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Attractiveness is influenced by the relationship between postures of the viewer and the viewed person

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Abstract. Many factors influence physical attractiveness, including degree of symmetry and relative length of legs. We asked a sample of 112 young adults to rate the attractiveness of computer-generated female bodies that varied in terms of symmetry and leg-to-body ratio. These effects were confirmed. However, we also varied whether the person in the image was shown sitting or standing. Half of the participants were tested standing and the other half sitting. The difference in the posture of the participants increased the perceived attractiveness of the images sharing the same posture, despite the fact that participants were unaware that their posture was relevant for the experiment. We conclude that our findings extend the role of embodied simulation in social cognition to perception of attractiveness from static images.

Keywords: attractiveness, mimicry, embodied simulation, symmetry, leg-to-body ratio.

1 Introduction

There is much interest in the study of physical attractiveness. A recent cross-cultural investigation by Li, Valantine, and Patel (2011) found that both males and females value physical attractiveness as the most important factor for short-term mate choice. Many studies have demonstrated the importance of attractiveness in relation to judgement and mate choice (Gangestad & Scheyd, 2005; Langlois et al., 2000). The preference for attractive images starts in early infancy (Van Duuren, Kendell-Scott, & Stark, 2003), and functional magnetic resonance imaging (fMRI) has shown that viewing attractive images activates reward pathways in the brain, such as the nucleus accumbens (Aharon et al., 2010). However, a challenge for this field is the complex interplay of the many factors that affect perceived attractiveness. Some of these factors are likely to be stable and rooted in evolution, and other may be best understood in terms of the interaction between individuals. In this study, we tested three factors: the role of symmetry in perceived attractiveness, the role of leg-to-body ratio in perceived attractiveness, and finally, the role of similarity of posture between the observer and the individual in the image.

1.1 Posture and attractiveness

Research has suggested that an individual's bodily posture can influence preferences towards objects based on how easy it would be to interact with such objects (Ping, Dhillon, & Beilock, 2009), and that postures not only reflect one's feelings but also influence them (Laird, 1974; Roberts & Arefi-Afshar, 2007). In our study, we test the hypothesis that there is a preference towards images of individuals who have a similar posture to that of the observer. This idea has never been tested before; however, some relevant speculations have been put forward, in particular in relation to how observers relate to works of art. A specific proposal by Freedberg and Gallese (2007) is that viewers may find visual images more aesthetically pleasing when imitating the bodily form perceived in the works of art. Freedberg and Gallese (2007) link this phenomenon to the mirror-neuron system, a mechanism where perceiving stimuli activates the same brain region that would be activated in performance. In a classic set of studies, Rizzolatti, Fadiga, Gallese, and Fogassi (1996) and Gallese, Fadiga, Fogassi, and Rizzolatti (1996) found neurons in the premotor cortex that activated both when the monkey performed an action and when the monkey perceived a similar action being performed by another monkey. This mirror-neuron network is also a feature of the human brain (for a review see Rizzolatti & Craighero, 2004).

The existence of this mirror-neuron system has led to theories that see a role for embodied simulation in social interaction (Gallese, 2007; Gallese & Sinigaglia, 2011). Some details of embodied cognition are debated, and they are beyond the scope of this paper. What is critical here is the evidence of an overlap between action perception, action execution, and affect. This theory suggests that simulation plays a key role in understanding others, in empathy, and in social interactions.

A recent study has found empirical support for the hypothesis put forward by Freedberg and Gallese (2007). Leder, Bär, and Topolinski (2012) found that when participants simulated the actions of the painter, using either stroking or stippling motions, this increased the appreciation of works of art that were painted using the simulated strokes. Note that in this case what is simulated is the action used to produce the image, rather than the action depicted in the work of art.

