THE DIMPLES OF VENUS:
AN ADAPTIVE MORPHOLOGICAL TRAIT OF PHYSICAL ATTRACTIVENESS

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ABSTRACT

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This thesis documents a series of studies investigating the Dimples of Venus (DOV) as a physically attractive fitness-relevant cue in mating contexts. Judgments of attractiveness across four studies were measured through forced-choice tasks and ratings of attractiveness. Cross-cultural data was attained between The United States of America and Turkey. Results indicate that men consistently prefer the DOV on women whereas women hold a weaker preference for the DOV on men. The sex-differentiated preference may be linked to pregnancy fitness-benefits in women since the DOV are linked to underlying biological structures related to spinal health and stability for carrying heavy loads, such as offspring.

Keywords: Dimples of Venus, Evolutionary Theory, Physical Attractiveness

ÖZET

VENÜS'ÜN GAMZELERİ: FİZİKSEL ÇEKİMİN ADAPTİF MORFOLOJİK KARAKTERİ

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Bu tez, Venüs'ün Gamzeleri'ni (VD), fiziksel çekicilik ile alakalı bir eş seçimi kriteri olarak inceleyen çalışmaları belgelemektedir. Bu çalışmalarda çekicilik seviyesi zorunlu cevaplama yöntemi ve çekicilik seviyesi derecelendirme ile ölçülmüştür. Bu çalışmalar için Amerika Birleşik Devletleri'nde ve Türkiye Cumhuriyeti'nde kültürler-arası veri elde edilmiştir. Sonuçlar, erkeklerin tutarlı olarak kadınlarda VD'yi tercih ettiklerini, kadınlarınsa VD'ye karşı erkeklerin gösterdiğine kıyasla daha düşük şiddette bir seçim eğiliminde olduğunu göstermektedir. Cinsiyetler arası seçim farklılığı, VD'nin kadınlarda potansiyel doğurganlık işareti olduğuna delalet edebilir; çünkü VD, hamilelikte olduğu gibi ağır bir yükü taşımayı kolaylaştıran sağlam ve sağlıklı bir biyolojik altyapının varlığına kanıt teşkil eder.

Anahtar kelimeler: Evrimsel Teori, Fiziksel Çekicilik, Venüs'ün Gamzeleri

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PREFACE

Past research identified specific physical features that individuals find attractive in a mate and the goal of this thesis is to establish a previously unknown feature of physical attractiveness – the Dimples of Venus. The Dimples of Venus (DOV) refers to the skin indentations on the region of the lower back, formed by the skeletal and muscular systems of the lower spinal region (Centeno & Young, 2006; Cuenca-Guerra & Ouezada, 2004). These indentations have been colloquially described as either “butt dimples” or “back dimples.”

The following studies will emphasize the implications of the Dimples of Venus as an important factor in determining the attractiveness of an individual. The observable morphological cues of the dimples reflect the muscular, skeletal, and ligamentous tissues of the person. These underlying structures indicate an individual’s spinal support, spinal strength, spinal health, and ability to transfer heavy loads (Standring et al., 2008).

The DOV are an especially important cue in women because of the adaptive challenge of carrying offspring for nine months. Since the dimples are created by the biologically underlying physical structures of the lower spinal region, they convey information about a female’s spinal musculature and ability to carry offspring.

The following chapters will: (a) introduce the research approaches for investigating physical attractiveness, (b) convey evidence that physically attractive features are cues to reproductive fitness-benefits, (c) introduce the key components

of human anatomy and biomechanics for the DOV, (d) reveal research findings and (e) discuss limitations and future directions.

CHAPTER 1

INVESTIGATING ATTRACTIVENESS

Why do individuals find certain physical features attractive? The search for the origins of human physical attractiveness created two approaches of investigation: 1) the socio-cultural approach and 2) the adaptationist approach.

The socio-cultural approach emphasizes that an individual's beliefs about "what is attractive" is imposed upon their psyche through learned associations (Eagly et al., 1991). This line of thought posits that individuals will make observable associations about attractiveness through social norms conveyed by the proximate environment, such as the media (Groesz et al., 2002; Silverstein et al., 1986; Smolak et al., 1996). This perspective suggests that individuals learn about what should be attractive from culturally specific norms and ideals from the agents in the environment (Calogero et al., 2007).

An adaptationist approach utilizes an evolutionary framework that focuses on the selection pressures of adaptive challenges and their solutions. Essentially, through a long lens of evolutionary time, preferences for specific traits enabled reproductive benefits and an increase in a genes ability to propagate through individuals (Darwin 1859; Dawkins, 1970; Fisher 1930; Symons 1979; Trivers, 1972). Therefore, certain physical features are attractive because they signal reproductive value and fitness-benefits for gene propagation.

1.1 Evolutionary Theory and The Adaptationist Approach

1.1.1 Evolutionary Theory

Evolutionary theory is not necessarily a "theory" but a framework that focuses on the distal explanations of functional mechanisms for an organism (Lewis et al., in press). This evolutionary framework allows for the creation of middle-level theories, whereby specific hypotheses are generated and empirically tested (Buss, 1995; Lewis et al., in press). An adaptationist approach posits that various selective pressures in conjunction with adaptive challenges guided the emergence of adaptive solutions in the form of specific traits (i.e., behaviors or physical features). In other words, selection favors a genotype or phenotype that increases an organism's ability to survive or reproduce (Darwin, 1859; Trivers 1972). Natural selection, a middle-level theory, is one of the processes whereby specific traits (i.e. behaviors or physical features) emerge in a species through differential abilities in survival and reproduction (Darwin 1859; Wallace 1858). This middle-level theory has produced many separate but related hypotheses, such as sexual selection.

Sexual selection, as proposed by Darwin, suggests possible selection pressures on the formation of mate-preferences for physical characteristics and behaviors. Sexual selection occurs through the principles of 1) same-sex competition and 2) the preferences of the choosier sex (i.e., females among all mammals) (Darwin, 1859). Simply stated, a female will choose a characteristic in a mate which increases her ability to survive or reproduce viable progeny. If a female selects a specific trait related to fitness-benefits, then she will have a better ability to survive, reproduce and continue her genetic lineage. Men who have this fitness-benefit trait

will also reap the rewards of higher reproductive success and propagation of his genetic lineage by defeating same-sex competitors and mating with females. Additionally, offspring may benefit by having higher reproductive success as well (Fisher, 1930). This runaway process is one method which links a specific trait of one sex with the preference for that trait in its opposite sex partner.

"Good Genes" sexual selection is another related mechanism for the emergence of mate-preferences for specific characteristics. It suggests that certain characteristics are selected in a mate because the associated genes lead to fitness-benefits in reproductive success and offspring survival (Fisher, 1930; Thornhill & Gangestad, 1993; Williams, 1975). Good-genes sexual selection is not necessarily one specific theory, but a perspective that allows the generation of multiple theories and hypotheses. For example, one good-genes theory is based on the handicapping principle which proposes that costly traits are signals to superior genes (Zahavi, 1975). This handicapping principle suggests that individuals will select extravagant displays in mates because lower quality mates are not able to produce dishonest displays of quality (Hamilton & Zuk, 1982; Andersson, 1994). Overall, indicators of good-genes are selected in mates because they are honest signals to superior genetic quality that increases survival and reproductive success.

1.1.2 The Adaptationist Approach to Attraction

Broadly, an adaptationist approach investigates the "adaptive challenges" which our past ancestors faced and the outcomes of solving such challenges. Adaptive challenges encompass the situations which affected the reproductive success and survival capabilities for homo-sapiens' past ancestors (Lewis et al., in press). An individual that finds a successful solution to an adaptive problem is afforded advantageous benefits to their genetic lineage by increased reproductive

success. Simply stated, an individual that solves an adaptive problem will benefit over an individual whom did not successfully solve the problem.

An adaptationist approach to mate-attraction contends that current psychological mechanisms pertaining to mating behaviors and preferences for physical features had fitness-relevant benefits in human's ancestral past (Buss 1992; Fisher 1930; Symons, 1979). For instance, waist-to-hip ratios around 0.7 have been linked to better health and reproductive success in women (Singh, 1993). Men that had the preference to select women with these optimal waist-to-hip ratios would have benefited by increased levels of reproductive success relative to men who either had no preference or preferred different ratios.

The meta-framework of Evolutionary Theory is rooted in the evolving nature of an organisms' functionality through selective pressures and has produced various middle-level theories, such as Sexual Selection Theory and Good Genes Sexual Selection. The adaptationist approach is nested underneath evolutionary theory and investigates the adaptive challenges and solutions of our ancestors' past. Both of the previously discussed middle-level theories delve into the distal explanations for specific mating behaviors and preferences for certain physical traits. The overall takeaway is that the existence of specific mate preferences for physically attractive features is linked to fitness-relevant benefits in survival and reproductive success.

1.2 The Socio-Cultural Approach to Attraction

The socio-cultural view regarding attraction stipulates that preferences are derived from "culture" and social learning (Smolak & Levine, 1996; Sugiyama, 2005). This argument posits that an individual's specific community dictate and create preferences concerning what should be considered attractive. Within a cultural community "sociocultural agents" pass on information about attractiveness ideals

and beliefs to others (Calogero et al., 2007). These agents include: the media (e.g., television, magazines, blogs, and social media), peers, and familial members (Gordon, 2000). These agents will transmit ideals and beliefs onto others, who will then internalize them into their own ideals (Swami, 2015).

