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The leg-to-body ratio as a human aesthetic criterion

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Abstract

There are surprisingly few empirical studies on the aesthetic appeal of human legs, examining such variables as length or shape. The human legs are conspicuous in erotic contexts, but few studies have experimentally tested preferences for longer legs. This study examined the utility of the human leg-to-body ratio (LBR) as a specific aesthetic criterion among 71 British undergraduates. Participants rated for physical attractiveness line drawings that varied in five levels of LBR. The results showed that a longer LBR was preferred as maximally attractive in women, whereas a shorter LBR was preferred in men. Evolutionary psychological and socio-cultural explanations for this aesthetic preference are discussed, and the study's limitations are considered.

Keywords: Leg-to-body ratio; Physical attractiveness; Aesthetic criteria

Introduction

A great many studies have considered height as an important component of physical attractiveness. Tallness is generally considered a socially desirable attribute (Keyes, 1981; Roberts & Herman, 1986), and is associated with improved social status (Jackson & Ervin, 1992; Judge & Cable, 2004), persuasiveness (Young & French, 1996) and leadership skills (Higham & Carment, 1992; Stogdill, 1948). Among men, tallness is further associated with greater reproductive success (Pawlowski, Dunbar, & Lipowicz, 2000), dating history (Shepperd & Strathman, 1989), higher lifetime number of cohabiting partners and decreased probabilities of childlessness (Nettle, 2002a).

Accordingly, some evolutionary psychologists have argued that women have an evolved preference for taller men (e.g., Pawlowski & Koziel, 2002), expressing a direct preference for men who are taller than themselves (Pawlowki, 2003). By contrast, there is no advantage for women in terms of reproductive success in being taller than average (Nettle, 2002b). This is in line with the finding that height is less important to the physical attractiveness of women, and men find women of average height most attractive and date them most often (Gillis & Avis, 1980; Shepperd & Strathman, 1989).

A relatively unexplored approach to further elucidate the relation between height and attractiveness is to consider the different components of height separately. One such component, recognised in clinical research but neglected otherwise, is the leg-to-body ratio (LBR; cf. Leitch, 1951; Mitchell, 1962). Because the LBR is relatively easy to measure, it is often used as criteria for the study of nutrition and development especially among children (e.g., Albanes, Jones, Schatzkinm, Micozzi, & Taylor, 1988; Gunnell, Davey Smith, Holly, & Frankel, 1998). However, the available research has variously defined the LBR as the ratio of leg length

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relative to the torso, trunk or body including the head. While these different measures refer to a similar concept and are sometimes used interchangeably within the literature, we refer to the latter measurement for the purposes of the present study (although we note where other measures have been used in the following review).

Human growth in stature is determined by various factors, resulting from the lengthening of bones regulated by somatotropin. Somatotropin, or human growth hormone, also stimulates the release of another growth-inducing hormone (insulin-like growth factor 1), and both hormones operate on most tissues of the body. Peak secretion of both hormones coincides with peak growth velocity and gradually subsides with age after adolescence. The majority of linear growth occurs as growth of cartilage at the epiphysis (ends) of the long bones which gradually ossify to form hard bones (Mitchell, 1962; Tanner, 1989). The legs compose approximately half of adult human height, and are a sexually dimorphic trait (cf. Morris, 1987). In general, women tend to have a higher LBR than men.

From an evolutionary perspective, there are a number of different reasons why the LBR may be important in aesthetic judgements of men and women. One possibility is that the LBR is a signal or cue of both stable childhood development as well as current well-being. In terms of the former, the interruption of growth at any stage of the life-cycle results in a relatively long torso and short legs (Leitch, 1951). If the rate of growth is sufficiently slowed down (e.g., due to nutritional deficiencies or psychological stress), the adult will have shorter legs relative to the trunk. Indeed, some studies suggest that leg length measured in childhood may be the component of stature most sensitive to environmental influences (Gunnell, Davey Smith, Holly et al., 1998).

