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Original Article

THE EFFECT OF LEG LENGTH ON PERCEIVED ATTRACTIVENESS OF SIMPLIFIED STIMULI

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Abstract
In Western culture there are countless examples of reference to female legs as a factor in sexual attraction. It is not surprising, therefore, that both males and females perceive female figures as more attractive as leg length increases, in proportion to torso or stature, and perhaps the opposite should be true for male figures. Both evolutionary and socio-cultural factors can play a role in the effect, such as the emphasis on longer legs in images of attractive women. To isolate leg length from other factors we conducted three studies using an extremely simplified type of stimulus: stick figures. Results using three different dependent variables (a forced choice, a rating, and a production task) confirm a role for leg length in attractiveness judgments, modulated also by level of estimated self-attractiveness. We discuss the potential of simplified stimuli, which do not attempt to appear realistic, as a tool in the study of factors affecting attractiveness.

Keywords: Physical attractiveness; Sex differences; Health

The Effect of Leg Length on Perceived Attractiveness of Simplified Stimuli

A number of factors affect physical attractiveness, for instance height for men (e.g. Pawlowski, Dunbar & Lipowicz, 2000) and waist-to-hip ratio for women (e.g.

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Singh, 1994). From an evolutionary perspective it is interesting to explore the relationship between perceived attractiveness and mate quality (Gangestad & Scheyd, 2005; Hönecopp, Rudolph, Beier, Liebert & Müller, 2007).

Although more empirical work has been carried out on facial attractiveness than on body attractiveness, faces and bodies may not signal the same aspects of mate value (Hönecopp et al., 2007). It is, therefore, important to study factors affecting body attractiveness separately from facial factors.

Recently, Swami, Einon and Furnham (2006) studied leg-to-body ratio, defined as a ratio between leg length to the length of the rest of the body. Participants were undergraduates from a British University and they rated attractiveness on a seven-point Likert scale. Both males and females showed a preference for a higher leg-to-body ratio when judging women and a lower leg-to-body ratio when judging men.

Smith, Cornelissen and Tovée (2007) did not set out to look at leg length in particular, but they measured torso-to-leg ratio and found a non-significant correlation between this variable and ratings of attractiveness. Because this correlation was negative for torso-to-leg ratio (Pearson r=-0.17), the direction of the trend was consistent with the finding by Swami et al. (2006) for leg-to-body ratio. Whilst Swami et al. used drawings, Smith et al. used videos of 43 female undergraduates volunteers. The variables in these two studies were not simply the inverse, leg length was measured as height at the hip by Swami et al. and from the perineum to the ankle by Smith et al., therefore, a direct comparison is impossible. The range was 0.4 in the former (from 1.0 to 1.4), and 0.31 in the latter (from 0.75 to 1.06).

In their conclusions, Swami et al. (2006) suggested that over time people may have come to associate a higher leg-to-body ratio with femininity and a lower leg-to-body ratio with masculinity. In other words, secondary sex characteristics are, almost by definition, prototypically feminine or masculine. This association may be based on a real dimorphism or simply on culture. However, anthropometric data show that women do not have proportionally longer legs than men, if anything they have slightly shorter legs, in particular after puberty (Eveleth & Tanner, 1976; Martin & Nguyen, 2004; Sorokowski & Pawlowski, 2008).

Swami et al. (2006) discuss other possible interpretations of their findings. From an evolutionary perspective there may have been an association between having higher leg-to-body ratio in women and reproductive success because of a potential correlation between leg-to-body ratio and wider pelvises. However, this does not explain why a lower leg-to-body ratio was seen as more attractive in men. Moreover, Smith et al. (2007) found no correlation between torso-to-leg ratio and waist-to-hip ratio (Pearson r=0.06).

Even more recently, Sorokowski and Pawlowski (2008) examined the relationship between leg-to-body ratio and attractiveness. Our own research was conducted and written before this paper was published, but we discuss it here because it is relevant. They used silhouettes based on photographs of an average Polish male and an average Polish female, thus anthropometrically correct, as their basic stimuli. They also tested the stimuli from Swami et al.. Their results showed that both smaller and larger than average ratios were considered less attractive. They found the greatest preference for 5% longer legs than average, so they suggested this was not simply a preference for the average. Unlike Swami et al. (2007), Sorokowski and Pawlowski found the same preference for longer legs for both the male and the female figure. They argue that both

small and large leg-to-body ratios might represent poor genetic and environmental conditions and evolutionary maladaptiveness (Trivers, 1972; Symons, 1979; Gansestead & Scheyd, 2005).

Using simple stimuli

Swami et al. (2006) used the drawing of a man and a woman in a black swimming costume. They digitally manipulated the image to increase or decrease the leg-to-body ratio while keeping the drawing as constant as possible. They discussed some limitations of their stimuli. For instance, the stretching of the image may have affected apparent crotch size in men, a proxy for genital size, or breast size in women. Another problem with stretching images of this type is that the arms become shorter with higher leg-to-body ratios.

We report three studies in which we manipulated leg length using a new type of stimuli. In the literature it has been argued that the small scale of line drawings may lead to results not compatible with full-scale stimuli (Holder & Keates, 2006). One solution to this problem is to use realistic full-scale images. However, no one to date has tried to do this primarily because of the difficulty of controlling for extraneous factors. We, instead, are interested in exploring the possibility of using the opposite extreme, that is, extremely simplified human figures. Our stimuli can be described as stick figures.

