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Adaptive preferences for leg length in a potential partner

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Abstract

It has been shown that height is one of the morphological traits that influence a person's attractiveness. To date, few studies have addressed the relationship between different components of height and physical attractiveness. Here, we study how leg length influences attractiveness in men and women. Stimuli consisted of seven different pictures of a man and seven pictures of a woman in which the ratio between leg length and height was varied from the average phenotype by elongating and shortening the legs. One hundred men and 118 women were asked to assess the attractiveness of the silhouettes using a seven-point scale. We found that male and female pictures with shorter than average legs were perceived as less attractive by both sexes. Although longer legs appeared to be more attractive, this was true only for the slight (5%) leg length increase; excessively long legs decreased body attractiveness for both sexes. Because leg length conveys biological quality, we hypothesize that such preferences reflect the workings of evolved mate-selection mechanisms. Short and/or excessively long legs might indicate maladaptive biological conditions such as genetic diseases, health problems, or weak immune responses to adverse environmental factors acting during childhood and adolescence.

Keywords: Biological quality; Health; Physical attractiveness; Legs; Leg-to-body ratio; Mate selection criteria

1. Adaptive preferences for leg length in a potential partner

A principal morphological trait that influences male attractiveness (at least in Western societies) is height (Pawlowski & Koziel, 2002; Pierce, 1996). There are several biological reasons why taller men are perceived as more attractive by women (see review Pawlowski, 2000). Body height was found to be positively related to reproductive success for men (Nettle, 2002a, Pawlowski, Dunbar, & Lipowicz, 2000) and negatively for women (Nettle, 2002b). It is worth noting, however, that all these results are for Western societies and that it is not true, for instance, for rural Gambia, where Sear, Allal, and Mace (2004) found a positive correlation between female height and reproductive success, and no correlation between male height and reproductive success (Sear, 2006).

A new approach to further elucidating the relationship between stature and attractiveness is to analyze the different components of height. Here, we aim to test how important body length proportions are for assessing human physical attractiveness. Attractiveness may be related to relative leg length because this trait might be a cue of health status (Davey Smith et al., 2001; Gunnell et al., 1998; Gunnell et al., 2003; Gunnel et al., 2005; Lawlor, Ebrahim, & Davey Smith, 2002; Lawlor, Taylor, Davey Smith, Gunnell, & Ebrahim, 2004) and biomechanical efficacy, e.g., due to running ability (Cavanagh & Kram, 1989; Ropret, Kukolj, Ugarkovic, Matavulj, & Jarlic, 1998). Short legs have been found to be related to a higher risk of cardiovascular disease (Gunnel et al., 2005) and Type II diabetes (Gunnell et al., 2003, Lawlor et al., 2002). Men with shorter legs tend to have higher triglyceride level and higher insulin resistance (Davey Smith et al., 2001). It is also known that any interruption of human growth during adolescence, such as that resulting from nutritional or energetic deficiency, results

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in relatively shorter legs (Leitch, 1951; Mitchell, 1962). Out of all of the components of stature, it is the leg length that is the most sensitive to environmental influence, particularly in the prepubertal period (Gunnell et al., 1998, Gunnell, 2002). This means that different adverse factors during infancy or puberty might affect leg growth to a greater extent than trunk growth (Wadsworth, Hardy, Paul, Marshall, & Cole, 2002), potentially explaining why leg length is a good indicator of childhood socioeconomic circumstances (Davey Smith et al., 2001). All these findings indicate that relatively short legs may be a cue to poor genetic quality and an inability to expend energy on leg growth whilst coping with adverse environmental factors.