In addition, longer leg length relative to the torso is associated with various life outcomes including reduced risk of coronary heart disease, diabetes resistance, low blood pressure, better cardiovascular profiles, lower adult mortality and reduced risk of cancer (Davey Smith et al., 2001; Gunnell, Davey Smith, Frankel et al., 1998; Gunnell, Davey Smith, Holly et al., 1998; Gunnell, May, Ben-Shlomo, Yarnell, & Smith, 2003; Gunnell, Whitley et al., 2003; Langenberg, Hardy, Kuh, & Wadsworth, 2003; Lawlor, Ebrahim, & Davey Smith, 2002; Smith et al., 2001). Moreover, secular increases in height, representing nutritional improvements in the nutritional status of populations, appear to arise more from increases in leg length relative to trunk growth (Tanner, Hayashi, Preece, & Cameron, 1982; Udjus, 1964).

From this perspective, it might be predicted that a higher LBR will be preferred in both men and women because it is both an indicator of the ability to resist developmental insults and current health (cf. Gangestad & Scheyd, 2005; Gangestad & Simpson, 2000). In evolutionary terms, only individuals with certain underlying genetic features will be able to develop this trait despite adverse environmental conditions, and maintain it through adulthood. Thus, individuals who have evolved a preference for individuals with a higher LBR may be expected to have greater lifetime reproductive success. In short, mating with an individual with a high LBR would likely increase one's own reproductive potential, and thus a preference for a high LBR may have spread in ancestral populations.

A different possibility is that the LBR plays a differential role in judgements of men and women. As noted earlier, the LBR is a sexually dimorphic feature, with women tending to have higher LBRs than men. If this sex difference between men and women is noticed by observers, is possible that over time a higher LBR becomes associated with femininity and a shorter LBR with masculinity (cf. Fessler et al., 2005). Moreover, because peak growth occurs during adolescence, a higher LBR may also be a cue of youthfulness. Thus, sexual dimorphism in LBR may have evolved due to a human male preference for women with higher, youthful LBRs (cf. Sear, Allal, & Mace, 2004). Therefore, women (but not men) who exhibit the hallmark version of the feminine trait will be viewed as highly attractive.

Consistent with the above discussion, the LBR may be expected to play a role in judgements of both male and female physical attractiveness. If a higher LBR is attractive because it is positively associated with stable development and overall well-being in both men and women, it may be predicted that a higher LBR should be maximally attractive for both genders (Hypothesis 1). By contrast, if a higher LBR is perceived as being feminine, then it is possible that only women will be considered maximally attractive with high LBRs. The LBR preference for men may either be the default (that is, a preference for the average; cf. Fessler et al., 2005) or possibly for men with lowers LBRs if such a trait is considered masculine (Hypothesis 2).

Method

Participants

The participants of this study were 71 British undergraduates (31 females, 40 males) enrolled in a variety of courses. Only participants who self-reported as being heterosexual were invited to take part in the study. The mean age of the sample was 20.23 years

($SD = 2.89$). In terms of ethnicity, the majority of participants were Caucasian (75%), with smaller groups of British Asians (17%) and Britons of Afro-Caribbean descent (8%). Participant ethnicity did not have a significant effect on subsequent ratings. The socio-economic backgrounds of the participants were relatively homogenous.

Materials

The stimuli were 10 line drawings of the human figure in front view, of which 5 depicted the female figure and the other 5 depicted the male figure. Although previous studies have suggested that line drawings may be an imperfect tool for the measurement of aesthetic preferences (see Swami & Furnham, 2006), they nevertheless have the advantage of allowing easy manipulation of particular phenotypes.

For both the male and female stimuli, there were five levels of LBR (1.0, 1.1, 1.2, 1.3 and 1.4). To design the stimuli, a baseline figure with an LBR of 1.2 was first created. Next, figures with LBRs longer and shorter than this baseline were created by extending or shortening the legs of the stimuli while extending or shortening body length. In addition, the length of the arms was altered accordingly. The legs were measured as the distance between the bottom of the feet and top of the pelvic region (above the hips and below the waist). The body was measured as the distance between the top of the head and the pelvic region as before.

