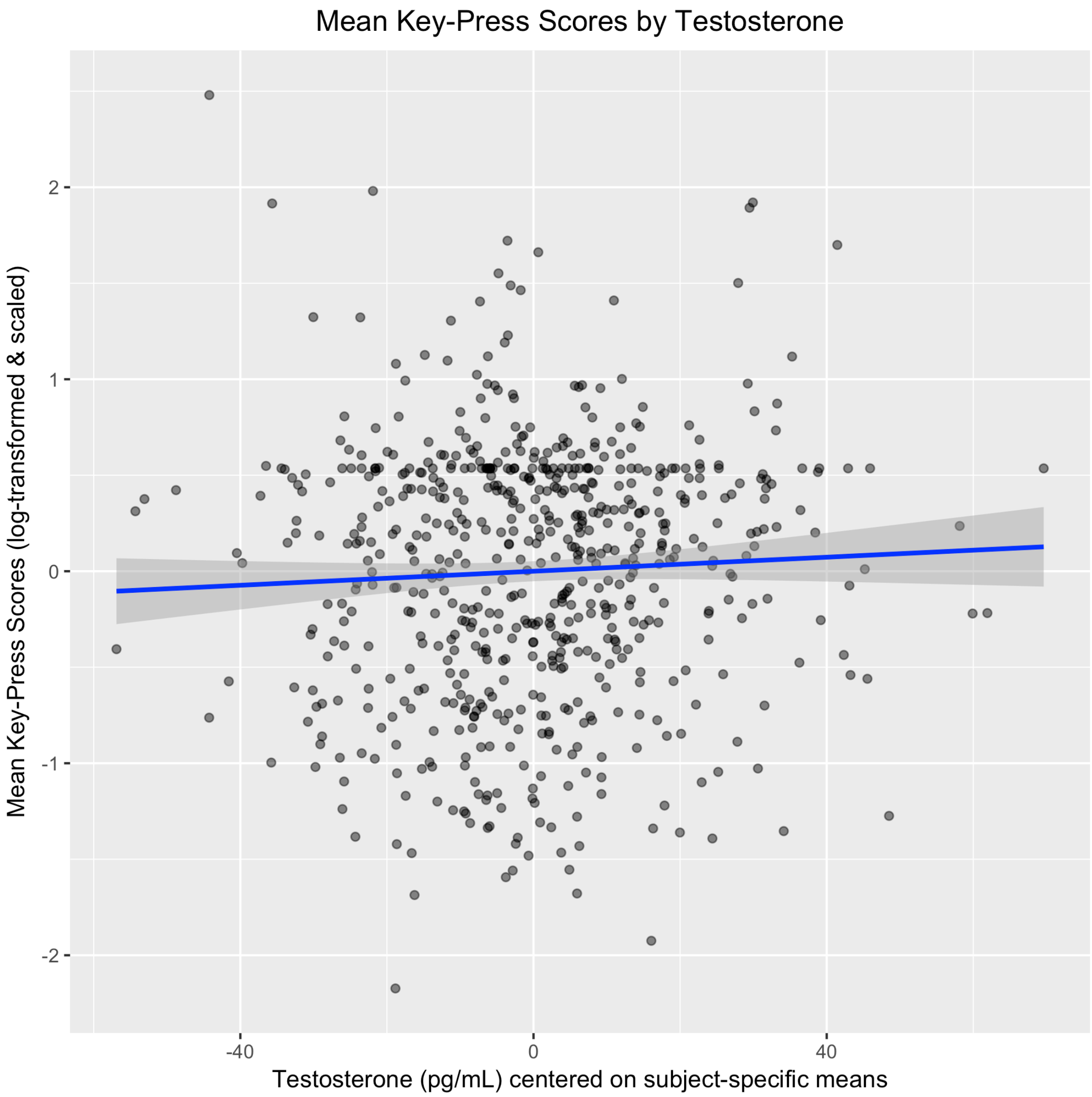

Figure 4.3. Mean Key-Press Scores by Testosterone. There was a positive main effect of testosterone on key-press scores for all stimuli.

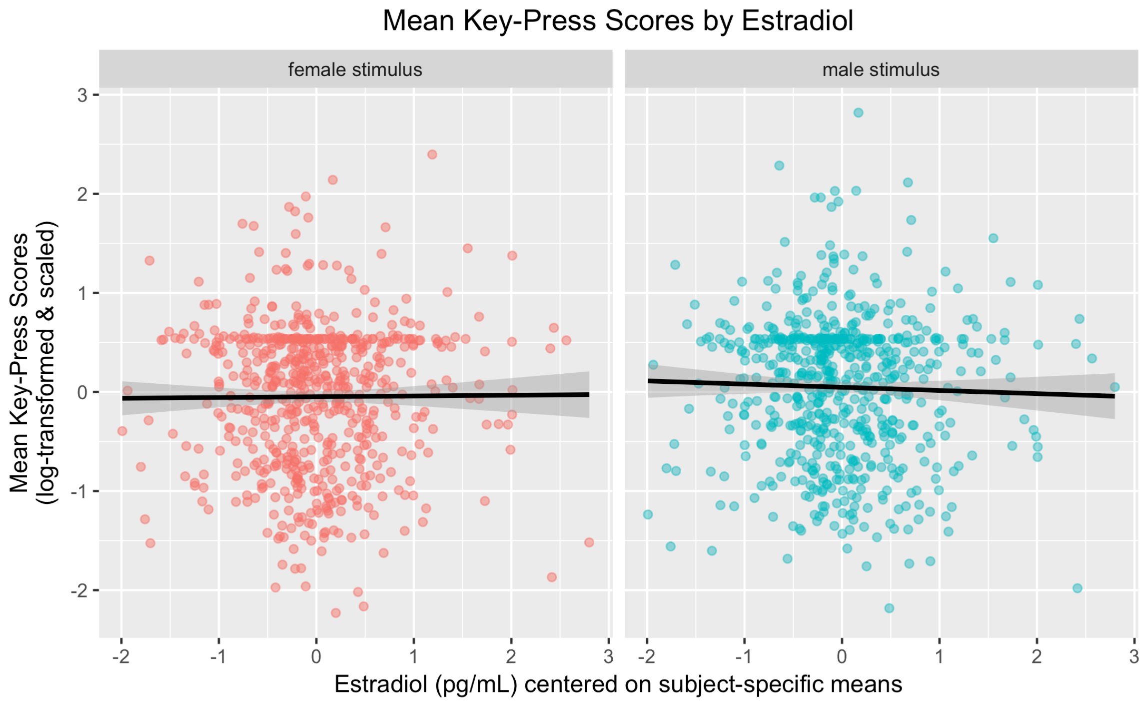

Figure 4.4. Mean Key-Press Scores by Estradiol Split by Stimulus Sex. The main effect of estradiol was qualified by stimulus sex, whereby the effect was significant only for male stimuli.

To explore the interactions between stimulus sex and the social perception PC, estradiol, and estradiol-to-progesterone ratio, we ran the same model above for male and female stimuli separately. For male stimuli, the model was significantly better than the null model ($\chi^2(9) = 129.91$, $p < 0.001$). For female stimuli, the model was significantly better than the null model ($\chi^2(9) = 141.02$, $p < 0.01$).

The social perception PC predicted key-press scores positively for both male and female stimuli, but the effect was larger for male stimuli (beta = 0.284, p = < .001) than for female stimuli (beta = 0.177, p = < .001). Progesterone did not significantly predict key-press scores for male or female stimuli (male: beta = 0.153, p = 0.212; female: beta = 0.228, p = 0.066). Estradiol predicted key-press scores negatively for male stimuli (beta = -0.404, p = 0.005), but not female stimuli (beta = -0.181, p = 0.218). Estradiol-to-progesterone ratio predicted key-press scores positively for male and female stimuli (male: beta = 0.079, p = 0.543; female: beta = 0.020, p = 0.881), but neither effect was significant although the effect was greater for male stimuli. Testosterone predicted key-press scores positively for both male and female stimuli (male: beta = 0.204, p = 0.044; female: beta = 0.236, p = 0.023). The social perception PC did not qualify any effects of hormone levels for male or female stimuli. See Tables 4.2 and 4.3 for full statistics on these analyses.

Table 4.2. Hormones and Social Perception PC Key-Press Regression Output for Male Stimuli. Regression output for the key-press scores of male stimuli with regards to hormones and the social perception component.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	0.008	0.059	127.399	0.139	0.890
Social Perception PC	0.284	0.017	163.280	16.917	< .001
Estradiol	-0.404	0.144	513.802	-2.795	0.005
Progesterone	0.153	0.122	511.416	1.249	0.212
Testosterone	0.204	0.101	509.915	2.015	0.044
E-to-P Ratio	0.079	0.130	507.430	0.608	0.543
Estradiol x Social Perception PC	0.067	0.106	632.772	0.633	0.527
Progesterone x Social Perception PC	-0.022	0.090	632.772	-0.247	0.805
Testosterone x Social Perception PC	0.045	0.075	632.772	0.595	0.552
E-to-P Ratio x Social Perception PC	0.035	0.096	613.404	0.361	0.718

Table 4.3. Hormones and Social Perception PC Key-Press Regression Output for Female Stimuli. Regression output for the key-press scores of female stimuli with regards to hormones and the social perception component.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.088	0.058	123.235	-1.519	0.131
Social Perception PC	0.177	0.011	294.692	15.692	< .001
Estradiol	-0.181	0.146	516.187	-1.234	0.218
Progesterone	0.228	0.124	513.798	1.843	0.066
Testosterone	0.236	0.103	512.299	2.283	0.023
E-to-P Ratio	0.020	0.132	512.986	0.150	0.881
Estradiol x Social Perception PC	0.025	0.084	632.923	0.302	0.762
Progesterone x Social Perception PC	0.020	0.071	632.923	0.279	0.780
Testosterone x Social Perception PC	-0.042	0.060	632.923	-0.703	0.482
E-to-P Ratio x Social Perception PC	-0.019	0.076	608.521	-0.253	0.801

4.4 Discussion

Following previous research demonstrating a positive effect of testosterone on the motivational salience of adult (Wang et al., 2014) and infant (Hahn et al., 2015b) faces that was stronger for higher-valence faces, here we examined the relationships between the motivational salience of bodies and hormones (testosterone, estradiol, progesterone, and the estradiol-to-progesterone ratio) and whether any potential relationships were qualified by stimulus sex and a measure of stimulus valence (i.e., the general social perception component calculated in Chapter 2). We replicated the predicted main effect of testosterone, in which motivational salience of bodies was greater when testosterone was high.