A discussion of our stimuli is necessary here. The first impression may be that stick figures are too different from human bodies to be useful. We believe that one has to consider this issue carefully to weight pros and cons. On the one hand, realistic images of people may seem ideal to study attractiveness. But the number of features that influence perceived attractiveness is large, most of these would have to be sampled in the stimuli, and in some way one would have to ensure that none of them were correlated with the variable of interest. Singling out one phenotype, as in the Swami et al.'s study, would be problematic because little is known about how different factors interact. For instance, the specific values of waist to body ratio chosen for the female and the male models may be important. In addition, the two individuals may be perceived as different in age, and different leg-to-body values may be seen as more appropriate for different ages.

This general problem is also illustrated by the discussion in Smith et al. (2007). A strong association exists between waist-to-hip ratio, waist-to-chest ratio and body mass index, making it hard to identify which physical features drive perceived attractiveness (Smith et al., 2007). In the specific case of leg length, leg-to-body ratio inevitably correlates with factors such as leg-to-shoulders ratio, and, more subtly, changing leg-to-body ratio may affect the perceived stature of an individual.

There is another problem with using realistic images of people, and it is more serious. The same pair of individuals were shown by Swami et al. after a digital manipulation that altered their leg-to-body ratio. The same was true for Sorokowski and Pawoloski (2008). However, changes to this variable in adults is practically impossible, at least without a significant change in age. Leg length of an individual does not change in the short term, for instance, as a consequence of diet or exercise. Thus, ecologically, it is unrealistic to be presented with the image of the same individual but with a different leg-to-body ratio.

At the outset one might have thought that the stimuli used by Swami et al. (2006) were more ecological valid than stick figures. But now we have seen that a change of leg-

to-body ratio (in a given individual) is actually not ecologically valid, and asking people to express different judgments of attractiveness in response to an impossible change in body shape is, therefore, problematic.

No set of stimuli is perfect. Our contention is that, beyond the first impression, there are good reasons to study judgments about simplified forms, not exclusively, but in addition to other studies with realistic images of people.

Stick figures have some specific advantages over drawings and photographs in the study of perceived attractiveness. The main advantage is that stick figures allow the removal of all secondary sex characteristics. Breasts do not need to be included in a female stick figure, and stick figures are not more or less muscular, and these factors are also known to affect attractiveness (e.g., Lindner, Rychman, Gold & Stone, 1995; Dixson, Halliwell, East, Wignarajah & Anderson, 2003).

Indeed, with stick figures the sex manipulation can be entirely confined to the instructions: participants may be asked to look at a set of stick figures as representing males or as representing females. In addition, parameters can be manipulated easily and precisely.

We note also that we did not invent stick figures. They are a widely used simplification of the human body that is not specific to one culture. Something quite similar to a stick figure representing the human body can be found in Paleolithic art. The most famous example of this is the bison scene from the Lascaux cave in southern France (circa 16.000 years old).

Finally, simplified stimuli have a long and distinguished place in psychophysics. A dot jumping from one position to another may have very little in common with an ecologically valid stimulus, such as a moving animal, yet our understanding of motion perception has been enhanced by studying apparent motion (Wertheimer, 1912). The strategy is based on the idea of isolating the variable of interest, and this is precisely what stick figures allow. Within this philosophy, the simpler the stimulus the better.

Study 1

We prepared a set of stimuli in which only three variables were manipulated: the size of the head, the length of the legs relative to the body, and the smile of the face. The hypothesis was that leg length would differentially affect men and women because men would prefer higher values and women would prefer lower values. The other two variables were included to provide variability in the stimuli, but the design was fully factorial so that each could be tested.

Heads in stick figures are typically too large compared to human anatomy. We used heads that were approximately as high as the legs. In our analysis we will focus, therefore, on leg-to-torso ratio rather than leg-to-body ratio.

We used a novel type of dependent variable. Participants had to select the most attractive individual out of a set of six figures, which we refer to as a 'parade'. The idea was that selecting the most attractive was in some way more similar to choosing a partner compared to the task of rating a single image.

Participants were also asked to estimate their own attractiveness on a ten-point Likert scale. This is interesting because the hypothesis that longer legs for females bodies are simply deemed more attractive in our culture does not predict a correlation between

preference for longer legs and estimated self-attractiveness. However, from an evolutionary perspective people who believe they are worth more should also be more selective in terms of the physical characteristics possessed by potential mates (Little, Burt, Penton-Voak & Perrett, 2001; Scheyd, 2004).

Method

The study was carried out using a paper and pencil questionnaire. In total, 82 men and 81 women took part. The sample was taken from the University undergraduate population and the age ranged between 18 and 45 years.

We varied three factors: head size (12mm, 12.7mm, and 13.2mm), leg length (12mm, 13.5mm and 15mm; in leg-to-torso ratio the values were l.1, 1.5, 2.0) and smile (more curved or less curved). The factorial combination of these factors gives 18 unique stick figures. They were grouped in lines of six, which we call a 'parade'. Using a Latin square design the 18 figures created three parades in which each factor varied over the entire range, as is the nature of a Latin square. These three parades were arranged on a A4 page as illustrated in Figure 1. In addition, a different order of the same stimuli was used in a separate but similar A4 page, i.e. there were two permutations. Both pages (permutations) were used with each participant to balance for possible order effects and also to increase the number of measurements.

