Archives of Sexual Behavior
https://doi.org/10.1007/s10508-023-02575-w

ORIGINAL PAPER

Tendencies Toward Supernormality/Subnormality in Generating Attractive and Unattractive Female and Male Avatars: Gender Differences

Slobodan Marković[1] · Tara Bulut[1]

Received: 23 August 2021 / Revised: 18 February 2023 / Accepted: 26 February 2023

Abstract
In the present study, we investigated the differences in the experience of attractiveness and unattractiveness of human bodies. A total of 101 participants (55 females) were asked to create the most attractive and the most unattractive female and male figures using a computer animation. They performed this task by adjusting the size of six body parts: shoulders, breasts/chest, waist, hips, buttocks, and legs. Analyses indicated that attractive body parts were distributed normally with the peak shifted to moderately supernormal sizes, while unattractive body parts had mostly U-shaped or skewed distributions with extremes in super-supernormal and/or subnormal sizes. Generally, both male and female attractive bodies had prominent "sporty" look: supernormally wide shoulders and long legs. Gender differences showed that men prefer more supernomal masculine and feminine sizes, while women show an ambivalence toward both groups of traits. Principal components analysis revealed gender differences on the multitrait level: males focus on prominent masculine and feminine traits, while women focus on traits that make both male and female bodies more elongated and slender. Gender differences were in line with specific male and female positions in the partner selection process, while a certain tendency toward masculinization of the female body required the inclusion of social factors, such as the influence of the culture of a sporty and fit look.

Keywords Physical attractiveness · Femininity · Masculinity · Avatars

Introduction

As sexually dimorphic animals, we humans are emerging into two general body shapes—female and male. In addition to the difference in the total body mass (i.e., weight and height), men and women also differ in the specific distribution of muscles, fat, and bones (Wells, 2007). Specifically, compared to men, women have wider pelvic bones and more body fat accumulated mostly in the gluteofemoral region (hips and buttocks) and breasts (Clarys et al., 1984), while, compared to women, men have longer shoulder bones, as well as a greater muscle mass dominantly distributed in the upper body part (shoulders, chest, back, and arms) (Wang et al., 2001). The sexual difference in the size of individual body parts (e.g. the size of shoulders, the waist, hips etc.) results in a difference in the global body structure that shapes the typical feminine "hourglass" and the masculine "inverted triangle" appearance.

Evolutionary biologists and psychologists argued that this morphological difference reflects the difference in the reproductive roles of men and women: in particular, the robust masculine build has an important role in the male intra-gender competition, while the curvy shape of the female body is closely related to the fat deposits which are crucial for maintaining pregnancy and breastfeeding (Barber, 1995; Buss, 2003; Gangestad & Scheyd, 2005; Grammer et al., 2003; Singh, 2002; Symons, 1979). Stressing this morphological–functional connection, evolutionary biologists and psychologists hypothesized that the sexual selection has shaped the human's ability to identify the most promising mates who are well equipped for their specific reproductive roles. Specifically, in order to choose the best possible partners, men and women have developed sensitivity and preference for typical feminine and masculine traits as the honest signals of "good genes", i.e., general health, immunocompetence,

✉ Slobodan Marković
smarkovi@f.bg.ac.rs

[1] Faculty of Philosophy, Laboratory for Experimental Psychology and Department of Psychology, University of Belgrade, Čika Ljubina 18-20, 11000 Belgrade, Serbia

Published online: 30 March 2023

reproductive quality (fertility and fecundity) and competitive ability (strength, agility, endurance, etc.) (Barber, 1995; Buss, 2003; Gangestad & Scheyd, 2005; Grammer et al., 2003; Singh, 2002; Symons, 1979). However, some recent findings challenged the "good gene" hypothesis, showing that, at least for faces, a healthy lifestyle has a more significant effect on the experience of attractiveness than the strength of the immune system itself (Jones et al., 2021).

The following presents the findings of physiological and psychological studies that supported the "good genes" hypothesis (attractive is healthy, fertile and strong). In addition to positive signals, negative signals related to poor health, poor reproductive abilities and low physical competence are also important for sexual selection, so in this paper we focus on the physical constraints of both attractiveness and unattractiveness of body appearance. Our general theoretical framework is based on the model of sexual strategies in partner selection. According to this model men and women have partially overlapping criteria of attractiveness/unattractiveness, but they also have gender-specific standards arising from their different positions in the sexual selection and intra-gender competition. Finally, we expect that gender differences are reflected not only in the evaluation of individual body traits, but also in the multitrait domain, i.e., in the patterns of correlated traits.

Attractive Is Good

Waist and Hips

The most prominent feature of the typical female "hourglass" shape is a relatively small waist-to-hip ratio or WHR (smaller WHR = narrower waist and wider hips). Anthropometric data show that average WHR for women in the reproductive period ranges from 0.70 and 0.80, and for comparison, the average male WHR is between 0.85 and 0.95 (Dijkstra & Buunk, 2001; Hughes & Gallup, 2003; Singh, 1993). Many studies, including different cross-cultural studies, indicate that the most attractive female bodies have the WHR mostly within the above-mentioned range (Marković & Bulut, 2014, 2017a; Dixson et al., 2007; Henss, 2000; Marlowe & Wetsman, 2001; Singh, 1993; Swami & Furnham, 2008). Interestingly, when compared with the hips, a waist width is specified as a more significant constraint of physical attractiveness (Brooks et al., 2015). All these findings are in line with the evolutionary hypothesis that a typical body appearance is an honest signal of "good genes" indicating that a smaller WHR is associated with positive physiological parameters, such as a woman's general health (Björntorp, 1988; Folsom et al., 1993; Manolopoulos et al., 2010; Misra & Vikram, 2003) and their reproductive potential (DeRidder et al., 1990; Jasieńska et al., 2004; Lassek & Gaulin, 2006, 2008; Zaadstra et al., 1993). Taken separately, a smaller waist size indicates a better general health status (Björntorp, 1991; Misra & Vikram, 2003) and higher sex hormone levels (Jasieńska et al., 2004). On the other hand, pelvis size is associated with ease of pregnancy and giving birth, while fat deposits on the hips serve as additional energy reserves (Cant, 1981; Huss-Ashmore, 1980).

Buttocks

One of the possible reasons for the evolutionary adaptation which shaped the larger gluteal stores in the female body may lie in the importance of fat for the normal development of the relatively large brain of the human fetus. This assumption is indirectly supported by studies which have shown that the amount of this fat in mothers is associated with the normal prenatal development of the fetal brains and even with the further child's cognitive achievements (Lassek & Gaulin, 2006, 2008). Cross-cultural studies show that attractiveness of the female buttocks follows their average size and typical shape in a given population. For instance, African American men prefer larger buttocks than Caucasians (Cunningham et al., 1995; Thompson et al., 1996), while men from the Tanzanian Hadza tribe are more attracted to profiles of female figures with a more prominent (protruding) buttocks than American Caucasian participants (Marlowe et al., 2005). A recent study finds that the preference for buttocks does not depend as much on its size as on the shape, i.e., angle of the lumbar curvature (Lewis et al., 2015): the most attractive curvature is slightly greater than the average measure in the US female population (Fernand & Fox, 1985). Unlike the size, which is associated with fetal nutrition, the protruding shape of the buttocks may play a special role in sexual selection. According to some authors, in the protruded buttocks and arched back (i.e., greater lumbar curvature), men see a signal of female sexual proceptivity (similar arching the back is characteristic for estrus reflexes in females of many other mammals; cf. Beach, 1976; Dixson, 1998; Miller et al., 2007; Pazhoohi et al., 2018).

Breasts

Some studies suggested that large breasts indicate high reproductive potential in women (Jasieńska et al., 2004), as well as a low correlation with the lactation capacity (Anderson, 1988; Pond, 1998). Since their size is not related to milk production, the function of larger breasts may lie in the internal economy of nutrients (i.e., fat tissue in the breast as an additional energy deposit), but, according to some authors, large breasts have a more emotional function because they offer babies a comfortable and soft surface ("pillow"), thus contributing to the strengthening of the affective bond between the child and the mother (Smith, 1986).The research of the female breast attractiveness revealed no consistent results showing men's preference for all range of sizes including large (Singh & Young, 1995; Zelazniewicz & Pawlowski, 2011), smaller (Furnham et al., 2006), as well as medium-sized breasts (Wiggins et al., 1968). However, some recent findings suggest that, as in the case of the buttocks, the shape of breasts is a more important factor than their size. Namely, Havlíček and associates (2017) found that men prefer the breasts whose shape suggests firmness and tightness typical for young and fertile women. These findings are in line with an alternative evolutionary explanation which shifts the focus from breast function in child feeding to their role in the sexual selection as an advertisement for woman's sexual maturity (Marlowe, 1998).

Shoulders and Chest

In addition to generally higher muscularity (cf. Wang et al., 2001), one of the most prominent structural characteristics of the male body is the shoulder-to-hip ratio (SHR). Anthropometric measures show that the average male SHR is about 1.20 (Marković et al., 2016; Dijkstra & Buunk, 2001; Horvath, 1979), while, for comparison, the female SHR is lower, about 1.00 (Marković et al., 2016; Dijkstra & Buunk, 2001). In addition to SHR, there are also other ratios which highly predict male attractiveness, such as the waist-to-shoulder ratio (WSR) (Braun & Bryan, 2006), as well as the waist-to-chest ratio (WCR) (Fan et al., 2005; Maisey et al., 1999). Although different, all three measures overlap because they depict a male torso in the form of an "inverted triangle" (broad shoulder/chest and narrow hip/waist). Unlike the female body, the typical masculine body constitution is not so clearly associated with men's general health, but rather with physical strength and higher testosterone levels that play a significant role in their reproductive, competitive and protective behavior (Barber, 1995; Batrinos, 2012; Evans, 1972; O'Connor et al., 2004). Although muscularity (as well as other somatotypes) is very important for the experience of male physical attractiveness (e.g. Dixson et al., 2014), we did not include it in this study because we intended to examine the "pure" effects of the structural relationships of body parts regardless of the total body mass. Namely, if addition or subtraction of muscle mass is even, it does not substantially change the specific body structure—for instance, if we look at the stimuli used in the research of male body attractiveness we see that figures have variable muscularity but a constant SHR (e.g. SHR about 1.3 in Buchanan & Friedman, 2005; Frederick et al., 2005; Frederick & Haselton, 2007).

Legs

Relative leg length is usually specified as a leg-to-torso ratio (LTR): when the leg length is measured from the perineum to the ankle, then the average LTR for both males and females is about 1.00 (Greil, 2006; Martin & Nguyen, 2004; Smith et al., 2007; Sorokowski & Pawlowski, 2008). Studies show that the most attractive female figures have an average leg length (Frederick et al., 2010; Kiire, 2016; see also an extensive cross cultural study Sorokowski et al., 2011) or legs longer than the average (Marković et al., 2016; Bertamini & Bennett, 2009; Brooks et al., 2015; Fan et al., 2005; Rilling et al., 2009; Sorokowski & Pawlowski, 2008; Swami et al., 2006). A similar preference for longer legs has also been identified for male figures (Authors, 2016; Versluys & Skylark, 2017). Some medical studies support the "good genes" hypothesis indirectly showing that leg length in both women and men correlates with general health. Namely, short legs are associated with a cardiovascular disease risk (Gunnell et al., 2003), type II diabetes (Gunnell et al., 2005; Smith et al., 2001), and higher triglycerides and higher levels of insulin resistance in men (Smith et al., 2001). Also, the length of legs is positively correlated with a biomechanical efficiency, such as the ability to run (Cavanagh & Kram, 1989; Ropret et al., 1998).

Attractiveness and Unattractiveness

Attractiveness: Peak Shift from Average to Supernormal

While standard evolutionary approaches hypothesized that typical or average bodies are attractive because they represent the evolutionary most successful morphological solutions (cf. Buss, 2003; Symons, 1979), some studies questioned the primacy of average, showing that the most attractive female and male bodies are more feminine or masculine compared to the average ones (Marković & Bulut, 2014, 2017a, b; Marković et al., 2016; Dijkstra & Buunk, 2001; Pettijohn & Jungeberg, 2004; Voracek & Fisher, 2002). Ramachandran and Hirstein (1999) argued that the preference for more prominent or supernormal bodily features is based on the so-called peak shift effect according to which the appetitive (e.g. sexual) behavior intensifies when the key trigger features are amplified (Tinbergen, 1951; Tinbergen & Perdeck, 1950; see also Staddon, 1975). The preference for supernormality is based on clear evolutionary logic. Namely, increasing feminine-masculine differences sharpens the female or male sexual signals, which in turn leads to and increased limbic activation, and consequently results in higher attraction (Ramachandran & Hirstein, 1999). This hypothesis was indirectly supported by our recent findings showing that higher masculinity/femininity (measured by SHR and WHR, respectively) induced a faster gender categorization and higher attractiveness ratings (Authors, 2019). In other words, the amplification of typical sex signals helps both the ease of gender categorization, i.e., processing fluency (cf.