In addition, motivational salience was greater when estradiol was low. This negative effect of estradiol, along with no evidence for a main effect of estradiol-to-progesterone ratio or interaction between the general social perception component and the estradiol-to-progesterone ratio, contradicts previous work finding that the main effect of the valence measure (i.e., facial attractiveness) was greater when women had high estradiol-to-progesterone ratios (Wang et al., 2014). The lack of interaction between the general social perception component and the estradiol-to-progesterone ratio represent the corresponding effect within our data. Rather than the combination of estradiol and progesterone interacting with valence to influence motivational salience, the current results found that motivational salience was greater when estradiol alone was low.

While we predicted that the main effect of testosterone would be qualified by the general social perception component for bodies, this interaction was not significant. The social perception component could represent a proxy measure of valence, as it is highly correlated with attractiveness ratings (PCA loadings: males = 0.948, females = 0.938; see Table S4). Therefore, this lack of significance fails to replicate previous research finding that the relationship between testosterone and motivational salience is particularly strong for attractive stimuli (Hahn et al., 2015b; Wang et al., 2014).

Additionally, male stimuli had higher motivational salience than female stimuli. This difference in motivational salience between male and female stimuli aligns with previous research showing that the effect of motivational salience is more pronounced for preferred-sex images (Hahn et al., 2016; Levy et al., 2008). All participants were heterosexual women, meaning that male stimuli represented their preferred sex. On the other hand, Chapter 3 found that female stimuli had higher motivational salience.

However, Chapter 3 and Chapter 4 may have found that female and male stimuli had higher motivational salience respectively because the preferred-sex effect on motivational salience may be greater for men than women with respect to bodies (Levy et al., 2008).

Stimulus sex qualified the effects of estradiol, the estradiol-to-progesterone ratio, and the general social perception component on motivational salience. Replicating previous work (Wang et al., 2016) and my Chapter 3 results, the social perception component positively predicted motivational salience for both male and female stimuli. However, the effect of the social perception component was larger for male stimuli. If the social perception component truly does represent a valence or attractiveness quality, the greater effect of the social perception component on male stimuli compared to female stimuli most likely reflects the increased motivational salience of preferred-sex images (Hahn et al., 2016; Levy et al., 2008). While motivational salience for both male and female stimuli was greater when estradiol was low, this was significant only for male stimuli. Separate analyses of male and female stimuli revealed non-significant but positive effects of estradiol-to-progesterone ratio that were larger for male than female stimuli.

The current work extended that of Wang, Hahn, DeBruine, and Jones (2016) and replicated Chapter 3 by finding that the general social perception component for bodies predicted motivational salience. Furthermore, we showed that motivational salience of bodies was greater when testosterone was high, providing evidence for our first hypothesis. However, we found no evidence for our second hypothesis that the general social perception component for bodies qualified the main effect of testosterone.

In terms of limitations and future directions, including male participants would provide a more comprehensive picture. For example, higher testosterone levels are related to increased reward sensitivity in healthy men (Morris et al., 2015). Morris and colleagues (2015) even suggest that their results support the idea that testosterone levels influence the neurotransmission of dopamine, which is related to reward. In general, testosterone can lead to increased reward sensitivity (van Honk et al., 2004) as well as higher activation of brain areas related to reward (de Macks et al., 2011; Morris et al., 2015). Therefore, while this and previous work (Hahn et al., 2015b; e.g., Wang et al., 2014) focus on female participants, it is an important future direction to examine how testosterone affects the relationship between motivational salience and social perception in both sexes.

Another limitation of our study is that nude bodies are relatively novel in Western society. Unadorned bodies are much less mundane than faces in Western society and many times viewed only in a specifically sexual context. Chapter 3 even found that bodies were more motivationally salient than faces, supporting the idea that bodies in general possess heighted motivational salience due to their novelty. Therefore, the interaction between the social perception component and testosterone (i.e., the main effect of testosterone being greater for highly motivationally salient faces) might not have arisen because all the stimuli were highly motivationally salient. In order for the interaction to arise, both low and high motivationally salient images must be included in the stimuli set. If participants found all unadorned bodies novel, then all stimuli would be highly motivationally salient. In order to test if the novelty of unadorned bodies caused all the stimuli to be highly motivationally salient, the same experiment should be replicated with clothed bodies or in a society in which nudity lacks novelty and narrow sexual connotations. Such a replication could potentially determine if our results were in part due to lack of exposure to stimuli, a focus on sexual content, or a combination thereof.

Overall, we found evidence supporting our first hypothesis that the motivational salience of bodies would be greater when testosterone was high. This replicates previous studies showing a main effect of testosterone with regards to motivational salience (Hahn et al., 2015b; Wang et al., 2014). However, we found no evidence supporting our second hypothesis that the main effect of testosterone would increase as the general social perception component and, thus, valence increased. This lack of interaction could be due to the high novelty of our stimuli. If all unadorned bodies are high in novelty and thus, high in valence, then no interaction between testosterone and the general social perception component could occur.

Chapter 5: General Discussion

Although the specific pattern of social perception for faces and voices has been established (McAleer et al., 2014; Oosterhof & Todorov, 2008), no one has yet examined the pattern of social perception for bodies. The pattern of social perception being organized into roughly orthogonal components of valence and dominance may be (1) a fundamental organizing principle of social perception, regardless of the social stimulus or (2) a pattern that is specific to face and voice perception, but does not necessarily generalize to all social stimuli. Given that bodies can provide cues to information that is important to social perception, such as strength, attractiveness, and dominance (Fink et al., 2007; Furnham et al., 1997; Han et al., 2015; Sell et al., 2009; Shoup & Gallup, 2008; Singh, 1993a, 1993b), bodies may follow a similar social perception pattern to faces and voices. My first empirical chapter addresses this gap by examining the specific social perception pattern of bodies.

In addition to social perception, the motivational salience of faces has been studied extensively (Hahn et al., 2014; Hahn et al., 2016; Levy et al., 2008; Wang et al., 2016, 2014), but not so for bodies. Moreover, the social perception components of valence and dominance have been shown to predict motivational salience of faces, indicating that these social perception components measure aspects of motivational salience (Wang et al., 2016). However, just as gaps exist in the literature regarding the social perception and motivational salience of bodies, a gap also exists examining the relationship between the two. Therefore, my second empirical chapter extended the first by examining the relationship between motivational salience and social perception of bodies.

Researchers have also examined how hormones of perceivers can influence the motivational salience of faces (Hahn et al., 2015b; Wang et al., 2014). Again, though, the same can not be said for bodies. In particular, the motivational salience of both adult and infant faces were higher when women had higher levels of testosterone, suggesting that testosterone and motivational salience are related across a range of social stimuli (Hahn et al., 2015b; Wang et al., 2014). As such, my third empirical chapter extended the first two by investigating how hormones of perceivers and social perception can influence the motivational salience of bodies.

5.1 Findings and consistency with literature

5.1.1 Social perception

The first empirical chapter investigated if the social perception of bodies followed the same pattern as that of faces and voices. Following the methods first described by Oosterhof and Todorov (2008), I determined inter-rater reliability for all the trait ratings across male faces, female faces, male bodies, and female bodies. With only six exceptions (i.e., male bodies: trustworthy and weird; female bodies: aggressive, intelligent, mean, and trustworthy), trait ratings showed strong inter-rater reliability (alpha > 0.7).

Next, I investigated the specific social perception patterns of faces and bodies. I replicated previous research (McAleer et al., 2014; Oosterhof & Todorov, 2008; Sutherland et al., 2013) showing that social perception of faces could essentially be summarized by two principal components of valence (i.e., intent to cause harm) and dominance (i.e., ability to cause harm). These trait loadings for the two principal components of male and female faces were extremely similar, indicating that the same pattern of social perception applies regardless of the face's sex.

However, I also found a third principal component for female faces that moderately loads onto the traits unattractive, intelligent, responsible, unsociable, and untrustworthy. Therefore, the third principal component for female faces represents a social perception component best described as 'geekiness.' While Oosterhof and Todorov (2008) also found a third component, it explained less than six percent of the variance whereas my third component for female faces explains eight percent of the variance. Although the difference in explanation of variance between the third components found by Oosterhof and Todorov (2008) and myself is minimal (i.e., explains 6 versus 8 percent of variance), Oosterhof and Todorov (2008) state that their third component lacked clear interpretation. However, I find a clear 'geekiness' interpretation for my third component for female faces.

Although the pattern of social perception of faces summarized by valence and dominance replicated, this pattern was not apparent for social perception of bodies. First, when including the trait ratings with low inter-rater reliability, male and female body perception each produced two principal components. However, for both male and female bodies, most traits loaded strongly onto the first principal component, while the second principal component loaded most strongly onto the traits with low inter-rater reliability.

A second analysis excluding the traits with low inter-rater reliability produced only one principal component for male and female bodies. In this second analysis, all traits loaded strongly onto the single body component. Therefore, this component may not necessarily represent only valence or dominance or even a combination of the two. Instead, this one principal component for bodies may represent an entirely distinct concept. Either way, the finding that social perception of bodies follows a different pattern than faces and voices evidences that social perception as a whole is not always organized by the two components of valence and dominance.

5.1.2 Motivational salience

After establishing the pattern of social perception for faces and bodies, I focused on the motivational salience of faces and bodies in Chapter 3. More specifically, I first determined the relationship among motivational salience, stimulus type, stimulus sex, participant sex, and stimulus body measures. In Chapter 4, I also tested the motivational salience of male and female bodies to female observers to assess potential effects of hormones on motivational salience.

In Chapter 3, I found that female stimuli had higher motivational salience, particularly to male participants. This finding could also be thought of as male stimuli having particularly low motivational salience to male participants. In Chapter 4, I found that male stimuli (i.e., male bodies) had higher motivational salience than female stimuli (to female participants). Since heterosexual men found female stimuli more motivationally salient in Chapter 3 and heterosexual women found male stimuli more motivationally salient in Chapter 4, the results from both Chapters 3 and 4 replicate previous work showing that motivational salience is higher for images of the preferred-sex (Hahn et al., 2016; Levy et al., 2008).

However, Chapter 3 also showed that female participants found female stimuli slightly more motivating than male stimuli with regards to both faces and bodies. Chapter 3's results contradict the finding in Chapter 4 that female participants found male stimuli more motivating than female stimuli. Yet, both chapters replicate previous findings. Chapter 3 replicates that women found both male and female attractive faces motivationally salient (Hahn et al., 2013; Levy et al., 2008) while Chapter 4 replicates that preferred-sex images are more motivationally salient (Hahn et al., 2016; Levy et al., 2008). Perhaps unadorned female bodies are more motivationally salient to men than unadorned male bodies are to women, as is suggested by Chapter 3 results and previous research (Levy et al., 2008). Regardless, this presence of contradictory findings across multiple papers suggests that more research is necessary, especially given the small differences between motivational salience of stimuli for female participants.