Cross-cultural studies concerning body ideals have been examined and explained through processes of "Westernization" and "Modernization" (Swami, 2015). Westernization refers to the transmission of the ideals of western countries, (e.g., The United States), towards individuals from different cultural communities. Evidence has shown that individuals from non-western countries will change their attractiveness ideals and body image beliefs when exposed to western agents, such as the media or a new living environment in a "western country" (Nasser, 1986; Bush et al., 2001). For example, immigrated South Africans into Britain changed their body ideals to match their host country of Britain instead of their previous native home environment (Tovee et al., 2006).

Modernization, which refers to urbanization, economic growth, and industrialization, has been purported as another process through which attractiveness ideals are transmitted (Gordon, 2001; Swami, 2015). It has been noted that as a community gains socioeconomic growth and stability, it will begin to change its "culture" as well. Furthermore, socioeconomic status has been identified as a predictor for attractiveness ideals about body types (Swami & Tovee, 2005).

Overall, the socio-cultural approach emphasizes that every community will have their own beliefs and values concerning "attractiveness" which they will pass onto those in the same community. In essence, the proximate society will dictate attractiveness. This implies a large variability in the observations of attraction preferences between cultures, yet there is no substantial evidence to support this

claim. Cross-cultural research investigating standards of attractiveness have revealed the existence of universally accepted attractive physically features (Buss, 1989; Sugiyama, 2005).

The socio-cultural approach should not be seen as a competitor to an adaptationist approach, but rather as an approach with a different level of focus. The socio-cultural approach focuses on the level of the proximate environment whereas an adaptationist approach encompasses the level of distal explanations. Both approaches should be used in conjunction to glean insights into attractiveness research without competition over which approach is "correct." Research concerning human attractiveness will need as many perspectives and approaches as necessary in order to gain the best comprehension into its secrets.

1.3 Summary

The study of attraction has been guided by two major approaches: the socio-cultural approach and the adaptationist approach. The socio-cultural approach places an emphasis on the proximate community and the transmission of beliefs concerning attractiveness through agents in the community, such as the media. In this approach, an individual is told about "what is attractive" and then internalizes it into his beliefs about attractiveness. The prime focus is placed on "society" as an entity that tells an individual about attractiveness ideals. The adaptationist approach uses an evolutionary framework to study attractiveness and emphasizes the link of attractiveness to fitness-relevant benefits traits whereby attractive traits are those which help survival and reproduction.

This thesis will utilize the adaptationist approach to attraction and elucidate the Dimples of Venus as a fitness-relevant trait. Chapter 2 will discuss the past and current research regarding physically attractive features and their links with fitness.

Chapter 3 will introduce the Dimples of Venus and their functionality through fitness benefits. Chapter 3 will also reveal the findings for the initial three studies. Chapter 4 will further investigate the DOV with a study entailing a methodological expansion. Chapter 5 will discuss limitations and future directions for the investigation of the DOV.

CHAPTER 2

PHYSICAL ATTRACTIVENESS AND FITNESS RELATED CUES

A constantly growing body of research has utilized an evolutionary framework to guide the study of physical attractiveness and link it to cues of an individual's health, mate value, and reproductive success (Barber, 1995; Cloud & Perilloux, 2014; Gangestad, 1993; Gangestad & Scheyd, 2005; Grammer et al., 2003; Lewis et al., 2015; Pfluger et al., 2012; Singh, 1993; Singh & Singh, 2011; Sugiyama, 2005; Tovee et al., 2012). While some specific characteristics are advantageous to all humans (e.g., strong immune system), a multitude of fitness-relevant traits are dimorphic among the sexes and become instigated during biological maturity through sex associated hormones (Cronin 1991; Smith et al., 2006). The following sections will give a brief overview regarding evidence of mate preferences for physically attractive morphological features and their associations with fitness benefits.

2.1 Non-Sex-Differentiated Preferences for Fitness-Related Cues

2.1.1 Health and Physical Attractiveness Preferences

Identifying and selecting a healthy mate is crucial for reproductive success and attaining other related fitness-benefits, such as protection or successful resource

acquisition. An important aspect to an individual's ability to survive and reproduce hinges on their mate's current and past health state. One method of obtaining information concerning an individual's health is through phenotypic traits whereby phenotypic traits are defined as the observable physical morphological components of an organism. The phenotypic condition of an individual conveys the capability to convert outside resources into fitness benefits and life longevity (Sugiyama, 2005). Issues with health, due to sickness or injuries, have the ability to greatly impact an individual's ability to survive and provide resources to offspring. For example, researchers found that bacterial infections were linked to the incapability to search for food during the days of severe infection (Sugiyama & Chacon, 2000). Given this information, individuals who have better immunity and stronger parasite resistance should be more valued as mates. In accordance with this information, a past study confirmed that physical attractiveness is more valued in environments with high levels of parasites (Gangestad & Buss, 1993).

2.1.2 Limbal Ring

The limbal ring is the dark outline that encompasses the iris and serves as a border to the white region of the eye (Shyu & Wyatt, 2009; Peshek et al., 2011). The thickness of the ring will become less visible as an individual ages or as medical issues arise, which affords an observable cue to reproductive fitness. The limbal ring serves as a factor of facial attractiveness since it displays signals of health and youth (Cavallotti & Ceruli, 2008; Peshek et al., 2011). In accordance with this notion, evidence has revealed that both sexes find the existence of limbal rings as more attractive in a mate (Peshek et al., 2011). The ring is also suggested to enhance the contrast against the white sclera of eye, which would also indicate healthy eyes (Peshek et al., 2011; Russel et al., 2014).

2.1.3 Skin Morphology

Skin condition is a visual cue to determine an individual's genetic quality, health status, developmental history, and has been linked to attractiveness (Fink et al., 2006; Symons, 1979, 1995; Stephen et al., 2009; Whitehead, 2012). Skin is an easily observable feature whereby an individual can visually attain information about a person's past and current health state (Fink et al., 2006; Sugiyama, 2005). Exposure to harmful ultraviolet rays will negatively impact the visual features on the skin and an individual with a better developed immune system will be more resistant to such changes (Fink et al., 2006).

Skin blemishes and facial attractiveness have been linked, whereby more attractive faces had lower levels of skin abnormalities (Sugiyama, 2005). Additionally, skin tones, such as red and carotenoid complexions are perceived as more attractive and healthier (Stephen et al. 2009; Whitehead 2012). Skin lesions and discoloration afford clues to a person's health state whereby evenly distributed smooth skin signals good genotypic qualities (Fink et al., 2001; Fink et al., 2006).

2.1.4 Dental Morphology

Teeth and dental aspects such as color, shape, and spacing signal good-genes and provide information regarding developmental history (Hendrie & Brewer, 2012, Thornhill and Moller, 1997). Oral health conveys past developmental stress as well as current bacterial resistance and body immunity (Hillson, 1996). Bright white teeth signal youth, good genotypic qualities, and reveal informational about an individual's past interactions with their environment to acquire proper nutrition (Symons, 1995). Additionally, teeth become darker and greyer as an individual ages (Hassan, 2000; Jahangiri et al., 2002), which allows as an observable cue to an individual's age and reproductive value.

2.1.5 Symmetry

Body symmetry is another method to observe genetic quality and attain information about an individual's developmental background (Moller & Swaddle. 1997). Fluctuating asymmetry (FA) is a term used to describe the changes of symmetry in an individual, whereby low FA describes an individual as having higher levels of symmetry. Individuals with low FA are rated as more attractive since the lack of asymmetry conveys that the individual is well suited to survive in its environment by overcoming pathogens and any past obstacles in the developmental process (Gangestadt & Thornill, 1999; Thornill & Gangestadt, 1993).

2.2 Female Preferences Regarding Men's Physical Attractiveness

Good-genes theories suggest that women have mate preferences for men who display honest phenotypic characteristics associated with better survival and reproductive abilities (Hamilton & Zuk, 1982; Thornhill & Gangestad, 1993; Zahavi, 1975). The following sections will highlight a few examples regarding the features that women find attractive in a mate and the associated fitness-benefits.

2.2.1 Facial Features

Muscular facial features allow observable cues to hormonal levels and genetic quality (Penton-Voak & Chen, 2004; Roberts et al., 2005). Masculine features in healthy men display good genotypic quality because the negative effects of testosterone to the immune system would be compensated by genetic quality (Folstad & Karter, 1992; Thornhill & Gangestad, 1993, Thornhill & Moller, 1997). Attractive men with higher levels of facial symmetry displayed bolder cheekbones and jawlines (Sheib et al., 1999). Facial components such as a wide jaw and a large chin are rated as more attractive in men and correlate to higher levels of testosterone

(Grammer & Thornhill, 1994; Mueller & Mazue, 1997). Women's preferences for masculine features would have links to more physically fit men who display honest signal of good genotypic quality. Direct and indirect benefits from selecting a masculine facial featured man would have allowed better reproductive success and an increase in offspring viability. In agreement with this notion, a study concerning the Kung San tribe found multiple correlations with facial features and number of offspring (Winkler & Kirchengast, 1994).

2.2.2 Body Cues

Body symmetry predicts attractiveness and health in men (Al-Eisa et al., 2004). Men with higher levels of body symmetry have higher levels of physical strength and are more muscular (Fink et al., 2014; Gangestad & Thornhill, 1997). Male height has been linked to health and reproductive success, whereby taller men have more offspring (Kirchengast, 2000; Mueller & Mazur, 2001; Nettle, 2002; Pawlowski, 2000).