To our knowledge, the only study that has tested the role of relative leg length in attractiveness was carried out by Swami, Einon, and Furnham (2006). They showed that longer legs, but only in women, are perceived as more attractive. They also found that there is a negative linear relationship between male leg length and attractiveness. According to Swami et al., this can be explained by the fact that since women have higher leg-to-body ratio (LBR) than men, sexual selection over time should promote women with higher LBR (increased femininity) and men with lower LBR (higher masculinity). However, it is questionable whether women have higher LBR than men, throwing this explanation into doubt. Many studies show either that there is no sexual dimorphism in relative leg length within many human populations (Flugel, Greil, & Sommer 1983; Martin & Saller, 1958) or that 17-year-old boys (Martorell, Malina, Castillo, Mendoza, & Pawson, 1988) and adult men (Eveleth, 1978) have relatively longer legs and shorter trunks than women. More recently, Dangour, Schilg, Hulse, & Cole (2002) have shown that 18-year-old boys from Southeast England have relatively longer legs than girls. The mean subischial leg length to stature index is 0.472 for boys and 0.465 for girls (calculated from Dangour et al.'s 2002 data). As we will demonstrate, in our own sample of Polish adults (100 men and 118 women), men have a significantly higher LBR than women ($t=-2.21$, $p<.03$).

Since relative leg length may indicate a person's biological condition (or quality) both for men and women, one can reasonably postulate that this trait should affect body attractiveness assessment in the same way for both sexes. This suggests that the differential results of Swami et al. (2006) for men and women may be a methodological artifact. Firstly, the stimuli of Swami et al. were not based on anthropometric data, and therefore, they might not have been representative of a real population. Secondly, their stimuli differ not only in leg length but also in arm length or groin proportions (e.g., shorter-legged men seem to have bigger genitals). Lastly, women could have paid attention mainly to the chest size and musculature, which were more accentuated in the first two silhouettes in comparison to the last ones; the contributions of leg length may thus have been obscured in their studies by chest size and musculature.

We hypothesize that, both for men and women, body attractiveness should strongly depend on relative leg length. Moreover, this relationship should follow a bell-shaped curve, as both too short (e.g., Gunnell et al., 2003; Gunnel et al., 2005; Lawlor et al., 2002) and too long legs paired with a short trunk (Davey Smith et al., 2001; Pyeritz, 2000) can be a consequence of disease. In our study, we employ different stimuli from those used by Swami et al. (2006), basing our images on actual anthropometric data in order to create stimuli whose LBR correspond to the natural population level variation.

Our principal study was not intended as a direct test of the thesis of Swami et al. (2006), as it was conducted prior to publication of the latter. However, as our results differed from that of Swami et al., we decided to conduct an additional study. We examined preferences for LBR using modified versions of the stimuli employed by Swami et al. In order to avoid some of the abovementioned drawbacks of the original Swami et al. stimuli, and to make them similar in colour to our stimuli, we remade them by blackening the images to create silhouettes. This also enabled us to draw attention of the raters to leg length rather than to chest size and musculature.

2. Materials and method

Stimuli were created electronically from black and white photographs of a man and a woman. These two individuals were chosen because their leg to torso length proportions were very close to the mean for Polish adults (Gedliczka, Pochopeń, Szklarska, & Welon, 2001). The mean index in the Polish population of height to perineum/total height is 0.516 for men and 0.513 for women. We used this index because, in blackened silhouette pictures, the best referential point for leg length is the perineum (crotch). We are not certain whether participants use the perineum in real life when judging leg length, although this seems quite reasonable because there are no other straightforward visual ways to assess leg length. We used this point for measurement because it was the most unequivocal. It also enabled us to create stimuli that represented the average LBR for the population.

The pictures were converted into silhouettes, with the legs of the figures lengthened or shortened in such a way that body height remained the same. Creation of the stimuli involved leg elongation at the cost of shortening the trunk. The perineum was used as a referential point. Neck and head size remained unchanged. We used small 5% steps between figures to obtain 7 male stimuli and 7 female stimuli (the original picture; pictures with legs elongated by 5%, 10%, and 15%; and pictures with legs shortened by 5%, 10%, and 15%) (see Fig. 1). These stimuli were then presented to raters in a random order. The raters were able to compare the pictures and were informed that the images differed in LBR. The raters were asked to assess the attractiveness of the