Reber et al., 2004; Winkielman & Cacioppo, 2001) and effective sexual behavior (cf. Ramachandran & Hirstein, 1999).

Unattractiveness: From Subnormal to Super-Supernormal

In addition to the experience of physical attractiveness, sexual selection also has its negative side which is manifested through the sensitivity to unattractive body features. While attractive bodies, as the evolutionary "winning" morphological solutions epitomized in the typical or average or somewhat supernormal appearance of men and women, unattractive phenotypic traits express adverse genetic mutations that can deviate from the zone of average in different directions (Darwin, 1861; Dobzhansky, 1970). Unfortunately, to the best of our knowledge, there are no studies specifically designed to investigate the physical constraints of human unattractiveness, so, there are no available data on exact values of the most unattractive bodily proportions and body part sizes. Nevertheless, existing data can suggest indirectly what the distribution of unattractiveness ratings might look like. Namely, if attractiveness ratings are normally distributed (as it was specified in our previous study, Marković & Bulut, 2017a; see also Frederick & Haselton, 2007), they peak at the average or slightly supernormal body part sizes, and then decrease in both directions, toward the reduced and enlarged body parts. On the other hand, the unattractive traits are expected to have inverse or U-shaped distributions with peaks at extremely smaller and larger sizes (i.e., less and more masculine and feminine) than the average (see Fig. 1).

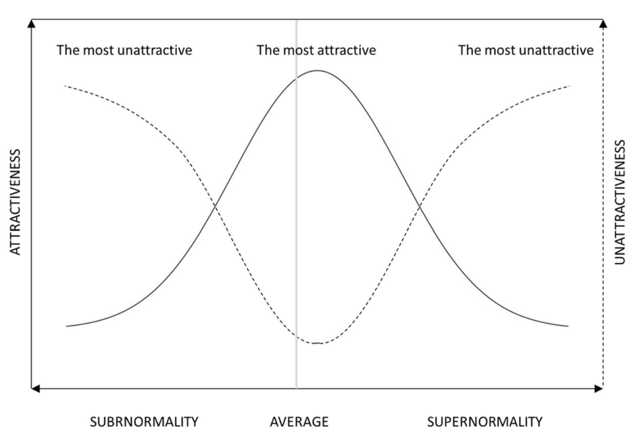


Fig. 1 Hypothetical distributions of attractiveness (full line) and unattractiveness (dashed line). Subnormality and supernormality refer to the sizes of either decreased or increased femininity/masculinity in respect to the average values. The average size does not correspond with the highest attractiveness which is slightly shifted toward supernormal sizes (see the text for details, cf. Marković & Bulut, 2017a)

Gender Differences

Having in mind that both attractiveness and unattractiveness are closely related to sexual selection, they should always be viewed through gender differences. According to evolutionary psychologists, gender differences should not be substantial, because men and women have relatively similar positions in the mating process: both compete with same-gender competitors and select other-gender partners (Buss, 1992; Tovée & Cornelissen, 2001). On the other hand, although small, gender differences are significant because men and women have distinct reproductive roles and different mating strategies (Buss, 2003; Buss & Schmitt, 1993; Schmitt, 2014; see also a cross-cultural study Buss, 1989).

Male Standards

In general, compared to women, men show a more pronounced preference for supernormal feminine characteristics of the female body (lower WHR, larger breasts and buttocks) and supernormal masculine characteristics of the male body (wider shoulders and chest) (Marković & Bulut, 2014, 2017a, 2019; Dagnino et al., 2012; Franzoi & Herzog, 1987; Horvath, 1979; Krantz et al., 1997; Lippa, 1983; Singh & Young, 1995). Men's preference for supernormal masculine and feminine traits is most likely based on their specific mating and reproductive motivations. So, guided by competitive motive, men emphasize the importance of enhanced masculinity of the male body: more masculine = stronger = more competitive = more attractive (Buss & Perry, 1992; Puts, 2010). On the other hand, the preference for supernormal feminine traits is driven by *sexual* motive which enhances men's sensitivity for honest signs of fertility of a potential partner. In the context of the real choice of partners, these criteria are especially evident when choosing a partner for long-term relationships, while in choosing a short-term partners, men rely primarily on the sexual availability of women, and only then on attractiveness (Buss, 2003; Buss & Schmitt, 1993; Schmitt, 2014).

Female Standards

According to Buss and Schmitt (1993), women, as well as men, have different standards of attractiveness for short-term and long-term relationships (see also Buss, 2003; Schmitt, 2014). Data support this distinction showing that women are primarily focused on a men's masculine appearance when ovulating, choosing a short-term partner (Gangestad & Thornhill, 2008; Kenrick et al., 1993), while they find masculine men less attractive for long-term relationships (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Rhodes et al., 2005; Wiederman & Dubois, 1998). Generally, in the transition from short-term to long-term relationships women reduce the minimal standards of male attractiveness from about the 70th to approximately 60th percentile (Kenrick et al., 1993; Regan, 1998). The period of the menstrual cycle also influences a woman's choice of partner and the preference for masculinity. Namely, women are more prone to short-term sexual relationships during ovulation showing a higher preference for more masculine men (Haselton et al., 2007; Schmitt, 2014), while during the non-fertile phase of the menstrual cycle they change their preference to less masculine traits (Penton-Voak et al., 1999). Moreover, some findings revealed that increased masculinity is even rated as unattractive by female participants (Lippa, 1983).

Female ambivalence toward the masculinity of a man's appearance has its adaptive function which lies in their sensitivity for the "dual nature" of testosterone (Kasperk et al., 1997). Namely, being linked to higher testosterone levels, higher masculinity provides men a greater protection ability (Barber, 1995), higher fertility and more intense sexual behavior (Hughes & Gallup, 2003), but on the other hand, high masculinity has its negative side manifesting in less desirable competitive, aggressive and possessive behavior, tendency to coercion and jealousy (Batrinos, 2012; Beck et al., 1976; Dijkstra & Buunk, 2001; O'Connor et al., 2004).

Being less competitive than men, women show less preference for enhanced feminine characteristics on woman's body (Buss & Perry, 1992; Puts, 2010). Moreover, according to the Social role theory, in modern society there is a noticeable shift in the focus of female competition from the sexual to the economic realm, resulting in the female acceptance of some traditional male traits (Eagly & Wood, 1999; Wood & Eagly, 2012). This phenomenon is partly reflected in the shift of the emphasis of the ideal female appearance from the increased feminine to the somewhat masculine traits (muscularity, fit build, etc.) (cf. Cunningham & Shamblen, 2003; Edwards et al., 2014; Pope et al., 2001).

Individual Traits, Ratios, and Patterns

According to evolutionary genetics, sexual (as well as natural) selection is not focused on changing single physical characteristics, but rather on a wider complex of traits that shape the masculine and feminine bodily appearance. Attempting to formalize such a multivariate phenotypic selection quantitative geneticists generated models in which (1) the change of multiple phenotypic traits across generations is mathematically conceptualized as a product of (2) multiple genetic traits variance (expressed as a genetic (co)variance matrix) and (3) a directional selection gradient (expressed as vector of selection gradients) (Blows, 2007; Fuller et al., 2005; Lande, 1980; Lande & Arnold, 1983; Lawler, & Blomquist, 2010; Philips & Arnold, 1989; Roff & Fairbairn, 2007; Walsh & Blows, 2009).

Although psychological studies do not deal with real evolutionary changes through generations, some of them still use a similar multivariate approach for investigating physical attractiveness. In one such study, researchers simulated the sexual selection within a digital ecosystem of 120 female figures with a varied 24 traits (Brooks et al., 2015). Participants rated the attractiveness of the figures, and after that, half of the least attractive figures were eliminated, while half of the most attractive ones were minimally modified (the simulation of small mutations), thus obtaining a new full set. This procedure was repeated through 8 generations until finally the most attractive morphological solutions emerged: slenderness, narrow waists and long legs.

Using a single session in which participants rated attractiveness of 81 female figures we tested the effect of sizes of four physical traits: WHR, breasts, buttocks, and tights (Marković & Bulut, 2014). Multiple regression analysis have shown that WHR was the best predictor of attractiveness in both male and female participants, with additional significant contribution of breasts size in male participants.

In the present study we analyzed both the individual and multitrate effects on attractiveness/unattractiveness of female and male bodies. To test multivariate effects on attractive traits, we used the principal components analysis (PCA) while for unattractive traits we used cluster analysis. In the next section, we will summarize the main predictions regarding these effects in the context of gender differences (i.e., male and female standards of attractiveness).

Purpose of the Study and the Hypotheses

The main empirical purpose of the present study was to specify the physical constraints on the experience of attractiveness and unattractiveness of female and male bodies, while its theoretical goal is to set sensitivity to these constraints in an interpretive framework of sexual selection principles and partner selection strategies. In the following paragraphs, we will briefly summarize and specify two general hypotheses that were developed in the introductory sections of the paper.

Attractiveness of Supernormal and Unattractiveness of Extremes

The first hypothesis is that both genders prefer the physical appearance of female and male bodies which signals health, reproductive and competitive abilities (cf. Barber, 1995; Buss, 2003; Gangestad & Scheyd, 2005; Grammer et al., 2003; Singh, 2002; Symons, 1979). We expect that the stronger expression of these "good signals" (a moderate tendency toward supernormality) is experienced as more attractive, while deviations from them (a super-supernormal and/or subnormal size of body parts) will be perceived as unattractive. Specifically, we hypothesized that the attractiveness of all body parts is normally distributed with the peak at supernormal sizes (cf. Marković & Bulut, 2017a; Ramachandran & Hirstein, 1999), while the unattractiveness has an inverse or U-shaped distribution which means that the extremely large or small body part sizes will increase ratings of unattractiveness (see Fig. 1). This general framework should apply to both genders, but, in some of its segments, significant gender differences are expected (see the next section).

Gender Differences: Males Prefer Supernomal More Than Females

Based on previous findings (Sect. 1..), we expected that compared to females, male participants will prefer larger breasts (cf. Jones, 1996; Marković & Bulut, 2014, 2017a) and buttocks in female figures (cf. Jones, 1996), as well as broader shoulders and chest in male figures (Franzoi & Herzog, 1987; Horvath, 1979; Lippa, 1983). According to the sexual selection theory, the male preference for enhanced masculinity is based on a stronger competitive motive (Buss & Perry, 1992; Puts, 2010), while the preference for enhanced femininity is associated with the tendency to choose the most fertile partner (Buss, 2003; Buss & Schmitt, 1993; Schmitt, 2014). On the other hand, being less competitive as well as more cautious when choosing a very masculine partner, females will show relatively lower preference for supernormal masculine traits as well as equally (Batrinos, 2012; Beck et al., 1976; Dijkstra & Buunk, 2001; O'Connor et al., 2004). Also, since they are less competitive than men, women will show a weaker tendency toward supernormality of the female body.

Method

Participants

A total of 101 undergraduate heterosexual students recruited from the University of Belgrade participated in the experiment (55 females, mean age 19.21 and 46 males, mean age 19.80).

Stimuli

Default stimuli, i.e., basic female and male figures (avatars) were created using a program for computer animation DAZ 3D Studio 4.6 Pro (the same program we used in our previous studies, cf. Marković & Bulut, 2017a, b; Marković et al., 2016). When specifying a basic avatar, we took care to maintain a compromise between two requirements regarding the ecological validity of stimuli appearance: (1) the figure should be relatively simple, without unnecessary details such as body hair, nipples, genitals, clothing, face, hair, etc., but also (2) it should be relatively realistic, natural, and voluminous as stylized sculptures (e.g., for a similar perceptual distinction between real and artificial faces see Balas et al., 2017). This way, we wanted to reduce both the offensive sexual connotation of bodily nudity and the effect of the perceptual context on physical appearance (e.g. swimsuit cut, leotards, etc.).