A muscular body type is preferred in men and signals advantageous skills for hunting or protection (Buss & Schmitt, 1993, Dixson et al., 2003) Correlations have been found between highly attractive male bodies and better physical fitness (Honekopp et al., 2007). Additionally, fitter men reported more sexual encounters. Low waist-to-chest ratios (WCR) have been linked to attractiveness in men, whereby wide shoulders that taper down to narrow hips are preferred (Maisey et al., 1999, Price et al., 2013; Swami et al., 2007). This "V-shape" of a male's torso is related to upper body strength and physical prowess.

2.3 Male Preferences regarding Women's Physical Attractiveness

Both men and women have a preference for selecting mates with good-genetic qualities, yet male reproductive success is greatly impacted by a females' fertility and reproductive value (Buss & Schmitt 1993; Symons, 1979). Reproductive value relates to the capability to create viable offspring and since women's fertility decreases with age, youth is highly valued by men (Buss, 1989; Symons, 1979). Therefore, features related to youthfulness are regarded as attractive due to higher reproductive value. Additionally, other features of high reproductive value include traits that signal healthy hormonal production necessary to properly carry and maintain viable offspring. The following sections will provide evidence for male preferences regarding women's physical attractiveness and fitness-benefits.

2.3.1 Hair Quality

Hair length, lushness, color, and density have all been linked to attractiveness and reproductive value in females (Etcoff, 1999; Hinsz et al., 2001; Symons 1995). Nutritional issues and genetic problems have been linked to hair health. Lack of proper nutrition will lead to hair loss due to vitamin deficiencies as well as hair discoloration (Etcoff, 1999). Therefore, hair health signals an individual's past abilities to acquire proper nutrition in their current environment. Additionally, hair growth in women has been linked to the developmental time of their highest level of fertility (Etcoff, 1999). Research has indicated that men typically prefer long hair and that women with longer hair were younger (Etcoff, 1999; Hinsz et al., 2001). Furthermore, women with fewer health issues had their hair samples judged as better quality (Hinsz et al., 2001).

2.3.2 Facial Features

There is ample evidence that men prefer women with certain facial features, such as: smooth skin, small chins, high cheekbones, full lips, and large eyes (Cunningham, 1986; Fink et al., 2001; Gangestad & Scheyd, 2005). The preference for features concerning facial femininity have been linked to a woman's reproductive value and quality of life (Gangestad & Scheyd, 2005; Thornhill & Gangestad, 1993). As a woman ages, the accumulation of androgen exposure reduces the sharp feminine features of the face (Thornhill & Gangestad, 1993). In women, youth is linked to higher levels of fertility (Symons, 1979), which means that higher levels of facial femininity equate to higher reproductive value.

Facial femininity displays evidence of a woman's developmental background, such as her past ability to acquire proper nutrition and avoid disease (Gangestad & Scheyd, 2005). Additionally, women with more attractive facial features report fewer health issues (Hendersen & Anglin 2003; Hume & Montgomerie, 2001; Thornhill & Gangestad, 2005). Facial attractiveness has been linked with reproductive success (i.e., the number of offspring) for a hunter-gatherer tribe as well as for a modern community in Austria (Hill & Hurtado, 1996; Pfluger et al., 2012). Women with higher levels of facial attractiveness and reproductive success had facial features corresponding to more full lips, small noses, and higher arching brows (Pfluger et al., 2012). Additionally, women with evenly distributed facial skin color and smooth skin texture are judged as more attractive and associated with better health (Fink et al., 2001; Fink et al., 2006; Matts et al., 2007).

2.3.3 Body Cues

Men and women have clear dimorphic features concerning body shape and function. Women have a different topography in terms of adipose levels on the body,

whereby more fat tissue accumulates around the hips and breasts due to estrogen (Singh, 1993). Female fertility and pregnancy health have links to adipose levels in a woman's body (Singh, 1993; Frisch, 1990). Adipose levels are so important to the biological function of a woman's reproduction system that when a female becomes malnourished and in poor nutritional health, her body will no longer continue her ovarian cycle until she becomes healthy again (Frisch et al., 1987).

2.3.3.1 Waist-to-Hip Ratios. Given the importance of adipose levels in women and reproduction, Waist-to-Hip ratios have been proposed as a feature related to physical attractiveness and fitness benefits (Singh, 1993). Waist-to hip ratios (WHR) measure the relative size of the waist to the hip and results have indicated that men typically prefer women with waist-to-hip ratios around 0.7 (Singh, 1993; Singh 1994; Singh & Luis, 1995). Additionally, results indicated that figures with WHR closer to 0.7 were perceived as healthier. WHR is suggested to convey information about a woman's current hormonal and ovulatory regulation status. Young pre-pubescent girls share similar WHR values to boys, yet the values will begin to change for girls once puberty begins, signaling reproductive capability (Marti et al., 1991; Singh 1993).

Women with lower WHR have higher hormonal levels (e.g., estradiol and progesterone) which equate to higher levels of fecundity (Jasienska et al., 2004). WHR will also signal if a woman is pregnant since pregnancy will slowly change a woman's ratio value beyond a rating of 1. In this case, WHR will be an observable clue to the fertility availability of a woman. Additionally, cross-cultural studies have confirmed the preference for low WHR in women among many different nations (Furnham et al., 2002; Singh & Luis, 1995).

2.3.3.2 Breasts. Breast features, such as size, shape, symmetry and firmness have been linked to physical attractiveness and reproductive value. Breast ptosis, or level of sagging, changes as a woman ages which allows as an observable cue to reproductive value (Barber, 1995; Groyecka et al., 2017; Rinker et al., 2008; Symons, 1979). Larger than average breasts are rated as more attractive and perceived as healthier (Dixson et al., 2011; Furnham et al, 1998; Singh & Young, 1995). Women with larger breasts have higher levels of estrogen which equate to higher success levels of conception (Jasienska et al., 2004). Additionally, women with low levels of breast asymmetry have more offspring, reproduce at a younger age, and have reduced health risks (Manning et al., 1997; Moller et al., 1995; Scutt et al., 1997).

2.3.3.3 Lumbar Curvature. The spinal curvature of a woman has been linked to pregnancy-related fitness benefits (Lewis et al., 2015). During pregnancy, women gain weight in their abdomen which shifts their center of mass. This shift in weight increases harsh forces placed on the hips and has spinal health consequences. Selection pressures has guided the emergence of spinal wedging in women to minimize the negative health effects of a shifting center of mass (Whitecome et al., 2007). Research has revealed that attractive preference ratings are u-shaped for the amount of curvature in female spines, with optimal lumbar curvature around 45 degrees (Lewis et al., 2015). Too little curvature or too much curvature would lead to muscle strain or increases in spinal injuries.

2.3.3.4 Leg Length. Leg length has been investigated as a physical attractiveness feature which displays information about an individual's health and reproductive value (Gunnell et al., 2001; Smith et al., 2001; Sorokowski et al., 2012). Leg-to-body ratio (LBR) measures the amount of proportion which the leg accounts

for the body's total height (Swami et al., 2006). LBR is linked to cholesterol levels, heart health, and body blood regulation (Gunnell et al., 2003). Leg length conveys information about an individual's past developmental history since length has been shown to be affected by living conditions (Gunnell et al., 2003). Given that leg length is mitigated by an individual's growing conditions, it can be utilized as an observable cue to that individual's ability to acquire the proper resources during developmental growth. Additionally, women have higher LBR than men and it has been proposed as a method to differentiate a person as more feminine (Swami et al., 2006). LBR may have an optimal point whereby the maximum value is selected through biomechanical efficacy (Sorokowski et al., 2012).

2.4 Summary

Preferences for physically attractive features correspond to fitness-relevant benefits. Individuals that selected a mate with a beneficial trait to survival and reproductive success attained an advantage over others who did not display a preference. Good genes theory posits that individuals select mates who display signals pertaining to superior genes necessary for survival and reproductive success. Women will often select features of masculinity which are necessary for resource acquisition, whereas men will often select features pertaining to youth and reproductive value.

CHAPTER 3

THE DIMPLES OF VENUS AND FITNESS BENEFITS

3.1 Introduction

From an adaptationist perspective, the physical attractiveness of a feature is related to fitness-benefits (Barber, 1995; Cloud & Perilloux, 2014; Gangestad, 1993; Gangestad & Scheyd, 2005; Grammer et al., 2003; Lewis et al., 2016; Pfluger et al., 2012; Singh, 1993; Sugiyama, 2005; Symons, 1979). An individual will find a feature attractive on the opposite sex because it leads to direct or indirect fitness benefits to that individual's survival or reproductive success. These preferences concerning physical morphological traits have been formulated through evolutionary mechanisms such as sexual selection (Darwin, 1859). Countless studies concerning the physical attractiveness of morphological features have found links to health, reproductive value, and survivability (Cunningham, 1986; Fink et al., 2001; Gangestad & Scheyd, 2005; Gangestadt & Thornill, 1999; Singh & Singh, 2011; Sugiyama 2005; Thornill & Gangestadt, 1993).

3.2 Current Aim

The current aim of this study is to investigate the implications of a novel physical attractive morphological trait –The Dimples of Venus. The Dimples of Venus (DOV) refers to the skin indentations (i.e., dimples) formed on the lower

spinal region of the back above the buttocks. The DOV are formed by a collection of muscular, skeletal, and ligature components (Centeno & Young, 2006; Cuenca-Guerra & Quezada, 2004; Slipman et al., 2001). Since the dimples are paired with underlying biological structures, it may be an observable cue to an individual's genetic quality, health status, and reproductive value. The current set of studies will be the first to investigate the physical attractiveness of the DOV and its possible relationship to health and reproductive benefits. The following sections will explicate the biology and biomechanics of the regions related to the DOV.