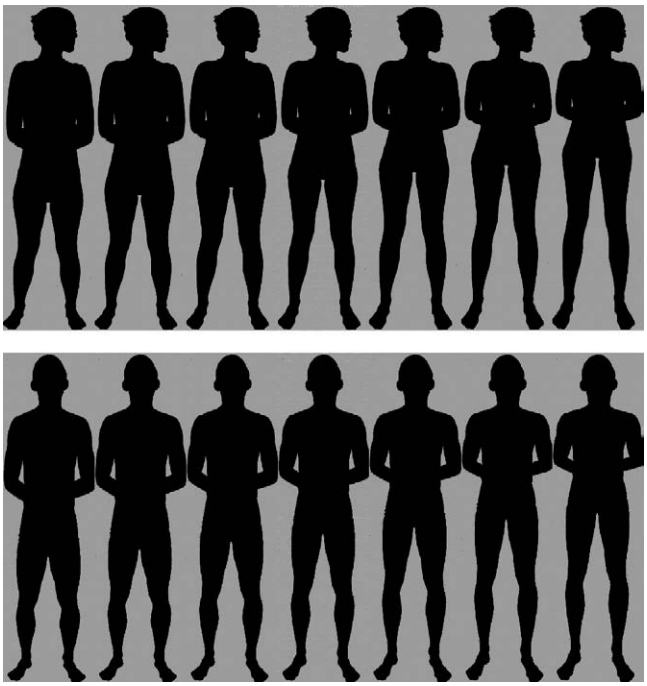

Fig. 1. Seven female and 7 male stimuli used in our study; the middle silhouette represents the population mean. Those on either side increase or decrease leg length in 5% gradations.

silhouettes using a seven-point scale (from 1="I don't like it" to 7="I like it very much"—"I like" in Polish is comparable to "I am attracted to" in English). First, female, then male, silhouettes were judged. The raters were 100 men aged 16–49 (mean=24.4, S.D.=6.5) years and 118 women aged 15–45 (mean=21.5, S.D.=5.7) years. All were living in Wroc^{3}aw (Poland), and all were ethnic Poles. Details of their sexual orientation were not requested. The raters were recruited at the University Sport Campus and near the coaching station. They were not remunerated for participation. In order to test whether the preferences for LBR are dependent on the raters' own LBR, height, and weight, this information too was collected. Weight, height, and sitting height of all raters was measured by the first author (P.S.) who was trained in anthropometric measurements and who used specific anthropometric points. Leg length and relative leg length (LBR) (leg length/body height ratio) were subsequently calculated for each participant.

To eliminate the possibility that rather than having a strong preference for some particular LBR, people tend to select individuals in the center of the LBR distribution for the seven stimuli presented, we carried out a second study. In Study 2, we used only four stimuli from the first study: the original picture and pictures with legs shortened by 5%, 10%, and 15%. If people have a preference for some particular LBR irrespective of the LBR distribution in the stimuli presented, then one should expect that, in Study 2, the subjects would express the strongest preference for the man and woman with the largest LBR presented. The raters were 90 men aged 19 to 30 (mean=22.0, S.D.=3.2) years and 108 women aged 19 to 28 (mean=21.3, S.D.=2.0) years. All raters were students of the University of Wroclaw and were of Polish ethnicity. They were not remunerated for their participation.

In Study 3, we examined preferences for LBR using modified (blackened) version of the stimuli of Swami et al. (2006) (Fig. 3). We showed them to 40 men aged 19 to 27 (mean=21.3, S.D.=2.1) years and 40 women aged 19 to 26 (mean=21.1, S.D.=2.0). All raters were ethnic Poles, and all were students from the University of Wroclaw (Poland).

To test the attractiveness assessments for different stimuli and the relationship between raters' own morphological traits [their own height, weight, body mass index (BMI) or LBR], we used a GLM (General Linear Model) with repeated-measures analysis of variance (ANOVA). We used a 2×(2×7) ANOVA [rater sex×(stimuli sex×stimuli leg length)] in order to test whether preferences are related to a rater's morphology. The effects of the raters' height, weight, BMI, and relative leg length (all in four categories, between-group analysis) on their personal choices were tested in separate analyses. All analyses were carried in STATISTICA 6.0 (Statsoft Inc., 2006).