In Chapter 3, body stimuli also were more motivationally salient than face stimuli, potentially because of their novelty. This effect of body stimuli possessing more motivational salience was also greater for male participants. Additionally, the interactions among stimulus type, stimulus sex, and participant sex indicate that female body stimuli possessed the strongest motivational salience, particularly for male participants.

The results regarding stimulus sex, stimulus type, and participant sex replicate previous research showing that preferred-sex stimuli possess more motivational salience. For example, men will expend more effort than women to view adult female faces (Hahn et al., 2013). Furthermore, this preferred-sex effect may be stronger for men, as female stimuli possessed higher levels of motivational salience for men than male stimuli did for women (Levy et al., 2008). Additionally, the lack of exposure to unadorned bodies may lead to bodies having more novelty and, thus, more motivational salience than faces.

5.1.2.1 Relationship between social perception and motivational salience

The second empirical chapter (i.e., Chapter 3) extended the work of Wang, Hahn, DeBruine, and Jones (2016) as well as Chapter 2 by investigating the relationship between motivational salience and social perception of bodies and faces. Specifically, I examined the relationship among each social perception component, participant sex, and motivational salience of male faces, female faces, male bodies, and female bodies. For both male and female faces, the social perception components of valence and dominance independently and positively predicted motivational salience. For male faces, this effect of dominance was greater for female participants. For female faces, the third 'geekiness' component negatively predicted motivational salience. For both male and female bodies, the single social perception component positively predicted motivational salience. Therefore, each social perception component predicted motivational salience for male faces, female faces, male bodies, and female bodies.

Chapter 4 and Chapter 3's findings are consistent in that the general social perception component for bodies predicted motivational salience. Furthermore, the interaction between the general social perception component for bodies, a potential proxy measure of valence, and stimulus sex showed that female participants (only female participants were tested in Chapter 4) found male stimuli (i.e., the preferred-sex stimuli) more motivationally salient, replicating previously mentioned work regarding increased motivational salience for preferred-sex images (Hahn et al., 2016; Levy et al., 2008). When examining male and female stimuli separately in Chapter 4, I found again that the general social perception component positively predicted motivational salience for both male and female stimuli and that this effect was greater for male stimuli.

Overall, I replicated the finding of Wang and colleagues (2016) that valence and dominance significantly predict motivational salience while also showing that the social perception component for bodies predicts motivational salience. However, in contrast to Wang and colleagues (2016), I found that the effect of dominance of male faces was larger for female observers than for male observers. This interaction could indicate that dominance may be more important for women to ascertain from male faces due to the possibility that dominant male faces may represent higher risk and/or danger.

5.1.2.2 Relationship between hormones and motivational salience

The third empirical chapter (i.e., Chapter 4) extended previous published work (Hahn et al., 2015b; Wang et al., 2016, 2014) as well as my previous empirical chapters by investigating the relationship among hormones, motivational salience, and social perception. Specifically, I examined the relationship among motivational salience of bodies, social perception of bodies, and perceiver levels of testosterone, progesterone, estradiol, and the estradiol-to-progesterone (e-to-p) ratio.

Motivational salience of bodies was greater when testosterone was high, which echoes previous work using adult and infant face stimuli (Hahn et al., 2015b; Wang et al., 2014). These results add to existing literature regarding testosterone and reward by consistently showing that increased testosterone levels are associated with an overall increase in motivational salience for adult faces, infant faces, and adult bodies. Additionally, increased testosterone levels are directly related to increased reward sensitivity (Morris et al., 2015; van Honk et al., 2004). Testosterone can also heighten activation of reward-related areas of the brain (de Macks et al., 2011) and influence the transmission of the reward-related neurotransmitter dopamine (Morris et al., 2015).

Motivational salience of bodies was also greater when estradiol was low. This negative effect of estradiol, no significant effect of the e-to-p ratio, and no interaction between the e-to-p ratio and general social perception component (i.e., a proxy measure of valence) contradict Wang and colleagues' (2014) finding that the positive main effect of facial attractiveness (i.e., a measure of valence) on motivational salience was greater when women had higher e-to-p ratios. However, my results find no effect of the e-to-p ratio and that motivational salience was greater when estradiol alone was low.

Contrary to previous research finding that the effect of testosterone was greater for stimuli with higher valence, the main effect of testosterone was not qualified by the general social perception component. For my data, the general social perception component for bodies may represent a proxy measure of valence because of its high correlation with attractiveness (loadings: males = 0.948, females = 0.938; see Table S4). Therefore, the data from Chapter 4 do not replicate previous findings showing that the main effect of testosterone is greater for attractive or high valence stimuli. However, this may be an artifact of the high novelty and generally high valence of unclothed body stimuli.

5.1.3 Lack of replication for one ornament of mate quality

In Chapter 2, I investigated the relationship between trait ratings of corresponding faces and bodies. Only confidence and dominance for male faces and bodies significantly correlated. No trait ratings for female faces and bodies significantly correlated. In

Chapter 3, I determined the relationship between motivational salience of corresponding faces and bodies. While motivational salience of male faces and bodies significantly correlated (r = 0.298), motivational salience of female faces and bodies did not (r = -0.120). The findings of Chapter 3 are consistent with the findings of Chapter 2 in that correlations between face and body were only found for male stimuli, not female stimuli.

These findings from Chapters 2 and 3 do not align with any of the one-ornament literature in which faces and bodies are purported to represent one ornament of health or mate quality (Fink et al., 2010; reviewed in Hahn & Perrett, 2014; Henss, 1995; Hönekopp et al., 2007; Sell et al., 2009; Shackelford & Larsen, 1999; Thornhill & Grammer, 1999; Zebrowitz & Montepare, 2006; Zebrowitz et al., 2003). Such studies use ratings of facial and bodily attractiveness in conjunction with perceived and actual health, BMI, and waist-to-hip ratio (WHR) to suggest that facial and bodily attractiveness represent one ornament of health and/or mate quality.

For example, Thornhill and Grammer (Thornhill & Grammer, 1999) found that BMI negatively correlated with both facial and bodily attractiveness. Andrews and colleagues (2017) found that cues of reproductive value mainly explained ratings of women's bodily attractiveness. However, in addition to only examining bodily and not facial attractiveness, Andrews and colleagues (2017) measured reproductive value by estimates of age and number of offspring. Other studies found that facial attractiveness was associated with physical health (Shackelford & Larsen, 1999) and longevity (Henderson & Anglin, 2003). While these studies often use a considerable number of participants and stimuli, health is sometimes measured in various and potentially erroneous ways, including daily symptom reports (Shackelford & Larsen, 1999) and simple length of life

(Henderson & Anglin, 2003), which may obscure long-term issues and overall quality of health. Furthermore, I did not even find evidence in Chapter 2 that facial and bodily attractiveness correlated, as has been found by others (Fink et al., 2010; Hönekopp et al., 2007; Thornhill & Grammer, 1999).

However, some studies have found evidence opposing the one ornament theory. For example, Hönekopp and colleagues (Hönekopp et al., 2007) found that a composite measure of physical fitness correlated only with bodily attractiveness and not facial attractiveness. Additionally, Peters, Rhodes, and Simmons (2007) found that face and body attractiveness made significant and independent contributions to overall attractiveness for both males and females.

Cunningham, Barbee, and Pike (1990) even suggest a hypothesis that directly opposes the one-ornament theory: the multiple motives hypothesis. This hypothesis claims that women will find men most attractive when they possess physical features encompassing both youth and maturity and who appear sociable, approachable, and of high social status (Cunningham et al., 1990). Rather than face and body attractiveness separately and independently signaling one ornament of mate quality, researchers did indeed find that different physical features across faces and bodies provided information regarding youth, maturity, sociability, approachability, and social status (Cunningham et al., 1990). All of these physical features and the accompanying information regarding youth, maturity, sociability, approachability, and social status combined to form one overall measure of attractiveness across both faces and bodies. Therefore, the multiple motives hypothesis and accompanying studies provide evidence against the one-ornament theory. While my data do not examine specific physical features with regards to youth, maturity, sociability, approachability, and social status, the lack of correlation between face and body attractiveness provides evidence indirectly supporting the multiple motives hypothesis.

Furthermore, facial and bodily attractiveness may be more or less important depending on relationship context. Currie and Little (2009) found that female bodily attractiveness, as rated by male participants, was more important than facial attractiveness in the context of short-term relationships. If faces and bodies truly represented one ornament of health and mate quality, facial and bodily attractiveness would be equally important regardless of relationship context.

5.1.4 Body measures

In Chapter 2, I investigated how body measures of waist-to-chest ratio for men (WCR), waist-to-hip ratio for women (WHR), age, BMI, and BMI^2 related to social perception. WCR significantly predicted the only body component for male body perception, indicating that men with a more sexually dimorphic shape scored higher on this component. Age significantly related to the third component for female faces, indicating that older faces scored higher on this component. This result of age relating to the third female face component aligns with previous research, which found a third female face component encapsulating age (Sutherland et al., 2013). Oosterhof and Todorov (2008) may not have found this third component of age for female faces due to their limited stimuli age range or failure to examine age as a variable. Although my stimuli age range is smaller than Sutherland et al.'s (2013), I specifically examine the relationship between social perception and age, which may explain why I find that age relates to this third female face component.

BMI^2 significantly predicted the only component for male and female bodies, indicating that men and women with either high or low BMIs scored lower on this component. The quadratic relationship derives from the combination of high and low, but not healthy, BMIs scoring lower on this first body component.

In Chapter 3, the negative relationship between BMI and motivational salience was stronger for face stimuli than body stimuli. BMI^2 also negatively predicted motivational salience and this effect of BMI^2 was greater for body stimuli. Dimorphic shape (i.e., WCR and WHR) positively predicted motivational salience of stimuli in general and for specifically male bodies.

For male faces, the negative relationship between BMI and motivational salience was stronger for female participants than male participants. For male body stimuli, dimorphic shape (i.e., WCR) positively predicted motivational salience. The main effect of dimorphic shape being present for only male body stimuli also reflects the Chapter 2 finding that dimorphic shape predicted the first social perception component only for male bodies.

