Shading cues in the perception of biological motion: a neural model and a new illusion.

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Most research on biological motion perception has focused on the influences of 2D motion and form cues, while the influence of shading cues has been largely neglected. The perception of 3D static shapes from 2D images is strongly influenced by surface shading (Brewster, 1847; Ramachandran, 1988; Yamane, 2008). We discovered a new visual illusion, where the change of the light source direction flips the perceived walking direction. We also developed a neural model highlighting the illusory effect based on biological motion recognition theory (Giese, 2003). METHOD: We used walker stimuli in which the limbs are rendered as 3D conic shapes with reflectance properties based on light source position. We studied the dependence of the perceived walking direction on the position of the light source. The supporting neural model consists of a hierarchical feature computation to represent the shading of the body snapshots, and a 2D neural field encoding the view of the walker and the individual snapshots, to model the multistable dynamics of biological motion recognition. RESULTS: The light source position has a strong influence on the perceived walking directions (for walking away: $F(16,176)=178.9, p< 0.01$; towards: $F(16,176)=154.3, p< 0.01$), where illumination from below results in a flip of the perceived walking direction by 180 deg. The model suggests that shading-sensitive receptive fields with maximal activity over the whole gait cycle contribute the most to the perceived direction, which corresponds to the conic shapes representing the feet, upper legs and lower arms of the walker. Control experiment confirms that constraining the shading features to only those limbs keeps the effect. Removing the shading from those limbs reduces it to bistable stimuli (Vangeneugden, 2011; Vanrie, 2004), characteristic for walkers with no shading.

Acknowledgements: BMBF, FKZ: 01GQ1002A, ABC PITN-GA-011-290011, AMARSi-FP7-248311, CogIMon H2020 ICT-644727; HBP FP7-604102; Koroibot FP7-611909, DFG GI 305/4-1, DFG GZ: KA 1258/15-1.

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