All manipulations were done using the Stretch/Skew function on Microsoft Paint, a simple graphics painting programme. The final set consisted of five female figures and five male figures, each with five different LBRs (see Appendix A). Two participants unaffiliated with this study made measurements of the stimuli to check that the only difference between stimuli related to the LBR. This confirmed that there were no differences in the height, waist-to-hip ratios (WHRs) and shoulder-to-hip ratios (SHRs) of both male and female figures. In addition, pilot testing ($n = 8$) suggested that there were no perceivable differences in the body fat and muscularity for male and female figures, respectively.

Procedure

Participants were presented with a single-page questionnaire on which to record their ratings. The questionnaire consisted of brief instructions followed by rating scales and a request for participants' demographic details (age, gender and ethnicity). The stimuli were presented randomly on sheets of paper measuring 210 mm × 297 mm, so that each image covered almost the entire page. All participants viewed both male and female images, which were presented in a randomised order.

Participants were tested in groups of 5–10 people, and were instructed not to share answers and remained silent throughout the experiment. Each image was presented for 15 s, and participants were asked to provide a rating of physical attractiveness on a 7-point Likert scale (1—Not at all attractive; 7—Very attractive). Participants were instructed to use the entire scale range from 1 to 7 as necessary. The testing session lasted about 15 min and participants were debriefed following the experiment.

Results

A 2 × 2 × 5 repeated measure analysis of variance (ANOVA) with 71 participants was computed. The sex of the stimuli and LBR were treated as within subjects factors, and participant gender was treated as a between subjects factor. The Greenhouse–Geisser correction was applied to results involving LBR, as the Mauchly's Test of Sphericity was shown to be significant for this variable. A summary of the ANOVA results and the main effects of stimuli sex, LBR and their interactions are shown in Table 1.

Table 1
ANOVA results with the main effects of leg-to-body ratio (LBR), stimuli sex and their interactions

Source	*df*	*F*	Effect size (η_p^2)
LBR × stimuli sex	2.36, 136.06[a]	222.36[*]	0.76
Stimuli sex	1, 69	58.69[*]	0.46
LBR	2.48, 170.97[a]	18.03[*]	0.21
LBR × participant gender	2.48, 170.97[a]	1.07	0.01
Sex × participant gender	1, 69	0.02	0.00
LBR × stimuli sex × participant gender	2.36, 136.06[a]	0.99	0.01

[a] Greenhouse–Geisser corrected.
[*] $p < 0.001$.

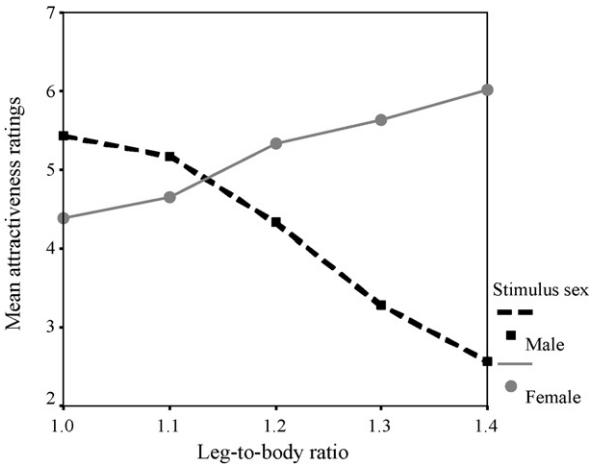


Fig. 1. Mean attractiveness ratings of male and female stimulus figures.

The ANOVA revealed that both LBR ($\eta_p^2 = 0.21$) and the sex of the stimuli ($\eta_p^2 = 0.46$) had significant main effects on the ratings of the figures. There was also a significant LBR × stimuli sex interaction, which had the largest effect size ($\eta_p^2 = 0.76$). This interaction is depicted in Fig. 1. Overall, participants showed a preference for higher LBRs for the female images, and lower LBRs for the male images. This was confirmed by Pearson's correlations between attractiveness ratings and female LBR ($r = 0.53$, $p < 0.001$) and male LBR ($r = -0.67$, $p < 0.001$). For the female figures the preferred LBR was 1.4, whereas for the male figures the preferred LBR was 1.0. Finally, the results also showed that there was no significant effect of participant gender, suggesting that both male and female participants were rating the images in the same manner.