Previous research shows that higher BMIs and less dimorphic shapes are perceived as less attractive (Coy et al., 2014; Furnham et al., 1997; Henss, 1995; Singh, 1993a, 1993b; Singh, 1994; Streeter & McBurney, 2003, Han et al. (2015); Tovée et al., 1999a; van Anders & Hampson, 2005), which aligns with my Chapters 2 and 3 results for male bodies. However, I do not replicate this for female faces or bodies. Perhaps a stimuli set with a wider BMI range could provide insight into this relationship between female bodies and motivational salience. Indeed, 16.2 to 23.7 represents the BMI range for my female stimuli and 17.7 to 29.9 for my male stimuli. All female stimuli posses either low or normal BMIs while male stimuli possess low to overweight BMIs. The smaller range of female BMI compared to male BMI and wider BMI ranges in other studies may have prevented significant results regarding female stimuli from arising in my empirical chapters.

5.2 Future directions

5.2.1 Body perception

While my empirical chapters extend previous social perception, motivational salience, and hormone work regarding faces to bodies, future studies could take this research even further. For example, using a stimulus set with a wider age range would allow a more in-depth examination of the effect of age on social perception. Perhaps, as found by Sutherland et al. (2013), a further social perception component that is correlated with age would be found in a more diverse stimulus set. A stimulus set covering a wider range of BMI could also provide more insight into how BMI may relate to the social perception of bodies. Along the same vein, stimuli representing a wider range of ethnicities could examine the influence of race on social perception.

In addition to using a more diverse stimulus set, examining height could shed further light on the relationships between body measures and social perception. For example, height stereotypes of both men and women suggested that shortness represents a liability, as short individuals were judged negatively compared to individuals who were tall or of average height (Jackson & Ervin, 1992). Furthermore, height positively influenced men and women's perception of leadership with taller individuals perceived as being higher on leadership than shorter individuals (Blaker et al., 2013). Dominance, health, and intelligence perceptions mediated leadership perceptions of male stimuli while only intelligence perceptions mediated leadership perceptions of female stimuli (Blaker et al., 2013). These findings suggest that height influences social perception and motivational salience of bodies in general, including social perception and motivational salience studied within this thesis. For example, height could have influenced perceptions of dominance and dominance related traits (i.e., the second PC for male and female faces and dominance related traits in the only PC for male and female bodies) discussed within this thesis. Without examining height as a factor, though, its influence will remain unknown. Therefore, height should be examined in future studies.

Additionally, using a bottom-up approach to determine the social perception components for bodies would provide supplementary information. In this thesis, I examine if the same social perception components arise for faces and bodies by using identical traits that are then investigated via Principal Component Analysis (PCA). Such a technique tests if the traits used to form first impressions based on faces will lead to a similar or different pattern of social perception for bodies. However, using the same bottom-up, free description approach for bodies as Oosterhof and Todorov (2008) did with faces would allow a more nuanced investigation of the social perception pattern specific to bodies. Replicating Chapter 2, but starting with free description of bodies rather than providing predetermined traits, would provide further evidence either solidifying or contradicting the one-component pattern of social perception of bodies found in Chapter 2.

Another potential future direction could regard novelty of nude bodies. For modern Western culture, nude bodies are mainly novel and not often viewed. Even brain regions associated with processing faces and bodies are more activated for nude bodies than clothed bodies (Hietanen & Nummenmaa, 2011). In contrast, individuals see and hear a multitude of faces and voices in a single day. This discrepancy in exposure to specific social perception channels may contribute to bodies following a different pattern of social perception. All the same information could potentially be present in faces and bodies, but a lack of exposure could mean that people have not had the chance to develop associations between personality traits and body morphology. Therefore, one potential future direction would be to replicate this experiment using participants from a society that views unadorned bodies nearly as often as they view faces. This replication would then provide a better idea of whether or not the different pattern of social perception for bodies derives from lack of skill or different information being present in bodies and faces.

On the other hand, additional future directions should include replicating these studies using clothed bodies. This could be particularly interesting with regards to social perception. If a similar pattern of social perception arises to that of unclothed bodies, then the pattern will be more strongly affirmed. However, if a different pattern of social perception arises, then perhaps adorned bodies provide different information than unadorned bodies, even when clothing matches across individuals. Some evidence suggests that the brain perceives nude and clothed bodies differently, particularly when sexual cues are present (Hietanen & Nummenmaa, 2011). This difference in brain activity regarding nude and clothed bodies further suggests that clothed and nude bodies provide different information which may interact to form an overall perception of an individual.

Taking this concept a step further, providing clothes of different styles could enhance or detract from the most basic social perceptions based on bodies. In addition to forming clothing-based perceptions regarding personality, behavior, social roles, health, hygiene, and biological traits, people also believe they are accurate at decoding this information (Johnson, Schofield, & Yurchisin, 2002). Furthermore, people genuinely are accurate at judging clothed, static, and neutral bodies for extraversion, self-esteem, and religiosity (Naumann, Vazire, Rentfrow, & Gosling, 2009).

Evidence shows that different clothing worn by the same model, even just a tailor-made suit versus an off-the-rack suit, can increase overall ratings as well as those of success, confidence, salary, and flexibility (Howlett, Pine, Orakçioğlu, & Fletcher, 2013). This evidence suggests that various clothing styles and qualities can influence person perception and potentially interact with the basic perceptions formed from only the individual's nude body.

Specific clothing can also influence students' and teachers' perceptions of intelligence, which could greatly affect academic performance and potential career achievement (Behling & Williams, 1991). Even wearing certain clothing can alter one's behavior, which could influence how the individual is perceived. For example, participants increased their sustained attention when wearing a lab coat described as a doctor's coat in comparison to it being described as a painter's coat (Adam & Galinsky, 2012). Furthermore, these results of increased sustained attention were stronger when wearing the lab coat as opposed to only viewing the lab coat when described as either a doctor's or painter's coat (Adam & Galinsky, 2012).

My empirical chapters establish a foundation for understanding the social perception of bodies while extending and replicating the same foundation for faces. However, a multitude of further variables could influence person perception, including clothing and a more generalizable stimulus set (i.e., wider range of BMIs, ethnicities, etc.). Therefore, further research could investigate the influence of these variables on person perception.

5.2.2 Motivational salience

In terms of motivational salience, future research could include more generalizable stimuli, particularly with regards to BMI. A wider BMI range could highlight the relationship between motivational salience and BMI, particularly for female bodies, especially considering the evidence linking BMI and female attractiveness (Han et al., 2015; Tovée et al., 1999a). However, obtaining a nude stimulus set with a wide BMI range could be difficult. For example, people who have low or normal BMIs may be more comfortable with their bodies and, therefore, may be more comfortable posing nude. It may therefore be difficult to obtain a nude stimulus set representing a wide range of BMIs.

Future motivational salience research could also include various measures of reward value. Motivational salience is, in part, a proxy measure of reward value. Therefore, replicating the same types of experiments using different types of reward value measures will provide a clearer picture. If similar results arise, then my original findings will be affirmed more strongly. If dissimilar results arise, then the nuances between results may provide a deeper explanation. One alternative method of measuring reward value would be brain imaging. For example, attractive faces activate brain areas associated with reward (Bzdok et al., 2011; Mende-Siedlecki et al., 2013; Rhodes, 2006) and activation in these areas increases with attractiveness (Cloutier et al., 2008). By examining activation in reward areas of the brain when viewing stimuli, future research could show which images the brain finds most rewarding. Sexual orientation would also be interesting to investigate, as it modulates activation in reward areas of the brain (Kranz & Ishai, 2006).

An increase in activity in reward areas of the brain occurs for attractive bodies just as it does for attractive faces. Males' reward areas of the brain increase when viewing females who possess optimal WHRs, also referred to as hourglass figures (Platek & Singh, 2010). This brain and reward circuitry activation evidence aligns with results from key-press studies showing that attractive faces are rewarding and that female stimuli possess more motivational salience for men (Hahn et al., 2014; Hahn et al., 2016; Levy et al., 2008; Wang et al., 2014). Combined, this evidence suggests that attractive bodies will show similar reward circuitry activation as attractive faces and that using alternative measures of motivational salience will likely strengthen the conclusions drawn from key-press studies.

5.2.3 Body movement and emotion

Movement and expression are also logical future directions for social perception research, as each gesture can carry meaning and alter person perception. Emotion has been extensively researched with regards to faces (Biehl et al., 1997; Ekman, 1993; Ekman & Oster, 1979; Ekman & Rosenberg, 1997; Hall, 1977; Russell, 1994), but less so with regards to bodies (de Gelder, 2009). Just as overgeneralization of emotions expressed via the face can lead perceivers to attribute certain traits to an individual (Said et al., 2009; Zebrowitz & Montepare, 2008), the same could occur for bodies. If an individual's neutral and resting body pose could be overgeneralized as an angry pose, then he or she could be attributed certain traits such as aggressiveness and dominance.

Emotional expressions could also enhance or mitigate social perceptions based on only unadorned bodies. For example, Todorov, Baron, and Oosterhof (2008) found that trustworthy faces appeared happier than untrustworthy faces when both were manipulated for the same degree of happiness. This suggests that basic perceptions (i.e., perceptions formed from neutral, static stimuli) can exacerbate other social perception signals, such as emotion or clothing. Given that expressions within the face and body are both highly recognized (de Gelder, 2009), basic perceptions could interact with bodily expressions. Thus, subsequent research could focus on how the interaction of perceptions from various channels, including nude bodies, bodily expressions, and clothing, could form one complete person perception.

Just as static, neutral bodies can provide important information with regards to personality and mate quality (Fink et al., 2010; Fink, Weege, Neave, Ried, & Do Lago, 2014; Johnson et al., 2002; Naumann et al., 2009; Thornhill & Grammer, 1999), body movement can as well. For example, dance ability can provide information about mate quality through various traits, including attractiveness and strength (Fink, Weege, Neave, Pham, & Shackelford, 2015). Even handgrip strength, an indicator of mate quality, can predict dance quality (Hugill, Fink, Neave, & Seydel, 2009; McCarty, Hönekopp, Neave, Caplan, & Fink, 2013). Dancing can also convey mate quality through more expansive and variable head, trunk, and arm movements, which could signal such traits as health and fitness (McCarty et al., 2013; Neave et al., 2010). For female dancers, larger hip swings and asymmetric thigh movements suggest high dance quality, strong developmental health, and sexual dimorphism (McCarty et al., 2017).

Furthermore, women's judgments of men's dance ability correlates positively with conscientiousness and social agreeableness (Fink et al., 2012). Even identity, potentially sexual orientation, and emotion (Fink et al., 2014) as well as sensation seeking (Hugill, Fink, Neave, Besson, & Bunse, 2011) can be perceived via men's body movement. Moreover, perceptions formed from male dance movements are consistent cross-culturally (Fink et al., 2014). Combined, the evidence regarding dance strongly suggests that future research should focus on how the basic perceptions formed from just a neutral body interact with perceptions formed from the same moving body. Dance quality in particular may also provide more information on how mate quality is ascertained from the integration of static and dynamic body information.

