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Research report

People watching: The perception of the relative body proportions of the self and others

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ABSTRACT

We have an abundance of perceptual information from multiple modalities specifying our body proportions. Consequently, it seems reasonable for researchers to assume that we have an accurate perception of our body proportions. In contrast to this intuition, recent research has shown large, striking distortions in people's perceptions of the relative proportions of their own bodies. Specifically, individuals show large distortions when estimating the length of their body parts with a corporal metric, such as the hand, but not with a non-corporal object of the same length (Linkenauger et al., 2015). However, it remains unclear whether these distortions are specific to the perception of the relative proportions of one's own body or whether they generalize to the perception of the relative proportions of all human bodies. To assess this, individuals judged the relative lengths of either their own body parts or the body parts of another individual. We found that people have distorted perceptions of relative body proportions even when viewing the bodies of others. These distortions were greater when estimating the relative body parts of someone of the same gender. These results suggest our implicit full body representation is distorted and influences our perceptions of other people's bodies, especially if the other person's body is similar to our own.

1. Introduction

As a social species, the human body is one of the most familiar objects that we encounter in our environment. Our own body is ever present in our perceptual experience, and we are constantly interacting with other individuals whose body morphology is roughly the same as our own. Hence, we have an abundance of perceptual information specifying the relative proportions of our own bodies as well as the bodies of others. Indeed, a wealth of research has shown that we are experts in recognizing human bodies and human motion (see Shiffrar, 2011 for review). Consequently, it stands to reason that our perceptions of body proportions should be extremely accurate. However, recent research counters this intuition. Individuals have been shown to have drastically distorted

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visual perceptions of their own body proportions in that people perceive less tactilely sensitive body parts such as the torso as being proportionally longer relative to more sensitive body parts, such as the hand (Linkenauger et al., 2015).

Specifically, Linkenauger et al. (2015) had individuals estimate the length of different body parts using either their hand length or a baton (matched to the length of their hand) as a metric. When people used their hand as a metric, they drastically overestimated the length of their body parts. The amount of overestimation of each body part appeared to vary inversely with the amount of area on the somatosensory cortex associated with that body part. However, when people used the baton as a metric, the overestimations were greatly reduced or even eliminated. Using another tactilely sensitive body part as a metric, the foot, produced similar results as the hand. Yet when using a less tactilely sensitive body part, the forearm, people began to *underestimate* their body parts and were unbiased with a forearm length baton. These distortions were present even when individuals viewed their body in a full-length mirror, and were not present when estimating cylinders that were the same lengths as their body parts.

Linkenauger et al. (2015) explained these effects through a hypothesis that they referred to as *reverse distortion*. Body parts that perform precise motor movements require more detailed proprioceptive and tactile feedback to execute precision movements successfully (Mountcastle, 2005). Hence, some body parts, notably the hands, have many small, dense somatosensory receptive fields to support these types of movements leading to a larger representation of that area on the somatosensory cortex than other less sensitive body parts (e.g., Powell & Mountcastle, 1959; Sur, Merzenich, & Kaas, 1980). This difference in somatosensory receptive field distribution and somatosensory cortical representation presumably accounts for the experience that tactile stimuli feel larger on more sensitive body parts (popularly known as Weber's illusion; Weber, 1834/1996). However, the actual difference in perceived size across different body parts is only a fraction of what it should be if tactile size perception derives solely from the difference in body parts' representations on the somatosensory homunculus (Taylor-Clarke, Jacobsen, & Haggard, 2004). Consequently, the perceptual system likely employs a compensatory mechanism to achieve a commensurate degree of tactile size constancy across different body parts.

These aforementioned visual distortions of one's body proportions are an aspect of this compensatory mechanism, i.e., *reverse distortion*, because they appear to inversely relate to the ratio of body parts' somatosensory representation and the body part's actual size (Linkenauger et al., 2015). Put simply, these distortions *reverse* the distortions imposed by the differences in tactile receptive field sizes across different body parts. Several previous studies have shown perceived tactile size is modulated by changes to perceived body size, such as those induced by visual magnification (Taylor-Clarke et al., 2004), proprioceptive-tactile illusions (de Vignemont, Ehrsson, & Haggard, 2005), the rubber hand illusion (Bruno & Bertamini, 2010), auditory-tactile illusions (Tajadura-Jiménez et al., 2012), and tool use (Canzoneri et al., 2013; Miller, Longo, & Saygin, 2014). The co-existence of such effects with Weber's illusion suggests that tactile size perception results from the integration of information coming from distorted somatotopic maps with higher-order representations of body size and shape. The idea of reverse distortion proposes that distorting the representation of the body part in the opposite direction may compensate for the differences in the size of the tactile representation. For example, consider that an object may feel larger on the hand than on the forearm due to the differences in the sizes of somatosensory receptive fields on these skin regions. However, if the hand is also experienced as much smaller than the forearm, then an object placed on the hand must be relatively smaller than an object placed on the forearm. Indeed, the tactile size perception of objects increases when the rubber hand illusion is used to make individuals feel as if their hand is larger (Bruno & Bertamini, 2010) or when a part of the body is visually magnified (Taylor-Clarke et al., 2004). In support of reverse distortion, when comparing a body part to a non-corporal object, these distortions become severely reduced in magnitude (Linkenauger et al., 2015).

Although previous findings clearly show that individuals perceive distortions in their own body proportions, it is unknown if we perceive such distortions in others. Presumably, if body distortions are indeed a compensatory mechanism to achieve tactile constancy, then there is no reason to predict distortions in the perceptions of others, as there is no perceptual tactile discrepancy to be corrected. That said, presumably, one would expect individuals to notice large differences between the experience of the proportions of their own body and the body proportions of others. Nevertheless, despite the propensity for dramatic distortions of one's own body as seen in individuals with eating disorders (Bruch, 1962; Cash & Deagle, 1997) and body dysmorphic disorder (Phillips, Didie, Feusner, & Wilhelm, 2008), most individuals do not seem to notice drastic differences between their own and other's morphologies. Due to humans being a social species, perceiving commonalities between our bodies and others' was likely important to interpret and predict the actions of others as well as emphasize social and emotional bonds (Aron, Aron, & Smollan, 1992). Indeed, developmental psychologists have argued that the ability to perceive conspecifics as being "like me" is at the core not only of social development, but also our sense of self (Meltzoff, 2007). Hence, in order to achieve consistency across our bodies and those of other, it is possible that we perceptually distort other individuals' bodies in the same manner as our own. Alternatively, it is also possible that our representation of our own body is used to identify and interpret the bodies of others. This possibility is supported by the abundance of research that has shown that we use our own motor system to simulate the movements of others in order understand their actions and intentions (Jeannerod, 2001). In support of this notion, people are amazingly adept at recognizing human biological motion in point light displays (Shiffrar, 2011). People are also better at interpreting biological motion when the point light displays are of their own motion or more similar to their own motion (see Shiffrar, 2008, for a review). Hence, if we map information specifying the bodily proportions of others onto our own body representations, we should also expect similar distortions when viewing the bodies of others. If this is the case, then the distortions should be greater when estimating the body proportions of individuals whose bodies are more similar to our own body