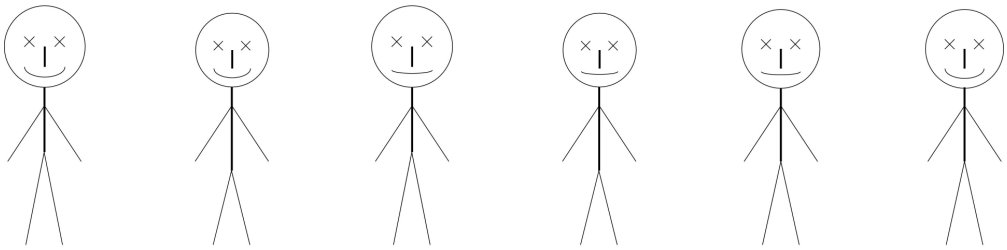
Results

Usually only heterosexual participants are included for this type of analyses. Unfortunately in our case it was not practical to collect information about sexual orientation. This may add noise but cannot in itself produce completely spurious results.

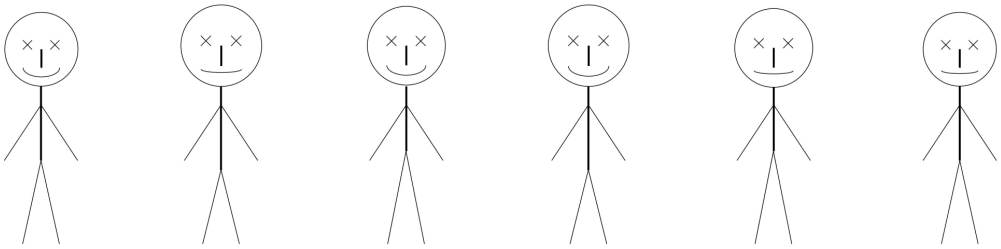
For each observer we computed the average number of times that a stick figure was selected from a parade. Each unique figure was only present twice in the stimuli (once in each A4 page) but we also averaged over the other conditions when analysing each of the three independent variables (head size, leg-to-torso ratio, and smile). We present these scores scaled to be between 0 and 1, but note these are not proportions. Mean values are plotted in Figure 2. Because we cannot make parametric assumptions about the distribution of our means, we performed non-parametric analyses on rank order.

As expected, smiley stimuli were picked as most attractive more often than non-smiley stimuli (the means were 0.90 and 0.12 respectively). This effect was strong (Friedman Rank Test, $p<0.001$) but there was no gender difference (Mann-Whitney Tests, ns).

Please circle below the figure (only one) you think is the most attractive.



Please circle below the figure (only one) you think is the most attractive



Please circle below the figure (only one) you think is the most attractive

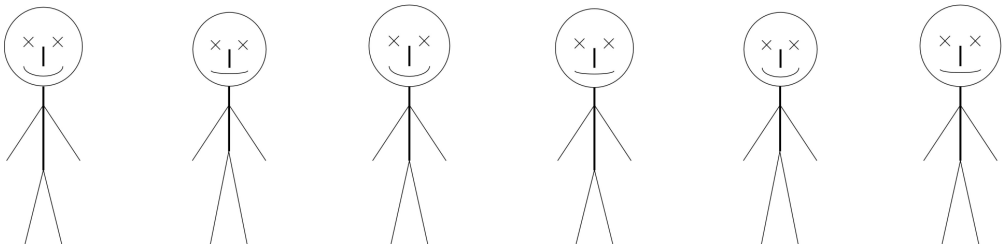


Figure 1. Stimuli for Study 1. This illustrates three parades on a single A4 sheet of paper.

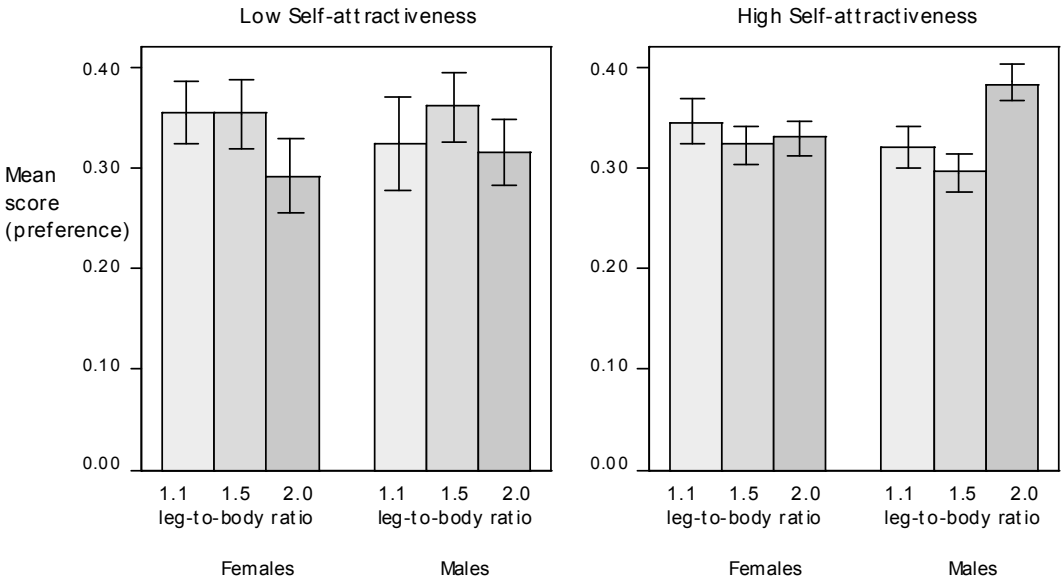


Figure 2. Data from Study 1. Mean scores based on how often a stimulus was selected are plotted as a function of leg-to-torso, as a function of the sex of the participant, and separately for the low and high self-attractiveness group (split according to the median). Error bars are standard errors for the mean.