Bodily and facial expressions may also provide different information, depending on the emotion being portrayed. For example, facial expressions may provide more information for the individual's mental state while bodily expressions may provide more information for the individual's actions (de Gelder, 2009). Body posture can also provide information that is important for social interaction and perception. For example, raters can accurately judge the five different personality factors of aversion, irritation, happiness, self-confidence, and openness from body postures (Grammer et al., 2004). Therefore, future research could investigate the interaction among body posture, facial expressions, and body language that forms one overall perception of the individual.

Although a multitude of research has investigated perceptions via facial features and expressions, considerably less has investigated bodily features and expressions. My empirical chapters begin to address how bodily features influence perceptions. Therefore, future research could go a step further and investigate how bodily expressions influence perceptions.

5.2.4 Hormones

With regards to future directions for hormone research, consistent novelty of bodies may have influenced the results just as it may have for motivational salience and social perception. Unadorned bodies are fairly novel within Western society and are usually only viewed within a specifically sexual context. Therefore, all of the body stimuli could have possessed high motivational salience and valence for participants. Previous studies found that the positive effect of testosterone on motivational salience was greater for high valence stimuli. However, the same interaction may not have arisen within my data because all the body stimuli could have possessed high valence due to their high novelty. Therefore, a replication should include body stimuli with varying degrees of novelty or novelty levels similar to that of corresponding faces.

Moreover, further experiments should include male participants. While data from female participants replicated previous work, data from male participants could provide a more comprehensive picture. In addition to a positive relationship with reward sensitivity (Morris et al., 2015; van Honk et al., 2004), testosterone levels positively correlate with activation of reward-related brain areas for both boys and girls (de Macks et al., 2011) and the reward-related neurotransmitter dopamine (Morris et al., 2015). Even if the same relationships between hormones and motivational salience arise for male and female participants, understanding these relationships is important for grasping the complete picture.

Although previous work has established that testosterone positively predicts motivational salience of adult and infant faces (Hahn et al., 2015b; Wang et al., 2014), essentially just my own research has focused on the same relationship for bodies. Replications of my research here would solidify the finding that motivational salience of bodies is greater when testosterone is high. Additionally, further research should also focus on using stimuli possessing a range of novelty values in order to test if an interaction between testosterone and the general social perception component for bodies arises.

5.3 General Conclusion

Although there are a multitude of potential future directions, my empirical studies here replicate and extend previous research regarding social perception, motivational salience, and hormones. By replicating that social perception of faces can be summarized by the two components of valence and dominance, and discovering that the social perception of bodies can be summarized by one general component, I found that faces and bodies are perceived along completely different components. My second empirical chapter detailed how each social perception component (i.e., faces: valence and dominance; bodies: general social perception component) positively predicted motivational salience of faces and bodies. Lastly, my third empirical chapter found that motivational salience of bodies was greater when testosterone was high. Combined, these results indicate that while faces and bodies are perceived via different component patterns, the social perception components positively predict motivational salience of faces and bodies, and that within-subject changes in women's testosterone are related to the motivational salience of both male and female bodies.

Chapter 6: References

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Chapter 7: Supplemental Materials

7.1 Chapter 2 Supplemental Materials

Table S1. Stimuli Information. Age, height, weight, BMI, chest circumference, waist circumference, and hip circumference for male and female stimuli. Stimuli names are publically identified by first name on 3d.sk site.

Name	Sex	Age	Height (cm)	Weight (kg)	BMI (classification)	Chest (cm)	Waist (cm)	Hip (cm)
alexandra	female	22	178	55	17.4 (low)	86	61	92
anastazie	female	22	184	60	17.7 (low)	86	60	90
anezka	female	26	166	54	19.6 (normal)	86	71	93
bera	female	22	162	46	17.5 (low)	83	60	83
bohdana	female	22	158	53	21.2 (normal)	83	65	90
brenda	female	25	170	52	18.0 (low)	83	68	96
carol	female	24	165	44	16.2 (low)	82	61	86
christianne	female	29	166	56	20.3 (normal)	83	67	94
dagmar	female	27	166	54	19.6 (normal)	87	63	91
debra	female	30	164	55	20.4 (normal)	83	64	91
dobromila	female	23	173	56	18.7 (normal)	89	64	99
dusana	female	28	175	53	17.3 (low)	80	63	89
edita	female	19	169	58	20.3 (normal)	92	80	100
eleanora	female	22	170	52	18.0 (low)	80	65	90
elena	female	23	167	58	20.8 (normal)	87	79	95
eugenia	female	28	178	75	23.7 (normal)	105	88	105
evzenie	female	22	180	60	18.5 (normal)	91	75	99
gabriela	female	24	176	68	22.0 (normal)	101	97	107
gejza	female	25	161	57	22.0 (normal)	93	72	97
ida	female	21	158	49	19.6 (normal)	87	70	87
ingrid	female	24	174	53	17.5 (low)	92	62	88
irena	female	23	163	63	23.7 (normal)	96	81	106
jindriska	female	20	174	59	19.5 (normal)	85	62	91
jitka	female	30	166	54	19.6 (normal)	91	65	95
karina	female	30	155	48	20.0 (normal)	88	64	89
kordula	female	25	165	48	17.6 (low)	84	72	85
lea	female	24	176	63	20.3 (normal)	89	63	89
linda	female	25	165	58	21.3 (normal)	90	64	94
livia	female	19	172	48	16.2 (low)	83	64	89
lujza	female	27	170	55	19.0 (normal)	83	66	92
margita	female	23	172	57	19.3 (normal)	88	64	93
marika	female	20	174	60	19.8 (normal)	90	73	102

matylda	female	20	168	48	17.0 (low)	80	63	88
miloslava	female	23	175	59	19.3 (normal)	90	70	95
milota	female	25	170	50	17.3 (low)	86	62	90
miriama	female	24	162	46	17.5 (low)	83	63	89
peggy	female	21	169	48	16.8 (low)	84	64	87
perla	female	25	166	49	17.8 (low)	88	60	88
radmila	female	28	166	55	20.0 (normal)	86	68	86
sarlota	female	21	165	55	20.2 (normal)	86	69	97
saskie	female	20	158	42	16.8 (low)	86	62	84
sidonia	female	29	170	64	22.1 (normal)	104	69	93
stela	female	23	178	56	17.7 (low)	85	62	94
tamara	female	25	178	63	19.9 (normal)	87	66	93
ursula	female	24	173	61	20.4 (normal)	96	71	97
viktoria	female	20	170	60	20.8 (normal)	92	70	92
viola	female	28	167	50	17.9 (low)	87	64	85
vladena	female	24	173	52	17.4 (low)	87	61	90
zelmira	female	26	157	52	21.1 (normal)	86	63	89
zlata	female	25	172	56	18.9 (normal)	88	67	95
andrej	male	21	185	73	21.3 (normal)	97	81	95
aurel	male	23	178	70	22.1 (normal)	87	69	101
bernard	male	27	177	91	29.0 (overweight)	95	96	112
blazej	male	22	175	75	24.5 (normal)	96	75	83
boris	male	30	200	88	22.0 (normal)	91	91	105
bretislav	male	30	176	70	22.6 (normal)	91	74	90
bystrik	male	25	181	87	26.6 (overweight)	105	82	107
cenek	male	28	176	90	29.1 (overweight)	109	98	114
cestmir	male	27	187	87	24.9 (normal)	100	86	106
cornelius	male	25	178	75	23.7 (normal)	93	85	104
cyril	male	24	183	78	23.3 (normal)	98	77	103
dalimil	male	26	180	84	25.9 (overweight)	103	82	104
denis	male	24	172	70	23.7 (normal)	97	77	97
dionyz	male	24	187	82	23.4 (normal)	100	86	98
dominik	male	23	189	72	20.2 (normal)	81	78	96
drahomir	male	25	179	77	24.0 (normal)	95	85	104
elias	male	21	186	90	26.0 (overweight)	99	88	105
ferdinand	male	24	183	83	24.8 (normal)	104	86	99
gabriel	male	24	174	68	22.5 (normal)	87	79	100
hanus	male	28	183	86	25.7 (overweight)	96	84	106
henrich	male	25	191	74	20.3 (normal)	88	77	102
hynek	male	25	176	78	25.2 (overweight)	91	85	99
josef	male	20	191	80	21.9 (normal)	90	76	104
justin	male	19	174	64	21.1 (normal)	84	74	84
kamil	male	22	183	100	29.9 (overweight)	115	90	95
kazimir	male	23	182	71	21.4 (normal)	93	73	98
leonard	male	24	182	76	22.9 (normal)	98	78	92
libor	male	29	181	84	25.6 (overweight)	101	91	109

lumir	male	20	183	72	21.5 (normal)	107	77	92
maxim	male	25	183	78	23.3 (normal)	92	84	102
mike	male	24	168	59	20.9 (normal)	98	78	88
milos	male	23	175	59	19.3 (normal)	90	70	95
mojmir	male	20	175	65	21.2 (normal)	89	73	89
moric	male	28	190	75	20.8 (normal)	94	80	98
oleg	male	30	181	85	25.9 (overweight)	102	90	106
oliver	male	24	178	60	18.9 (normal)	85	78	91
patrik	male	26	189	75	21.0 (normal)	89	85	95
prokop	male	22	176	73	23.6 (normal)	89	80	104
ramiro	male	22	175	75	24.5 (normal)	92	82	97
rehor	male	20	200	100	25.0 (overweight)	100	86	112
rudolf	male	22	179	70	21.8 (normal)	95	86	103
sobeslav	male	23	187	100	28.6 (overweight)	108	97	111
stefan	male	22	180	73	22.5 (normal)	86	81	88
svatopluk	male	21	173	53	17.7 (low)	90	71	80
tichomir	male	28	187	83	23.7 (normal)	95	84	104
tomasi	male	19	190	75	20.8 (normal)	98	74	92
valer	male	24	184	77	22.7 (normal)	95	84	102
vasil	male	25	175	68	22.2 (normal)	94	77	100
vendelin	male	30	178	75	23.7 (normal)	95	85	104
vladislav	male	20	176	63	20.3 (normal)	85	72	91

Table S2. Number of Participants. The total number (male | female) of participants by trait, type, and sex of stimulus.