There is also a large body of psychological literature on mimicry, and observational studies go back to the 1970s. One finding is that mimicking and liking were correlated when individuals were acquainted, and negatively correlated when they were not (La France & Broadbent, 1976; La France & Ickes, 1981). Other authors have shown that people automatically adopt the behaviour of other people (the chameleon effect), and that this effect creates shared feelings of empathy and rapport (Chartrand & Bargh, 1999). Stel and Vonk (2010) in a recent study instructed participants to mimic a partner. They found that both mimickers and mimickees became more affectively attuned to each other. Recently, Sparenberg, Topolinski, Springer, and Prinz (2012) found that matching an avatar's movements, without explicit instruction to mimic, influenced perceived attractiveness. This is a very interesting finding because the critical variable was the effector matching (which limb was moved) rather than the actual movement executed. However, questions remain on how to interpret these results. Sparenberg et al. (2012) concluded that matching of the moving body parts is a "minimal sufficient condition for mimicry to induce preference" (p. 299). The focus, therefore, is on the sensorimotor aspects of mimicry. By definition, this involves movement as a minimal condition and therefore in the absence of such movement one would predict no effect on preference. Moreover, the critical role of the effector raises questions about the relationship of this finding with the mirror-neuron literature in which the key variable is action understanding and therefore the meaning of an action (but see Hickok, 2009, for a critical review on this issue).

This literature on mimicry has mainly studied similarity in behaviour, and in particular the spontaneous mimicking during social interaction (Bernieri & Rosenthal, 1991). Posture, however, can be perceived in static images and our study focused on posture without the involvement of active mimicry, or indeed any type of active movement.

In the design of the current study, we manipulated two factors (body symmetry and leg length) that are known to influence attractiveness. These are discussed in the next section. However, the main focus is whether there is an interaction between the body posture of the image and the body posture of the observer in relation to perceived attractiveness. Importantly, we gave no indication to our participants of the role of body posture, and we asked them after they had produced their responses what they thought the study was about, to test how aware they were of this variable.

1.2 Factors that affect attractiveness

An evolutionary perspective explains attractiveness as the perception of traits that signal genetic qualities. For example, genetic qualities such as the ability to adapt to stressors, high fertility, and superior health will be highly desired by potential mates. Darwin was first to propose this idea of sexual selection. Gangestad and Scheyd (2005) suggested that sexual selection works in parallel with a specific signalling system. According to Gangestad and Scheyd (2005), each sex possesses both signals (morphological traits) and receivers (cognitive abilities to respond to the signals). This is known as the Signalling Theory of attractiveness.

One particular factor of attractiveness that has been extensively researched is that of symmetry (Cardenas & Harris, 2006; Hume & Montgomerie, 2001; Little & Jones, 2003). Previous studies suggest that deviations from bilateral symmetry (fluctuating asymmetry) may be linked to various stressors in pre-natal development (Rhodes, Louw, & Evangelista, 2009; Tovée, Tasker, & Benson, 2000). The extent of these deviations may reflect the inability of an individual to cope with environmental and genetic stressors. Fluctuating asymmetry is related with various genetic diseases and chromosomal abnormalities, such as scoliosis, Down's syndrome, and Fragile-X syndrome (Thornhill & Møller, 1997, but see Milne et al., 2003). Superior symmetry, therefore, signals the quality of genes that are more resistant to biological and environmental stressors such as disease, pathogens, and parasitic infection (Swami & Furnham, 2006). However, there is also some evidence against a direct link between symmetry and mate quality (Van Dongen, 2011). An alternative interpretation of the role of symmetry is that the visual system uses symmetry in object recognition, and preference for symmetry is a by-product (Enquist & Arak, 1994; Makin, Pecchinenda, & Bertamini, 2012).

The majority of research investigating symmetry in relation to attractiveness has focused on facial symmetry (Rhodes, 2006; Saxton, Debruine, Jones, Little, & Craig-Roberts, 2011). However, symmetry is also apparent in the human body, although it is possible that information from face and body is used differently (Hönecopp, Rudolph, Beier, Liebert, & Müller, 2007). Tovée et al. (2000) investigated whether preference for facial symmetry can be extended to the human body. They asked participants to rate asymmetrical and symmetrical body images. The findings did not reveal a difference in the attractiveness rating, but a difference was found using a forced-choice methodology. Møller and Thornhill (1998) conducted a meta-analysis across species of the effects of asymmetry. They report a negative correlation between fluctuating asymmetry and sexual selection, greater for males than for females.