In a pre-study, we specified the zero points as medium or average looking sizes of six body parts: shoulders, breasts (female figures) or chest (male figures), waist, hips, buttocks and legs. Ten participants, including the authors, were working as a discussion group and made the final decisions by consensus. Participants were asked whether the program's default baselines (i.e., "zero" points) matched their representation of the average size of individual body parts. All participants specified the program's default baseline as corresponding to their representation of average size of all body parts. We additionally evaluated these specifications by measuring some main body part ratios, such as WHR, SHR and LTR of default avatars. All values were obtained from the avatar's frontal view. For the female default avatar, we obtained approximately average ratios: SHR = 1.05 (cf. Dijkstra & Buunk, 2001), WHR = 0.70 (cf. Dijkstra & Buunk, 2001; Hughes & Gallup, 2003; Singh, 1993), and LTR = 1.00 (cf. Smith et al., 2007). For the male default avatar we also obtained approximately average ratios: SHR = 1.25 (cf. Dijkstra & Buunk, 2001), WHR = 0.82 (cf. Dijkstra & Buunk, 2001; Hughes & Gallup, 2003; Singh, 1993), and LTR = 1.00 (cf. Smith et al., 2007). Unfortunately, we couldn't find the data for average breast and buttocks size in terms of corresponding ratios (e.g. breasts-to-waist or breasts-to-chest ratio or buttocks-to-waist ratio, etc.) in the available literature, so we only relied on the participant's subjective representation of the "average size". Nevertheless, we believed that the subjective impressions of the average breasts and buttocks size are about as reliable as impressions related to waist, hip, shoulders and legs (i.e., WHR, SHR, and LTR).

For all male body parts, as well as for female waist and legs, the minimum and maximum sizes were specified to be at the same interval relative to the zero (i.e., medium) point. However, for most female body parts the minima and maxima were asymmetrically positioned in respect to a zero point. Namely, in a pre-study, participants noticed that some minimal or maximal sizes of female body parts should be extended or reduced in order to obtain more natural extreme values: for shoulders, breasts and buttocks the maxima are moved toward larger sizes in respect to the minima (i.e., the interval 0-max was greater than the interval 0-min), while the hip minimum was moved toward smaller sizes (i.e., the interval 0-min was greater than the interval 0-max). All minimum–maximum ranges given in DAZ 3D Studio scale measures are shown in Table 1.

Table 1 Minima and maxima for all body parts sizes expressed in DAZ 3D Studio scale measures

	Female avatar Min to Max	Male avatar Min to Max
Shoulders	−50 to 150	−100 to 100
Breasts/Chest	−50 to 100	−1 to 1
Waist	−100 to 100	−1 to 1
Hips	−100 to 500	−60 to 60
Buttocks	−100 to 150	−100 to 100
Legs	−100 to 100	−40 to 40

Procedure

We used the production method for capturing the experience of attractiveness and unattractiveness of the human body. Participants were asked to generate the most attractive and the most unattractive female and male figures (avatars) using DAZ 3D Studio. They performed this task by adjusting the size of six avatar's body parts: shoulders, breasts (female figures) or chest (male figures), waist, hips, buttocks and legs. An example of the experimental display is shown in Fig. 2: scale sliders were placed on the left and the avatar figure on the right side. All scales were bipolar with zero points and both minima and maxima. The avatar height was 14 cm (13 deg).

Participants worked individually using a laptop computer Dell Inspiron 15 3000 (15.6-inch screen). After confirming that they understood the instructions, the participants proceeded to generate an attractive avatar by moving scale sliders. In order to observe the avatar's appearance from all sides, participants were free to rotate the figure in all three dimensions (for that purpose they were told to use a rotating tool, a cube icon placed in the up-right angle of display, see Fig. 2). After completing this task, participants saved the file with the generated avatar and opened a new one. One half of the participants first generated female, and then male avatars, while the other half generated avatars in the inverse order. In both groups, participants first generated attractive and then unattractive avatars.

Results

Attractiveness

Single Traits: Distributions and Differences

Figure 3 shows the distributions of the attractive sizes of body parts of female and male avatars. As expected, the distributions of the attractive body parts sizes were approximately normal (see Fig. 1). The baselines (zero points) as hypothetical representatives of the average sizes are marked by dashed lines.

Even a superficial glance at the charts reveals that in most cases the attractive means deviate from the theoretically defined baseline, which is specified as the DAZ 3D Studio default size (i.e., zero value of bipolar scales). In order to test the differences between empirically obtained attractive sizes and theoretically specified baseline sizes, we performed one sample *t*-test. Also, to specify gender differences in the generation of attractive avatars, we performed *t*-tests for independent samples, with the participants' gender as a group factor. The results of all *t*-tests are shown in Table 2. In addition to the individual parts, we also tested the differences for the two key ratios, SHR and WHR. We calculated them on the basis of transformed DAZ measures in millimeters (the frontal width of the shoulders, waist and hips of the avatar was measured).

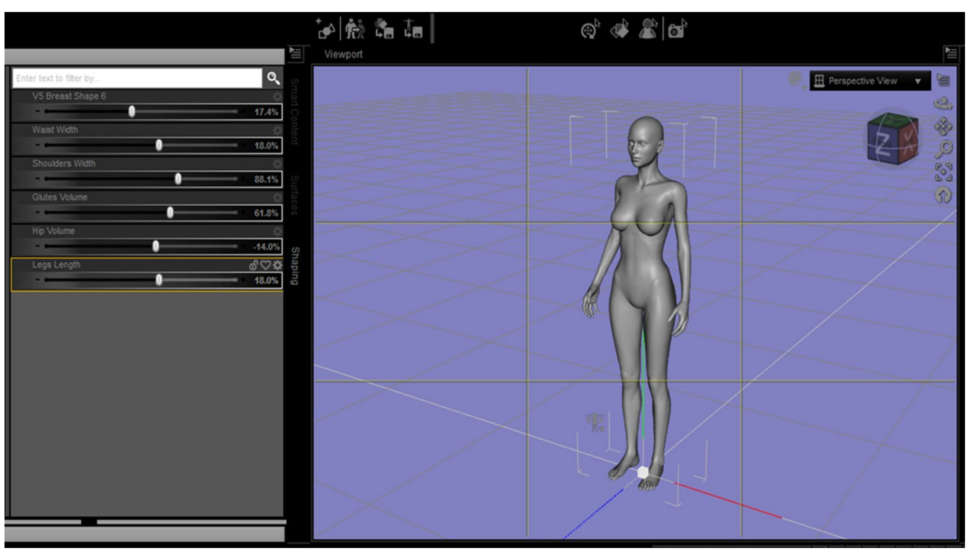


Fig. 2 Working display of DAZ 3D Studio. Left: scale sliders for the adjustment of body parts. Right: 3D rotatable figure

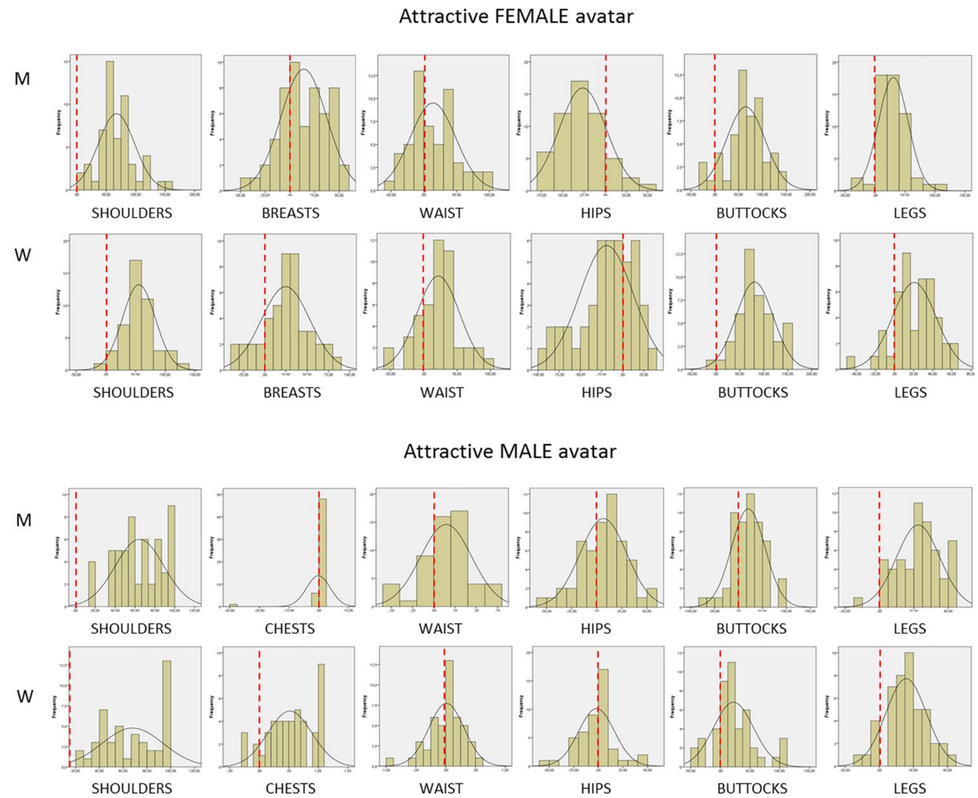


Fig. 3 The distributions of the attractive body parts sizes of female and male avatars are shown. W and M denote the productions by women and men, respectively. The dashed lines indicate the baseline (zero sizes)

Table 2 This table shows (1) *t*-tests of differences between empirically obtained attractive sizes of avatars' body parts and ratios and theoretically specified baseline sizes and (2) *t*-tests of gender differences in generated attractive body part sizes and ratios

	Women: Attractive-baseline	Men: Attractive-baseline	Attractive: Women–men
Female avatar			
Shoulders	$t(54) = 16.20, p < .01$	$t(45) = 13.55, p < .01$	$t(99) = 2.01, p < .05$
Breasts	$t(54) = 4.53, p < .01$	$t(45) = 5.88, p < .01$	$t(99) = -2.05, p < .05$
Waist	$t(54) = 2.99, p < .01$	$t(45) = 4.67, p < .01$	$t(99) = -1.20$, ns
Hips	$t(54) = -7.11, p < .01$	$t(45) = -4.08, p < .01$	$t(99) = -1.23$, ns
Buttocks	$t(54) = 11.5, p < .01$	$t(45) = 14.11, p < .01$	$t(99) = -2.02, p < .05$
Legs	$t(54) = 9.02, p < .01$	$t(45) = 6.14, m < .01$	$t(99) = 2.02, p < .05$
SHR	$t(54) = 20.5, p < .01$	$t(45) = 13.52, p < .01$	$t(99) = 2.01, p < .05$
WHR	$t(54) = 8.56, p < .01$	$t(45) = 7.40, p < .01$	$t(99) = -0.27$, ns
Male Avatar			
Shoulders	$t(54) = 19.61, p < .01$	$t(45) = 17.92, p < .01$	$t(99) = -0.66$, ns
Chest	$t(54) = -0.33$, ns	$t(45) = 9.39, p < .01$	$t(99) = -1.18$, ns
Waist	$t(54) = 3.58, p < .01$	$t(45) = 0.28$, ns	$t(99) = 2.23, p < .05$
Hips	$t(54) = 2.09, p < .05$	$t(45) = -0.67$, ns	$t(99) = 1.99, p < .05$
Buttocks	$t(54) = 4.30, p < .01$	$t(45) = 4.44, p < .01$	$t(99) = 0.25$, ns
Legs	$t(54) = 13.15, p < .01$	$t(45) = 8.96, p < .01$	$t(99) = 2.74, p < .01$
SHR	$t(54) = 10.32, p < .01$	$t(45) = 13.41, p < .01$	$t(99) = -1.97, p < .05$
WHR	$t(45) = 10.56, p < .01$	$t(45) = 13.37, p < .01$	$t(99) = -0.53$, ns

Results are shown in two sub-tables, separately for the female and male avatar

We also presented the results schematically. In Fig. 4 the basic avatars as well as the avatars reconstructed based upon the participants' production are shown: the symbols indicate the direction of the significant differences between the generated sizes and the baseline, as well as between the female and male participants. We believe that this figure can help us in the better understanding of the main findings. *T*-tests for independent samples indicate that both women