Traits	Male Face	Female Face	Male Body	Female Body
aggressive	20 (10 | 10)	22 (10 | 12)	22 (10 | 12)	24 (12 | 12)
attractive	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	24 (12 | 12)
caring	24 (14 | 10)	21 (11 | 10)	20 (10 | 10)	25 (12 | 13)
confident	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	25 (12 | 13)
dominant	21 (10 | 11)	20 (10 | 10)	22 (10 | 12)	20 (10 | 10)
emotionally stable	20 (10 | 10)	24 (10 | 14)	20 (10 | 10)	21 (11 | 10)
happy	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)
intelligent	20 (10 | 10)	20 (10 | 10)	23 (10 | 13)	20 (10 | 10)
mean	20 (10 | 10)	21 (10 | 11)	20 (10 | 10)	20 (10 | 10)
responsible	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)
sociable	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)
trustworthy	20 (10 | 10)	21 (10 | 11)	20 (10 | 10)	20 (10 | 10)
weird	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)	20 (10 | 10)

Table S3. Descriptive Statistics for Ratings. All rating means and SDs for male body, male face, female body, and female face stimuli by trait.

Traits	Male Face	Female Face	Male Body	Female Body
aggressive	3.90 (0.78)	3.70 (0.54)	3.02 (0.58)	2.94 (0.34)
attractive	2.83 (0.51)	3.04 (0.60)	3.29 (0.77)	3.33 (0.66)
caring	3.35 (0.69)	3.40 (0.79)	3.81 (0.58)	3.45 (0.43)
confident	3.52 (0.64)	3.77 (0.61)	3.96 (0.91)	3.72 (0.59)
dominant	3.24 (0.59)	3.92 (0.57)	3.32 (0.89)	3.11 (0.61)
emotionally stable	3.85 (0.67)	4.01 (0.54)	3.83 (0.43)	3.87 (0.45)
happy	3.44 (0.72)	3.63 (0.79)	4.08 (0.59)	4.01 (0.49)
intelligent	3.80 (0.47)	3.93 (0.43)	3.75 (0.38)	3.83 (0.36)
mean	3.69 (0.66)	3.88 (0.65)	3.11 (0.61)	3.42 (0.39)
responsible	3.68 (0.60)	3.75 (0.63)	3.62 (0.52)	4.00 (0.49)
sociable	3.29 (0.56)	3.24 (0.68)	3.52 (0.67)	3.72 (0.66)
trustworthy	3.72 (0.55)	3.73 (0.53)	3.68 (0.35)	3.50 (0.37)
weird	4.42 (0.76)	4.57 (0.66)	3.60 (0.39)	3.12 (0.52)

Table S4. PCA Output For High Alpha Traits. The table shows the loadings onto each PC for each trait that had an alpha > 0.7.

Trait	Male Face PC1	Male Face PC2	Female Face PC1	Female Face PC2	Female Face PC3	Male Body PC1	Female Body PC1
aggressive	-0.578	0.741	-0.636	0.655	0.004	0.850	NA
attractive	0.771	0.413	0.724	0.438	-0.403	0.948	0.938
caring	0.889	-0.307	0.852	-0.336	0.035	0.860	0.856
confident	0.678	0.507	0.590	0.642	0.273	0.973	0.938
dominant	0.086	0.867	-0.235	0.860	0.186	0.898	0.902
emotionally stable	0.901	-0.061	0.763	0.476	0.082	0.931	0.868
happy	0.772	-0.243	0.874	0.088	0.145	0.896	0.915
intelligent	0.705	0.154	0.668	0.121	0.464	0.882	NA
mean	-0.580	0.745	-0.566	0.751	-0.005	0.848	NA
responsible	0.734	0.170	0.791	-0.019	0.351	0.893	0.800
sociable	0.837	0.138	0.780	0.318	-0.380	0.952	0.940
trustworthy	0.875	-0.072	0.848	-0.339	-0.031	NA	NA
weird	-0.676	-0.523	-0.614	-0.273	0.503	NA	-0.877

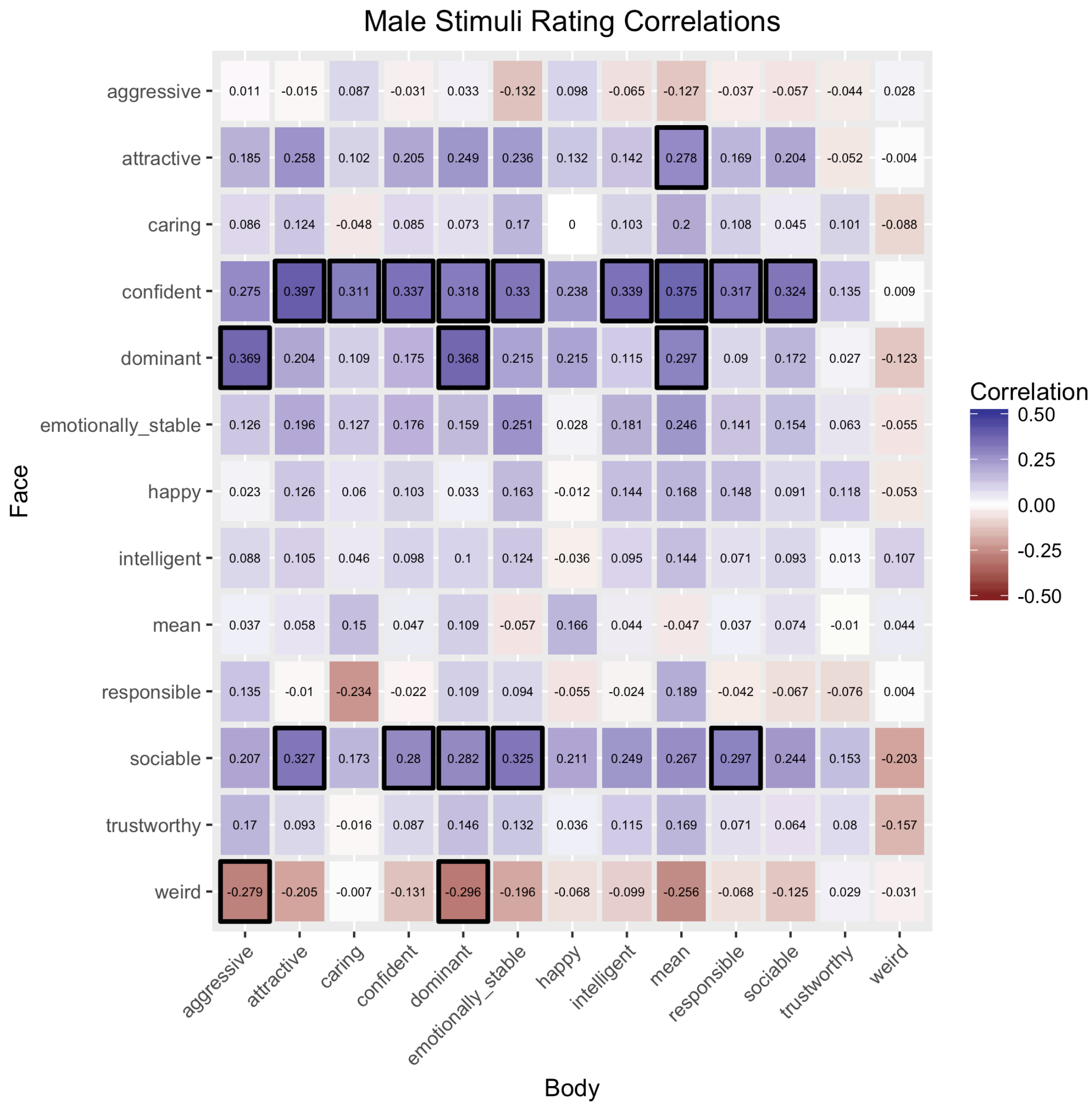

Figure S1. Male Stimuli Rating Correlations. All correlations between ratings for male face and male body stimuli by trait. Significant correlations are marked with a thick black outline. The colorbar to the right and numbers in the figure depict the correlation values.

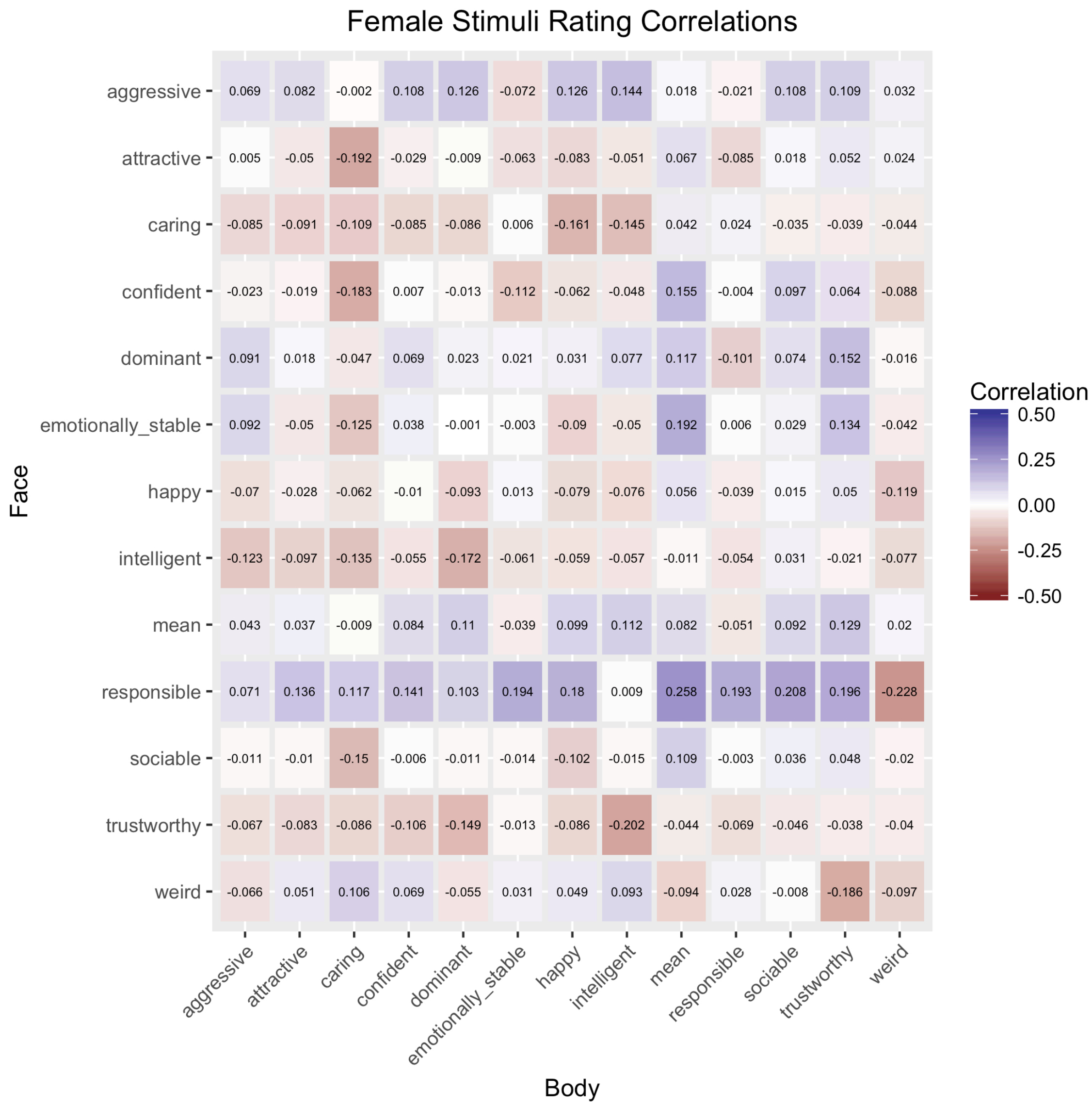

Figure S2. Female Stimuli Rating Correlations. All correlations between ratings for female face and female body stimuli by trait. The colorbar to the right and numbers in the figure depict the correlation values, none of which are significant.