Another factor that has received attention more recently is leg length, as a proportion of total height of a person (Bertamini & Bennett, 2009; Sorokowski & Pawlowski, 2008; Swami, Einon, & Furnham, 2006). To gain a standard measure of leg length, researchers typically examine leg-to-body ratio, defined as leg length divided by the entire height of the human body. Western culture often encourages the idea that long legs are attractive and are, therefore, much favoured and sought after by both men and women. Leg length also correlates with indices of health (Davey Smith et al., 2001). Tovée, Mason, Emery, McCluskey, and Cohen-Tovée (1997) found that fashion models are on average 11 cm taller than the average woman, which was accounted for mostly by leg length. Bertamini and Bennett (2009) confirmed a preference for higher leg-to-body ratios (longer legs) even for simple stick figures that had no secondary sexual characteristics. There is also some evidence that as legs become too long, mid-ranging leg-to-body ratio is perceived more attractive than both low and high leg-to-body ratios (Frederick, Hadji-Michael, Furnham, & Swami, 2010).

In the current study, we manipulated both the leg-to-body ratio and the symmetry of a female body, and presented a set of these images to a large group of observers, both males ($N = 58$) and females ($N = 58$). The main focus of our study, however, was on body posture and more specifically on whether the participant posture matched that of the body to be evaluated.

1.3 Predictions

Previous studies have investigated leg-to-body ratio (Bertamini & Bennett, 2009; Frederick et al., 2010; Sorokowski & Pawlowski, 2008) and symmetry (Grammer & Thornhill, 1994; Hume & Montgomerie 2001; Little & Jones, 2003). In our study, we combined these two factors in a factorial design, allowing a test of their relative influence, and we added the new factor of body posture. Based on the previous literature reviewed, the hypotheses for the current study were as follows: (i) Higher leg-to-body ratio (longer legs relative to the body) would be rated more favourable in comparison to shorter leg-to-body ratio, (ii) symmetrical models would be rated more favourable in comparison to less symmetrical models, and (iii) participants would rate models with similar posture as more attractive in comparison to models with a different posture.

From a methodological standpoint, we believe that concurrent manipulation of more than one factor is extremely important in the design of experiments on attractiveness. This makes the task more ecological (or at least less artificial). Interactions can emerge when each factor is evaluated in the context of different levels of other factors. Moreover, when a single factor is manipulated, it inevitably comes to the foreground for the participants, and their beliefs and expectations play a greater role. In our design, participants are less likely to be aware of the experimental variables.

After the ratings of attractiveness for the images were collected, participants were also interviewed about their understanding of the task. Specifically, we asked three questions: (a) What do you think this study is primarily about? (b) Did you use a particular strategy in giving your ratings? (c) Why do you think half the images were showing a sitting person and half a standing person? We predict that participants will have limited insight into the role of posture in the study, even when asked directly about it.

2 Methods

2.1 Stimuli

The stimuli consisted of 16 images of a female body. The images varied on the following parameters: leg-to-body ratio (high/low), body symmetry (symmetrical/asymmetrical), body posture (sitting/standing), and viewing angle (three quarters left/three quarters right). Images were generated using