3.3 Anatomy and the Dimples of Venus

3.3.1 Skeletal Components

3.3.1.1 Anatomy and Function of the Sacroiliac Joint (SIJ). The pelvis consists of two hips bones, the sacrum, and the coccyx. The sacrum and iliac (part of the hip bone) are connected by many thin ligaments and constitute a specific region of the pelvis, called the sacroiliac joint. The sacroiliac joint (SIJ) is an important region for weight bearing while in an upright position as well as minimizing the shock of energy for shifts in weight during ambulation, such as running or walking (Snijders et al., 1993; Standring et al., 2008; Wilder 1980).

3.3.2 Muscular Components

3.3.2.1 Multifidus and the Gluteus Maximus. Two major muscular components of the DOV are the multifidus and gluteus maximus (Centeno & Young, 2006; Cuenca-Guerra & Quezada, 2004; Slipman et al., 2001). The multifidus is a cluster of muscles connected to the spine which aid in back stability (Standring et al., 2008). The multifidus is regarded as the most important muscle regarding back

stability and strength (Wilke et al., 1995). The gluteus maximus is the largest muscle in the human body and is critical for balance during movements or standing erect (Standring et al., 2008).

3.4 Evolutionary Function and the Dimples of Venus

Previous notions concerning the region associated with the DOV came from plastic surgery journals and identified the sacral region as aesthetically pleasing (Centeno & Young, 2006; Cuenca-Guerra & Quezada, 2004). Yet, there has been no distal explanation for its appeal other than circular reasoning that it's pleasing. A bottom-up evolutionary approach will offer insights by identifying the potential adaptive origins and generating testable predictions.

As previously noted, the morphological cue of the DOV reflect important underlying biological structures of critical muscular, skeletal, and ligamentous tissues necessary for maintaining spinal health (Snijders et al., 1993; Standring et al., 2008; Wilder 1980). Men and women would benefit from spinal stability and efficient shock-reducing transmission of loads, therefore, selection would favor such spinal structures. The fitness benefits gained from individuals with these biological structures would instigate sexual selection mechanisms to identify mates with such morphological cues. Since the DOV signal beneficial tissues for maintaining a healthy lower-spinal region, it's predicted to evolve as a mate preference. A critical point for the signals relayed by the DOV is the major links with general spinal health as well as reduced lower-back injuries, especially among pregnant women. Pregnant women with low probabilities of lower-back injuries would have been more successful at everyday tasks, such as foraging for food to sustain herself and rearing viable offspring. Evidence has revealed that among a hunter-gather tribe, injured

individuals were not able to forage and were incapacitated to engage in normal day-to-day duties (Sugiyama & Chacon, 2000). Lower-back injuries can have serious consequences on an individual's living abilities (Albert et al., 2001; Gutke et al., 2008; Mens et al., 1996; Wilson, 2005) therefore individuals should seek a mate that displays advantageous benefits for survival and reproductive success.

Hypothesis 1: The presence of the DOV increases the attractiveness of both males and females due to the fitness-benefits of advantageous biological structures.

If the DOV are a desirable trait in an individual, then humans should have mate preferences to select an individual with the DOV. When given the choice to select if a person is more desirable with or without the DOV, a person with the DOV should be judged more attractive.

Prediction 1a: A woman will be judged more attractive if she has the DOV rather than if she did not possess the DOV as a morphological cue.

Prediction 1b: A man will be judged more attractive if he has the DOV rather than if he did not possess the DOV as a morphological cue.

The multifidus and gluteus maximus both play important roles in hip extensions which reap sex-differentiated benefits (Standring et al., 2008). Women endure the adaptive challenge of a forward shifting center of mass during pregnancy where torque pressures on the hip increase by 800 percent (Whitcome et al., 2007; Lewis et al. 2015) The increase in torque is corrected by shifts in posture and the extension of hips (Whitcome et al., 2007). Injury and spinal fatigue increases while maintaining the contraction of muscles involved in correcting posture (White & Punjabi, 1990). This injury and spinal risk during pregnancy would be mitigated by a well-developed multifidus and gluteus maximus muscle since they play important

roles in hip extension and back stability (Reiman et al., 2012; Wilson et al., 2005; Wilke et al., 1995)

Hypothesis 2: Women will gain additional sex-differentiated fitness benefits (related to pregnancy) from the structures pertaining to the DOV.

Since a well-developed multifidus and gluteus maximus contribute to the sculpting of the DOV, it becomes a reliable externally observable cue to underlying muscular structures. Pregnant women with these more developed muscular structures should have been more efficient and better able to engage in bipedal tasks. Men would not have gained a pregnancy-specific benefit of hip extensions, leading to sex-differentiated benefits directed more-so to women.

Prediction 2: Men's preferences for the DOV in women should be stronger than women's preferences for the DOV in men.

In summary, the presence of the DOV is predicted to increase the attractiveness of both males and females, yet due to women gaining both non-sex-differentiated and pregnancy-linked fitness benefits of the structures underlying the DOV, men's preferences for the DOV in women should be stronger than women's preferences for the DOV in men.

A series of three studies were conducted to determine the preference of the DOV between men and women. The studies utilized a forced-choice task and are cross-cultural (i.e., The United States of America and Turkey). Study 1 surveyed a United States population. Studies 2 and 3 surveyed two distinct samples in Turkey, whereby study 2 was conducted in English and study 3 was conducted in Turkish.

3.5 Study 1

3.5.1 Method

3.5.1.1 Participants. Three-hundred and ninety-seven men (M age = 36.99 years, SD age = 11.32, age range 19 – 74) and two-hundred and ninety-eight women (M age = 39.78 years, SD age = 12.28, age range 18 – 83). All participants were recruited from Mechanical Turk and were from the United States of America.

3.5.1.2 Photographic Stimuli. Male and female target stimuli were initially obtained through a web search, then manipulated afterwards with Adobe Photoshop. First, target images were obtained through searching the DeviantArt website (http://www.deviantart.com). The DeviantArt website was used for convenience because all photographs are directly linked to their photographers, which enabled easy access to obtain copyright permissions. The website was searched by keywords such as: “nude”, “profile”, “back”, “butt”, “back dimples”, and “butt dimples”. The searches resulted in over 20,000 images. From the specified search results, six different pictures of women and six different pictures of men were selected. Images were selected on the main basis that the target individual in the image displayed the Dimples of Venus on their lower back-side.

After obtaining the twelve total images (i.e., six women, six men) and consent from the photographers, the images were manipulated using Adobe Photoshop. All initial photographs contained individuals with the Dimples of Venus displayed. These target images with the Dimples of Venus displayed will be referred to as Morph 1 stimuli. Adobe Photoshop was used to “remove” the DOV from the target images and these images will be referred to as Morph 2 stimuli.

The removal of the Dimples of Venus was modified using multiple tools within Adobe Photoshop: the clone stamp tool, the brush tool, the smudge tool, and

the blur tool. All tools were used in conjunction to erase the DOV from the images in the most naturally appearing outcome. (See Appendix for stimuli)

3.5.1.3 Procedure & Questionnaire. Participants were recruited online using Mechanical Turk. The survey began with basic demographic questions, such as: age, gender, origin of birth, and sexual orientation. The next set of questions asked about sociosexual orientation and utilized the SOI-R (Penke & Asendorpf, 2008). The SOI-R measures an individual's mating style and level of sexual restriction. The last block of questions utilized a forced-choice paradigm that asked participants to "please click on the woman/man that you think is more attractive" (i.e., Morph 1 vs Morph 2 of the same individual).

During the last block of questions, two morph images of a target were shown simultaneously side-by-side. There were six questions pertaining to images of six target women followed by six questions pertaining to images of six target men. Each of these target images had two morphs. Morph 1 consisted of the target with the DOV and morph 2 was the same target with the DOV removed. Morphs were randomized in their side-by-side slots. The first six questions pertained to the six target women and the order of the women were randomized. The next six questions pertained to the six target men and the order of the men were randomized.

3.5.2 Results

All target images had two morphs. Morph 1 images displayed the dimples and morph 2 images displayed no dimples. Each participant made six decisions regarding the side-by-side images of the opposite sex. All participants' decisions regarding the selection between morph 1 and morph 2 were combined into a single column to compute a chi-square goodness of fit test. A null hypothesis would find no difference in the selection of either morph by participants. A chi-square goodness of

fit test was conducted to identify if the selection between the two morphs were equally preferred or biased. The chi-square test for male participants revealed a bias preference to select the women displaying the DOV $\chi^2(1, N = 2367) = 15.41$, $p < 0.001$ (fig. 1). The chi-square test for female participants revealed no bias preference to select either morph $\chi^2(1, N = 1494) = 0.217$, $p = 0.641$ (fig. 2). Results suggest that men have a preference to select the DOV images, whereas women appear to display no preference.