Discussion

The results of this investigation are consistent with the idea that the LBR plays a role in judgements of male and female physical attractiveness. Overall, both male and female participants showed a preference for higher LBRs in women and lower LBRs in men, which is consistent with Hypothesis 2. In other words, the favoured LBR in men was a direct inverse of the preferred LBR in women. In addition, the result was possibly stronger in terms of disfavoured male LBR, which suggests that there was a stronger sentiment in our sample regarding what makes a man less attractive in comparison with women.

This set of findings runs counter to Hypothesis 1, which predicted that a high LBR should be considered attractive for both women and men considering the benefits of a high LBR in terms of developmental stability and well-being. Rather, it lends some support to Hypothesis 2, which predicts that a higher LBR increases female attractiveness but decreases male attractiveness. If the LBR is a stable sexually dimorphic phenotype indicative of gender, it is possible that this difference was noticed by people in human history. Eventually, the LBR would have been viewed as being emblematic of differences between the sexes. Over time, people may have come to associate a longer LBR with femininity and a shorter LBR with masculinity. As such, they may view as attractive women who have a longer LBR and men who have a shorter LBR.

It is also possible, however, that evolutionary predispositions play a role in this preference. For example, some studies have suggested that tall women have wider pelvises than shorter women, and this would allow easier births and higher birthweight babies (both of which reduce infant and maternal mortality; Martorell, Delgado, Valverde, & Klein, 1982; Rey, Ortiz, Fajardo, & Pradilla, 1995; Sokal, Sawadogo, & Adjibabe, 1991). If this is linked with differences in the LBR, men may have evolved a preference for higher LBRs in women so as to increase their own reproductive potential. However, this explanation still leaves open the question of why both men and women find a low LBR attractive in men.

It is possible that socio-cultural factors play a role in determining attitudes and preferences toward male and female LBR. As documented by Morris (1987), exposure of the female legs has long been considered to be sexually appealing, at least in Western contexts. At different periods, the amount of female leg flesh considered appropriate for exposure has varied considerably. By contrast, male legs have attracted far less attention, which may be explicable in terms of fashion dictates (Morris, 1987). From this perspective, it might be argued that a high LBR is considered feminine and thus attractive in women, while the opposite might be considered optimally masculine and thus attractive in men.

Alternatively, it is possible that the preference for low male LBRs was an artefact of the stimuli. It is possible that, by increasing the area of the upper body available for musculature development, a lower LBR enhances perceived male muscularity. This is consistent with the idea that muscularity is an important component of male physical attractiveness (cf. Maisey, Vale, Cornelissen, & Tovée, 1999; Swami & Tovée, 2005). In the pilot study, however, we found no suggestion that perceived muscularity differed between the male stimuli. However, the number of participants in

this pilot study was small, and it may be worth examining more systematically whether the LBR is related to perceived muscularity in men.

A similar concern is that manipulating the LBR may have differentially affected apparent crotch size, which could act as a proxy for genital size. The preference for a low LBR may, therefore, be confounded with the preference for large genitals. This is, of course, a limitation of the use of line drawings. Future studies could overcome this confound by using photographic or three-dimensional images of real men and women, although the manipulation of LBR may be more problematic in such designs (cf. Treleaven, Furnham, & Swami, 2006).

There were a number of other limitations to this study. It is worth considering that the levels of LBR used in this study may not be representative of population norms, as they were not based on any anthropometric data. Rather, the LBRs were more likely levels that would be considered within a 'normal' range. By contrast, some growth disorders are characterised by abnormally short (e.g., skeletal displasias) or long (e.g., Marfan syndrome) limbs, while other disorders are characterised by abnormally shorter torsos. It would therefore be useful for future studies to manipulate both trunk size and leg length simultaneously, and include exaggerated stimuli.