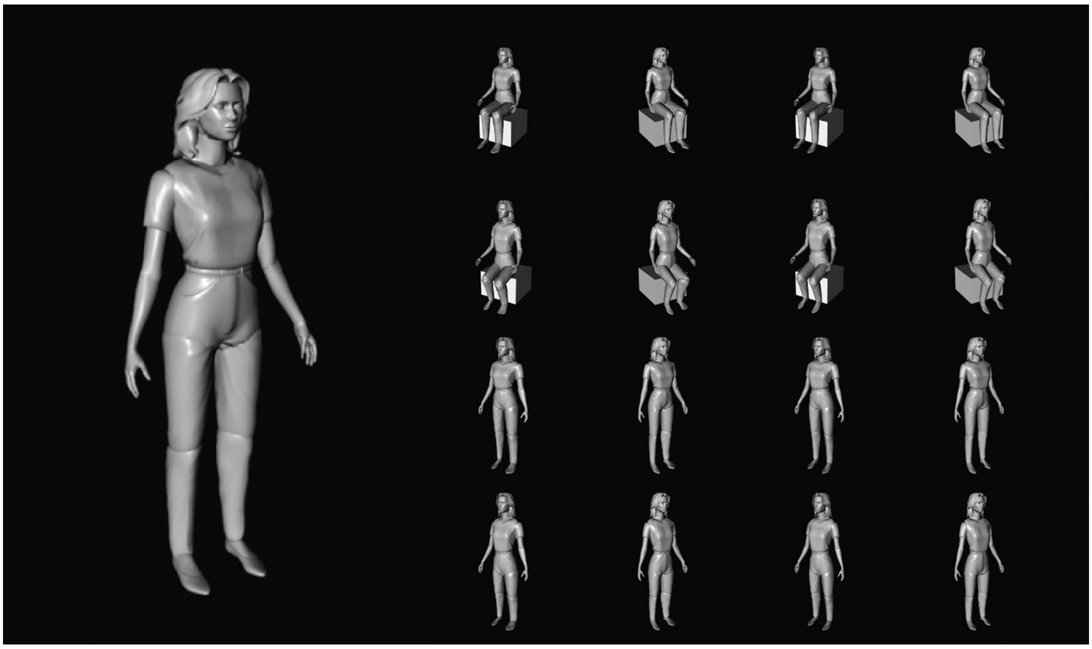

Figure 1. On the left, an example image of the female body standing. On the right, the full set of 16 images used in the experiment. These are the factorial combination of two symmetry values (symmetrical and asymmetrical), two leg lengths (long and short), two postures (sitting and standing), two facing orientation (left and right).

MAXON Cinema 4D (Maxon, GmbH, Friedrichsdorf, Germany) from a 3D model. The rendering provided accurate manipulations of each of the images (see Figure 1).

The leg-to-body ratio was defined as the leg length (bottom of feet to perineum) divided by the total height of the individual. Sorokowski and Pawlowski (2008) investigated the leg-to-body ratio of Polish adults and found that the variation of the leg-to-body ratio was between 0.41 and 0.54. The two leg-to-body ratios used in the current study were 0.46 (short) and 0.53 (long). Therefore, these values are anthropometrically plausible.

To determine the body symmetry, a measurement of limbs (arm and leg) from the right side of the body was divided by the measurement of limbs from the left side. A symmetrical body, therefore, would give a ratio of 1. The asymmetrical models had a symmetry ratio of 0.82 as the limbs on the left side were bigger than on the right. Body posture was manipulated by showing the model in a sitting position (half of the images) or as standing up (the other half). Finally, we also included a manipulation of the viewpoint. Models were viewed at either −30° (left cheek showing) or 30° (right cheek showing). A three-quarters pose is more common in portraits than a frontal view, and there is evidence that recognition is highest for the three-quarters view (Logie, Baddeley, & Woodhead, 1987). Illumination was always from top left, as is more typical in paintings compared to top right (Mamassian, 2008).

Images were combined to form three sets based on a randomization carried out using a random number generator, and printed with a black background to create images with high contrast. Each set consisted of 16 images, 8 standing and 8 sitting.

2.2 Design

Each independent variable consisted of two levels: leg-to-body ratio (high and low), body symmetry (symmetrical and asymmetrical), posture of the image (sitting and standing), and posture of the participant (sitting and standing). The first three were within-subjects factors that were combined factorially. The last was a between-subjects factor. The dependent variable was the attractiveness score.