3. Results

We found significant differences in attractiveness assessments both for male ($F_{6,1296}$=155.6, p<.0001, eta^2=.42) and female pictures ($F_{6,1296}$=146.9, p<.0001, eta^2=.41) with different leg lengths (see Fig. 1). These preferences were independent of the raters' sex (male stimuli: $F_{6,1296}$=1.15, p=.33, eta^2=.01; female stimuli: $F_{6,1296}$=1.4, p=.2, eta^2=.01). Post hoc least significant difference (LSD) Fisher tests revealed that apart from the lack of difference between the original picture and +10%, in all other cases, there were significant differences in attractiveness between the original picture and the manipulated pictures (see Fig. 2).

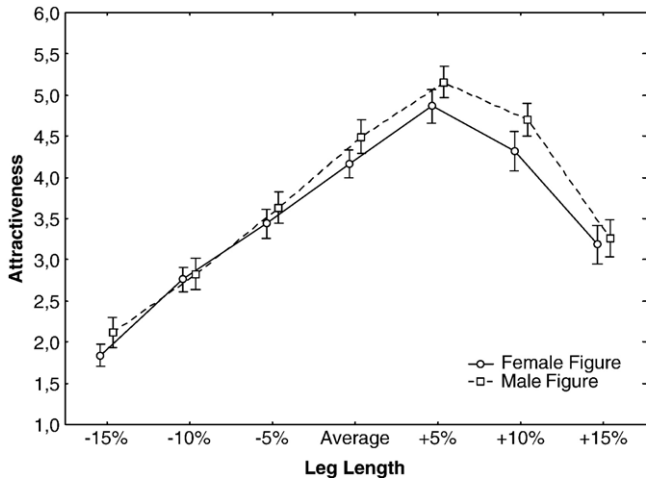

Fig. 2. Attractiveness scores (combined for two sexes) for men and women silhouettes with different leg length (from −15% LBR to +15% LBR).

Table 1
Descriptive statistics of the raters

	Females (n=118)			Males (n=100)		
	Mean	Range	S.D.	Mean	Range	S.D.
Height (cm)	168	152–187	6.2	179.4	164–200	6.7
Weight (kg)	58.3	44–85	7.5	73.5	56–107	9.0
BMI	20.6	16–28	2.3	22.8	17–33	2.4
Leg length (cm)	82.8	62–97	5.0	89.4	78–100	4.7
LBR	.49	.41–.54	.018	.5	.46–.53	.015
Age	21.5	15–45	5.7	24.4	16–49	6.5

The preferences proved to be independent of the raters' height ($F_{18,1284}$=1.15, p=.31, η^2=.01), weight ($F_{18,1284}$=1.02, p=.42, η^2=.01), BMI ($F_{18,1284}$=1.06, p=.39, η^2=.01), and relative leg length ($F_{18,1284}$=1.21, p=.23, η^2=.01).

The Study 1 raters' descriptive statistics are presented in Table 1.

In Study 2, we found significant differences in attractiveness assessments both for male ($F_{3,588}$=156.4, p<.0001, η^2=.44) and female pictures ($F_{3,588}$=241.4, p<.0001, η^2=.55) with different leg lengths. These preferences were independent of raters' sex (for male stimuli: $F_{1,196}$=.88, p=.52 η^2=.01; for female stimuli: $F_{1,196}$=.81, p=.5, η^2=.01).

The most attractive was the original picture (Table 2). Post hoc LSD Fisher tests revealed that there were significant differences in attractiveness ratings between all the pictures when comparing the rates separately within the male and female stimuli.

Lastly, (Study 3) we checked the attractiveness of the modified (blackened) Swami et al. (2006) stimuli (see Fig. 3). In contrast to Swami et al., we found that both female ($F_{4,312}$=62.8, p<.0001, η^2=.45) and male stimuli ($F_{4,312}$=35.3, p<.0001, η^2=.31) were more attractive with longer legs (Table 3). These preferences were independent of raters' sex (male stimuli: $F_{1,78}$=.41, p=.53, η^2=.01; female stimuli: $F_{1,78}$=.95, p=.34, η^2=.01).