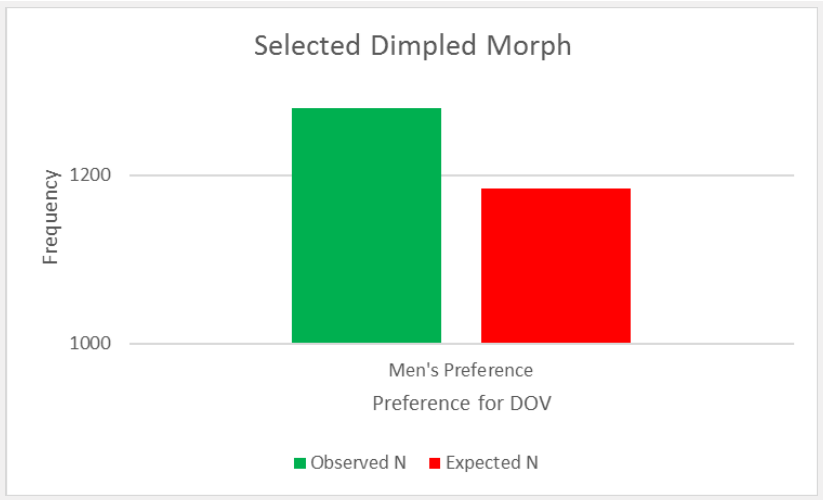

Figure 1. The observed vs expected selection of the morph displaying the DOV for male participants in Study 1.

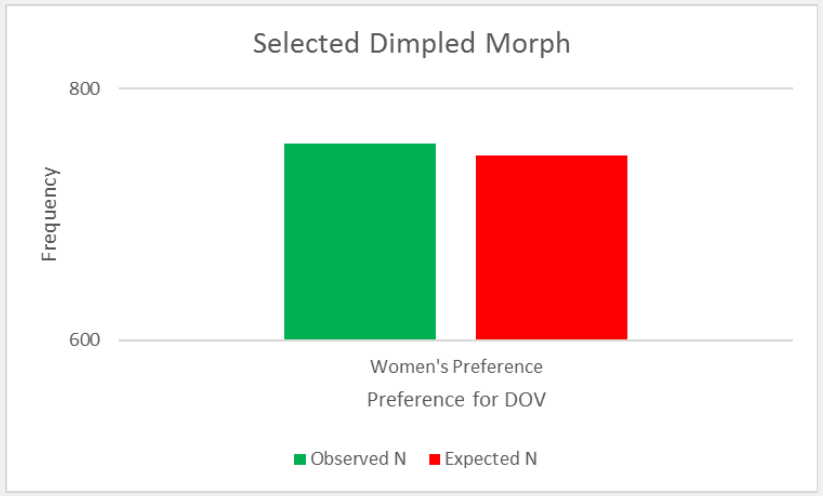

Figure 2. The observed vs expected selection of the morph displaying the DOV for female participants in Study 1.

3.5.3 Discussion

The results of study 1 support the prediction that a woman with the Dimples of Venus is seen as more attractive than without the DOV. When given the choice to select which morph of a woman is more attractive, male participants significantly selected the morph with the DOV. Women did not display this preference for men as previously predicted and it may appear to be a much lower influential feature of physically attractiveness than anticipated. The preference could be stronger for men than women because of the sex-differentiated fitness-benefits related to pregnancy and offspring viability.

3.6 Study 2

The DOV may be a physically attractive trait in women because they could be an observable morphological cue to beneficial underlying biological structures with pregnancy-related fitness relevance. In study 1, women did not show a preference for the DOV in men and it may have been due to the dataset. The age range of the participants varied greatly and the mean age was above the typical peak of higher reproduction success in men and women. Older individuals may enlist different psychological mechanisms for mate preferences and these adaptive preferences could impact the results (Buss, 1992; Kenrick et al., 1996; Kenrick & Keefe, 1996; Schmitt et al., 2001; Waynforth & Dunbar, 1995). In order to obtain a better suited homogenous dataset, a more focused sample of younger individuals around their prime reproductive age was obtained in Turkey.

3.6.1 Method

3.6.1.1 Participants. Forty-four men (M age = 25.95 years, SD age = 13.43, age range 18 – 96) and one-hundred and twenty-five women (M age = 21.80 years,

SD age = 4.07, age range 17 – 44) were recruited online. The survey was conducted in English and was completed by multilingual Turkish citizens.

3.6.1.2 Procedure & Questionnaire. Participants were recruited online through social media websites, such as Facebook, and given a link to the English version of the survey on Qualtrics. The survey procedure was an exact replication of study 1.

3.6.2 Results

All target images had two morphs. Morph 1 images displayed the dimples and morph 2 images displayed no dimples. Each participant made six decisions regarding the side-by-side images of the opposite sex. All participants' decisions regarding the selection between morph 1 and morph 2 were combined into a single column to compute a chi-square goodness of fit test. A null hypothesis would find no difference in the selection of either morph by participants. A chi-square goodness of fit test was conducted to identify if the selection between the two morphs were equally preferred or biased. The chi-square test for male participants revealed a bias preference to select the women displaying the DOV $\chi^2(1, N = 290) = 14.12$, $p < 0.001$ (fig. 3). The chi-square test for female participants revealed a bias preference to select the men displaying the DOV $\chi^2(1, N = 683) = 89.33$, $p < 0.001$ (fig. 4). Results suggest that both men and women have a biased preference for the DOV in an opposite sex individual.

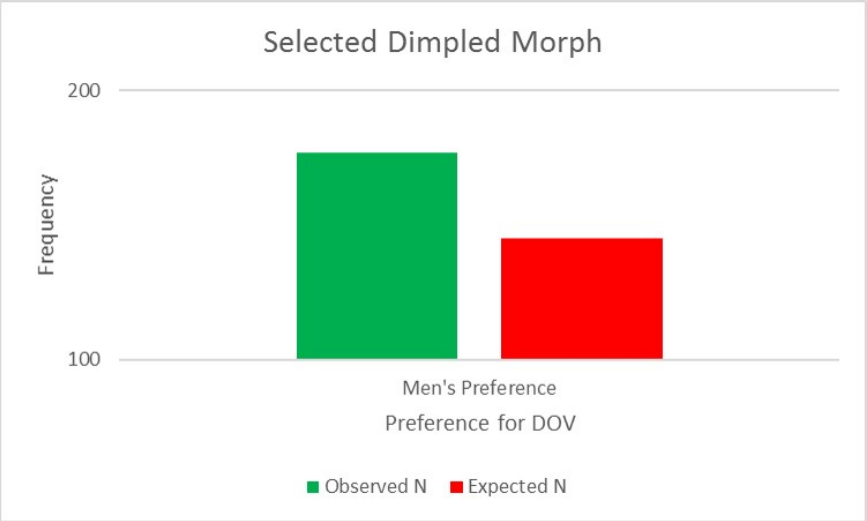

Figure 3. The observed vs expected selection of the morph displaying the DOV for male participants in Study 2.

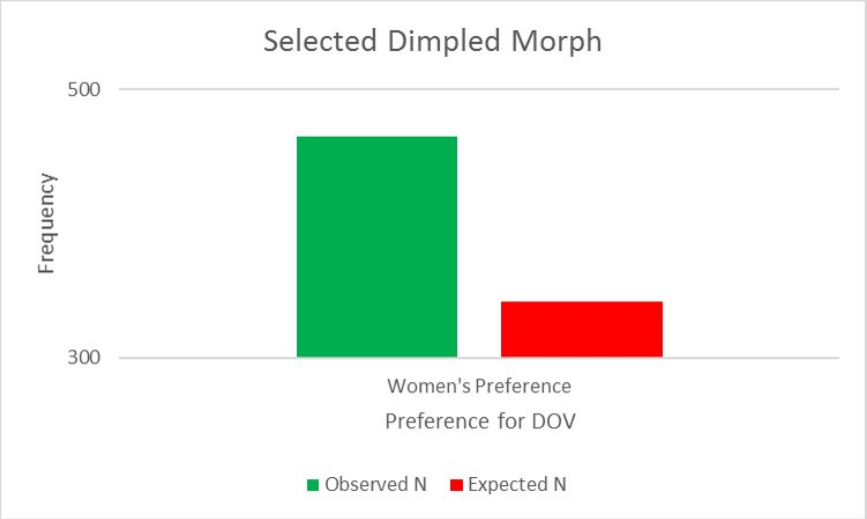

Figure 4. The observed vs expected selection of the morph displaying the DOV for female participants in Study 2.

3.6.3 Discussion

The results of study 2 supported the predictions that both men and women have a preference for the Dimples of Venus in an opposite sex individual. When given a choice, both sexes significantly selected the opposite-sex target individual who displayed the DOV. In agreement with study 1, men significantly preferred women with the DOV. Additionally, in this younger homogenous sample, women significantly preferred men who displayed the DOV.

3.7 Study 3

The DOV may be a physically attractive because they could be observable cues to advantageous biological structures that display good genotypic quality and spinal health in an individual. The previous two studies found consistent agreement with male preferences for the DOV in women, but was inconsistent in the findings concerning female preferences for the DOV. Study 2 was conducted with an English-speaking sample of individuals from Turkey and yielded initial evidence of a cross-cultural preference for the DOV. Study 3 will utilize a Turkish translation of the survey.

3.7.1 Method

3.7.1.1 Participants. Eighty-three men (M age = 23.43 years, SD age = 4.29, age range 18 – 41) and seventy women (M age = 22.06 years, SD age = 3.27, age range 18 – 38) were recruited online. The survey was conducted in Turkish and was completed by Turkish citizens.

3.7.1.2 Procedure & Questionnaire. Participants were recruited online through social media websites, such as Facebook, and given a link to the Turkish version of the survey on Qualtrics. The procedure was identical to the past two studies except that the survey was translated into Turkish. The translation process included: 1) an initial translation session using a collective committee of eight multilingual individuals, then 2) a back translation using an independent translator (Breslin, 1970; Douglas & Craig, 2007). If there was a translation inconsistency a second team of translators was utilized for clarification.