Stimuli with smaller heads were picked as most attractive more often than stimuli with larger heads (the means were 0.52, 0.28 and 0.20). This effect was strong (Friedman Rank Test, $p<0.001$) but there was no gender difference (Mann-Whitney Tests, ns).

Overall, stimuli with longer or shorter legs were picked as the most attractive with similar frequency and, therefore, similar scores (the means were 0.33, 0.32, and 0.34 for leg-to-torso ratios of 1.1, 1.5, and 2.0 respectively). The rank differences were not significant (Friedman Rank Test, ns). However, when performance for men and women was compared, responses were similar for the 1.1 and 1.5 ratios (Mann-Whitney Tests, ns), but they were significantly different for the 2.0 ratio (Mann-Whitney Test, $p=0.018$). The longer-legged figures were preferred more often by men.

Participants also rated, on a ten-point scale, how attractive they thought they were. To test whether the effect was related to degree of self-attractiveness we used a median split of the sample into two groups, one relatively low in estimated self-attractiveness (<=5) and one relatively high (>5). The data are plotted separately for the two groups in Figure 2. We repeated the same analysis of leg-to-torso ratio at level 2.0 and found that when performance for men and women was compared, responses were similar within the low self-attractiveness group (Mann-Whitney Test, ns) but they differed within the high self-attractiveness group (Mann-Whitney Test, $p=0.049$). There is, therefore, an association between the preference for a higher leg-to-torso ratio and how attractive the male participants rated themselves. This difference was small but it is interesting because it is consistent with the hypothesis that leg length is a cue to desirability in mate selection and individuals who believe they can be more selective may be more sensitive to such a cue.

Study 2

The second study was carried out using a paper and pencil questionnaire similar to the first study. However, we introduced a number of changes. First, instead of a parade we used a Likert scale more similar to that used by Swami et al. (2006). On one A4 page we arranged eight figures with a seven-point scale underneath each of them (see Figure 3).

Second, we specifically instructed participants to look at a set of stick figures as either male or female. By doing this we obtained judgments of what appears attractive in male and female figures from the perspective of both men and women. The actual stimuli presented on one A4 page were identical under both instructions, but the order of the figures on the page was different.

Method

In total 67 men and 164 women took part. The study was conducted in a large lecture theatre during an Open Day, age, therefore, ranged from 17 to 67 years. This included parents as well as prospective students.

We varied two factors: leg-to-torso ratio (l.0, 1.2, 1.4, 1.6) and smile (more curved or less curved). The combination of these factors gives 8 unique stick figures.

On one A4 page with 8 stick figures the instructions were "Please look carefully at these stick figures. They represent MEN. Please rate how attractive each MAN appears to you using the rating scale provided (circle one number)". In another version the words "MEN" and "MAN" were replaced by "WOMEN" and "WOMAN". We refer to these two versions as M and W. There were also two versions of the random order in which the figures were organised on the page, which we call order A and B.

Participants responded to the M condition first and the W condition second or vice versa. They saw different orders on the two pages. The combination of sex of the stick figure and order gives, therefore, four possible groups of participants (MAWB, MBWA, WAMB, WBMA).

Results

For each observer we computed the average rating. Mean values are plotted in Figure 4.

We ran a repeated measures analysis of variance. The within factors were leg-to-torso ratio (1.0, 1.2, 1.4, 1.6), smile (more curved or less curved) and sex-of-stick (male or female). In the case of leg-to-torso ratio we specifically treated this as a linear contrast, with one degree of freedom. This is because in this experiment leg-to-torso ratio was varied by equal steps and we are interested in the slopes. The between factors were sex (of the participant) and order (one of the four orders of presentation of the stimuli, as described in the Methods).

