Does a convexity prior explain the facing-the-viewer bias in the perception of biological motion?

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INTRODUCTION

Biological motion point-light displays & stick-figures (SF) are ambiguous with respect to the depth-order of features. This gives way to two possible interpretations at fronto-parallel projection:

FACING THE VIEWER vs. FACING AWAY FROM THE VIEWER.

Observers *prefer* the facing-the-viewer (FTV) interpretation (Vanrie et al., 2004) – i.e., there is a **FTV-bias**.

The cause for this bias is unclear:

- Vanrie et al. (2004) & Brooks et al. (2008) suggest social relevance of biological motion leads to figures being seen as approaching.
- Schouten et al. (2011) indicate importance of low-level stimulus features.

Silhouettes

Silhouettes also display depth-ambiguity, allowing bistable perception.

Troje & McAdam (2010) report that the Kayahara silhouette (a woman in a ballet-pose) does NOT afford a FTV-bias.

This gives us a valuable tool for examining the cause of FTV bias.

There are a number of variables that differ between SFs and the Kayahara silhouette:

- Gender – Kayahara silhouette is female; SF is gender neutral.
- Posture – Kayahara silhouette is in an unusual ballet-pose.
- Biological motion – SF is walking, Kayahara silhouette is not.
- Intrinsic structural features vs. extrinsic occlusion contours, respectively.

These factors were the foci of Experiment 1 (see Fig. 1).

CONCLUSION

We found that the critical feature for FTV bias was the intrinsic structures of the stick figures. We theorised that convexity inferences, based on attitude assignments that are influenced by intrinsic structures, engender FTV bias for stick figures. Our second experiment supported this theory.

We conclude that the FTV bias must manifest before human form is resolved – that is, at the 2 ½ -D sketch (Marr, 1982) stage where local surface attitudes are estimated. This suggests FTV bias may not be unique to biological motion perception.

REFERENCES

Brooks, A., et al. (2008). *Current Biology*, 18:R728–R729.
Marr, D. (1982). Vision. *New York: Freeman*.
Schouten, B., et al. (2011). *Atten., Percep., & Psychoph.*, *73*:130-143.
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EXPERIMENT 1

What is the critical difference between SFs and silhouettes that drives the FTV bias?

METHOD

Design & Procedure

- Participants: 15 graduate students.
- Task: Continuous CW/CCW rating.
- Presentation time: 4 min.
- Rotation speed: 30°/s.
- 7 trials: See Fig. 1.

FTV Measure

- A CW/CCW rating is translated into an unambiguous facing orientation perception.
- FTV bias measured as:

$$\text{FTVB} = \frac{\text{Reversals from FA} \rightarrow \text{FTV}}{\text{Total reversals}}$$

RESULTS

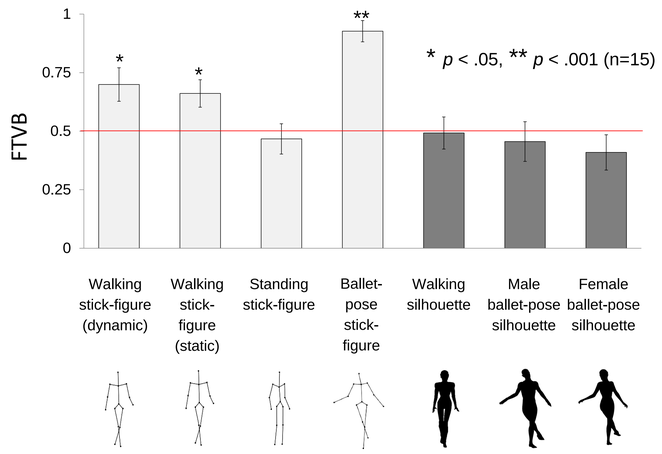

Fig. 1: Mean proportion FTV responses by condition. Error bars are SEM; red line indicates 'no bias'

- SFs in almost all configurations produced FTV bias.
- Silhouettes in all three configurations produced no bias.
- The standing SF did not elicit FTV bias: we propose this is due to lack of depth in anterior-posterior direction.
- FTV bias is not explained by gender, posture, or biological motion factors.

The results indicate the key to the cause of the FTV bias lies in the difference between intrinsic structures (as in PLDs) and external occlusion contours (as in silhouettes).

The fact that silhouettes typically elicit no FTV bias means recognition of surface orientation/depths (2 ½-D sketch, Marr 1982) must precede human form resolution.

PREDICTION:

When using intrinsic structures to make local attitude assignments, a bias for convex surfaces produces the FTV bias.
We tested this prediction in Experiment 2.

EXPERIMENT 2

If intrinsic structures are the critical features for FTV bias, we should be able to induce FTV bias by introducing intrinsic structures to silhouettes with emphasised convexities/concavities.

METHOD

Design & Procedure

- Participants: 16 graduate students.
- 4 trials: Crouch pose silhouettes with markers on knees/elbows/both/neither (Fig. 2).
- Task, Presentation time, Rotation speed & FTV Measure were all equal to those in Experiment 1.

RESULTS

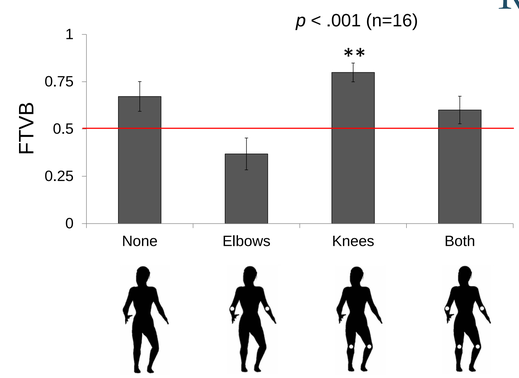

Fig. 2: Mean proportion FTV responses by condition. Error bars are SEM; red line indicates 'no bias'

- FTV bias was demonstrated in the knee-marker condition only.
- Elbow marker condition elicited more 'facing away' responses, but did not cause significant bias.
- Knee and elbow markers together did not elicit FTV bias.
- When no markers were used, no bias was demonstrated.

As predicted, the use of markers on emphasized convexities/concavities was shown to be sufficient to generate FTV bias for silhouettes.

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