4. Discussion

The results of our investigation clearly indicate that leg length influences both male and female body attractiveness. Figures with legs shorter than the average of the population were perceived as less attractive. This confirms our prediction that relatively short legs might be a cue to maladaptive biological conditions such as health problems (Davey Smith et al, 2001; Gunnell et al., 2003; Gunnel et al., 2005; Lawlor et al., 2002; Lawlor et al., 2004), low resistance to adverse environmental factors (Gunnell et al., 1998; Wadsworth et al., 2002) or poor running ability (Cavanagh & Kram, 1989; Ropret et al., 1998). Relatively short legs in women might also be a sign of lower reproductive capabilities: female leg-trunk ratio is positively associated with offspring birthweight (Lawlor, Davey Smith, & Ebrahim, 2003). As birthweight is a strong predictor of neonate survival rate (McCormick, 1985; Sappenfield, Buehler, Binkin, Strauss, & Hogue, 1987), all female morphological traits that are related to birthweight can be considered subject to selection (see e.g., Pawlowski & Dunbar, 2005, for women's waist-to-hip ratio and the birthweight of her first child). In terms of attractiveness preferences, it does not matter whether the short legs result from genetic or environmental factors (e.g., poor nutrition during prepubertal period); short legs simply convey some type of maladaptation.

Although we found that longer legs are more attractive, this was true only for a slight (5%) leg length increase; excessively long legs decrease body attractiveness as well. This may be due to long legs being a cue to maladaptive genetic diseases [Klinefelter syndrome (XXY) or Marfan

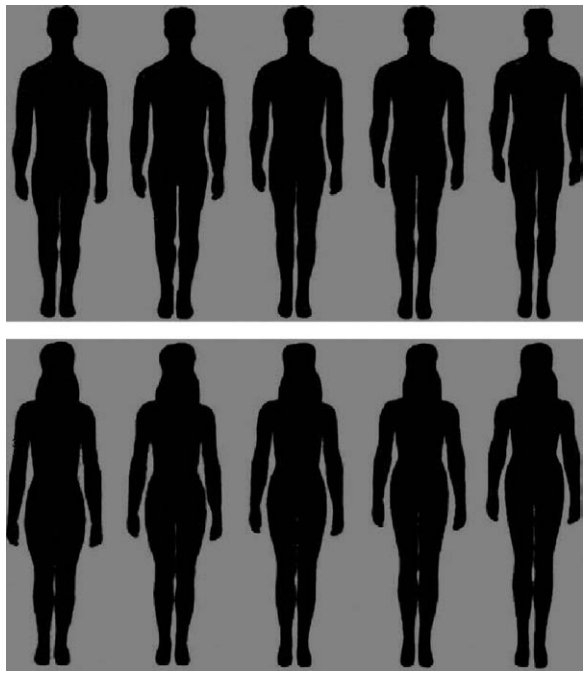

Fig. 3. Modified (blackened) versions of the stimuli used by Swami et al. (2006).

Table 2
Attractiveness scores for men and women silhouettes with different leg length (from −15% LBR to 0 LBR)

	LBR −15%	LBR −10%	LBR −5%	LBR 0
Female stimuli	1.9	2.9	4.2	5.0
Male stimuli	2.0	3.1	4.2	4.9

Table 3
Attractiveness scores for men and women silhouettes with different leg length (from 1.0 LBR to 1.4 LBR)

	LBR 1.0	LBR 1.1	LBR 1.2	LBR 1.3	LBR 1.4
Female stimuli	2.5	3.6	4.5	5.3	5.0
Male stimuli	2.5	3.2	4.1	4.5	4.4

Syndrome (Pyeritz, 2000; Roark, 1959)] or poor lung functioning among those with very short trunks (Davey Smith et al., 2001). Furthermore, excessively long legs might also indicate lack of sexual maturity among males (e.g., 13-year-old boys have relatively long legs—Dangour et al., 2002). One can also hypothesize that excessively long legs, and therefore excessively small torsos, might indicate insufficient space for the proper development of a fetus and, therefore, lower chances for successful pregnancy in females. Our results show also that perception of body attractiveness is not affected by the sex, height, weight, BMI, or relative leg length of the observer.