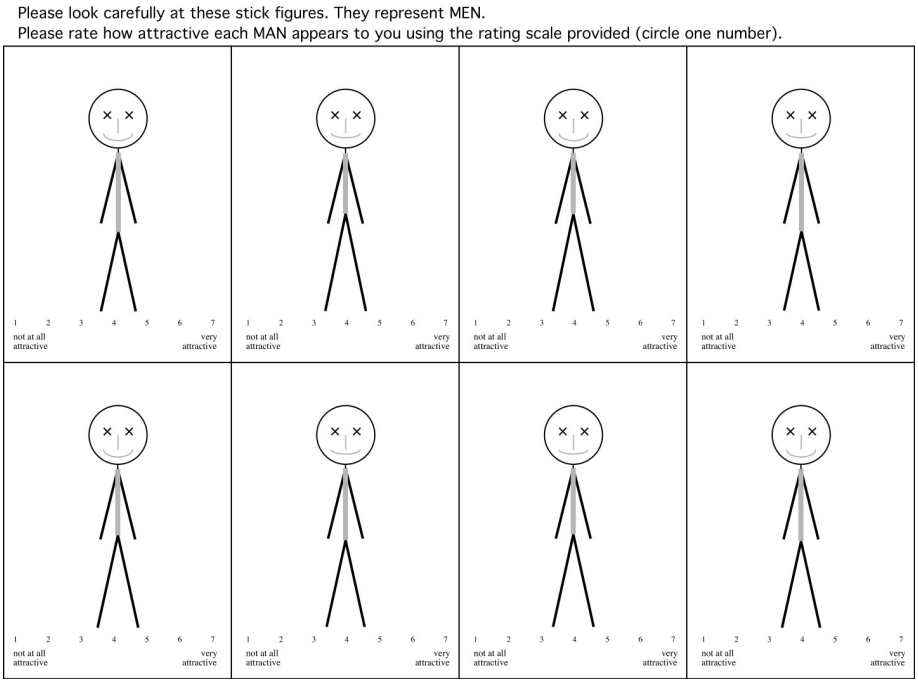


Figure 3. Stimuli for Study 2, as printed on a A4 sheet of paper. This illustrates the condition in which the 8 figures were described as men.

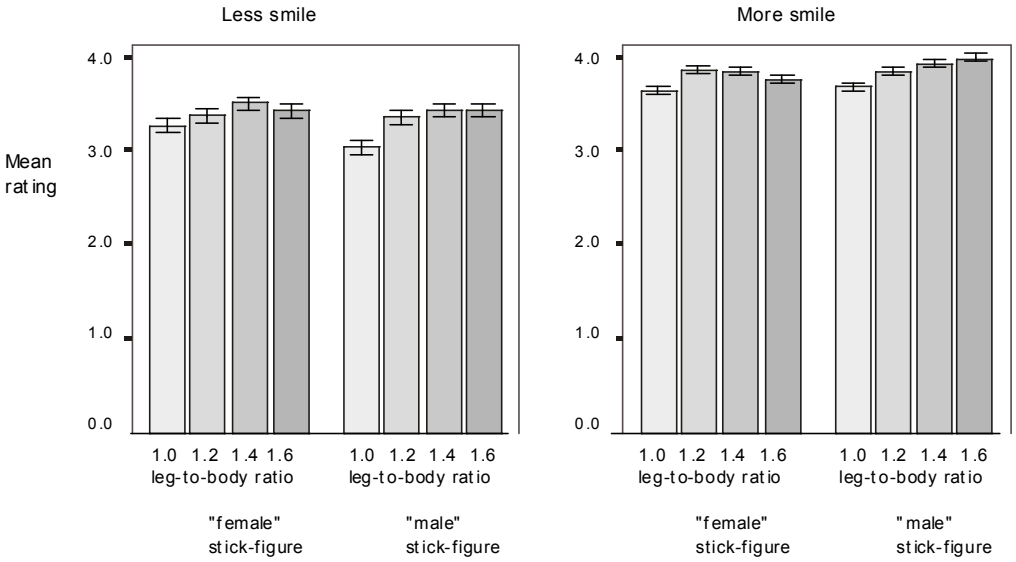


Figure 4. Data from Study 2. Mean rating values are plotted as a function of leg-to-torso ratio, as a function of the sex of the stick figure, and separately for the more smiley (left) and less smiley (right) stimuli. Error bars are standard errors for the mean. We are not interested in the effect of the smile, but the plots show that the pattern for leg-to-torso ratio is similar in the two subsets.

There was no significant effect of order, nor any interaction between order and other factors, therefore, we will not discuss this factor further. There was an effect of sex of participant ($F^{1,176}$=4.58; p=0.034). Women tended to use higher values on the attractiveness scale. There was also a significant effect of smile ($F^{1,176}$=42.10; p<0.001). As expected the larger the smile the more attractive the stimulus (the means were 3.36 and 3.81 respectively).

There was a significant effect of leg-to-torso ratio ($F^{1,176}$=10.46; p=0.001). This means that the values increased linearly with leg-to-torso ratio. Smile and leg-to-torso ratio interacted ($F^{1,176}$=9.77; p=0.002) because the slope was steeper for the stimuli with less smile. However, the slope was positive in both cases. There was also a three way interaction between sex of participant, smile and leg-to-torso ratio ($F^{1,176}$=8.16; p=0.005). Again all slopes were positive and the difference was only quantitative.

The most interesting result was the interaction between leg-to-torso ratio and sex of the stick figure ($F^{1,176}$=5.10; p=0.025). For both men and women the effect of leg-to-torso ratio was stronger when the stick figures were described as females. In terms of regression parameters, b was 0.275 for females stick figures and 0.420 for male stick figures. This is consistent with the idea that the effect of leg-to-torso ratio on attractiveness is gender modulated. However, from our data there was no evidence that shorter legs were preferred in the case of male stick figures.

Study 3

In Studies 1 and 2 the stimuli were prepared by the experimenter, so a fixed set of values for leg length had to be chosen. In Experiment 3 we instructed participants to produce stick figures of men and women, and we asked them to draw them to be as attractive as possible. The exact wording is shown in Figure 5.