3.7.2 Results

All target images had two morphs. Morph 1 images displayed the dimples and morph 2 images displayed no dimples. Each participant made six decisions regarding the side-by-side images of the opposite sex. All participants' decisions regarding the selection between morph 1 and morph 2 were combined into a single column to compute a chi-square goodness of fit test. A null hypothesis would find no difference in the selection of either morph by participants. A chi-square goodness of fit test was conducted to identify if the selection between the two morphs were equally preferred or biased. The chi-square test for male participants revealed a bias preference to select the women displaying the DOV $\chi^2(1, N = 427) = 26.81$, $p < 0.001$ (fig. 5). The chi-square test for female participants revealed no bias preference to select either morph $\chi^2(1, N = 337) = 0.074$, $p = 0.79$ (fig. 6). Results suggest that men have a preference to select the DOV images, whereas women appear to display no preference.

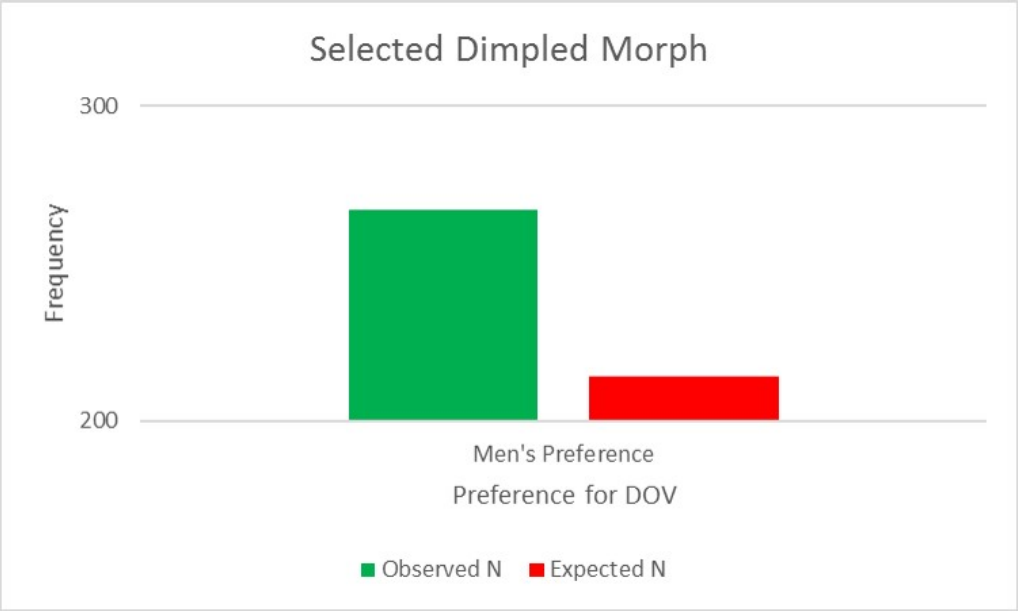

Figure 5. The observed vs expected selection of the morph displaying the DOV for male participants in Study 3.

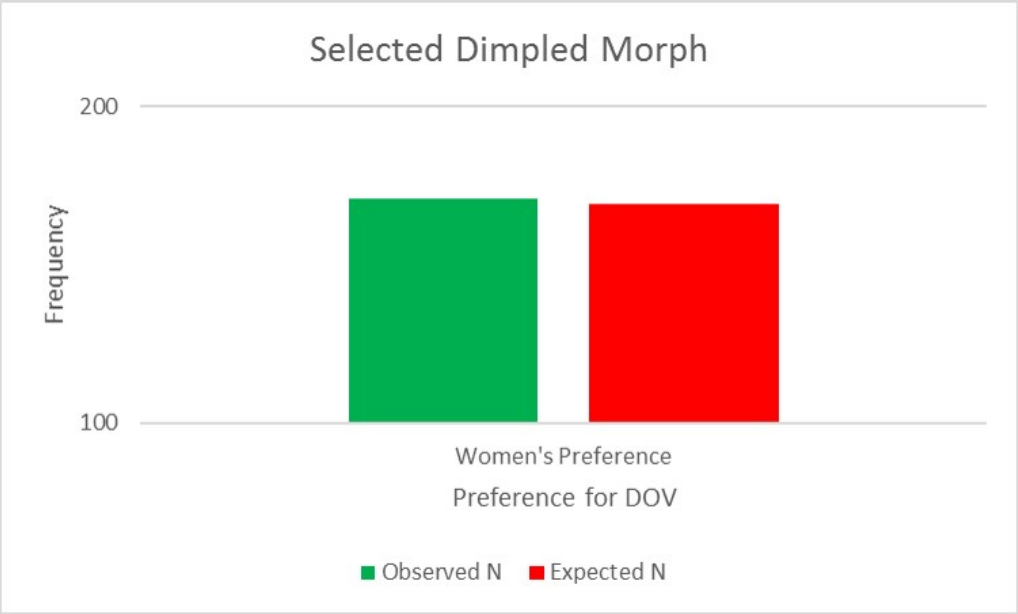

Figure 6. The observed vs expected selection of the morph displaying the DOV for female participants in Study 3.

3.7.3 Discussion

Study 3 was able to replicate and confirm a possible cross-cultural male preference for the DOV among a Turkish population. Additionally, it offers consistent agreement with the previous two studies whereby men significantly preferred women with the DOV. While studies 2 and 3 were both conducted using Turkish samples, inconsistencies arose regarding female preferences for the DOV. Overall, the three studies offer initial supporting evidence of a male preference for the DOV and weak support for a female preference.

3.8 General Discussion

The adaptationist approach posits that physically attractive features are linked to fitness-relevant benefits. Adaptive challenges in the mating domain in conjunction with selective pressures guided the emergence of psychological mechanisms for mate preferences attuned to solve these challenges. Individuals find a trait attractive

because it allows direct or indirect benefits for that individual through survival or reproductive advantages.

Broadly, the Dimples of Venus are physically attractive because they may be observable cues to advantageous biological structures for both sexes. However, women are afforded sex-differentiated benefits regarding the skeletal and muscular structures involved in the formation of the DOV. Evidence from the first three studies suggest strong support of a male preference for the DOV and weak support for a female preference. The difference in preferences between the sexes may be derived from sex-differentiated fitness benefits regarding pregnancy.

3.8.1 The DOV and Health. The appearance of the Dimples of Venus is created by a regional collection of anatomical components: 1) the sacroiliac joint of the skeletal system, 2) the gluteus maximus, 3) the multifidus and surrounding muscles of the muscular system, and 3) the connected ligaments. Each of these components play a role in maintaining spinal health and lower-back stability for an individual. Additionally, these components play a critical role for women during pregnancy.

The key skeletal structure involved is the sacroiliac joint (SIJ) which is crucial for: 1) posture while maintaining an erect position and 2) efficiently transferring heavy loads during movements (Standring et al., 2008). The SIJ is directly linked to lower-back pain and associated health injuries to the connecting muscles and ligament tissues (Hansen & Helm, 2003; McKenzie-Brown et al., 2005; Slipman et al. 2001). Up to 85% of all individuals will experience back pain at some point in life and SIJ pain is estimated to account for approximately 23% of all chronic back pain (Andersson, 1999; Bernard et al., 1987).

Lower-back pain and associated muscle injuries have a major impact on an individual's motor movements, such as walking (Gutke et al., 2008; O'sullivan et al., 2002; Wilson et al., 2005). Individuals with lower back pain will typically minimize movements to reduce pain which, in turn, weakens muscles from disuse (Wilson et al., 2005).

In ancestral times, many important bipedal duties involve the need of healthy movements, such as successful hunting or food gathering tasks. Therefore, mating with an individual with lower-back issues would have negative consequences to survival and reproduction. Individuals with lower-spinal health issues have higher levels of movement incapacity and muscle degeneration (Wilson et al., 2005) which would in turn affect their ability to acquire resources, sustenance, or protection for themselves and their mate. As previously noted, health issues affect the ability to acquire food (Sugiyama & Chacon, 2000). The current consequences of low back pain still play a major impact on resource acquisition and attaining a steady income for an individual and the family. Recent evidence has revealed that individuals with chronic back pain take more days off work and have higher levels of disability leave (Andersson, 1999).

3.8.2 The DOV, Pregnancy Related Health and Lower-Back Pain. Whereas both sexes have the possibility of acquiring lower-back health issues and muscle injuries, women have more direct links to health risks due to monthly menstrual cycles and pregnancy factors (DonTigny, 1985; Goldthwait & Osgood, 1905). During each menstrual cycle, women release a hormone called relaxin which relaxes the surrounding ligament tissues for the pelvis (DonTigny, 1985; Standring et al., 2008). The relaxed ligaments destabilize the pelvis and allow rotational risks of injury. Additionally, relaxin is crucial during pregnancy and conveys the same risks

of joint dysfunction (DonTigny, 1985; Maclennan et al., 1986; Standring et al., 2008). Women with higher levels of pelvic pain and more relaxed joints had higher levels of relaxin (MacLennan et al., 1986; MacLennan 1990). As a woman progresses throughout a pregnancy, there are changes to body shape and weight distribution. Women need to make adjustments to posture to compensate for the changes in weight distribution and the relaxin hormone allows tissues to become less taut for postural changes (Huang et al., 2002; Reese & Casey, 2015).