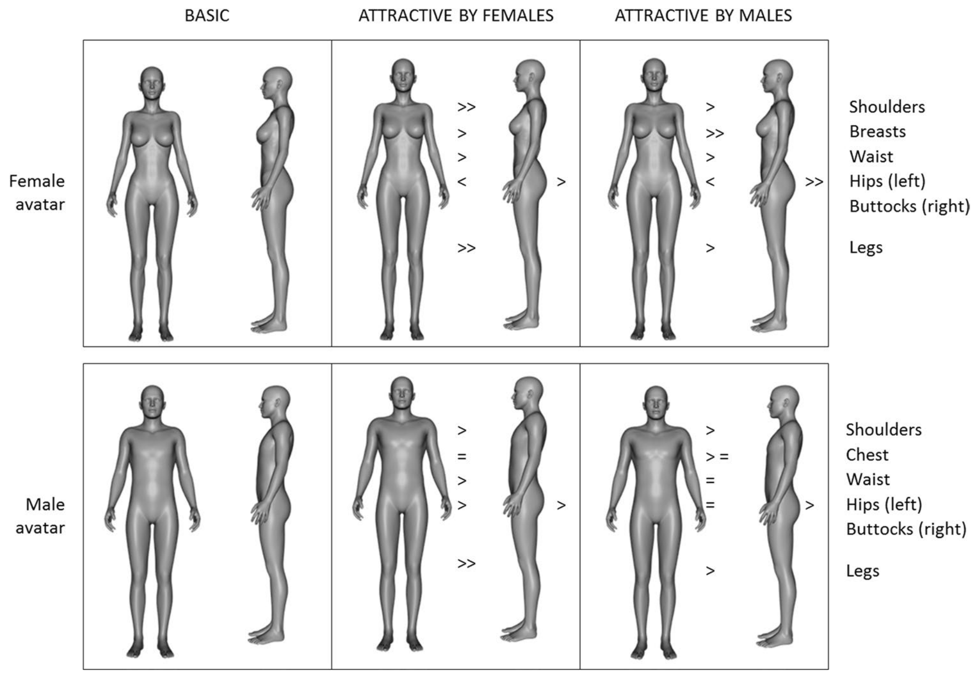


Fig. 4 The basic avatar and the reconstruction of attractive female and male figures according to the female and male participants' generating of six attractive body parts. Symbols greater-than (>), less-than (<), and equal (=) denote the significance and direction of the differences between attractive and baseline sizes: the attractive size can be larger (>), smaller (<) or equal (=) to the baseline sizes. The second symbol in the string (e.g. > > or > =) denotes gender (female–male) differences. For instance, if females have two symbols (e.g. > >) and males only one (e.g. >) that means that both genders generate larger sizes than the baseline, but females generate size larger than males do

and men increased almost all body parts of the female attractive avatar; only the size of the hips is reduced relative to the baseline. In other words, compared to the baseline figure, the attractive female avatar is larger—it has wider shoulders and waist, and larger breasts and buttocks, as well as a higher SHR (1.15 compared to default 1.06), WHR (0.74 compared to default 0.70), and a higher LTR (1.10 compared to default 1.03). The female attractive avatar is also taller thanks to a legs elongation—namely, since the torso was not changed, the length of the legs directly affected the height of the whole figure (see Fig. 4). Specifically, this avatar is generated as an interesting combination of some enhanced (supernormal) feminine features (larger breasts and buttocks) and some reduced female features (lower WHR and higher SHR).

A direct test of gender differences indicated that, although both genders generated female avatars with more prominent feminine characteristics (i.e., larger breasts and buttocks), men generated avatars with significantly larger breasts and buttocks relative to women. Similarly, although both genders generated female avatars with more prominent masculine characteristics (i.e., wide shoulders), women generated wider shoulders and higher SHR compared to men. Also, although both genders generated female avatars with longer legs, women generated avatars with longer legs relative to men.

Similar to a female avatar, the male attractive avatar is generally larger and taller than the baseline. Specifically, women generated male avatars with all body parts larger than the baseline, except for the chest, whose size didn't differ significantly from the baseline size. On the other hand, men increased all body parts relative to the baseline, except the waist and hips, whose size didn't differ significantly from the baseline sizes. In other words, women only partially increased the baseline avatar's masculinity (shoulders were extended, while the chest was left unchanged in respect to the baseline), whereas men consistently increased the masculinity of the avatar by the extension of both shoulders and chest, leaving the waist and hips size at their baseline level, which resulted in a higher SHR (1.32 compared to default 1.25). Both genders also increased WHR of the male avatar (0.85 compared to default 0.82), which additionally intensified the masculine appearance. Finally, the attractive male avatar is also higher due to higher LTR (1.07 compared to default 1.03). Analyzing direct gender differences in the generation of a male attractive avatar, we didn't obtain a difference in the shoulders, chests and buttocks size. However, compared to women, men generated male avatars with a narrower waist and hips, as well as a higher SHR.

Multitraits: Principal Components Analysis

In order to specify the inter-relations between different attractive traits, we performed a principal component analysis (PCA). A PCA with a varimax rotation was performed on data of both the male and female avatar and for both male and female participants. Results of the analyses are shown in Table 3.

Attractive Male Avatars Male and female participants show a focus on different combinations of traits when generating an attractive male avatar. In men, Factor 1 refers to the gluteofemoral region (negative correlation between buttocks size

Table 3 Results of the principal components analysis (varimax rotation) of attractive male and female avatars for male and female participants. In all analyses, two components were extracted. For each component, the percentage of the explained variance and corresponding indexes of rotated matrices are shown (indexes above .5 are bolded)

	Male participants			Female participants	
	F1	F2		F1	F2
	24.62%	23.52%		27.88%	19.65%
Attractive male avatars					
Shoulders	−0.221	**0.843**	Shoulders	**0.620**	−0.151
Chests	0.214	**0.736**	Chests	0.281	**0.573**
Waist	0.375	0.307	Waist	**0.684**	0.241
Hips	**0.772**	0.121	Hips	0.371	0.272
Buttocks	**−0.784**	0.210	Buttocks	**0.714**	0.000
Legs	−0.105	−0.157	Legs	0.257	**−0.850**
	29.12%	20.76%		25.41%	19.98%
Attractive female avatars					
Shoulders	**0.616**	0.161	Shoulders	0.469	0.337
Breasts	0.236	**0.815**	Breasts	**−0.750**	−0.181
Waist	0.343	0.242	Waist	0.175	**0.720**
Hips	**0.617**	0.018	Hips	−0.115	**0.767**
Buttocks	−0.096	**0.803**	Buttocks	0.071	0.037
Legs	**0.805**	−0.094	Legs	**0.755**	−0.242

Bold values indicate the most saturated (i.e., above 0.500)

and hip width), and Factor 2 on the shoulder–chest girdle (positive correlation between shoulder and chest width). On the other hand, Factor 1 in female participants refers to the general size of the male body (a positive correlation between shoulder and waist width and buttocks size), and Factor 2 to elongation and slenderness of the figure (negative correlation between chest width and leg length).

Attractive Female Avatars In Factor 1 male participants focus on the general size of the female body (shoulder and hip width and leg length), while in Factor 2 two prominent feminine characteristics were focused—breasts and buttocks (these two traits are positively correlated). On the other hand, in Factor 1 female participants focus on elongation and slenderness of the female body (a negative correlation between breast size and leg length), while Factor 2 reflects the tendency toward the maintenance of a constant WHR (a positive correlation between waist and hip width).

Unattractiveness

Single Traits: Distributions and Differences

Figure 5 shows the frequency distributions of the unattractive sizes of body parts. As expected, these distributions were mostly U-shaped (see prediction in Fig. 1), and analyses have shown that such a shape can be fit well with the quadratic function. Appendix A presents the results of the multiple regression analysis in which linear and quadratic functions were contrasted as predictors of these frequency distributions, and Fig. 5 shows the parabolic plots for distributions that have a significant prediction of a quadratic function.

The key feature of these distributions is that they have dominant extreme sizes (both or one), which means that the majority of participants, when generating unattractive body parts, increase or decrease the size to the minimum or maximum of the scale. In order to test the significance of the differences in the number of participants who generated extreme (the smallest and largest) sizes of unattractive body parts we used the chi-square test. Extreme sizes were specified as 25% of the smallest and 25% of the largest sizes. Interestingly, this 50% of extreme sizes was covered by about 85% of participants (for different body parts the range goes from 71 to 93%), indicating that only about 15% of the participants generated avatars with medium sizes as unattractive. A simplified symbolic presentation of the significant differences in the frequency between small and large sizes is embedded in the histogram charts (see Fig. 5), while the numerical results of χ^2 tests are shown in Appendix B.

The results of the chi-square test show the following. Women and men agree that a female avatar is equally unattractive with very wide and very narrow shoulders and very wide and very narrow hips. Also, both genders found unattractive only a very wide waist and very short legs, and a not

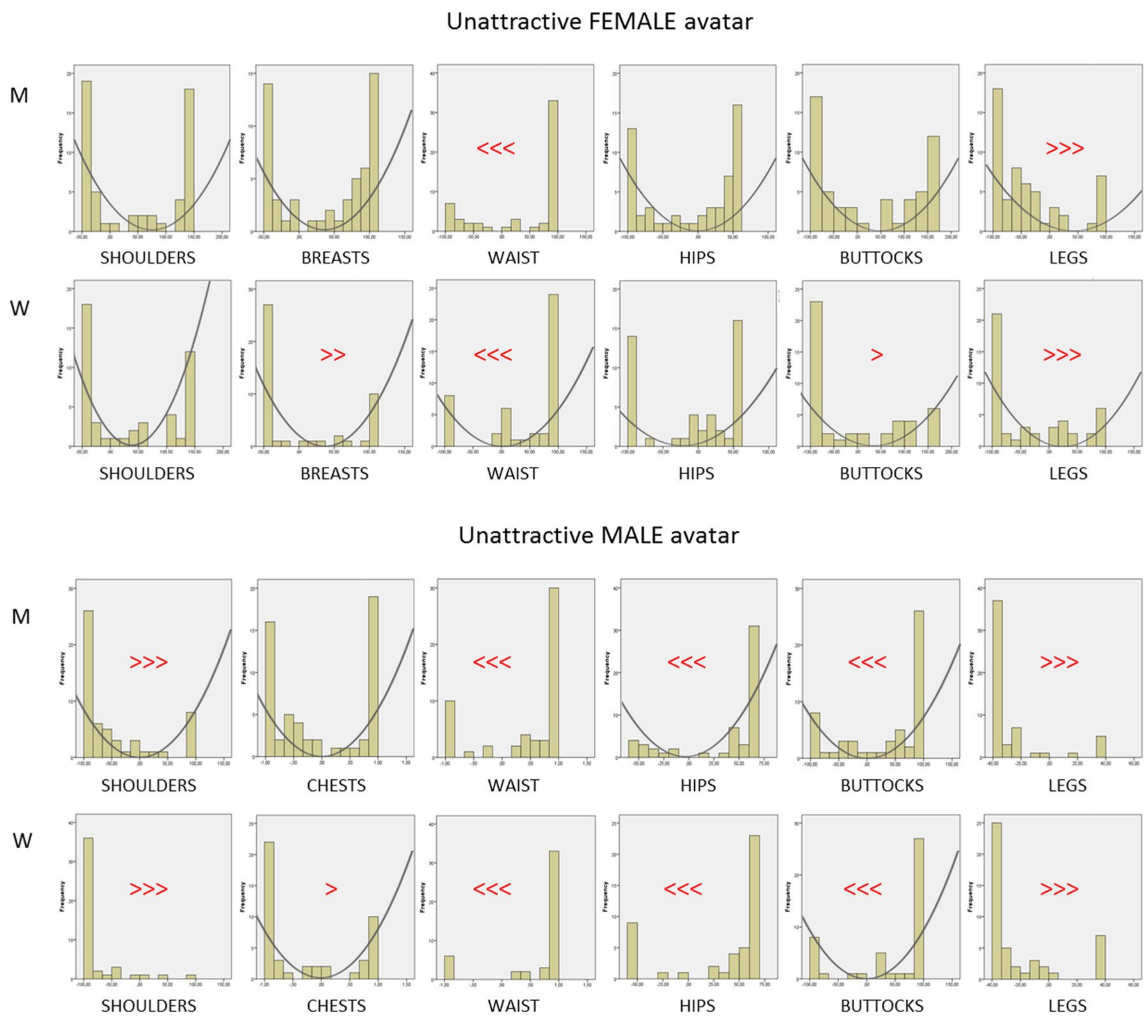


Fig. 5 The frequency distributions of the unattractive body parts sizes of female and male avatars are shown. The quadratic functions are plotted for distributions that have a significant prediction of this function. M and W denote the productions of women and men, respectively. Symbols greater-than (>) and less-than (<) denote the significant difference in frequency of the 25% largest and the 25% smallest sizes: > > > stands for $p < .01$, > > stands for $p < .05$, and > for $p = .06$ (marginal significant difference). The direction of angle indicates the direction of difference: differences where small sizes are more frequent than large ones are denoted by the angle pointing to the right, e.g. > > >, while differences where large sizes are more frequent than the smaller ones are denoted by the angle pointing to the left, e.g. < < <. See the text for a more detailed explanation