The results obtained do not support the hypothesis that one should prefer average leg length (e.g., Moreland & Zajonc, 1982; Zajonc, 1968): firstly, because figures with 5% longer legs are more attractive than those with average leg length, and secondly, because 5% shorter legs are far less attractive than 5% longer legs (i.e., there is no symmetry in terms of the perceived attractiveness of variations around the average body proportions).

As Study 2 revealed (strong linear effect from the lowest to highest LBR), the results obtained in Study 1 cannot be attributed to a preference for individuals in the center of the distribution of the presented stimuli but, rather, must be related to a preference for some absolute LBR.

Our results differ as well from those obtained by Swami et al. (2006) who found that shorter legged men are perceived as more attractive. For several reasons, our results may be more reliable. First, our sample size was almost three times larger, and our sample was homogenous in terms of ethnicity. Second, we found a bell-shaped curve when assessing leg length for both sexes, and this seems to be a more biologically justified result than any linearly increasing or decreasing preference (as in the results of Swami et al.). This is due to the fact that both overly short and overly long legs can be related to some diseases and/or body malfunctioning and, therefore, might be treated as a cue to lower biological quality. Third, from an evolutionary perspective, it seems unlikely that maladaptively short legs in men (which are related to poorer running skills) would be more attractive than longer legs. As Bramble and Lieberman (2004) argue, in our evolutionary past, running speed was an important determinant of fitness, as longer legs allow better efficacy during hunting, when escaping from predators, or during agonistic intrasexual encounters; hence, intersexual selection should have favored longer rather than shorter legs. Furthermore, as Swami et al. noted in their discussion, their stimuli were not based on anthropometric data and, therefore, might not have been representative of a real population. In our studies, the original stimuli represented the average LBR for the population. What is more, the results we obtained for the remade Swami et al. stimuli confirm the results we obtained from our stimuli.

One limitation of our research is that perceptions of silhouettes may differ from perceptions of actual bodies. In future experiments, more realistic stimuli might be used (e.g., 3D pictures, movies). Note, however, that many factors influence the attractiveness of the human body; hence, the use of silhouettes has the advantage that it allows for greater experimental control over the manipulation of the feature of interest.

In our stimuli, only female images had their heads looking off to one side. Such construction of the stimuli was not perfect, but the statistical analyses were conducted only within each sex and did not include comparisons between male and female attractiveness, so this fact should not influence the interpretation of the results.

In future studies, it would be interesting to investigate how ecological conditions influence preferences for LBR. For example, although some controversy surrounds their application to humans (Ashton, Tracy, & de Queiroz, 2000; Steegmann, 2005), Bergmann's rule and Allen's rule are two theoretically sound approaches to morphology predicated on basic principles of ecophysiology, namely, that in cold climates, heat loss of homeotherms can be reduced by decreasing surface area relative to volume of a body and by reducing the length of body appendages. Correspondingly, human populations differ in their body proportions, and it is plausible that aesthetic preferences are calibrated to the locally prevailing phenotype; hence, people in heat-adapted populations may prefer longer legs than those in cold-adapted populations.

In previous studies, attention was drawn to the fact that women should have an evolved preference for taller men; for instance, women prefer men who are taller than themselves (Pawlowski, 2003), and taller men's personal advertisements often elicit more responses (Pawlowski & Koziel, 2002). Therefore, it appears that taller men are considered more attractive than those of average height [on the other hand, a positive correlation between female height and attractiveness has not been proven (Gillis & Avis, 1980, Shepperd & Strathman, 1989)]. Our data show also that leg length (in this research measured as leg-to-body height ratio) influences the perception of male attractiveness. In further experiments, it could be tested whether height or LBR influences the perception of attractiveness more (it should also be noted that taller individuals have proportionally longer legs than shorter people).

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