Most individuals are, or feel, unable to draw realistic images of people. Yet, most of them are confident at drawing a stick figure. Thus, for stick figures alone, a production task is feasible. This is another unique advantage of stick figures.

Method

In total 36 men and 74 women took part. The study was conducted in a large lecture theatre during an Open Day; age, therefore, ranged from 17 to 64 years.

One A4 page had instructions about producing two drawings of stick figures. For 53 participants the space for the drawing of a man was above the space for the drawing of a female, for the remaining participants it was the other way around. The instructions made clear that "in a stick figure you can only use lines and circles", and we provide a thumbnail example (see example in Figure 5). At the bottom of the page participants were also asked to rate their own attractiveness on a ten-point Likert scale.

The drawings were measured using a ruler. The measurement task was carried out by a research assistant that was, at the time, unaware of the specific hypothesis of the study. That is, she was aware that the study was about body parts but she was not aware of the sex difference in leg-to-torso ratio found in Experiments 1 and 2.

Results

In general, there was great variability in the drawings produced. Some stick figures were much taller than others, some participants included details like skirts (24), hats (3), and breasts (16). The skirt was typically triangular as in the sign used on public toilets. We did not anticipate such variability, but as our interest was in a specific relationship between body parts within a figure –a proportion– the absolute scale of the drawing was not important. The details included by some participants also provide a fresh contrast with the very constrained stick figures used in Experiments 1 and 2. However, in a few cases the drawings departed so much from stick figures that it was impossible to extract accurate measures, for instance, if the female stick-figure had a dress without a waist. In total we excluded 16 participants.

We ran an analysis of variance in which the dependent variable was the value of leg-to-torso ratio computed from the drawing. The within factor was the sex-of-stick (male or female), the between factors were sex (of the participant), order (whether they drew the man or the woman first) and level of self-reported attractiveness (high or low). The two levels of attractiveness were based on a median split of the data. To include this factor we had to exclude 7 more participants who did not provide a self-attractiveness score. However, the overall pattern of significance was very similar in the analysis with or without these data.

No factor or interaction was significant with the exception of the sex-of-stick ($F^{1,79}$=9.66; p=0.003). Higher values of leg-to-torso ratio were drawn for the female stick figures (1.67) compared to the male stick figures (1.37). Although not significant, the difference between the mean ratios for female and male stick figures was greater for the high attractiveness group (0.33) compared to for the low attractiveness group (0.22). Figure 6 shows the average leg-to-torso ratio separately for male and female stick figures and for male and females participants.

There was great variability in the absolute values of these ratios. We, therefore, also looked at the proportionate difference instead of its metric value. We classified participants as belonging to one category if they drew female stick figures with higher leg-to-torso ratio than male stick figures, or to another category if they did the opposite. Sixty out of 94 participants belonged to the first category (64%). This difference is significant (χ^2_1=7.19; p=0.007).

At a later time, we tested ten individuals with the same questionnaire in the lab. This was done to be able to interview them, after they had completed the drawings, about what strategy they had used. None of them suggested that they were trying to draw the female figure as having longer legs than the male figure. A few mentioned that they were trying to convey muscularity in the case of the male figure. However, when the leg factor was mentioned by the interviewer, some volunteered that attractive women should have longer legs. It appears from this anecdotal evidence that participants do not set out with a few clear features in mind when they draw stick figures. However, they seem aware of the fact that legs are important.

Please draw a stick-figure in the space provided below. Although a stick-figure is only made up of simple lines please try and draw the most **attractive man** you can, in other words draw the body parts in the size you think should be in an ideal man. For instance you can make the eyes large or small, or the arms long or short. If you make a mistake cross it out and start again.
Remember in a stick figure you can only use lines and circles, for instance this is a stick figure: 

- top of stick-figure

- ground on which the stick-figure stands

Please draw a stick-figure in the space provided below. Although a stick-figure is only made up of simple lines please try and draw the most **attractive woman** you can, in other words draw the body parts in the size you think should be in an ideal woman. For instance you can make the eyes large or small, or the arms long or short. If you make a mistake cross it out and start again.
Remember in a stick figure you can only use lines and circles, for instance this is a stick figure: 

- top of stick-figure

- ground on which the stick-figure stands

One final question. Please circle on the scale below how physically attractive you think you are (1 means not very attractive at all, and 10 means extremely attractive):

1 2 3 4 5 6 7 8 9 10

Figure 5. Instructions for Study 3. In this example the top half of the page asked for the drawing of a man and the bottom half for the drawing of a women. The opposite order was used for a separate group of participants.