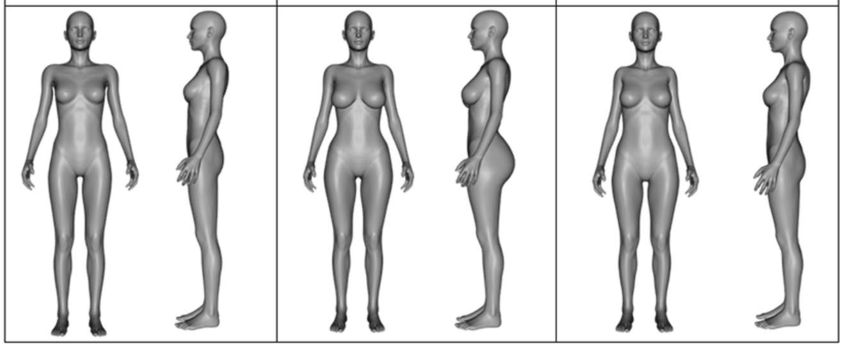
very narrow waist and very long legs. On the other hand, some gender differences have been identified. Namely, women found unattractive both very large and very small breasts, and both a very large and very small buttocks. Men, however, found only very small breasts and buttocks unattractive, but not very large ones. In the case of the *male avatar*, women and men largely agree that only one extreme size is unattractive—narrow shoulders, wide waist, wide hips, large buttocks and short legs. The only gender difference was identified in the chests: for women both wide and narrow chests of the male avatar are equally unattractive, while men found only narrow chests unattractive.

Multitraits: Cluster Analysis

We could not conduct a PCA on the data for unattractive traits because they were not normally distributed. We also found that data normalization would not be appropriate because it would disrupt the natural relationships between the variables (as presented in the previous section, the deviation from a normal distribution is not small but rather substantial, see Fig. 5). Instead of PCA we used a cluster analysis (K-means) to specify a multitraits grouping. We have performed a cluster analysis for attractive avatars as well, but results were not much informative—representatives of all clusters (3 and 2 in different analyses) were very similar to average attractive avatars (see Fig. 4). In other words, relatively small variability of

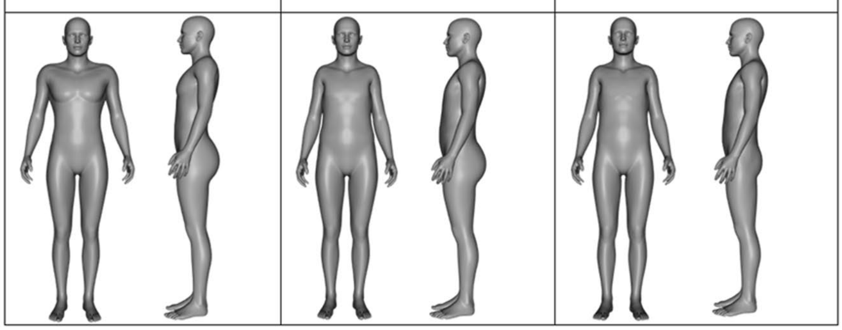
Fig. 6 The results of the cluster analysis (K-means) for the female and male avatar, as well as the percentage of women and men by cluster are shown. Three clusters are defined: Masculine +, Feminine + and Asexual. The values of the final cluster centers were expressed in a unique range from 0 (minimum) to 100 (maximum). The reconstructed avatars as cluster representatives are also shown below

FEMALE UNATTRACTIVE AVATARS



CLUSTERS	**Masculine +**	**Feminine +**	**Asexual**
Shoulders	90.86	52.05	4.62
Breasts	27.26	70.60	29.66
Waist	65.32	72.08	75.72
Hips	31.11	82.29	52.64
Buttocks	12.16	87.42	7.66
Legs	42.62	33.02	22.44
WOMEN %	25.46	45.45	29.09
MEN %	23.91	36.96	39.13

MALE UNATTRACTIVE AVATARS



CLUSTERS	**Masculine +**	**Feminine +**	**Asexual**
Shoulders	86.64	6.04	14.13
Chests	95.96	39.50	24.81
Waist	69.50	81.57	72.76
Hips	64.60	83.10	62.15
Buttocks	94.21	90.45	12.27
Legs	41.15	16.71	49.64
WOMEN %	18.18	50.91	30.91
MEN %	6.52	71.74	21.74

attractive traits did not show substantial difference in cluster structures. On the other hand, due to greater variability and tendencies to extreme measures, unattractive clusters were more diverse in appearance (see Fig. 6). To paraphrase the first sentence of Tolstoy's novel *Anna Karenina* the following can be said: Attractive bodies are all alike (slightly supernormal); every unattractive body is unattractive in one of two different ways (very subnormal or very supernormal).

1. The cluster Masculine + refers to avatars with more prominent masculine and reduced feminine characteristics. In the female avatars, this cluster features a body with very broad shoulders, small breasts, narrow hips, and a very small buttocks. In the male avatars, the body belonging to this cluster has very broad shoulders, a broad chest and buttocks.
2. The cluster Feminine + refers to avatars with more prominent feminine and reduced masculine characteristics. In female avatars, the body belonging to this cluster has large breasts, a wide waist, very wide hips, and a very large buttocks. The male avatar from this cluster has very narrow shoulders and chests, a very wide waist and hips, and a very large buttocks.
3. The Asexual cluster refers to a tiny body constitution with reduced masculine and feminine sexual characteristics. Both female and male avatars belonging to this cluster are characterized by very narrow shoulders, small breasts or narrow chests, and a very small buttocks, but a relatively wider waist and hips.

Interestingly, the Feminine + and the Asexual clusters include more participants than the Masculine + (particularly with the female avatar), which generally means that the participants find the pear-shaped body figures (upright triangle) more unattractive than the "bulky" figure (inverted triangle). This pattern is consistent by gender: chi-square tests showed no significant differences in the number of women and men included in the clusters.

Discussion

In this paper, we presented a study in which we investigated single and multiple physical constraints of attractiveness and unattractiveness of the male and female body. In the following sections, we will discuss the obtained findings within the general framework of the specific sexual selection model (Buss, 1992, 2003; Buss & Schmitt, 1993; Schmitt, 2014). As expected, the attractive body parts were distributed normally with the peak shifted to moderately supernormal sizes, while unattractive body parts have mostly U-shaped or skewed distributions with extremes in super-supernormal and/or subnormal sizes. At the most general level, the tendency to supernormal referred to the preference of two groups of physical traits. The first group included preference for male and female figures with broader shoulders and longer legs ("T-shape") while the second group concerns the preference for a more feminine appearance of female bodies that includes larger breasts and buttocks ("S-shape"). In addition to these general tendencies, other part of the findings reveals gender differences that show a different male and female focus on different body traits and their combinations. Both gender similarity (a tendency to supernormal) and gender differences (a different weight on supernormality of different traits) are theoretically particularly interesting because they can contribute to a better understanding of the complex interplay between biology and culture in sexual selection.

General Preference for "T-shape": Signals of Strength and Health

In the present study we identified supernormal SHR and shoulder width as well as an average WHR of both male and female attractive avatars. Interestingly, our participants generated avatars whose SHR is almost identical to the measures obtained on male and female fashion models (around 1.40 for male and 1.20 for female models, cf. Dijkstra & Buunk, 2001). One possible explanation for this phenomenon may lie in the fact that broad shoulders signal general physical strength and fitness, which are important for showing competitive qualities, and which are also especially advertized in modern society through the ideology of sports, particularly fitness and bodybuilding (Cunningham & Shamblen, 2003; Guthrie & Castelnuovo, 1992; Frederick et al., 2005; Harrison, 2003; Pope et al., 2001; Thornborrow et al., 2020). Thanks to the general social tendency to gender egalitarianism and the reducing differences in gender roles (e.g. man as competitive, women as a mother and housekeeper), a fit-looking culture is widely accepted not exclusively by men, but also by modern women (cf. Eagly & Wood, 1999; Wood & Eagly, 2012). A certain kind of "masculinization" of female appearance probably underlies the findings of our recent study of gender categorization in male–female "chimeras" showing that silhouettes with average male SHR (1.20) and average female WHR (0.70), despite this double signaling, in about 70% of cases were categorized as female (i.e., as female with broad shoulders), but not as male (i.e., as male with a narrow waist) (Marković & Bulut, 2019).

In addition to the higher SHR, the attractive male and female avatars also have proportionally longer legs, i.e., higher LTR, which indirectly contributes to the elongated and slender appearance characteristic for fashion models (cf. Swami et al., 2006; Versluys & Skylark, 2017) and athletes (e.g. runners) (Cavanagh & Kram, 1989; Ropret et al., 1998). We marked this set of traits (high SHR and LTR) as a "*T-shape*" in which the vertical elongation of the body (long legs) and broad shoulders were stylized.

Data on unattractive bodies are complimentary to these findings showing that the representatives of two out of three clusters of unattractive avatars have a pear-shaped look (narrow shoulders, wide waist and hips and short legs). Specifically, analyses of the distributions of individual body parts show that both genders found the most unattractive only very short, but not very long legs, which is consistent with the "good genes" hypothesis—short legs signal susceptibility to various diseases Smith et al., 2001; Gunnell et al., 2003, 2005) while longer legs are associated with better physical performance (Cavanagh & Kram, 1989; Ropret et al., 1998).

Taken together, this group of findings revealed a general preference for "T-shaped" bodies whose specific multitraits combination signals the general physical strength and health typical for both male and female athletes and fashion models. On the other hand, the unattractive multitraits pattern of pear-shape body significantly disrupts both masculine ("inverted triangle") and feminine ("hourglass") appearance, as it indicates weakness and propensity to disease.

Attractiveness of Female Body: "T-Shape" + "S-Shape"

Interestingly, the attractive female avatar had a supernormal SHR, but not a supernormal WHR—in our study, the most attractive WHR was in the average zone (0.74). This combination (high SHR and average WHR) additionally contributes to the sporty and fit look of the female body by reducing the feminine or "motherly" look (wider hips with a narrower waist). As we pointed out in the previous section, shifting preferences from a maternal to an athletic look is most likely a consequence of reducing gender stereotypes and differences in gender roles in the contemporary society (cf. Eagly & Wood, 1999; Wood & Eagly, 2012). It seems that this egalitarian tendency goes beyond the culture of sports and fitness by spreading to the whole society, even to the area of traditional "male taste"—for example, some studies show that WHR of models in the men's magazine such as *Playboy* increased across the years (1954–2000) becoming less and less feminine (Pettijohn & Jungeberg, 2004; Voracek & Fisher, 2002).

The contemporary idealization of a fit appearance and a high SHR, however, do not necessarily lead to the substantial "masculinization" and distortion of the femininity of the female body. Namely, a combination of a supernormal SHR and an average WHR also may induce the impression of an even more pronounced "hourglass" (i.e., feminine) appearance. After all, the shoulder extender pads in women's fashion, usually in combination with waisted dresses, serve as an artificial amplifier of the "hourglass" look (Ramachandran & Hirstein, 1999). Moreover, regardless of the average WHR, attractive female avatars are characterized by some other supernormal female characteristics, such as larger breasts and buttocks, which, in combination with wider shoulders, make a female figure especially attractive. We marked the pattern of larger breasts and buttocks as a "S-shape" because it outlines their stylized look observed in profile.

Tendencies toward a "T" and "S-shape" are noticeable in both genders, however, the findings show that men and women differ in the degree of their expression. In the next section, we will discuss the gender specifics in these tendencies.

Gender Differences and the Sexual Selection Model

The findings of the present study show that although both genders prefer supernormality, men and women differ in the intensity of this tendency. As we mentioned in the introduction (Sect. 1.3), this gender difference is most likely based on different strategies of men and women during the process of sexual selection.

