Stick figures and point light displays: Effects of inversion on the facing the viewer bias

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Introduction

Depth ambiguous point light displays are most often seen as facing the viewer. Inverting the displays considerably reduces this bias (Vanrie et al., 2004).

This finding has been used to argue that the facing the viewer bias depends on recognizing the stimulus as a person – which is more difficult when the stimulus is inverted.

However, recent research indicates that the facing the viewer bias may be largely caused by a bias to perceive depth ambiguous surfaces as convex (Weech & Troje, 2014).

Based on this research, we hypothesized that the effect of inversion on facing the viewer bias arises from the difficulty with which coherent 3D shape is resolved from inverted point light displays. Without this shape, the stimulus appears 'flat' and the convexity bias does not play out.

Here, we tested the hypothesis that the availability of explicit, coherent shape can lead to the emergence of a facing the viewer bias for inverted biological motion.

We replicated Vanrie et al. (2004) but added stick figure stimuli, for which explicit shape is provided. We predicted that these stimuli would produce facing the viewer bias when inverted that is not present for inverted point light displays.

Methods

Stimuli conformed to a 2 x 2 x 3 within-subjects design (see Fig. 1):

- form: point lights or sticks,
- orientation: upright or inverted, and
- facing direction: frontal view, three-quarter views to the left and right.

Stimuli subtended a visual angle of 11˚ vertically and 5˚ horizontally. They were white dots and lines on a black background. We used MATLAB and the Psychophysics Toolbox for presentation.

Participants: 24 naïve students of Queen's University.

Procedure:

- Task: "*Report the facing direction of the figure in each trial*".
- Participants moved an arrow attached to a horizontal sheet of card, onto which a circle with six directions was drawn (see Fig. 2).
- 5 practice trials, 240 trials (20 x each stimulus).
- 4 sec presentation (one gait cycle).
- Trials were blocked by stimulus type and orientation. Order of blocks was counter-balanced across the participants.

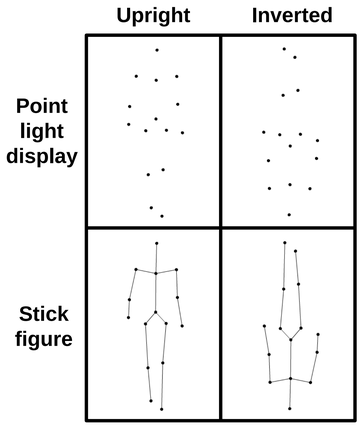

Figure 1: Stimuli, shown at frontal projection. Note: Three-quarter views are not shown.

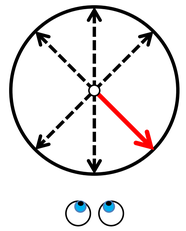

Figure 2: Apparatus seen from above. Red arrow was moved by observer to denote one of six facing directions.

Results

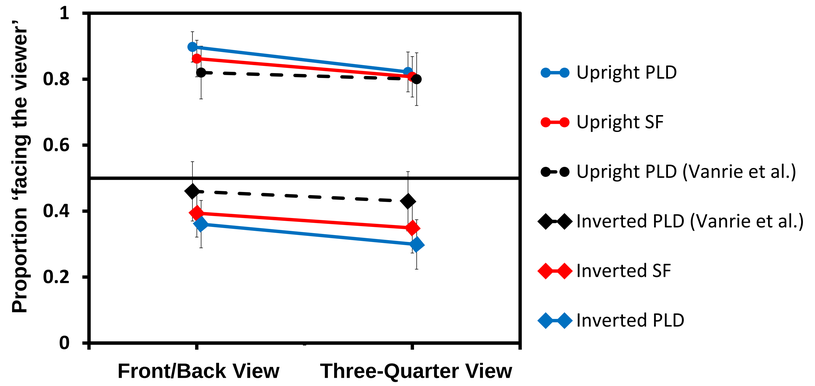

Figure 3: Proportion of facing-the-viewer responses in our data, compared to Vanrie et al. (2004). Black line at 0.5 indicates 'no bias'. Error bars are SEMs.

Participants were very accurate. One of two veridical interpretations was chosen at a rate of over 95% for all stimulus types.

As predicted, we found: sig. facing the viewer bias for all upright stimuli,

- One sample *t*-tests: $t(23)$s > 5.33, ps < .001

a main effect of orientation (upright vs. inverted),

- $F(1, 23) = 26.75$, $p < .001$

and a smaller inversion effect for stick figures (46%) than that for point light walkers (53%), although this difference was not significant.

- $F(1, 23) = 2.45$, $p = .13$

Unexpectedly, we found: sig. facing-away bias for inverted stimuli (three-quarter view),

- One sample *t*-test: $t(23) = 2.33$, $p = .029$

and no main effect of form (point lights vs. sticks).

- $F(1, 23) = 0.11$, $p = .74$

Discussion

We replicated the data of Vanrie et al. (2004), although our results showed that inverted figures were seen facing-away more often.

If the facing the viewer bias is driven by a bias to perceive shapes as convex, then why does the addition of sticks not generate facing the viewer bias for inverted figures?

Also, why do we see a *facing-away* bias for inverted figures?

Explanation: The lower part of the stimulus takes precedence.

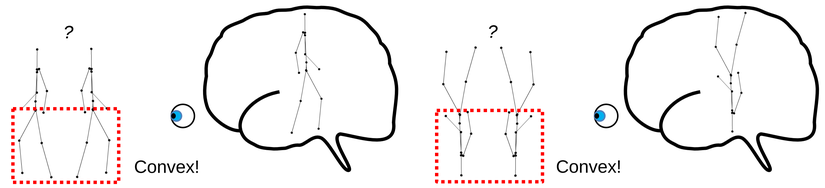

Figure 4: A convexity bias applied to the lower half of stimuli leads to a facing-towards percept for upright stimuli, A, and a facing-away percept for inverted stimuli, B.

The knees and elbows are opposing in terms of the facing direction implied (Schouten et al., 2011) .

Hirai et al. (2011) showed that information about heading is most readily available in the lower half of point light displays in sagittal view.

An efficient visual system would preferentially use this rich information source in making judgments of heading direction.

Conclusions

We did not support the role of low-level processing in the facing the viewer bias as was outlined in our hypothesis.

We found evidence for another bias – namely, a bias to prioritize information from the lower half of biological motion stimuli.

The data are in line with the finding that the lower half of biological motion stimuli alone produces equal facing the viewer bias to that of the whole body (Schouten et al., 2011). Hirai et al. (2011) also showed the importance of the lower part of biological motion for resolving heading direction.

Providing explicit shape to point light walkers only seems to influence the facing the viewer bias to a small extent. Participants appear to infer coherent shape in point light displays with no problem.

The bias for the lower half of biological motion merits further exploration.

References

Schouten, B., et al. (2011). *Atten., Percep., & Psychoph.*, *73*:130-143.
Hirai, M., et al. (2011). *Psyc. Science*, *22*:1543-1549.
Vanrie et al. (2004). *Perception,* 33:547-560
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