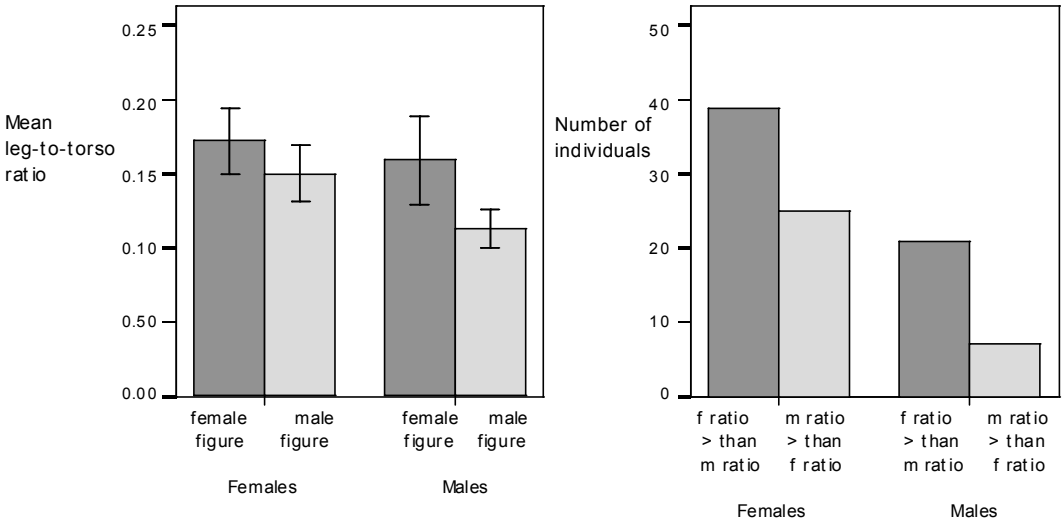


Figure 6. Data from Study 3. (left) The mean leg-to-torso ratio is plotted for females and male stick figures, and separately for females and males participants. Error bars are standard errors for the mean. (right) Participants were divided into one of two groups: those for whom the leg-to-torso ratio for females (f ratio) was greater than the leg-to-torso ratio for males (m ratio), and those for whom the opposite was true. The graphs shows the size of each group (number of individuals) as a function of sex.

Anthropometric and Epidemiological data

Neither the Swami et al. (2006) nor our own study were guided by normative data about body proportions in the population. If leg-to-body ratio is higher in women then perhaps our participants are simply displaying (implicit) knowledge of the world. However, a small difference between sexes may exist, but in the direction of relatively longer legs for men (Eveleth & Tanner, 1976; Sorowokswi & Pawoloski, 2008).

To obtain values of leg-to-body ratio for the adult population we used the 1988 U.S. Army Anthropometry survey (ANSUR) (Gordon et al., 1989). This is a widely used dataset because of the large number of measures and the rigorous methodology. Unfortunately, the term leg-to-body ratio is not a standard anthropometric measure. We based our calculations on the trochanterian height. The large trochanter is the rough knob on the femur (the upper thigh bone) which can be easily found by touch. This is slightly below the waist and, therefore, appears to conform fairly closely with the measurement used by Swami et al. The dataset included 1774 men and 2208 women. Average age was respectively 27.2 (SD 6.8) and 26.1 (SD 5.7). The average leg-to-body ratio for men was 1.123 (SD 0.06) and for females it was 1.124 (SD 0.07). If we were to express the same information as leg-to-height ratio the value is approximately 0.529 for both men and women. We prefer the latter formulation since it tells us that about 53% of a person's height is due to the leg length. The important point is that there is little or no difference between the sexes, and therefore, we are not confronted with a dimorphism. This was confirmed by the absence of a difference between men and women in sitting height (as a proportion of height). The values were 0.520 and 0.523. In summary, we could not confirm that Leg-to-body ratio is a biological marker of sex in young adults. It could still

be the case, however, that in the larger population a small difference exists, but this is in the direction of proportionally longer legs in men and not in women. [1].

Having established that longer legs are not a secondary sex characteristic of females, we turn to other factors. As discussed in the introduction, the origin of the fact that longer legs in women are found attractive may relate to a link with age, with fertility, or with general mate quality. With respect to age, we need to ask the question: how do body proportions vary with age? Cross-sectional data on leg-to-height ratio is available from the Carnegie Survey. It shows a monotonic increase with age from birth (Gunnell, 2002). A similar pattern has been found in Korean children (Yun et al., 1995). Another variable that has been recently studied is sitting height as a proportion of height in a large sample of the Dutch population. For adjusted sitting height there is a monotonic decrease until puberty, and is fairly flat after that (e.g. Fredriks et al., 2005). In other words, legs grow disproportionately during early childhood.

An interesting fact is that adjusted sitting height is negatively correlated with height. This means that in general taller people tend to have longer legs even when this measure is adjusted for height (e.g., Yun et al., 1995). It is already known that taller people are found more attractive, at least in the case of men (e.g., Pawlowski et al., 2000). This correlation may require further study. Note that for women there is a tendency in the opposite direction, i.e. a preference for shorter women (Nettle, 2002). This pattern is the opposite with respect to the gender specific response to leg length because in our data longer legs were judged more attractive for women, and in the Swami et al.'s data (2006) the opposite was true for men.