An estimated 50% of all pregnant women acquire lower-back pain while carrying offspring and the pain can typically continue after giving birth (Albert et al., 2001; Orvieto et al., 1994; Ostgaard et al., 1991; Ostgaard et al., 1996). One study documented that 72 % of women with low back pain report a resurgence of lower-back pain during each menstrual cycle due to negative hormonal effects (Mens et al., 1996). A woman with back pain will suffer many consequences to her daily life, such as socializing or the ability to engage in everyday tasks (Commissaris et al., 2002; Hansen et al., 1999; Mens et al., 1996). Pregnant women with lower back pain had issues related to walking, standing, and report reduced daily activity than before pregnancy (Hansen et al., 1999). Additionally, pregnant women report more days off work than before conception which may have financial implications to family life (Andersson, 1991; Hansen et al., 1999; Sydsj et al., 1998)

A critical source for lower-back pain and SIJ dysfunction emerges from repetitive shear forces during ambulation (Chou et al., 2004; DonTigny, 1985; O'Sullivan, 2002) and women are highly susceptible because hip torque increases greatly during pregnancy (Whitecome et al., 2007). One method for women to compensate for the increased levels of negative forces is through hip extensions (Standring et al., 2008; Whitecome et al., 2007) which are linked to the muscles

involved in the formation of the DOV (Reiman et al., 2012; Wilson et al., 2005). The gluteus maximus plays a major role in counteracting the toque during hip extension (Reiman et al., 2012; Wilson et al., 2005).

The gluteus maximus is connected to the SIJ and is necessary for normal day-to-day activities, such as walking or running (Wilson et al., 2005). The gluteus maximus helps in maintaining pelvic stability and gait control (Wilson et al., 2005). Pregnant women with lower back pain have weaker hip strength and walk more slowly (Gutke et al., 2008). A well-developed gluteus maximus muscle would afford bipedal advantages to women by mediating the harsh forces around the pelvis created during pregnancy. Since the DOV are linked to the gluteus maximus it affords an observable clue to better developed muscle tissues.

3.8.3 A Signal of Good Genes. The DOV in women display signals of good-genes able to counteract the risks of pelvic injuries during monthly menstrual cycles and pregnancy. Since a woman is more susceptible to injuries regarding the pelvic region due to hormonal releases of relaxin, a woman of higher genetic quality is able to overcome the weakening of tissues and health risks in the surrounding region through better developed ligaments and muscle tone from the DOV components.

3.8.4 A Signal of Developmental Stability. The appearance of the DOV are tied to important skeletal and muscular systems needed to maintain spinal stability and efficient load bearing. Issues with the SIJ or associated muscles would decline their appearance and strength due to changes in body movements to counteract lower-back pain. An individual that displays healthy DOV are signaling a healthy developmental past in biomechanics.

3.8.5 Considerations for Female Preference Inconsistences. Although men consistently preferred the DOV, female preferences were not in agreement among

the three studies. There are considerable muscular discrepancies between the male and female images utilized in the study. The men in the images display above average muscle tone and upper body strength. It is clear to the participant (i.e., women) that the men in these images work out and maintain well-developed muscle strength. The signals of physical prowess displayed by the muscles in the upper body and arms may be masking the signals of the DOV. The DOV may not be an important sign of spinal strength or developmental stability in the muscular men since the men already displayed many indicators of muscle strength necessary for successful hunting, protection, or resource acquisition. If the images of the men were less muscular, the DOV may have made a bigger impact on attractiveness ratings. Future investigation should use the images of less muscular toned men to identify how the DOV play a role in attractiveness judgments.

Additionally, depending on contexts, men and women differ in the values placed on certain mate characteristics (Buss, 1989; Buss & Barnes, 1986; Buss & Schmitt, 1993; Buss et al., 2001; Gangestad & Simpson, 2000; Gangestad et al., 2007; Li et al, 2011). Women typical place a greater importance than men on personality aspects, such as intelligence and dependability (Shackelford et al., 2005). These preferences are not necessarily consistent with the perceptions given to muscular men (Boothroyd et al., 2007; Perrett et al., 1998). Muscular men are perceived as less trustworthy and emotionally distant (Oosterhof & Todorov, 2008; Perrett et al., 1998). Muscular men are linked to high testosterone levels and men with higher testosterone levels have more marital problems, such as engaging in affairs or beating their wives (Booth & Dabbs, 1993). Therefore, women may bias the preference of features pertaining to strength and testosterone towards more valued personality characteristics.

3.8.6 Cross-Cultural Considerations. Although psychological mating mechanisms relating to reproductive value can be cross-culturally universal, their expressions are prone to vary in different cultures (Tooby & Cosmides, 1992). Ecological determinants (e.g., parasite prevalence) and cultural dimensions (e.g. moral values, religion) can influence the importance an individual place on certain mate preferences. For example, an ecological determinant such as parasite prevalence influences the value placed on physical attractiveness (Gangestad & Buss, 1993).

Studies 2 and 3 conveyed insight regarding a consistent male preference for the DOV in a Turkish population but inconsistencies arose among the Turkish women samples. Turkish women who took the survey in English displayed the preference for the DOV whereas the Turkish women who took the Turkish survey displayed no preference. One explanation may be due to extra exposure to western beliefs and ideals by the English-speaking Turkish women. Multilingual Turkish women may expose themselves to more western agents, such as English television. This exposure may lead these multilingual Turkish women to absorb and internalize different ideas about expressing their mating behaviors.

Alternatively, cultural dimensions of Turkish society may be playing a role in the expression of Turkish women's sexual preferences. Turkey is patriarchal and gender norms are taught with clear sexist boundaries (Sakallı, 2001). Ambivalent sexist theory suggest that stereotypes are enforced upon women to follow traditional rules and to placate submissively to male authority (Sakallı & Glick, 2003). Turkish society fosters the belief for women to obey traditional gender rules that value sexual modesty (Sakallı et al., 2007; Sakallı & Glick, 2003). The datasets from study 2 and 3 may have divergent types of women who either comply with Turkish norms to be

less sexually expressive or reject the typical norms enforced by the patriarchal society.

The women sample from study 2 consisted primarily of Bilkent University students and these women may have fewer pressures upon them to obey typical gender roles in Turkey. Students attending universities such as Bilkent University and Middle East Technical University typically have less religious inclinations and more open-minded values (Sakallı & Glick, 2003). This could suggest that the women participating in study 2 did not feel constrained or obligated to mask their sexual preferences whereas the women from study 3 were behaving in line with normative Turkish values. Women from study 3 may not interact with the divergent views and beliefs that a place like Bilkent would support. The survey itself was limited in its demographic questions so these notions are only speculative and need further investigation in the future.

CHAPTER 4

STUDY 4: A REPLICATION AND METHODOLOGICAL EXPANSION

4.1 Introduction

An evolutionary perspective investigates physical attractiveness through the lens of fitness benefits. Numerous studies have elucidated evidence that a feature is physically attractive because it has links to health and reproductive benefits. The Dimples of Venus is suggested as a previously unknown morphological trait that is judged as attractive due to its cue to beneficial underlying biological structures. Previous evidence from forced-choice studies 1 through 3 supported a consistent male preference for the DOV and a weaker or possibly null female preference.

4.2 Current Aim

The current aim of this second study is two-fold: 1) a replication of the results confirming a male preference for the DOV using previous images as well as new images and 2) the utilization of a different methodology (i.e., ratings scale) to judge the attractiveness of the DOV.

Replication studies are necessary to judge the validity and credibility of initial results (Brandt et al. 2014, Moonesinghe et al., 2007; Rosenthal, 1990; Schmidt, 2009; Simons, 2014). Additionally, the use of different methodologies is

instrumental to further validating initial hypothesis and predications (Amir & Sharon, 1990; Hendrick, 1990).

The current study will utilize the six target women images from the initial three studies and will add another new set of six target women images. The study will utilize a new methodology to judge the attractiveness of the DOV whereby participants will be judging images on a continuous ratings scale from 0-10, where 0 indicates extremely unattractive and 10 indicates extremely attractive.

4.3 Method

4.3.1 Participants

Two-hundred and forty-seven men (M age = 35.97 years, SD age = 11.12 years, age range 19 – 73) and one-hundred and fifty-seven women (M age = 36.62 years, SD age = 11.87 years, age range 18 – 73) were recruited online through social media and Mechanical Turk.

4.3.2 Photographic Stimuli

All images were acquired through the website www.DeviantArt.com using search result examples such as: “nude”, “profile”, “back”, “butt”, “back dimples”, and “butt dimples”. Twelve target women images were selected on the main basis that the Dimples of Venus were displayed on their lower backside. Six of the women target images were utilized in the initial three studies and were utilized in this replication. Additionally, six new target images of women were selected for further investigation.

Similar to the initial three studies, two morphs of all target images were created. Morph 1 stimuli consist of the images were the DOV are displayed and

morph 2 stimuli consist of the images with the DOV removed. The DOV were removed for morph 2 stimuli using editing tools from Adobe Photoshop.

4.3.3 Procedure and Questionnaire

Participants were recruited online using Mechanical Turk. The survey began with basic demographic questions, such as: age, gender, origin of birth, and sexual orientation. The next set of questions asked about sociosexual orientation and utilized the SOI-R (Penke & Asendorpf, 2008). The SOI-R was utilized to determine how unrestricted an individual feels about sexual matters. The last block of questions utilized a ratings task that asked "on a scale from 0-10, please rate this person's physical attractiveness."