Male Preferences and Strategies: Stronger Tendency Toward Supernormal

When generating attractive avatars, compared to women, men show a stronger tendency to enhance the masculine traits of the male body, such as wider shoulders and chest. These findings are in line with previous studies (Franzoi & Herzog, 1987; Horvath, 1979; Lippa, 1983), as well as with predictions of the mate selection model (Buss, 1992, 2003; Buss & Perry, 1992; Buss & Schmitt, 1993; Puts, 2010; Schmitt, 2014). According to this model, men's preference for enhanced masculinity of the male body is based on their positive evaluation of competition-related traits: more masculine = stronger = more competitive = more attractive (see Sect. 1.3). In line with this is the finding that men find only very narrow, but not very broad male chests unattractive.

Compared to women, men also show a higher preference for supernormal feminine traits of the female body, such as larger breasts and buttocks. This preference is in line with previous findings (Jones, 1996; Marković & Bulut, 2014, 2017a), as well as with the mate selection model which argue that men positively evaluate sexually-related feminine traits (Buss, 1992, 2003; Buss & Perry, 1992; Buss & Schmitt, 1993; Schmitt, 2014). Many authors particularly stress the role of these traits in sexual selection as honest signals of a woman's sexual maturity and proceptivity (for breasts see Havlíček et al., 2017; Marlowe, 1998; for buttocks see Dixson, 1998; Lewis et al., 2015; Pazhoohi et al., 2018). As in the case of male chests, men also find very small but not very large breasts and buttocks in female figures the most unattractive.

To summarize, in both groups of analysis (attractive and unattractive traits), men show a consistent preference for larger shoulders and chests in male avatars and breasts and buttocks in female ones (a positive effect of increased masculinity and femininity) as well as an aversion to a narrow chest in the male avatar and small breasts and buttocks in the female (a negative effect of reduced masculinity and femininity).

Female Preferences and Strategies: Ambivalence Toward Femininity and Masculinity

Unlike men, who clearly show a preference for increased masculinity and femininity, women show a certain ambivalence toward both groups of traits. In the case of the female body, this ambivalence is manifested through the preference for partially supernormal femininity (slightly larger breasts and buttocks than average), but with enhanced elements of masculinity, such as wider shoulders and a generally more sporty and fit "T-shaped" look (wider shoulders + longer legs). We have already discussed the preference of the "T-shape" in the context of reducing the differences in gender roles and intra-gender competition (cf. Eagly & Wood, 1999; Wood & Eagly, 2012). According to the Social role theory, this finding is expected because the general direction of gender egalitarianism in modern society is to include traditionally masculine traits in a female social role (e. g. social competitiveness and dominance) (cf. Eagly & Wood, 1999; Wood & Eagly, 2012; see also Barry et al., 1957). However, in terms of the competitive behavior in women, a sort of ambivalence is present because the most attractive female body comprises enhanced both feminine or masculine characteristics. Data on unattractive traits well illustrate this ambivalence—unlike men who find only small but not large breasts and buttocks unattractive, in women, both extreme sizes of breasts and buttocks are equally unattractive.

Similar to competition-related traits of the female body, women also show ambivalence in terms of sexually-related i.e., masculine traits of the male body. The only indirect gender difference in the preference for masculine traits was identified in the chests—for women average chests are the most attractive, while men extend them to a supernormal width. Complementary to that, men find only narrow chests unattractive (narrow chests = lower masculinity), while women find both narrow and wide chests (i.e., lower and higher masculinity) equally unattractive. Similar ambivalence was also identified in some previous studies which have shown that women found a prominent masculine appearance both attractive and unattractive, suggesting that intensified masculinity is linked to both a higher sexual attraction (cf. Hughes & Gallup, 2003) and offensive, aggressive and possessive behavior (Batrinos, 2012; Beck et al., 1976; Dijkstra & Buunk, 2001; Lippa, 1983; O'Connor et al., 2004).

Multitraits: Gender-Specific Patterns of Traits

Although the PCA does not give us information about what is attractive, but only how individual traits are grouped based on their correlations, it can provide us with valuable insights into which pattern of traits participants focus as particularly important. As we presented in the Results section, male and female participants show a focus on different combinations of attractive traits which can further enrich our discussion of the relationship between an attractive physical appearance and different male and female sexual strategies. In short, the PCA suggests that in generating attractive avatars, male participants show the expected focus on prominent masculine traits of male bodies (shoulders and chests) and feminine traits of females (breasts and buttocks). On the other hand, female participants show an expected focus on traits that make both male and female bodies more elongated and slender (longer legs and narrower breasts or smaller breasts). In addition, participants of both genders show a tendency toward constancy, or more specifically, a tendency to maintain a constant size (e.g., constant volume of the gluteofemoral region in male avatars) or body proportions (e.g., constant waist-to-hip ratio in female avatars). Apparently, these tendencies are general (perhaps universal), so they can be identified in participants of different cultures and different sexual orientations (cf. Valentova et al., 2011, 2017).

Conclusion

In the present study we revealed two general tendencies in the experience of physical attractiveness. (1) The first is a biopsychological tendency based on sexual selection principles and manifesting in (a) the male preference for more feminine and masculine traits and (b) a female ambivalence toward prominent masculinity and femininity. (2) The second tendency points to the socioculturally mediated influences such as bringing the women's gender role closer to the men's, including the increase of dominance, competitiveness as well as a sporty and fit look. The interplay of biology and culture in shaping physical attractiveness and unattractiveness is certainly a big topic and a complex problem (cf. Buss et al., 2001, 2011; Laland, 1994), so its further research must include many other important factors we did not include in our study (e.g. different cultural backgrounds, non-heterosexual participants, different somatotypes, hairiness, facial traits, body dynamics, body ornamentation, clothes, as well as non-visual signals, such as voice and smell).

Appendix A

The table shows the results of a multiple regression analysis in which linear and quadratic functions were tested as predictors of the frequency distributions of the sizes of unattractive body parts. The standardized beta coefficient (β), *t* value, and significance (*p*) are shown for all body parts of female and male avatars generated by women and men.

	Female avatar						Male avatar					
	Women			Men			Women			Men		
	β	*t*	*p*	*β*	*t*	*p*	*β*	*t*	*p*	*β*	*t*	*p*
Shoulders												
Linear	−0.923	−2.023	0.055	−1.367	−3.072	0.008	0.259	1.340	0.192	−0.141	−0.510	0.619
Quadratic	1.003	2.198	0.038	1.398	3.142	0.007	0.546	2.824	0.009	0.290	1.046	0.315
Breasts/ Chests												
Linear	−0.713	−2.069	0.049	−0.897	−2.253	0.051	−0.033	−0.182	0.857	−0.335	−1.681	0.115
Quadratic	0.804	2.331	0.028	0.847	2.128	0.062	0.587	3.256	0.004	0.639	3.203	0.006
Waist												
Linear	0.341	1.684	0.109	0.146	0.657	0.522	0.200	0.954	0.353	0.427	1.492	0.196
Quadratic	0.395	1.950	0.067	0.529	2.374	0.032	0.422	2.010	0.060	0.767	2.680	0.044
Hips												
Linear	0.497	1.735	0.095	1.005	2.619	0.018	0.100	0.427	0.674	−0.194	−0.721	0.485
Quadratic	0.683	2.385	0.025	1.134	2.957	0.009	0.355	1.512	0.149	0.505	1.875	0.085
Buttocks												
Linear	−0.389	−1.719	0.098	−0.428	−1.866	0.078	0.188	1.095	0.284	0.214	1.011	0.334
Quadratic	0.657	2.900	0.008	0.498	2.171	0.043	0.467	2.713	0.012	0.671	3.164	0.009
Legs												
Linear	−0.189	−1.146	0.261	−0.410	−2.453	0.025	−0.086	−0.347	0.734	0.034	0.139	0.892
Quadratic	0.456	2.765	0.010	0.632	3.781	0.001	0.465	1.883	0.082	0.522	2.127	0.053

Appendix B

The table shows the results of the chi-squared test ($df = 1$) which was used to test the significance of the differences in the number of participants who generated extreme sizes of unattractive body parts. Extreme sizes were specified as 25% of the smallest sizes (Min 25%) and 25% of the largest sizes (Max 25%). The results are distributed by participants' gender (women and men) and the gender of the avatars (female and male avatar).

Female avatar						Male avatar					
Women			Men			Women			Men		
Shoulders	*N*	χ^2	Shoulders	*N*	χ^2	Shoulders	*N*	χ^2	Shoulders	*N*	χ^2
Min 25%	25	.00	Min 25%	19	.027	Min 25%	37	18.69	Min 25%	30	27.13
Max 25%	25	ns	Max 25%	18	n. s	Max 25%	8	0.01	Max 25%	1	0.01
Breasts	*N*	χ^2	Breasts	*N*	χ^2	Chests	*N*	χ^2	Chests	*N*	χ^2
Min 25%	20	2.00	Min 25%	29	5.23	Min 25%	23	.02	Min 25%	26	3.60
Max 25%	30	ns	Max 25%	14	0.05	Max 25%	22	ns	Max 25%	14	0.06
Waist	*N*	χ^2	Waist	*N*	χ^2	Waist	*N*	χ2	Waist	*N*	χ^2
Min 25%	13	10.80	Min 25%	7	14.30	Min 25%	13	9.38	Min 25%	6	21.43
Max 25%	36	0.01	Max 25%	30	0.01	Max 25%	34	0.01	Max 25%	36	0.01
Hips	*N*	χ^2	Hips	*N*	χ^2	Hips	*N*	χ^2	Hips	*N*	χ^2
Min 25%	20	.10	Min 25%	16	.95	Min 25%	10	19.69	Min 25%	9	13.71
Max 25%	18	ns	Max 25%	22	ns	Max 25%	42	0.01	Max 25%	33	0.01
Buttocks	*N*	χ^2	Buttocks	*N*	χ^2	Buttocks	*N*	χ^2	Buttocks	*N*	χ^2
Min 25%	25	.19	Min 25%	26	3.60	Min 25%	7	18.67	Min 25%	9	10.53
Max 25%	22	ns	Max 25%	14	0.06	Max 25%	35	0.01	Max 25%	29	0.01
Legs	*N*	χ^2	Legs	*N*	χ^2	Legs	*N*	χ^2	Legs	*N*	χ^2
Min 25%	31	12.10	Min 25%	24	8.00	Min 25%	48	37.23	Min 25%	31	15.14
Max 25%	9	0.01	Max 25%	8	0.01	Max 25%	4	0.01	Max 25%	7	0.01

Author's Contribution Conceptualization: SM, TB; Methodology: SM, TB; Formal analysis and investigation: SM, TB; Writing—original draft preparation: SM; Writing—review and editing: TB; Funding acquisition: SM; Resources: SM; Supervision: SM. Both authors read and approved the final manuscript.

Funding This study was supported by The Ministry of Science and Technological Development of Serbia, Grant Number 179033.

Availability of Data and Material Not applicable.

Code Availability Not applicable.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethical Approval Approval was obtained from the ethics committee of the Department of Psychology, Faculty of Philosophy, University of Belgrade (protocol number: 2019-042). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Anderson, J. L. (1988). Breast, hips, and buttocks revisited: Honest fatness for honest fitness. *Ethology and Sociobiology, 9*(5), 319–324.

Balas, B., van Lamsweerde, A. E., Auen, A., & Saville, A. (2017). The impact of face inversion on animacy categorization. *i-Perception, 8*(4), 2041669517723653.

Barber, N. (1995). The evolutionary psychology of physical attractiveness: Sexual selection and human morphology. *Ethology and Sociobiology, 16*(5), 395–424.

Barry, H., III., Bacon, M. K., & Child, I. L. (1957). A cross-cultural survey of some sex differences in socialization. *Journal of Abnormal and Social Psychology, 55*, 327–332.

Batrinos, M. L. (2012). Testosterone and aggressive behavior in man. *International Journal of Endocrinology and Metabolism, 10*(3), 563–568.

Beach, F. A. (1976). Sexual attractivity, proceptivity, and receptivity in female mammals. *Hormones and Behavior, 7*(1), 105–138.

Beck, S. B., Ward-Hull, C. I., & McLear, P. M. (1976). Variables related to women's somatic preferences of the male and female body. *Journal of Personality and Social Psychology, 34*(6), 1200–1210.

Bertamini, M., & Bennett, K. M. (2009). The effect of leg length on perceived attractiveness of simplified stimuli. *Journal of Social, Evolutionary, and Cultural Psychology, 3*(3), 233–250.

Björntorp, P. (1988). Abdominal obesity and the development of noninsulin-dependent diabetes mellitus. *Diabetes/metabolism Reviews, 4*(6), 615–622.