7.2 Chapter 3 Supplemental Materials

Table S5. Key-Press Scores and Body Measures Regression Output for All Stimuli. Regression output for the key-press scores of male and female face and body stimuli with regards to body measures. Stimulus sex, stimulus type, BMI^2, dimorphic shape (WHR and WCR), participant sex by stimulus sex, participant sex by stimulus type, stimulus sex by stimulus type, stimulus type by BMI, stimulus type by BMI^2, stimulus type by dimorphic shape, participant sex by stimulus sex by stimulus type, and stimulus sex by stimulus type by dimorphic shape (WHR and WCR) significantly predicted the key-press scores of all stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	0.000	0.081	59.641	0.000	1
Participant Sex	0.175	0.159	56.000	1.101	0.276
Stimulus Sex	0.195	0.032	99.078	6.075	< .001
Stimulus Type	0.152	0.015	10934.498	10.479	< .001
BMI	-0.009	0.019	99.078	-0.485	0.629
BMI^2	-0.041	0.018	99.078	-2.327	0.022
Dimorphic Shape (WHR or WCR)	0.043	0.017	99.078	2.462	0.016
Stimulus Age	0.014	0.018	99.078	0.767	0.445
Participant Sex x Stimulus Sex	-0.272	0.029	10934.498	-9.360	< .001
Participant Sex x Stimulus Type	-0.149	0.029	10934.498	-5.131	< .001
Stimulus Sex x Stimulus Type	0.139	0.029	10934.498	4.797	< .001
Participant Sex x BMI	-0.014	0.016	10934.498	-0.887	0.375
Stimulus Sex x BMI	-0.001	0.036	99.078	-0.034	0.973
Stimulus Type x BMI	0.042	0.016	10934.498	2.565	0.01
Participant Sex x BMI^2	-0.013	0.016	10934.498	-0.840	0.401
Stimulus Sex x BMI^2	0.009	0.035	99.078	0.259	0.796
Stimulus Type x BMI^2	-0.054	0.016	10934.498	-3.404	0.001
Participant Sex x Dimorphic Shape	0.028	0.016	10934.498	1.774	0.076
Stimulus Sex x Dimorphic Shape	-0.048	0.036	99.078	-1.351	0.18
Stimulus Type x Dimorphic Shape	0.047	0.016	10934.498	3.026	0.002
Participant Sex x Stimulus Sex x Stimulus Type	-0.337	0.058	10934.498	-5.800	< .001
Participant Sex x Stimulus Sex x BMI	0.030	0.032	10934.498	0.919	0.358
Participant Sex x Stimulus Type x BMI	0.038	0.032	10934.498	1.160	0.246
Stimulus Sex x Stimulus Type x BMI	-0.016	0.034	80.871	-0.489	0.626
Participant Sex x Stimulus Sex x BMI^2	0.021	0.032	10934.498	0.678	0.498
Participant Sex x Stimulus Type x BMI^2	-0.009	0.032	10934.498	-0.280	0.78
Stimulus Sex x Stimulus Type x BMI^2	0.039	0.032	10934.498	1.233	0.217
Participant Sex x Stimulus Sex x Dimorphic Shape	-0.021	0.031	10934.498	-0.678	0.498
Participant Sex x Stimulus Type x Dimorphic Shape	0.028	0.031	10934.498	0.878	0.38
Stimulus Sex x Stimulus Type x Dimorphic Shape	-0.092	0.032	71.612	-2.881	0.005
Participant Sex x Stimulus Sex x Stimulus Type x BMI	-0.097	0.067	80.871	-1.451	0.151
Participant Sex x Stimulus Sex x Stimulus Type x BMI^2	0.056	0.063	10934.498	0.891	0.373
Participant Sex x Stimulus Sex x Stimulus Type x Dimorphic Shape	0.078	0.064	71.612	1.214	0.229

Table S6. Key-Press Scores and Body Measures Regression Output for Male Face Stimuli. Regression output for the key-press scores of male face stimuli with regards to body measures. The interaction between participant sex and BMI significantly predicted the key-press scores of male face stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.139	0.097	62.454	-1.432	0.157
Participant Sex	0.301	0.189	56.379	1.596	0.116
BMI	-0.032	0.030	49.123	-1.087	0.282
BMI^2	-0.009	0.028	49.123	-0.324	0.747
Dimorphic Shape (WCR)	0.019	0.028	47.415	0.678	0.501
Stimulus Age	0.010	0.031	55.998	0.336	0.738
Participant Sex x BMI	-0.071	0.030	50.730	-2.390	0.021
Participant Sex x BMI^2	-0.006	0.029	49.306	-0.207	0.837
Participant Sex x Dimorphic Shape	0.043	0.028	31.278	1.528	0.136

Table S7. Key-Press Scores and Body Measures Regression Output for Female Face Stimuli. Regression output for the key-press scores of female face stimuli with regards to body measures. No body measures significantly predicted the key-press scores of female face stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.013	0.111	64.542	-0.122	0.904
Participant Sex	0.198	0.213	55.994	0.928	0.357
BMI	-0.010	0.039	49.215	-0.255	0.8
BMI^2	-0.023	0.036	49.166	-0.641	0.525
Dimorphic Shape (WHR)	0.024	0.037	49.166	0.649	0.52
Stimulus Age	-0.033	0.035	49.166	-0.953	0.345
Participant Sex x BMI	0.006	0.030	86.773	0.200	0.842
Participant Sex x BMI^2	-0.012	0.028	2639.639	-0.433	0.665
Participant Sex x Dimorphic Shape	-0.016	0.029	2639.639	-0.549	0.583

Table S8. Key-Press Scores and Body Measures Regression Output for Male Body Stimuli. Regression output for the key-press scores of male body stimuli with regards to body measures. BMI^2 and dimorphic shape significantly predicted the key-press scores of male body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.056	0.089	69.562	-0.629	0.532
Participant Sex	0.320	0.168	56.112	1.903	0.062
BMI	0.014	0.038	52.486	0.367	0.715
BMI^2	-0.081	0.036	51.541	-2.237	0.03
Dimorphic Shape (WCR)	0.116	0.039	66.986	2.959	0.004
Stimulus Age	0.021	0.037	49.195	0.570	0.571
Participant Sex x BMI	0.014	0.031	38.467	0.440	0.662
Participant Sex x BMI^2	-0.042	0.030	35.893	-1.418	0.165
Participant Sex x Dimorphic Shape	0.033	0.042	50.584	0.774	0.442

Table S9. Key-Press Scores and Body Measures Regression Output for Female Body Stimuli. Regression output for the key-press scores of female body stimuli with regards to body measures. No body measures significantly predicted the key-press scores of female body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	0.208	0.081	74.644	2.563	0.012
Participant Sex	-0.120	0.150	57.049	-0.799	0.428
BMI	-0.008	0.048	70.638	-0.170	0.866
BMI^2	-0.050	0.040	54.297	-1.254	0.215
Dimorphic Shape (WHR)	0.014	0.040	49.246	0.352	0.726
Stimulus Age	0.056	0.038	49.468	1.493	0.142
Participant Sex x BMI	-0.004	0.057	61.068	-0.075	0.94
Participant Sex x BMI^2	0.007	0.040	44.310	0.173	0.864
Participant Sex x Dimorphic Shape	0.051	0.036	48.561	1.416	0.163

7.3 Chapter 4 Supplemental Materials

As a replication of Chapter 3, we used a linear mixed model to investigate whether motivational salience of individuals' bodies were related to their ages, BMIs, BMI^2, and waist-to-hip ratios (WHR; if female) or waist-to-chest ratios (WCR; if male). For this and subsequent analyses BMI, BMI^2, dimorphic shape (WHR or WCR), and age were scaled within sex and dimorphic shape was reversed so that high numbers represent more sexually dimorphic shapes. BMI was centered before squaring to prevent collinearity. The first model examined if all stimuli key-press scores were predicted by stimulus sex, BMI, BMI^2, dimorphic shape (WHR or WCR), and stimulus age. Random intercepts were specified for each stimulus and participant. Random slopes by participant were specified for stimulus sex, BMI, BMI^2, stimulus age, and dimorphic shape. For all stimuli, the model was significantly better than the null model ($\chi^2(8) = 31.53$, $p < 0.001$).

Key-press scores were significantly related to stimulus sex (beta = -0.096, p = 0.026), whereby male stimuli had higher key-press scores. Key-press scores were also significantly related to BMI^2 (beta = -0.082, p = 0.001), and dimorphic shape (beta = 0.080, p = 0.001). These results replicate the corresponding analyses in Chapter 3. See Table S10 for full statistics on these analyses and Figures S3 - S4 for interaction effects.

