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Correspondences

Correlated changes in perceptions of the gender and orientation of ambiguous biological motion figures

Anna Brooks[1], Ben Schouten[2], Nikolaus F. Troje[3], Karl Verfaillie[2], Olaf Blanke[4], Rick van der Zwan[1,*]

The sensitivity of the mammalian visual system to biological motion cues has been shown to be general and acute [1–3]. Human observers, in particular, can deduce higher-order information, such as the orientation of a figure (which way it is facing), its gender, emotional state, and even personality traits, on the basis only of sparse motion cues. Even when the stimulus information is confined to point lights attached to the major joints of an actor (so-called point-light figures), observers can use information about the way the actor is moving to tell what they are doing, whether they are a male or female, and how they are feeling [4–6]. Here we report the novel finding that stimulus manipulations that made such walkers appear more female also had the effect of making the walkers appear more often as if they were walking away from rather than towards observers. Using frontal-view (or rear-view) point-light displays of human walkers, we asked observers to judge whether they seemed to be walking towards or away from the viewing position. Independent of their own gender, observers reliably reported those figures they perceived to be male as looking like they were approaching (as reported in [7]), but those they perceived to be female as walking away. Furthermore, figures perceived to be gender-neutral also appeared more often, although not exclusively, to be walking towards observers.

In Experiment 1a, observers judged the gender, male or female, of each walker. Mean ratings across observers are illustrated in Figure 1 (right ordinate, solid circles). A cumulative Gaussian was fitted to the ratings of each figure. Female walkers uniformly were judged as being female, and male walkers as male. The point of subjective ambiguity corresponded to the middle walker (indicated in Figure 1 as 0) of the 13 stimuli used. In Experiment 1b, the same observers were asked, when viewing the same stimuli, to judge whether or not each figure was walking towards them. Means were calculated, for each walker, as a proportion of the number of times observers judged that walker to be facing (walking towards) them and a cumulative Gaussian was fitted to the function (Figure 1, solid triangles, left ordinate). The point of subjective ambiguity — that is, the point at which observers were equally likely to judge the figure as walking towards them as away from them — corresponded to a female walker. In other words, all walkers perceived to be male were judged by observers to be facing towards them. Only when the walkers had characteristics consistent with being female did observers begin to perceive them more often as facing away. While not unequivocal these data do suggest that perceived direction-of-facing is related to the perceived gender of a point-light walker.

In Experiment 2, we examined the effect of perspective information on perceptions of orientation. Three point-light walkers used in Experiment 1, those judged as most female (–6), most male (+6), and gender-neutral (0), were presented again on a treadmill but this time with perspective information. The three walkers were presented to observers, this time incorporating visual cues consistent with the walker's approach or retreat. The addition of perspective cues was expected to standardise observers' perceptions across the three walkers if perspective affects perceived orientation more strongly than gender. Conversely, if perceived orientation is affected more strongly by the gender than the perspective of the walker the gender differences in Experiment 1b will persist.

The gender effects reported for Experiment 1 were confirmed. Although perspective cues modified facing judgements for each figure (female, neutral, male) from convincingly looming to convincingly receding, Figure 2 shows orientation biases that were consistent with the findings from Experiment 1b: male walkers were reported as facing towards observers on more than 50% of trials for all perspective cues except for the two walkers with perspective cues most strongly suggesting retreat. A similar pattern of results was observed for the neutral walkers. This was different for female walker stimuli which frequently were judged as facing away from observers even when perspective cues unambiguously signalled looming. Figure 2 (insert) illustrates those points by plotting the means of the fitted functions against the perspective cues. Veridical (non gender-biased) use of the perspective cues would place the mean for each of the walker stimuli at the perspective-cue neutral point (broken horizontal grey line). Instead, the means of the functions arising from judgements of the male and gender-neutral walkers are above the neutral point, consistent with those walkers appearing to

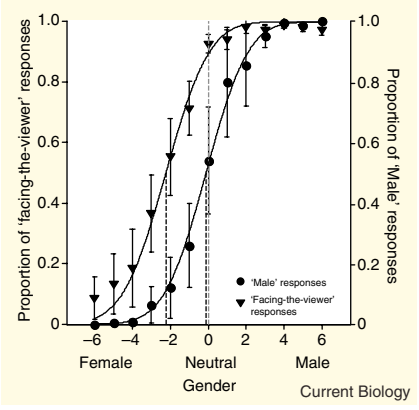

Figure 1. Mean proportions of 'male' answers (solid circles) and 'facing the viewer' answers (solid triangles), both as a function of the 13 point-light walkers used in Experiment 1.

The gender dimension (measured as z-scores) extends from extreme female (–6) to extreme male (+6); gender-neutral point (0) is indicated by broken vertical grey line). The mean of each function is indicated with a broken vertical black line. As with earlier studies [9] the morphed figures give rise to gender perceptions that range from female to male with the point of subjective neutrality at 0. These data show that only the point-light figures perceived as walking away from observers are those perceived as most female. Error bars indicate ±1 SE.