Björntorp, P. (1991). Adipose tissue distribution and function. *International Journal of Obesity, 15*, 67–81.

Blows, M. W. (2007). A tale of two matrices: Multivariate approaches in evolutionary biology. *Journal of Evolutionary Biology, 20*, 1–8.

Braun, M. F., & Bryan, A. (2006). Female waist-to-hip and male waist-to-shoulder ratios as determinants of romantic partner desirability. *Journal of Social and Personal Relationships, 23*(5), 805–819.

Brooks, R. C., Shelly, J. P., Jordan, L. A., & Dixson, B. J. (2015). The multivariate evolution of female body shape in an artificial digital ecosystem. *Evolution and Human Behavior, 36*(5), 351–358.

Buchanan, G. M., Frederick, D. A., & Friedman, M. A. (2005). *Preoccupation with body fat among heterosexual and homosexual males*. Unpublished manuscript.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*(1), 1–14.

Buss, D. M. (1992). Mate preference mechanisms: Consequences for partner choice and intrasexual competition. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 249–266). Oxford University Press.

Buss, D. M. (2003). Sexual strategies: A journey into controversy. *Psychological Inquiry, 14*(3–4), 219–226.

Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology, 63*(3), 452–459.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204–232.

Buss, D. M., & Schmitt, D. P. (2011). Evolutionary psychology and feminism. *Sex Roles, 64*(9), 768–787.

Buss, D. M., Shackelford, T. K., Kirkpatrick, L. A., & Larsen, R. J. (2001). A half century of mate preferences: The cultural evolution of values. *Journal of Marriage and Family, 63*(2), 491–503.

Cant, J. G. H. (1981). Hypothesis for the evolution of human breasts and buttocks. *American Naturalist, 117*, 199–204.

Cavanagh, P. R., & Kram, R. (1989). Stride length in distance running: Velocity, body dimensions, and added mass effects. *Medicine & Science in Sports & Exercise, 21*(4), 467–479.

Clarys, J. P., Martin, A. D., & Drinkwater, D. T. (1984). Gross tissue weights in the human body by cadaver dissection. *Human Biology, 56*, 459–473.

Cunningham, M. R., & Shamblen, S. R. (2003). Beyond nature versus culture: A multiple fitness analysis of variations in grooming. In E. Voland & K. Grammer (Eds.), *Evolutionary aesthetics* (pp. 201–237). Springer.

Cunningham, M. R., Roberts, A. R., Barbee, A. P., Druen, P. B., & Wu, C. H. (1995). "Their ideas of beauty are, on the whole, the same as ours": Consistency and variability in the cross-cultural perception of female physical attractiveness. *Journal of Personality and Social Psychology, 68*(2), 261–279.

Dagnino, B., Navajas, J., & Sigman, M. (2012). Eye fixations indicate men's preference for female breasts or buttocks. *Archives of Sexual Behavior, 41*, 929–937. https://doi.org/10.1007/s10508-012-9945-3

Darwin, C. (1861). *On the origin of species by means of natural selection or the preservation of favoured races in the struggle for life.* D. Appleton & Co.

DeRidder, C. D., Bruning, P. F., Zonderland, M. L., Thijssen, J. H. H., Bonfrer, J. M. G., Blankenstein, M. A., Huisvield, H. S., & Erich, W. B. M. (1990). Body fat mass, body fat distribution, and plasma hormones in early puberty in females. *Journal of Clinical Endocrinology & Metabolism, 70*(4), 888–893.

Dijkstra, P., & Buunk, B. P. (2001). Sex differences in the jealousy-evoking nature of a rival's body build. *Evolution and Human Behavior, 22*(5), 335–341.

Dixson, A. F. (1998). *Primate sexuality: Comparative studies of the prosimians, monkeys, apes, and human beings*. Oxford University Press.

Dixson, B. J., Dixson, A. F., Li, B., & Anderson, M. J. (2007). Studies of human physique and sexual attractiveness: Sexual

preferences of men and women in China. *American Journal of Human Biology, 19*(1), 88–95. https://doi.org/10.1002/ajhb.20584
Dixson, B. J., Grimshaw, G. M., Ormsby, D. K., & Dixson, A. F. (2014). Eye-tracking women's preferences for men's somatotypes. *Evolution and Human Behavior, 35*(2), 73–79.
Dobzhansky, T. (1970). *Genetics of the evolutionary process*. Columbia University Press.
Eagly, A. H., & Wood, W. (1999). The origins of sex differences in human behavior: Evolved dispositions versus social roles. *American Psychologist, 54*, 408–423.
Edwards, C., Tod, D., & Molnar, G. (2014). A systematic review of the drive for muscularity research area. *International Review of Sport and Exercise Psychology, 7*, 18–41. https://doi.org/10.1080/1750984X.2013.847113
Evans, R. B. (1972). Physical and biochemical characteristics of homosexual men. *Journal of Consulting and Clinical Psychology, 39*, 140–147.
Fan, J., Dai, W., Liu, F., & Wu, J. (2005). Visual perception of male body attractiveness. *Proceedings of the Royal Society of London b: Biological Sciences, 272*(1560), 219–226.
Fernand, R., & Fox, D. E. (1985). Evaluation of lumbar lordosis: A prospective and retrospective study. *Spine, 10*(9), 799–803.
Folsom, A. R., Kaye, S. A., Sellers, T. A., Hong, C. P., Cerhan, J. R., Potter, J. D., & Prineas, R. J. (1993). Body fat distribution and 5-year risk of death in older women. *Journal of the American Medical Association, 269*(4), 483–487.
Franzoi, S. L., & Herzog, M. E. (1987). Judging physical attractiveness: What body aspects do we use? *Personality and Social Psychology Bulletin, 13*, 19–33.
Frederick, D. A., & Haselton, M. G. (2007). Why is muscularity sexy? Tests of the fitness indicator hypothesis. *Personality and Social Psychology Bulletin, 33*(8), 1167–1183.
Frederick, D. A., Fessler, D. M., & Haselton, M. G. (2005). Do representations of male muscularity differ in men's and women's magazines? *Body Image, 2*(1), 81–86.
Frederick, D. A., Hadji-Michael, M., Furnham, A., & Swami, V. (2010). The influence of leg-to-body ratio (LBR) on judgments of female physical attractiveness: Assessments of computer-generated images varying in LBR. *Body Image, 7*, 51–55. https://doi.org/10.1016/j.bodyim.2009.09.001
Fuller, R. C., Houle, D., & Travis, J. (2005). Sensory bias as an explanation for the evolution of mate preferences. *The American Naturalist, 166*(4), 437–446.
Furnham, A., Swami, V., & Shah, K. (2006). Female body correlates of attractiveness and other ratings. *Personality and Individual Differences, 41*, 443–454.
Gangestad, S. W., & Scheyd, G. J. (2005). The evolution of human physical attractiveness. *Annual Review of Anthropology, 34*, 523–548.
Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23*(4), 573–587.
Gangestad, S. W., & Thornhill, R. (2008). Human oestrus. *Proceedings of the Royal Society b: Biological Sciences, 275*(1638), 991–1000.
Grammer, K., Fink, B., Møller, A. P., & Thornhill, R. (2003). Darwinian aesthetics: Sexual selection and the biology of beauty. *Biological Reviews, 78*(3), 385–407.
Greil, H. (2006). Patterns of sexual dimorphism from birth to senescence. *Collegium Antropologicum, 30*(3), 637–641.
Gunnell, D., Whitley, E., Upton, M. N., McConnachie, A., Smith, G. D., & Watt, G. C. M. (2003). Associations of height, leg length, and lung functionwith cardiovascular risk factors in the Midspan Family Study. *Journal of Epidemiology and Community Health, 57*, 141–146. https://doi.org/10.1136/jech.57.2.141
Gunnell, D., Miller, L. L., Rogers, I., & Holly, J. M. (2005). Association of insulin-like growth factor I and insulin-like growth factor–binding protein-3 with intelligence quotient among 8-to 9-year-old children in the Avon Longitudinal Study of Parents and Children. *Pediatrics, 116*(5), e681–e686.
Guthrie, S. R., & Castelnuovo, S. (1992). Elite women bodybuilders: Models of resistance or compliance? *Play & Culture, 5*, 401–408.
Harrison, K. (2003). Television viewers' ideal body proportions: The case of the curvaceously thin woman. *Sex Roles, 48*, 255–264.
Haselton, M. G., Mortezaie, M., Pillsworth, E. G., Bleske-Rechek, A., & Frederick, D. A. (2007). Ovulatory shifts in human female ornamentation: Near ovulation, women dress to impress. *Hormones and Behavior, 51*(1), 40–45.
Havlíček, J., Třebický, V., Valentova, J. V., Kleisner, K., Akoko, R. M., Fialová, J., Jash, R., Kočnar, T., Pereira, K. J., Štěrbová, Z. C., Varella, M. A., Vokurková, J., Vunan, E., & Roberts, S. C. (2017). Men's preferences for women's breast size and shape in four cultures. *Evolution & Human Behavior, 38*, 217–226.
Henss, R. (2000). Waist-to-hip ratio and female attractiveness. Evidence from photographic stimuli and methodological considerations. *Personality and Individual Differences, 28*(3), 501–513.
Horvath, T. (1979). Correlates of physical beauty in men and women. *Social Behavior and Personality, 7*, 145–151.
Hughes, S. M., & Gallup, G. G., Jr. (2003). Sex differences in morphological predictors of sexual behavior: Shoulder to hip and waist to hip ratios. *Evolution and Human Behavior, 24*(3), 173–178.
Huss-Ashmore, R. (1980). Fat and fertility: Demographic implications of differential fat storage. *American Journal of Physical Anthropology, 23*(S1), 65–91.
Jasieńska, G., Ziomkiewicz, A., Ellison, P. T., Lipson, S. F., & Thune, I. (2004). Large breasts and narrow waists indicate high reproductive potential in women. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 271*(1545), 1213–1217.
Jones, D. (1996). *Physical attractiveness and the theory of sexual selection: Results from five populations*. Museum of Anthropology Press.
Jones, B. C., Holzleitner, I. J., & Shiramizu, V. (2021). Does facial attractiveness really signal immunocompetence? *Trends in Cognitive Sciences, 25*(12), 1018–1020. https://doi.org/10.1016/j.tics.2021.09.003
Kasperk, C., Helmboldt, A., Borcsok, I., Heuthe, S., Cloos, O., Niethard, F., & Ziegler, R. (1997). Skeletal site-dependent expression of the androgen receptor in human osteoblastic cell populations. *Calcified Tissue, 61*, 464–473.
Kenrick, D. T., Groth, G. E., Trost, M. R., & Sadalla, E. K. (1993). Integrating evolutionary and social exchange perspectives on relationships: Effects of gender, self-appraisal, and involvement level on mate selection criteria. *Journal of Personality and Social Psychology, 64*(6), 951–969.
Kiire, S. (2016). Effect of leg-to-body ratio on body shape attractiveness. *Archives of Sexual Behavior, 45*(4), 901–910.
Krantz, J., Bailard, J., & Scher, J. (1997). Comparing the results of laboratory and World-Wide Web samples on the determinants of female attractiveness. *Behavior Research Methods, Instruments, & Computers, 29*(2), 264–269.
Laland, K. N. (1994). Sexual selection with a culturally transmitted mating preference. *Theoretical Population Biology, 45*(1), 1–15.
Lande, R. (1980). Sexual dimorphism, sexual selection, and adaptation in polygenic characters. *Evolution, 34*, 292–305.
Lande, R., & Arnold, S. J. (1983). The measurement of selection on correlated characters. *Evolution, 37*, 1210–1226.
Lassek, W. D., & Gaulin, S. J. C. (2006). Changes in body fat distribution in relation to parity in American women: A covert form of maternal depletion. *American Journal of Physical Anthropology, 131*, 295–302. https://doi.org/10.1002/ajpa.20394
Lassek, W. D., & Gaulin, S. J. C. (2008). Waist-hip ratio and cognitive ability: Is gluteofemoral fat a privileged store of