2.3 Participants

The participant sample consisted of 116 (58 males and 58 females) individuals currently living within the Merseyside area. Demographic details such as age (mean = 20.72, SD = 3.36), sexual orientation (heterosexual = 113, homosexual = 1, bisexual = 2), ethnicity (White = 108, Hispanic = 1, Chinese = 2, Indian = 2, Mixed = 3), and relationship status (single = 74, in a relationship = 42) were collected from each participant. These statistics are not necessarily representative of the population

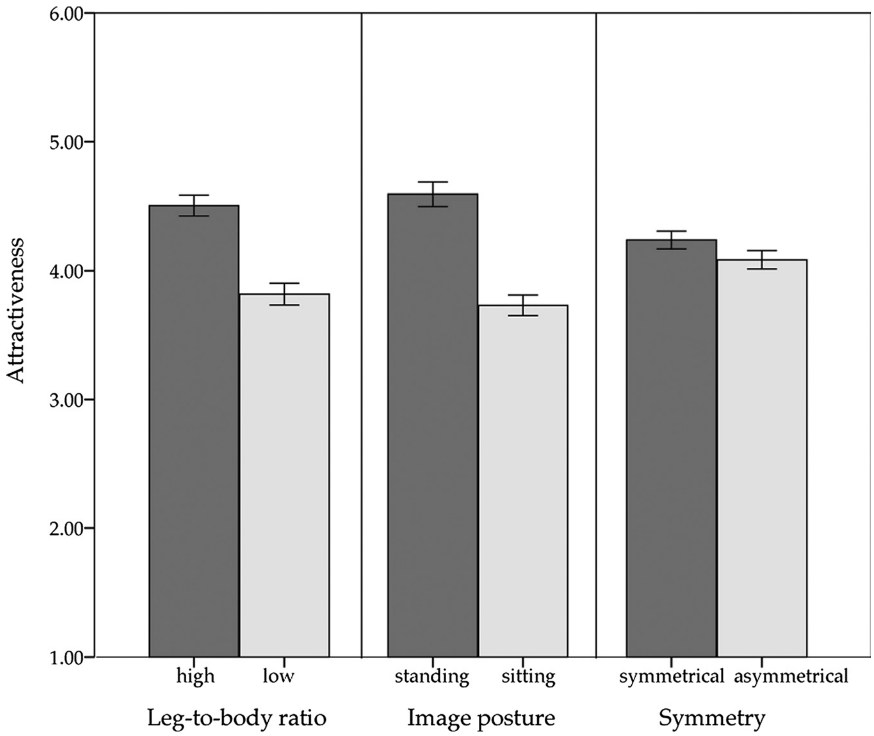

Figure 2. The graphs show mean attractiveness for the factors leg-to-body ratio, image posture, and symmetry. Error bars represent 1 SEM.

of the region and may reflect a slight bias towards the characteristics of the experimenters (White and heterosexual) who recruited participants. The study was approved and was carried out in accordance with the University of Liverpool ethical regulations, and in accordance with the Helsinki Declaration.

2.4 Procedure

Participants were approached by an experimenter and asked for their time to complete a short study on human attractiveness. Testing was done separately by a female experimenter (42 males and 42 females) and by a male experimenter (16 males and 16 females). Each experimenter tested half of their participants in the sitting posture and the other half in the standing posture. Therefore, although the female experimenter tested a larger sample, they both contributed in a balanced way to the design.

Each participant was given instructions and asked to either sit down or stand up depending on their group. To account for order effects, each participant saw one of three possible random orders of the stimuli on the page. Participants rated the attractiveness of each image using a Likert scale (1 = not attractive; 8 = very attractive).

After the responses were collected, participants were asked three questions about their understanding of what the study was about. (a) What do you think this study is primarily about? (b) Did you use a particular strategy in giving your ratings? (c) Why do you think half the images were showing a sitting person and half a standing person? All participants were debriefed once the task was completed.

3 Results

The overall mean rating of attractiveness was 4.16 (SD = 0.70), suggesting that observers mainly used the values in the middle of the range. We analysed the attractiveness ratings by means of a mixed ANOVA. The within-subjects factors were image posture, leg-to-body ratio, and symmetry. The between-subjects factors were participant posture and sex.