With respect to the link between leg length and mate quality, there are important factors that affect limb length. Hypochondroplasia, Down's and Turner's syndromes are associated with short stature and short legs, but a few other conditions, such as Marfan syndrome, are associated with relative longer legs (Fredricks et al., 2005). Given that these genetic conditions are rare, and the associated life expectancy in pre-industrial society short, they are probably of little importance from an evolutionary perspective. More interesting is the link between leg length and health. As noted by Swami et al. (2006), adjusted leg length is negatively associated with several health risks: coronary heart disease, diabetes, high blood pressure, adult mortality and cancer (e.g., Davey Smith et al., 2001; Gunnell et al., 1998; Gunnell et al., 2003). There is also an association of leg length with advantaged socioeconomic status and diet in early childhood. This is probably because early childhood is a period of rapid leg growth (Gunnell, 2002; Wadsworth, Hardy, Paul, Marshall & Cole, 2002). The association between leg length in adults and pre-pubertal health may make this a marker for mate quality, but in itself

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[1] Out of pure curiosity we computed two more leg-to-height ratios. Leonardo da Vinci's famous Vitruvian man (c. 1492) is a study of the proportions of the male human body as described in a treatise by the Roman architect Vitruvius. The leg-to-height was 0.57, which is only slightly higher than the one obtained from the ANSUR database. Next we consulted a manual intended to teach how to draw female Manga characters (Gray, 2004). Drawings of characters of different ages is based on multiples of head height, for an adult female the suggested value was eight and the trochanterian height was five heads, giving a leg-to-height ratio of 0.62. Manga females appear therefore to have rather long legs, supporting a role of legs in attractiveness.

cannot explain the gender specific response to leg length found in our study and by Swami et al. (2006). However, long legs relative to torso are also associated with health problems and with immaturity in men - since it is in early adolescence that the ratio is greatest (Dangour, Schilg, Hulse & Cole, 2002; Fredricks et al., 2005).

Fessler et al. (2005) studied foot size using line drawings. They tested two hypotheses. The observational hypothesis would predict that women with small feet would be seen as attractive, and men with big feet would be seen as attractive. The evolutionary hypothesis would work on the youth and nulliparity premise, i.e. women with small feet would be seen as more attractive, but it wouldn't matter for men. That is what they found: small feet in women are attractive but in men average feet are preferred. Looking at leg and feet together we have an interesting pattern. Women tend to have proportionally smaller feet and equal or slightly shorter legs than men; but while smaller feet are found to be more attractive in females (Fessler et al., 2005), longer legs are found more attractive in females.

Discussion

We have found empirical support for the hypothesis that the length of the legs relative to the body of an individual affects perceived attractiveness, and that longer legs are preferred for females, as judged both by men and by women.

In general this result is consistent with Swami et al.'s findings (2006). However, in Experiments 1 and 2 we could not confirm a preference for lower leg-to-body ratio for male figures, which Swami et al. found to be stronger than the preference for higher leg-to-body ratio for female figures. The lack of significance may be simply due to the particular values of leg-to-body ratio chosen (but see also Sorokowski & Powlowski, 2008). Moreover, given that this was the first time that stick-figures were used to study leg length it is probably safer to concentrate on relative differences, that is, how leg length is associated with sex of the stick figures.

Experiment 3 introduced a novel production task. Results confirmed a clear preference for longer legs (height adjusted) for females, as drawn by both males and females. Note that the design of this study does not allow us to separate a preference for longer legs for females from a preference for shorter legs for men. However, this study does provide estimates of the ideal leg length (in simplified stimuli) as produced by the participants. In terms of leg-to-torso ratio, the mean for female figures was 1.67 and the mean for male figures was 1.37.

Based on anthropometric data we argue that longer legs are not intrinsically more feminine. It is true that society may have created an association between longer legs and femininity, but this still begs the question: what is the possible underlying driving force?

The most likely explanation is in terms of mate quality, as argued also by Sorokowski and Powlowski (2008). An association between adjusted longer legs and health, particularly around early childhood, predicts that longer legs should be preferred for both men and women, but only so far. But if the association is mainly a signal of health rather than the quality of the genes, since it may depend critically on nutrition, this factor may matter more in the case of women. For instance, one could make the hypothesis that better health is critical for childbearing. Conversely, for a man poor health and poor nutrition during early childhood may not affect fertility, gene quality, or

the likelihood that such individual will provide good parental support. In other words this type of poor health would affect relatively little the kind of factors that are important from the female perspective, even though some health risks are associated with shorter legs. At present these are all speculations.

With respect to the preference for men with shorter legs in the images used by Swami et al. (2006), an inspection of the original stimuli suggests that a change in perceived muscularity is highly likely. A preference for mesomorphic body type in men has already been reported (Dixson et al., 2003). This would explain why such preference was not found with stick figures, nor by Sorokowski and Powlowski (2008).

In summary, our findings add to the literature on a number of levels. First, some of the confounding factors present in Swami et al.'s study are not present in our stimuli, for instance the length of the arms did not vary, nor were there changes in secondary sex characteristics. Second, the gender modulation in the effect of leg length in our study is remarkable given that it originates from how the figures were described, either as men and women. Third, our sample did not only include undergraduates, so it extends the result to the broader population. Fourth, the association between the effect of adjusted leg length and self-attractiveness rating suggests that this factor is useful in mate selection and is not simply a cultural effect.

The finding that female figures with higher leg-to-torso ratios are considered attractive was consistent across three experiments with different types of dependent variable: frequency, rating scale, and production. This, combined with the extremely simple stimuli, which controls for potentially confounding variables, suggests that this preference is robust.

Independent of the issue of leg length, and equally important, is the demonstration that stick figures can serve as a novel and useful tool in the study of attractiveness. Their extreme simplicity is both their limitation and their strength. With extremely simplified stimuli the variables of interest are more clearly isolated, and the complexity of the large number of secondary sex characteristics could be effectively eliminated. In addition, novel tasks can be used, for instance participants can be asked to draw stick figures themselves.

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