During the last block of questions, a single morph image of a target woman was displayed on screen with a continuous ratings scale from 0-10 located below the image. Each of the twelve women targets had two morphs, which meant the generation of 24 questions regarding attractiveness judgments. The order of the 24 morph images were randomized.

4.4 Results

Women and men both participated in this task, but the study was only intended to assess the preferences that men have for women with the DOV, therefore gender was split and only male results utilized. A composite mean score was created for women displaying the dimples and a separate composite mean score for women not displaying the dimples. A paired-samples t-test was conducted to compare the conditions between the images of women displaying the DOV and the images of women not displaying the DOV. There was a significant difference in the value for

the images of women displaying the DOV (M = 7.51, SD = 1.4) and the images of the women without the DOV (M = 7.46, SD = 1.4); t(224) = 2.16, p = 0.032.

4.5 Discussion

The current study was able to replicate previous findings that the Dimples of Venus are an important feature regarding male physical attractiveness judgements for women. To further investigate the strength of the preference a different methodology was utilized than in the initial studies. Additionally, previously utilized images as well as novel images were instituted to further investigate the DOV preference. Results confirmed the initial findings that men will significantly judge a woman with the Dimples of Venus as more attractive than if that same woman was lacking the physical trait.

4.6 Overall General Discussion Summary

The Dimples of Venus are a morphological trait with ties to lower-back health, reproductive value, and signal good-genes. The DOV reflect important underlying biological structures of critical muscular, skeletal, and ligamentous tissues. The skeletal structures of the sacroiliac joint are essential for strength and stability (Standring et al., 2008). The SIJ is instrumental in supporting the spine and trunk as well as optimally transferring heavy loads during movements (Snijders et al., 1993; Standring et al., 2008; Wilder 1980).

Men and women would benefit from spinal stability and efficient shock-reducing transmission of loads; therefore, selection forces would favor preferences for such spinal structures. The fitness benefits gained from individuals with these biological structures would instigate sexual selection mechanisms to identify mates

with such morphological cues. Since the DOV signal beneficial tissues, it's predicted to evolve as a mate preference.

The multifidus and gluteus maximus both play important roles in hip extensions which reap sex-differentiated benefits (Standring et al., 2008). Women endure the adaptive challenge of a forward shifting center of mass during pregnancy where torque pressures on the hip increase by 800 percent (Whitcome et al., 2007; Lewis et al., 2015) The increase in torque is corrected by shifts in posture and the extension of hips (Whitcome et al., 2007). Injury and spinal fatigue increases while maintaining the contraction of muscles involved in correcting posture (White & Punjabi, 1990). This injury and spinal risk during pregnancy would be mitigated by a well-developed multifidus and gluteus maximus muscle. Therefore, women will gain additional sex-differentiated fitness benefits (related to pregnancy) from the structures pertaining to the DOV.

Since a well-developed multifidus and gluteus maximus contribute to the sculpting of the DOV, it becomes a reliable externally observable cue to underlying muscular structures. Pregnant women with these more developed muscular structures should have been more efficient and better able to engage in bipedal tasks. Men would not have gained a pregnancy-specific benefit of hip extensions, leading to sex-differentiated benefits directed more-so to women. Therefore, men's preferences for the DOV in women should be stronger than women's preferences for the DOV in men.

CHAPTER 5

LIMITATIONS AND FUTURE DIRECTIONS

5.1 Limitations

5.1.1 Forced-Choice Task

The forced-choice task utilized in the first three studies may lead to social desirability bias from the participants. During the task, participants simultaneously viewed both the morph with dimples and the morph without the dimples. Participants may have been able to see the perceptual difference between the images and selected the morph with the dimple more-so, thinking that the experimenter was looking for that response.

Although, social desirability bias may have been possible, it does not account for a reason why female participants did not consistently select the dimple morph across the three studies. Only the English-speaking Turkish women in study 2 significantly selected the dimpled morph. It may be possible that they selected the dimple morph because they felt it was the correct answer. Since the women are taking the survey in another language, they may approach the survey like a game whereby they select the “correct answer.”

Yet, the question to raise is why participants think the dimpled morph was the expected answer. While bias may occur, it is not entirely credible because there is no explanation for the bias to exist in the first place, other than sociocultural values or

an evolved psychological mechanism to feel attracted to individuals with the Dimples of Venus.

5.1.2 Stimuli

The images of men and women utilized in the four studies varied greatly in overall appearances and body positions. The twelve female images did not control for multiple variables, such as body posture or waist-to-hip ratios. For example, some images had women standing while others were sitting. Additionally, the women standing, employed differences in their overall body direction which could affect the visual appearance of the dimples. Some images were in black and white, some in color, and others with a combination of black and white with color highlights. Many images of women were nude and contained unique props or extra clothing decorations that could have been distracting to the participant. Although, it is beneficial to see the possible preference for the DOV among the noise in the pictures, it may underestimate the role that dimples play in attractiveness.

The male images had less variation than the women images yet there were still some noticeable concerns. The men in the photos were more muscular and physically fit than a typical man. The observable signals of muscle strength in the men may have overshadowed the role of the dimples in attractiveness ratings. It would be useful to see if adjusting the muscle tone of the men would change the impact of attractiveness ratings for the DOV. Unfortunately, finding male stimuli images proved quite difficult which is why these images were utilized.

Future studies should implement a more controlled set of images with less variance. The best method to minimize extra factors would be to use human models that could be actively positioned and photoshopped. The use of 3D-modeling could also be employed to create human-like compositions to judge attractiveness.

5.2 Future Directions

5.2.1 Dimple Factors

Individual differences in the appearance of the Dimples of Venus is quite noticeable *between* the sexes and *within* the sexes. Since the DOV are created by a collection of components, there is a wide variety in visual appearance. Future studies should investigate the attractiveness impact for dimple factors such as: 1) symmetry, 2) spread, 3) depth, and 4) area. These factors may signal differences in spinal muscle strength and stability.

5.2.1.1 Symmetry. Asymmetrical dimples would signal abnormal pelvic structure, which implies health hazards and resource costs in a mate. Abnormal pelvic structure would lead to higher probabilities of chronic back pain and spinal concerns. Asymmetry will unequally distribute the force upon the pelvis and surrounding structure, such as the ligaments and muscles, which create issues for ambulatory movement (Hungerford et al, 2003). Future studies could investigate the effect of asymmetry on attractiveness ratings.

5.2.1.2 Spread, Depth, and Area. The distance between dimples could signal information about muscle size or proportion. Additionally, as the dimples are situated on the border of the buttocks, the contrast generated by the contours could help identify high adipose levels which could signal fertility and the capability to reproduce. It may also signal athletic ability since it's where the gluteus maximus begins. Increased depth may indicate more strength for spinal balance.

Area of dimple size may relate to adjacent muscle size or pelvic room. The dimples are sculpted by muscle connections to the multifidus, which is concerned with back stability (Wilke et al., 1995). It may be possible that a larger area may

correlate with more muscle tissue and a more stable multifidus. For women, better back stability would mean lower health hazards during pregnancy and afterwards.

A medical approach could be implemented to identify the links with spinal health and pregnancy and these factors. Studies would need to employ a longitudinal approach and observe if there are links among the factors and spinal health.

5.3 Body Fat Distribution

Not all individuals clearly display the DOV and it may have links to fat adipose tissue distribution (Stonelake et al., 1988). The stimuli images of women in the previous four studies were not necessarily above average weight or capable of being classified as overweight. Future research can investigate how the appearance of dimples can influence attractiveness for more obese women. The proposed hypothesis in this thesis would suggest that a woman with more body fat displaying the DOV will be seen as more attractive than the same woman without the DOV. Additionally, it would be insightful to attain information concerning the correlation of body fat with the appearance of the DOV.

5.4 Additional Correlating Components

As previously mentioned, lumbar curvature has been investigated as a feature related to physical attractiveness (Lewis et al., 2015). Since the DOV have relations to the spine, they may also give cues to lumbar curvature. It may be that the multifidus and ligament tissues have links to spinal curvature and affect the appearance of the DOV. Further investigation is needed to identify if the changes in lumbar curvature affect the same components that create the DOV.

The DOV could display additional signals besides better lower-back health and stronger muscle support. For instance, the DOV may signal personality

characteristics such as the capability for commitment or level of emotional motivation. An individual may be able to change or strengthen the appearance of the DOV by weight-training, exercise, and healthy eating. Therefore, individuals with better sculpted DOV may be displaying signs of motivation and determination to be fit. Future work can see if the DOV have links with personality traits for the individuals displaying the DOV and the perceptions of personality that are placed upon individuals with the DOV.

5.5 Mating Strategies

Previous research has identified how mating strategies can be linked to the attractiveness of physical features and mate preferences (Buss & Schmitt, 1993; Confer et al., 2010). Sexual strategies theory posits that men and women have short-term and long-term mating strategies (Buss & Schmitt, 1993). Additionally, these strategies entail the use of different mate preferences. For instance, men value reproductive value more-so in a long-term mate than a short-term mate (Buss & Schmitt, 1993). A past study revealed that men who employ a long-term mating strategy will value a woman's face and men employing a short-term mating strategy will value a woman's body (Confer et al., 2010). Explanations posit that a woman's facial features may be a better indicator of reproductive value whereas body components may better indicate fertility. The next important line of research regarding the DOV should investigate its links to mating strategies among men and women.

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APPENDIX

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