Table S10. All Stimuli Body Measures Regression Output. Regression output for the key-press scores of male and female body stimuli with regards to body measures. Stimulus sex, BMI^2, and dimorphic shape (WHR or WCR) significantly predicted the key-press scores of all body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.044	0.059	155.008	-0.754	0.452
Stimulus Sex	-0.096	0.042	99.252	-2.255	0.026
BMI	0.030	0.025	99.251	1.187	0.238
BMI^2	-0.082	0.023	99.251	-3.510	0.001
Dimorphic Shape (WHR or WCR)	0.080	0.023	99.250	3.454	0.001
Stimulus Age	-0.001	0.024	104.705	-0.022	0.983
Stimulus Sex x BMI	0.010	0.048	104.402	0.198	0.843
Stimulus Sex x BMI^2	0.028	0.047	102.628	0.599	0.550
Stimulus Sex x Dimorphic Shape	-0.093	0.048	103.528	-1.954	0.053

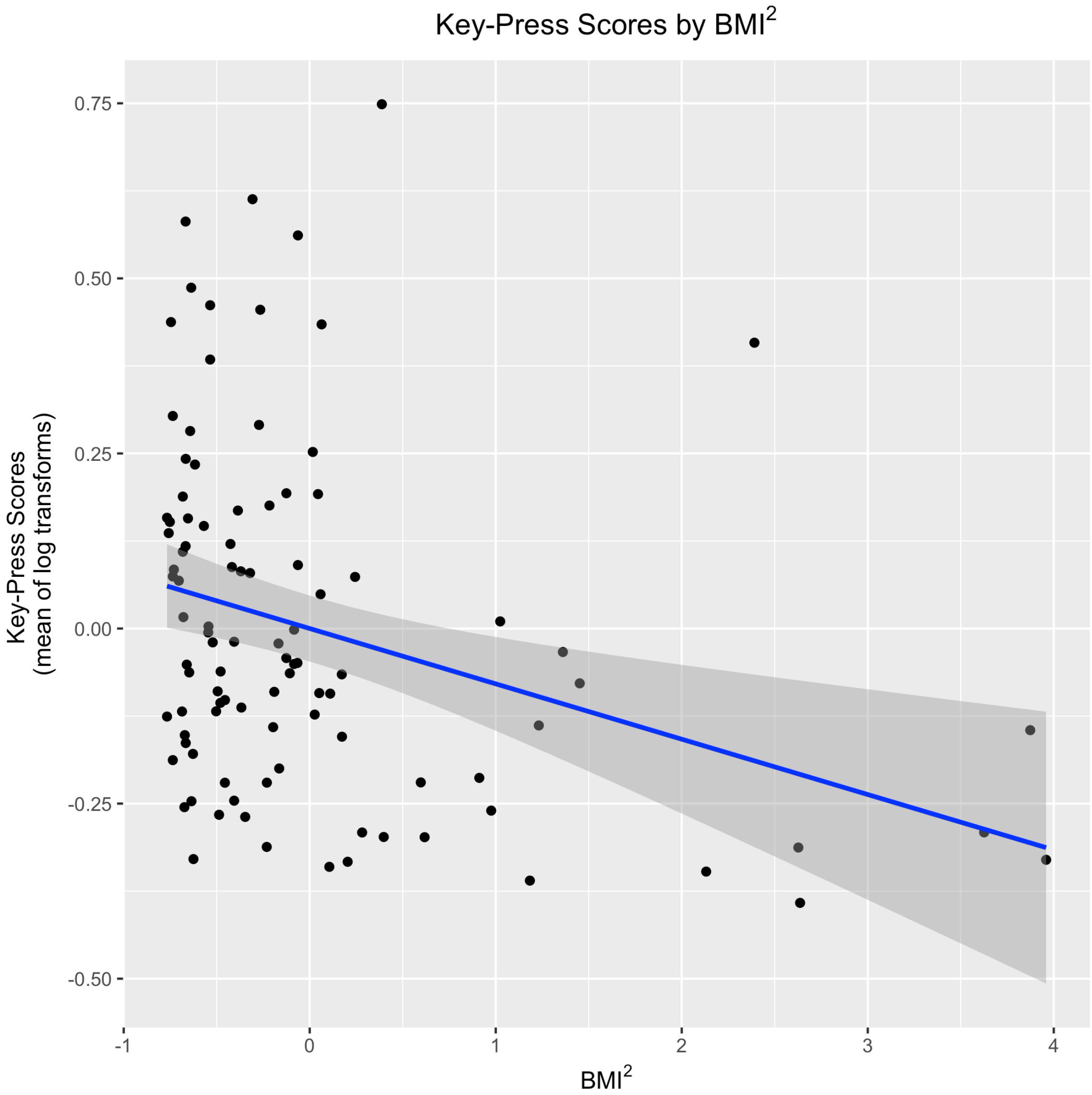

Figure S3. Key-Press Scores by BMI^2. There was a main effect of BMI^2, whereby key-press scores decreased as BMI^2 increased.

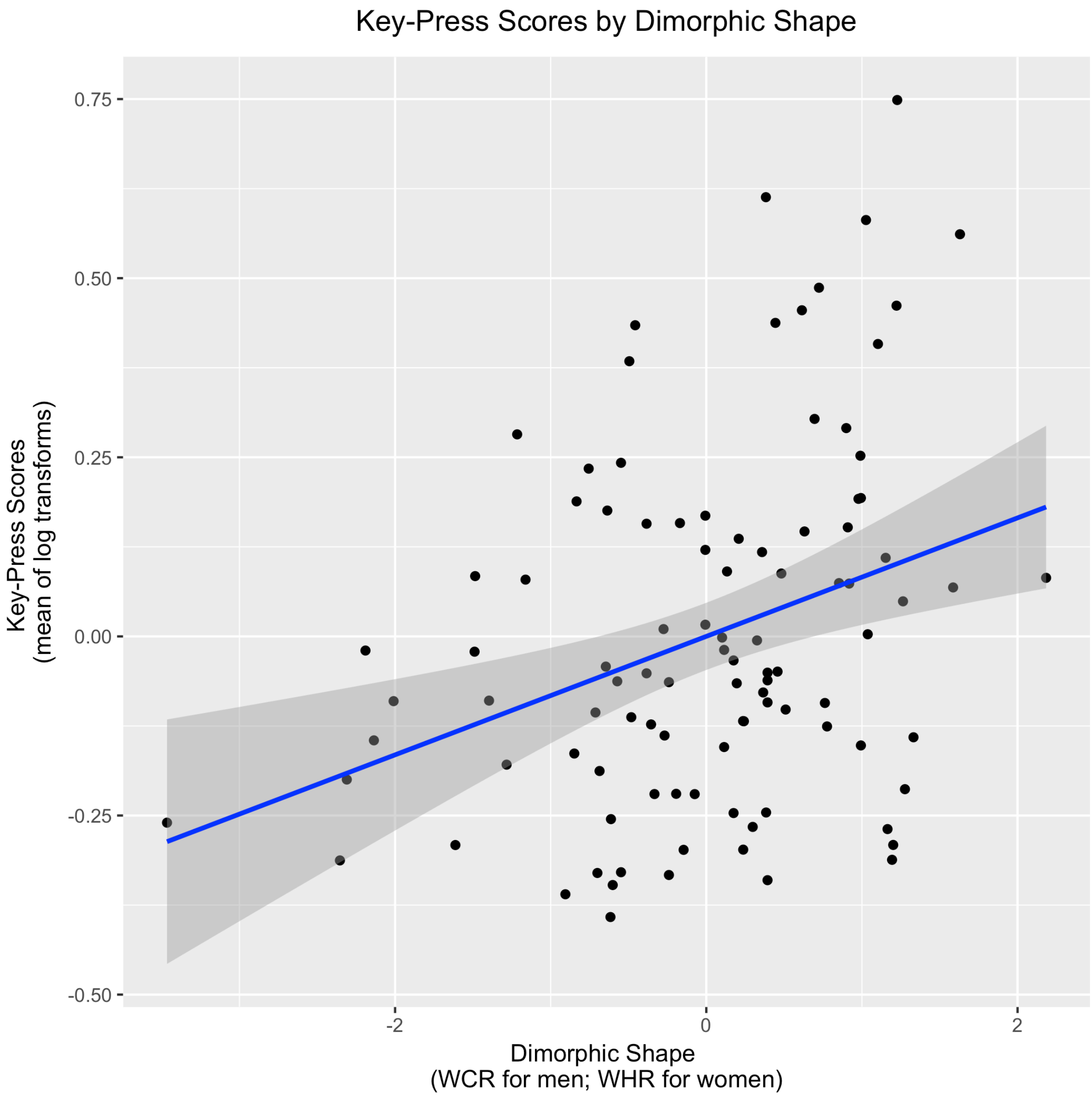

Figure S4. Key-Press Scores by Dimorphic Shape. There was a main effect of dimorphic shape (i.e., WCR for men and WHR for women), whereby key-press scores increased as dimorphic shape increased.

Due to the main effect of stimulus sex, we ran an additional two linear mixed models examining male and female stimuli separately. The first model examined if male stimuli key-press scores were predicted by BMI, BMI^2, dimorphic shape (WCR for males and WHR for females), and stimulus age. Random intercepts were specified for each stimulus and participant. Random slopes by participant were specified for BMI, BMI^2, stimulus age, and dimorphic shape. The second model examined the same relationship, but for female stimuli. For male stimuli, the model was significantly better than the null model ($\chi^2(4) = 14.81$, $p = 0.005$). For female stimuli, the model neared being significantly better than the null model ($\chi^2(4) = 8.74$, $p = 0.068$).

Key-press scores for male and female stimuli were negatively and significantly related to BMI^2 (male: beta = -0.094, p = 0.023; female: beta = -0.066, p = 0.017). Key-press scores for male stimuli were also positively and significantly related to dimorphic shape (beta = 0.128, p = 0.002). No other predictors were significant for male or female body stimuli. These results replicate previous findings from Chapters 3 and supplemental findings in Chapter 4. See Tables S11 - S12 for full statistics on these analyses.

Table S11. Male Body Measures Regression Output. Regression output for the key-press scores of male body stimuli with regards to body measures. BMI^2 and dimorphic shape (WCR) significantly predicted the key-press scores of male body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	0.001	0.067	168.412	0.020	0.984
BMI	0.026	0.043	56.700	0.601	0.550
BMI^2	-0.094	0.040	55.947	-2.337	0.023
Dimorphic Shape (WCR)	0.128	0.040	57.101	3.170	0.002
Stimulus Age	-0.002	0.041	49.663	-0.038	0.970

Table S12. Female Body Measures Regression Output. Regression output for the key-press scores of female body stimuli with regards to body measures. BMI^2 significantly predicted the key-press scores of female body stimuli.

	Estimate	Standard Error	Degrees of Freedom	t value	p value
Intercept	-0.089	0.062	152.742	-1.436	0.153
BMI	0.034	0.029	56.202	1.169	0.248
BMI^2	-0.066	0.027	57.995	-2.466	0.017
Dimorphic Shape (WHR)	0.034	0.027	49.786	1.279	0.207
Stimulus Age	0.000	0.025	49.247	0.019	0.985