neurodevelopmental resources? *Evolution and Human Behavior, 29*, 26–34. https://doi.org/10.1016/j.evolhumbehav.2007.07.005
Lawler, R. R., & Blomquist, G. E. (2010). Multivariate selection theory in primatology: An introduction to the concepts and literature. *The Open Anthropology Journal*, *3*(1), 206–229. https://doi.org/10.2174/1874912701003010206
Lewis, D. M. G., Russell, E. M., Al-Shawaf, L., & Buss, D. M. (2015). Lumbar curvature: A previously undiscovered standard of attractiveness. *Evolution and Human Behavior, 36*, 345–350. https://doi.org/10.1016/j.evolhumbehav.2015.01.007
Lippa, R. (1983). Sex typing and the perception of the body. *Journal of Personality, 51*, 667–682.
Maisey, D. S., Vale, E. L., Cornelissen, P. L., & Tovée, M. J. (1999). Characteristics of male attractiveness for women. *The Lancet, 353*(9163), 1500.
Manolopoulos, K. N., Karpe, F., & Frayn, K. N. (2010). Gluteofemoral body fat as a determinant of metabolic health. *International Journal of Obesity, 34*(6), 949–959.
Marković, S., & Bulut, T. (2014). Size of different body characteristics and female physical attractiveness: Gender differences. In P. Bernardis, C. Fantoni, & W. Gerbino (Eds.), *Proceedings of the Trieste symposium on perception and cognition* (pp. 41–49). Edizioni Università di Trieste.
Marković, S., & Bulut, T. (2017a). Attractiveness of the female body: Preference for the average or the supernormal? *Psihologija*, *50*(3), 403–426.
Marković, S., & Bulut, T. (2017b). Attractiveness of female and male body: Comparison of subjective and objective measures. *Journal of Vision*, *17*(10). https://doi.org/10.1167/17.10.1250
Marković, S., & Bulut, T. (2019). Gender categorization and attractiveness of the human body: The effects of gender ambiguity. *Perception*, *48*, 146.
Marković, S., Bulut, T., Rančić, K., Nikitović, T., Paunović, D., & Janičić, S. (2016). *Attractiveness of male and female body: Preference for average or preference for supernormal?* In 12th Alps-Adria Psychology Conference, Rijeka, Croatia.
Marlowe, F. (1998). The nubility hypothesis. *Human Nature, 9*(3), 263–271.
Marlowe, F., & Wetsman, A. (2001). Preferred waist-to-hip ratio and ecology. *Personality and Individual Differences, 30*(3), 481–489.
Marlowe, F., Apicella, C., & Reed, D. (2005). Men's preferences for women's profile waist-to-hip ratio in two societies. *Evolution and Human Behavior, 26*(6), 458–468. https://doi.org/10.1016/j.evolhumbehav.2005.07.005
Martin, J. T., & Nguyen, D. H. (2004). Anthropometric analysis of homosexuals and heterosexuals: Implications for early hormone exposure. *Hormones and Behavior, 45*(1), 31–39.
Miller, G., Tybur, J. M., & Jordan, B. D. (2007). Ovulatory cycle effects on tip earnings by lap dancers: Economic evidence for human estrus? *Evolution and Human Behavior, 28*(6), 375–381.
Misra, A., & Vikram, N. K. (2003). Clinical and pathophysiological consequences of abdominal adiposity and abdominal adipose tissue depots. *Nutrition, 19*(5), 457–466.
O'Connor, D. B., Archer, J., & Wu, F. C. (2004). Effects of testosterone on mood, aggression, and sexual behavior in young men: A double-blind, placebo-controlled, cross-over study. *Journal of Clinical Endocrinology & Metabolism, 89*(6), 2837–2845.
Pazhoohi, F., Doyle, J. F., Macedo, A. F., & Arantes, J. (2018). Arching the back (lumbar curvature) as a female sexual proceptivity signal: An eye-tracking study. *Evolutionary Psychological Science, 4*(2), 158–165.
Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., & Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 388*, 741–742.
Pettijohn, T. F., & Jungeberg, B. J. (2004). Playboy playmate curves: Changes in facial and body feature preferences across social and economic conditions. *Personality and Social Psychology Bulletin, 30*(9), 1186–1197.
Phillips, P. C., & Arnold, S. J. (1989). Visualizing multivariate selection. *Evolution, 43*(6), 1209–1222. https://doi.org/10.1111/j.1558-5646.1989.tb02569.x
Pond, C. M. (1998). *The fats of life*. Cambridge University Press.
Pope, H. G., Olivardia, R., Borowiecki, J. J., III., & Cohane, G. H. (2001). The growing commercial value of the male body: A longitudinal survey of advertising in women's magazines. *Psychotherapy and Psychosomatics, 70*, 189–192. https://doi.org/10.1159/000056252
Puts, D. A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans. *Evolution and Human Behavior, 31*(3), 157–175.
Ramachandran, V. C., & Hirstein, W. (1999). The science of art: A neurological theory of aesthetic experience. *Journal of Consciousness Studies, 6*, 15–51.
Reber, R., Schwarz, N., & Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review, 8*(4), 364–382.
Regan, P. C. (1998). What if you can't get what you want? Willingness to compromise ideal mate selection standards as a function of sex, mate value, and relationship context. *Personality and Social Psychology Bulletin, 24*(12), 1294–1303.
Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behavior: Does attractiveness enhance mating success? *Evolution and Human Behavior, 26*(2), 186–201. https://doi.org/10.1016/j.evolhumbehav.2004.08.014
Rilling, J. K., Kaufman, T. L., Smith, E. O., Patel, R., & Worthman, C. M. (2009). Abdominal depth and waist circumference as influential determinants of human female attractiveness. *Evolution and Human Behavior, 30*(1), 21–31.
Roff, D. A., & Fairbairn, D. J. (2007). The evolution of trade-offs: Where are we? *Journal of Evolutionary Biology, 20*, 433–447.
Ropret, R., Kukolj, M., Ugarkovic, D., Matavulj, D., & Jaric, S. (1998). Effects of arm and leg loading on sprint performance. *European Journal of Applied Physiology and Occupational Physiology, 77*(6), 547–550.
Schmitt, D. P. (2014). Evaluating evidence of mate preference adaptations: How do we really know what Homo sapiens sapiens really want? In V. A. Weekes-Shackelford & T. K. Shackelford (Eds.), *Evolutionary perspectives on human sexual psychology and behavior* (pp. 3–39). Springer.
Singh, D. (1993). Adaptive significance of waist-to-hip ratio and female physical attractiveness. *Journal of Personality and Social Psychology, 65*, 293–307.
Singh, D. (2002). Female mate value at a glance: Relationship of waist-to-hip ratio to health, fecundity and attractiveness. *Neuroendocrinology Letters, 23*(Suppl 4), 81–91.
Singh, D., & Young, R. K. (1995). Body weight, waist-to-hip ratio, breasts, and hips: Role in judgments of female attractiveness and desirability for relationships. *Ethology and Sociobiology, 16*(6), 483–507.
Smith, N. W. (1986). Psychology and evolution of breasts [Letter to the editor]. *Human Evolution, 1*(3), 285–286.
Smith, G. D., Greenwood, R., Gunnell, D., Sweetnam, P., Yarnell, J., & Elwood, P. (2001). Leg length, insulin resistance, and coronary heart disease risk: The Caerphilly Study. *Journal of Epidemiology and Community Health, 55*, 867–872. https://doi.org/10.1136/jech.55.12.867
Smith, K. L., Cornelissen, P. L., & Tovée, M. J. (2007). Color 3D bodies and judgements of human female attractiveness. *Evolution and Human Behavior, 28*(1), 48–54.
Sorokowski, P., & Pawlowski, B. (2008). Adaptive preferences for leg length in a potential partner. *Evolution and Human Behavior, 29*, 86–91. https://doi.org/10.1016/j.evolhumbehav.2007.09.002

Sorokowski, P., Szmajke, A., Sorokowska, A., Borg Cunen, M., Fabrykant, M., Zarafshani, K., Amiri, M., Bazzazian, S., Blazevska-stoilkovska, B., Casellas, V., Cetinkaya, H., Lopez Coutino, B., Chavez, M., Cheng, C., Cristea, I., David, D., Dural, S., Dzięcioł, A., Fauzee, S., … Tzu, F. (2011). Attractiveness of leg length: Report from 27 nations. *Journal of Cross-Cultural Psychology, 42*(1), 131–139.

Staddon, J. E. R. (1975). A note on the evolutionary significance of "supernormal" stimuli. *American Naturalist, 109*(969), 541–545.

Swami, V., Einon, D., & Furnham, A. (2006). The leg-to-body ratio as a human aesthetic criterion. *Body Image, 3*(4), 317–323.

Swami, V. & Furnham, A. (2008). *The psychology of physical attraction.* Routledge and Taylor & Francis Group.

Symons, D. (1979). *The evolution of human sexuality*. Oxford University Press.

Thompson, S. H., Sargent, R. G., & Kemper, K. A. (1996). Black and white adolescent males' perceptions of ideal body size. *Sex Roles, 34*(5–6), 391–406.

Thornborrow, T., Onwuegbusi, T., Mohamed, S., Boothroyd, L. G., & Tovée, M. J. (2020). Muscles and the media: A natural experiment across cultures in men's body image. *Frontiers in Psychology, 11*, 495. https://doi.org/10.3389/fpsyg.2020.00495

Tinbergen, N. (1951). *The study of instinct*. Clarendon Press.

Tinbergen, N., & Perdeck, A. C. (1950). On the stimulus situation releasing the begging response in the newly hatched herring gull chick (Larus argentatus argentatus Pont.). *Behaviour, 3*, 1–39.

Tovée, M. J., & Cornelissen, P. L. (2001). Female and male perceptions of female physical attractiveness in front-view and profile. *British Journal of Psychology, 92*, 391–402.

Valentova, J., Rieger, G., Havlicek, J., Linsenmeier, J. A., & Bailey, J. M. (2011). Judgments of sexual orientation and masculinity–femininity based on thin slices of behavior: A cross-cultural comparison. *Archives of Sexual Behavior, 40*(6), 1145–1152.

Valentova, J. V., Bártová, K., Štěrbová, Z., & Varella, M. A. C. (2017). Influence of sexual orientation, population, homogamy, and imprinting-like effect on preferences and choices for female buttock size, breast size and shape, and WHR. *Personality and Individual Differences, 104*, 313–319.

Versluys, T. M. M., & Skylark, W. J.(2017). The effect of leg-to-body ratio on male attractiveness depends on the ecological validity of the figures. *Royal Society Open Science, 4,* 170399. https://doi.org/10.1098/rsos.170399

Voracek, M., & Fisher, M. L. (2002). Shapely centrefolds? Temporal change in body measures: Trend analysis. *British Medical Journal, 325*(7378), 1447–1448.

Walsh, B., & Blows, M. W. (2009). Abundant genetic variation + strong selection = multivariate genetic constraints: A geometric view of adaptation. *Annual Review of Ecology, Evolution, and Systematics, 40*, 41–59.

Wang, Z., Heo, M., Lee, R. C., Kotler, D. P., Withers, R. T., & Heymsfield, S. B. (2001). Muscularity in adult humans: Proportion of adipose tissue-free body mass as skeletal muscle. *American Journal of Human Biology, 13*(5), 612–619.

Wells, J. C. K. (2007). Sexual dimorphism of body composition. *Best Practice & Research Clinical Endocrinology & Metabolism, 21*(3), 415–430. https://doi.org/10.1016/j.beem.2007.04.007

Wiederman, M. W., & Dubois, S. L. (1998). Evolution and sex differences in preferences for short-term mates: Results from a policy capturing study. *Evolution and Human Behavior, 19*(3), 153–170.

Wiggins, J. S., Wiggins, N., & Conger, J. C. (1968). Correlates of heterosexual somatic preference. *Journal of Personality and Social Psychology, 10*(1), 82–90.

Winkielman, P., & Cacioppo, J. T. (2001). Mind at ease put a smile on the face: Psychophysiological evidence that processing facilitation elicits positive effect. *Journal of Personality and Social Psychology, 81*, 989–1000.

Wood, W., & Eagly, A. H. (2012). Biosocial construction of sex differences and similarities in behavior. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (Vol. 46, pp. 55–123). Elsevier.

Zaadstra, B., Seidell, J., van Noord, P., te Velde, E., Hambemma, J., Vrieswijk, B., & Karbaat, J. (1993). Prospective study of the effect of body fat distribution on conception rates. *British Medical Journal, 306*, 484–487.

Zelazniewicz, A. M., & Pawlowski, B. (2011). Female breast size: Attractiveness for men as a function of sociosexual orientation (Restricted vs. unrestricted). *Archives of Sexual Behavior, 40*, 1129–1135. https://doi.org/10.1007/s10508-011-9850-1