PERCEIVED MOTION TRANSPARENCY CAN OVERRIDE LUMINANCE / COLOR CUES WHICH ARE INCONSISTENT WITH TRANSPARENCY

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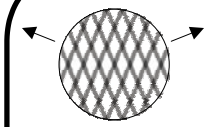
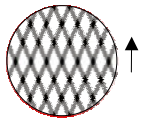
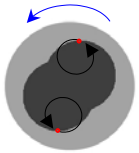
Introduction





Two superimposed moving gratings can be perceived either as a plaid moving rigidly or as two gratings sliding over each other (Wallach '35, '96; Adelson & Movshon '82). Stoner et al. ('90, '96) showed that the perception of motion transparency was affected by whether the luminance of the gratings' intersections was consistent with physical transparency or not.

Do luminance cues affect motion transparency also in other ambiguous motion displays where globally rigid and transparent, non-rigid interpretation compete?

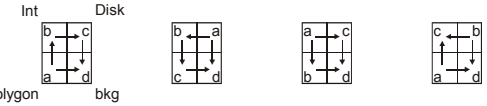


When rotated rigidly about its center, the figure on the left made of two overlapping disks splits after a while and two disks are perceived to move independently sliding over each other in circular translational motion while staying upright (Wallach '76). Is the luminance of the intersection region important for the perception of motion transparency also for this stimulus (right)?

?

Methods

Observers were required to press a button as soon as they perceived sliding. RTs were measured. The luminance of the intersection and its relation to the luminance of the two disks (or of the disk and of the polygon) was manipulated so it was consistent or not with physical transparency. A large number of stimuli of different colors was used.

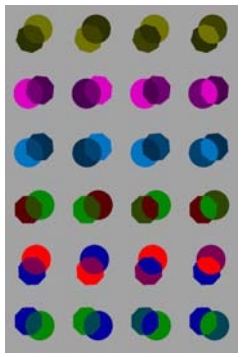


Single reversing, Disk in Front

Single reversing, Polygon in Front

No reversing, depth relationship ambiguous

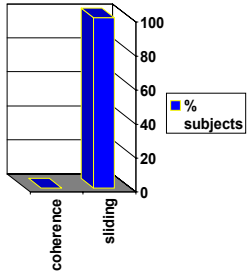
Double reversing, not transparent



luminance relationships:
a < b< c <d
2 / 4 /12 / 24 cd/m²

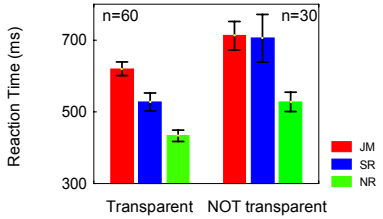
Result I

Transparent motion (sliding) is perceived for all tested combinations of luminance and color, including all inconsistent configurations (cf demo: **http://www.cns.nyu.edu/~hupe/arvo00demo/**).

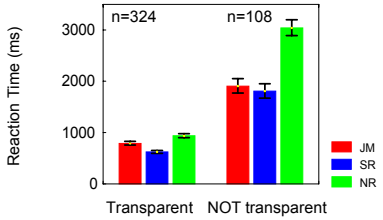


Result II

Nevertheless, a delay (~100ms longer) is found for luminance configurations inconsistent with transparency:



This delay is enhanced for rings:

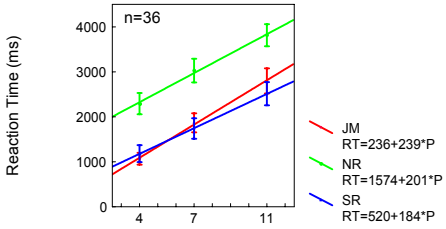


An energy-based model can explain the preference for sliding to coherence. The model involves the *area* of moving surfaces as well as their speed. The model predicts that the larger the intersection region, the less probable the perception of sliding.

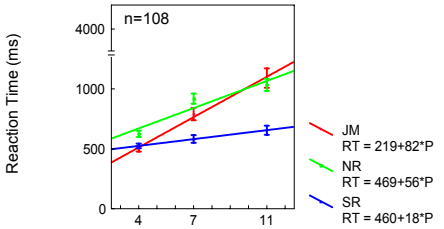
Result III

We tested this prediction by manipulating the thickness of the rings. Thicker rings have a larger intersection area. Accordingly, we find that thicker rings require longer RTs to perceive sliding, regardless of whether the luminance of the intersection is consistent with transparency or not. The slope is however much steeper in the case of non-transparent intersections.

Non-transparent intersections:



Transparent intersections:



Conclusions

Segmentation based on motion can override conflicting luminance cues. We propose that this happens when the motion cues strongly bias the perception towards sliding motion. There is however a cost when the luminance is inconsistent with transparency. An energy-based model can account for how this cost depends of the size of the intersection region.

References

Adelson & Movshon *Nature* 300: 523-525, 1982.

Mulligan *Vision Res.* 33: 2021-30, 1993.

Stoner, Albright & Ramachandran *Nature* 344: 153-5, 1990.

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Wallach *On Perception*. New York: Quadrangle, 1976, 490.

Wuerger, Shapley & Rubin ``On the visually perceived direction of motion'' by Hans Wallach: 60 years later. *Perception* 25: 1317-1368, 1996.

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