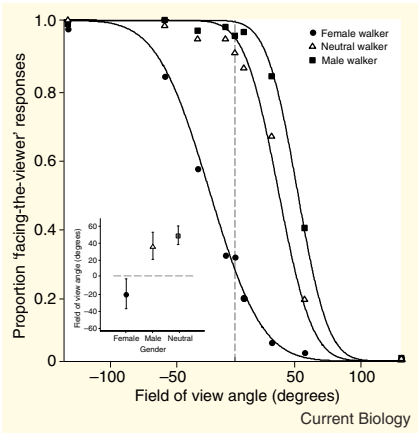

Figure 2. Proportions 'facing the viewer' answers as a function of perspective information, represented by field-of-view angle.

Negative scores denote perspective cues to looming and positive scores perspective cues to retreat. The dashed grey line indicates the perspective-cue neutral point (orthographic projection). Female walkers (filled circles) elicited mainly perceptions consistent with retreat. Neutral (open triangles) and male walkers (filled squares) elicited mainly perceptions consistent with approach. The means of the Gaussian functions fitted to each set of data (inset, bottom left) show that judgements of the orientation of the walkers could not be predicted on the basis of the perspective cues incorporated into each stimulus. Bars indicate 95% confidence intervals about each mean.

approach even when there were unambiguous perspective cues to retreat. Conversely, the mean of the function fitted to judgements of the female walker is below the neutral point, consistent with female walkers appearing to retreat even when there were unambiguous perspective cues to approach. These effects were independent of observer gender. The results demonstrate that the perceived direction-of-facing of an otherwise ambiguous point-light figure (see Supplemental data available on-line) is related to the perceived gender of the figure.

Humans, like many other species, are fundamentally social animals and have evolved mechanisms allowing them successfully to work in large social groups [8]. Our data suggest that biological motion is an important cue for social organisms trying to operate in environments where other cues as to the actions or intentions of other organisms may be ambiguous. Whilst the precise role of local cues in mediating these effects requires further explication, it is tempting to speculate that the orientation biases reported here reflect the development of perceptual mechanisms that weigh in the probable cost of *misinterpreting* the actions and intentions of others. For example, a male figure that is otherwise ambiguous might best be perceived as approaching to allow the observer to prepare to flee or fight. Similarly, for observers (especially infants) the departure of females might signal also a need to act, but for different reasons.

Supplemental data

Supplemental data are available at http://www.current-biology.com/cgi/content/full/18/17/R728/DC1

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[1]Laboratory of Perceptual Processing, Department of Psychology, Southern Cross University, Coffs Harbour, NSW 2450, Australia. [2]Laboratory of Experimental Psychology, University of Leuven, Tiensestraat 102, B-3000, Leuven, Belgium. [3]Department of Psychology and School of Computing, Queen's University, Kingston, Ontario, K7M 3N6, Canada. [4]Laboratory of Cognitive Neuroscience, Brain-Mind Institute, Ecole Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland.
*Email: rick.vanderzwan@scu.edu.au

Tardigrades survive exposure to space in low Earth orbit

K. Ingemar Jönsson[1,*], Elke Rabbow[2], Ralph O. Schill[3], Mats Harms-Ringdahl[4] and Petra Rettberg[2]

Vacuum (imposing extreme dehydration) and solar/galactic cosmic radiation prevent survival of most organisms in space [1]. Only anhydrobiotic organisms, which have evolved adaptations to survive more or less complete desiccation, have a potential to survive space vacuum, and few organisms can stand the unfiltered solar radiation in space. Tardigrades, commonly known as water-bears, are among the most desiccation and radiation-tolerant animals and have been shown to survive extreme levels of ionizing radiation [2–4]. Here, we show that tardigrades are also able to survive space vacuum without loss in survival, and that some specimens even recovered after combined exposure to space vacuum and solar radiation. These results add the first animal to the exclusive and short list of organisms that have survived such exposure.

The experiment was conducted within the Biopan-6 experimental platform provided by the European Space Agency (ESA) during the FOTON-M3 mission in September 2007. During ten days at low Earth orbit (258–281 km above sea level) samples of desiccated adult eutardigrades of the species *Richtersius coronifer* and *Milnesium tardigradum* were exposed to space vacuum and two different UV-radiation spectral ranges: UV-A and UV-B ($UV_{A,B}$, 280–400 nm), and the full UV range from vacuum-UV to UV-A (UV_{ALL}, 116.5–400 nm). The experiment included three sets of flight samples: samples exposed to space vacuum (SV) only, samples exposed to space vacuum and $UV_{A,B}$, and samples exposed to space vacuum and UV_{ALL}. All samples were also exposed