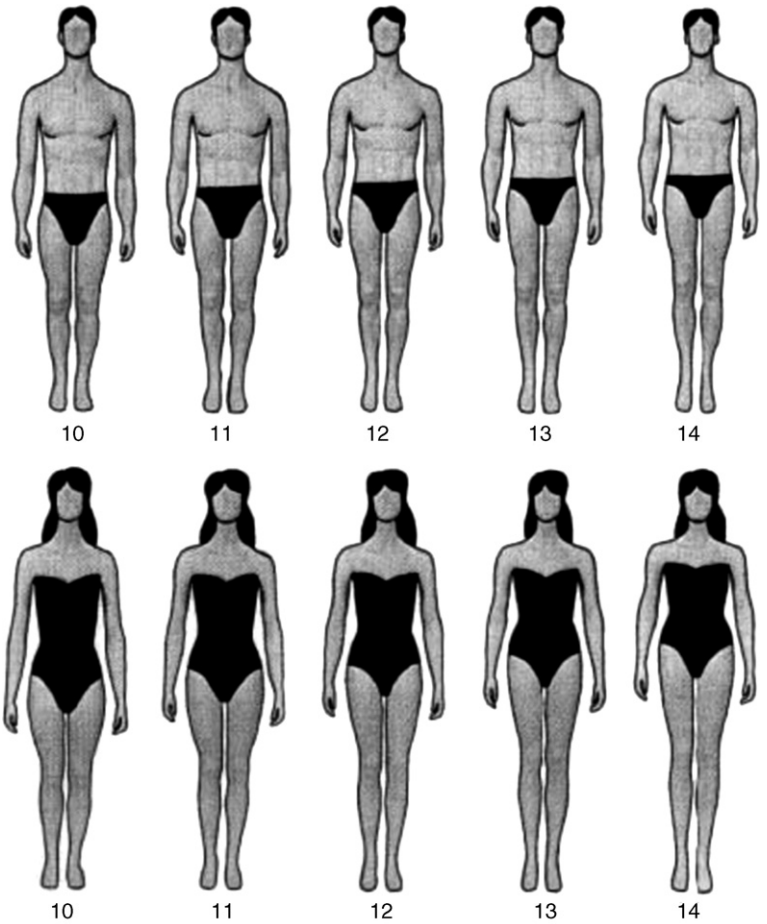
Furthermore, while our manipulation of LBR proved useful, clinicians and healthcare workers have generally used the LBR as a diagnostic tool for growth measurement in combination with other measures (e.g., Fredriks et al., 2005). It may be the case that there are other important sexually dimorphic measurements which are captured by overall measurements involving the LBR. A related issue concerns the manipulation of arm length in the present study. Although arm and leg length are highly correlated (e.g., Mohanty, Suresh Babu, & Sreekumaran Nair, 2001; Yun et al., 1995), this is of course an important confound which may be unavoidable in studies of this kind.

At present, it remains unclear whether these findings are generalisable to other cultures or socio-economic contexts. Certainly, the emphasis on the sexual attractiveness of longer female legs appears to be a Western phenomenon (Morris, 1987), although this would be expected to change with the globalisation of such things as the mass media. In addition, some evolutionary psychological theories predict local variation in aesthetic preferences as a result of calibration to locally prevailing ranges or ecologies (e.g., Sugiyama, 2004). Thus, if there are cross-sample differences in average LBRs (cf. Holliday & Ruff, 2001; Tanner et al., 1982), then we might expect cross-cultural or cross-national differences in LBR preferences. It would, therefore, be useful for future studies to conduct experiments on preferences for the LBR in different cultural contexts. Finally, the small sample size and reliance on undergraduates in the present study is an important limitation to the results.

These limitations notwithstanding, the present study highlights a previously neglected sexually dimorphic feature of the human form in judgements of physical attractiveness. Our results provide preliminary evidence of the LBR affecting preferences for male and female attractiveness, and highlight the importance of examining different components of human stature when investigating preferences for male and female height. Of course, in real life situations, it is likely that other variables such as clothing, posture and rest state (e.g., whether a person is standing or sitting) will mask minor variations in LBR. In such situations, the utility of the LBR is judgements of attractiveness may be limited.

Appendix A

The stimuli used in this experiment (the LBRs are noted below each image).



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