To understand the results, we start by noting that overall there was no difference in mean rating between participants standing and sitting, or between males and females ($F < 1$ in both cases). Next, we consider the significant main effects. These confirmed the predictions about what factors affect attractiveness, as shown in Figure 2. Images that were more symmetrical were rated as more attractive ($F(1, 112) = 8.27$, $p = 0.005$, $\eta^2_p = 0.069$), and images with a higher leg-to-body ratio were judged as more attractive ($F(1, 112) = 47.75$, $p < 0.001$, $\eta^2_p = 0.029$). The fact that standing images were

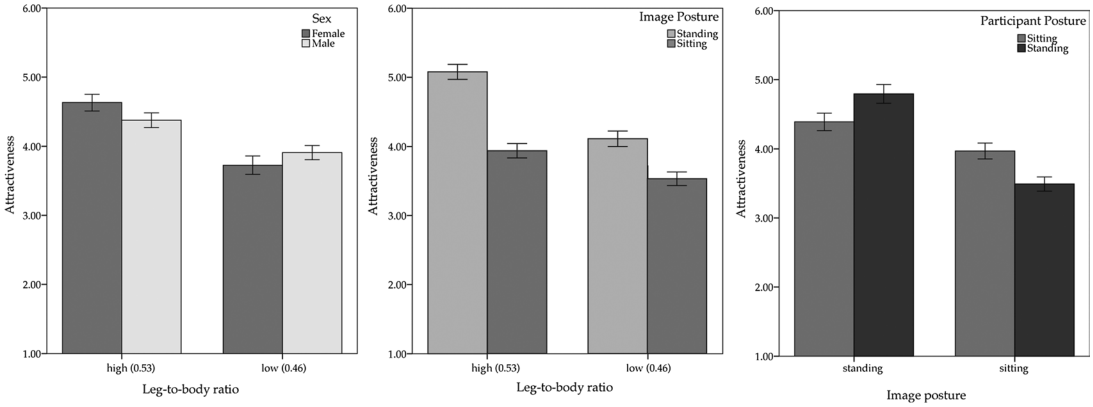

Figure 3. The graphs show the interaction between participant sex and leg-to-body ratio, between image posture and leg-to-body ratio, and between participant posture and image posture. Error bars represent 1 SEM.

also rated as more attractive than sitting images ($F(1, 112) = 61.51$, $p < 0.001$, $\eta^2_p = 0.355$) was not predicted but it may result from the less natural posture of the sitting figure.

There was a two-way interaction between a participant's sex and leg-to-body ratio ($F(1, 112) = 4.78$, $p = 0.031$, $\eta^2_p = 0.041$). This effect is interesting as it shows that female observers were more sensitive to leg length of female bodies than male observers. This may seem counterintuitive if one takes leg length as a biological marker of mate quality, but leg length is also, and perhaps mainly, an ideal promoted by our culture. Barbie dolls illustrate very well a female body with unnatural legs (leg-to-body ratio 0.61), but it is worth remembering that they are designed and marketed to girls, who have a much greater exposure to these images than boys.

There was also a two-way interaction between image posture and leg-to-body ratio ($F(1, 112) = 17.74$, $p < 0.001$, $\eta^2_p = 0.137$). This was because the effect of leg length, although in the same direction, was stronger for the standing body. It is likely that the difference in leg length was more salient in that case.

We now come to the most interesting result: the interaction between image posture and participant posture ($F(1, 112) = 15.99$, $p < 0.001$, $\eta^2_p = 0.125$). Although, in general, standing images were rated as more attractive than sitting images, this effect was much stronger for participants who were standing. In other words, the posture of the participants increased their ratings of images of bodies that shared the same posture, as illustrated in Figure 3.

As part of the experiment, participants were asked three questions about what they thought the study was about. There was little variability in these responses, as most people simply stated that they thought that the study was about attractiveness. In terms of strategy, nobody reported a strategy that involved his/her own posture. Finally, when prompted by the third question about the posture of the image, participants said that the study wanted to test whether individuals look more attractive standing or sitting. Only one individual in their answer discussed the relationship between the posture of the image and the posture of the participant. In our original plan, we intended to separate a subgroup of participants on the basis of the awareness of the study's aim, but the single individual (<1%) could not provide a meaning analysis of this factor.

We conclude that our participants in general were unaware of the role of their own posture in the study. This is likely to be as a result of the between-subject design adopted. Each person was tested either as standing or as sitting, without drawing any unnecessary attention to this aspect of the study.

4 Discussion

The primary objective of the current study was to examine how the posture of the participant influenced judgements of the attractiveness of images of bodies that had the same or a different posture. In addition, the images also varied in terms of relative leg length and degree of symmetry of the limbs. We confirmed that images of female bodies were rated as more attractive when their limbs were more symmetrical and when the relative length of the legs was longer (higher leg-to-body ratio). We also found that the standing image was rated higher than the sitting one, although this may have been an effect specific to the images we used. These findings are consistent with previous research that found long leg-to-body ratio to be an important factor (Bertamini & Bennett, 2009; Sorokowski & Pawlowski, 2008; Swami et al., 2006) and with the role of symmetry (Cardenas & Harris, 2006; Hume & Montgomerie, 2001).

The most interesting and surprising result was that posture of the participant and posture of the image interacted. A novel explanation for the interaction of body postures may be the mechanism of embodied simulation. Ping et al. (2009) hypothesized that the preference for stimuli is additionally driven by the motor system of the brain, suggesting that perceived postures activate the same neuronal regions as performing the posture. Thus, when an individual is given a choice between two postures, the posture most similar to that of the individual is preferred because it is more easily processed. Our participants rated more favourably images with the same posture as their own.

As we referred to in Section 1, Sparenberg et al. (2012) asked participants to make movements that were related to the movements made by an avatar. They concluded that mere effector matching is sufficient to induce preference. We conducted our study before we read this paper but there are some similarities in the conclusions. The key difference is that in Sparenberg et al. (2012) participants performed actions, whereas in our study they simply happened to have a posture. Based on our evidence, it seems that motor intentionality and motor performance are not necessary for an effect on preference. It is a matter of language whether it is appropriate or not to use the term mimicry for the sharing of a posture, as mimicry is usually defined as the action of imitating someone. A final point about the design by Sparenberg et al. (2012) is that the procedure required participants to perform a rather unusual motor task while watching a video. It is hard to know what exactly the participants made of these instructions, but an explicit task like this always draws attention to the task itself. Even without knowing the hypotheses of the study, it is impossible not to be aware that the action is part of the experimental manipulation.

Our finding is interesting because in our study participants were unaware that their own posture was a variable in the study. All participants were asked a set of questions about the study and even asked about the posture of the image they did not report thinking that their own posture was relevant for the experiment.

A final more general point is that our finding can be related to the fact that people like people who are similar to themselves, as evidenced by research on assortative mating: Humans tend to choose mates that are somewhat similar (positive assortment) to themselves (Buss & Barnes, 1986). In a study of recently married couples, Watson et al. (2004) found a link between partners in social and demographic factors, such as age, political orientation, and religion. They also found a moderate effect for physical and psychological attributes. These effects are complex and can be studied in major life choices like mating, but it is possible that there is a link with faster and more subtle effects of similarity and mimicry on preference formation that can be studied in the laboratory.

We found a new type of effect: observers seemed to rate as higher in attractiveness other individuals that shared their posture. This finding, to our knowledge, is the first demonstration of the dependence of aesthetic preference on body posture congruency, and it is in agreement with what was predicted by Freedberg and Gallese (2007) in relation to affective responses to works of art. The focus on observation rather than action links our findings with the idea that motor representations are generated when an action is observed or imagined, in the absence of any overt motor response (Filimon, Nelson, Hagler, & Sereno, 2007; Rizzolatti & Craighero, 2004).

In conclusion, we investigated three aspects of the image of a person: symmetry, leg-to-body ratio, and posture. All three affected perceived attractiveness. The most interesting finding arose from the interaction between image and participant' body posture. How attractive we find a person is influenced by whether we share their posture.

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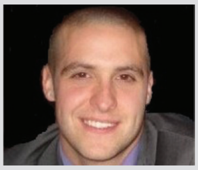

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