The Perception of path curvature: Effects of projected velocity and projected size

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Background

Previously (VSS 2007) we reported on the effect of the projected size and velocity functions on perceived trajectory, for an object moving along a linear trajectory in 3D. The present study examines the effects of size and velocity information on curvature discrimination for objects moving along a curved trajectory.

Todd (1984) showed that observers could discriminate the amount of curvature from the motion of texture elements in a 2D projection. Our recent research (VSS, 2007) has shown that observers are sensitive to both size and velocity information when judging trajectory of an object moving along a straight path in a 3D scene. This suggests that observers may use size and velocity information for judging trajectory in a more general manner.

General Methods and Stimuli

Observers viewed naturalistic scenes containing simulated objects that traveled in an arc toward their point of view. The projected path was constant across conditions, and was always below the observer's eye level. Size and velocity in the projection was varied according to the simulated curvature.

Figure 1: Observers viewed an object digitally inserted in a naturalistic scene.

Observers were asked to make judgments about the motion path of the ball.

Experiment 1: Discriminating upward and downward curvature

Method

Each trial consisted of a scene into which a moving ball had been digitally inserted. Direction of curvature, size, and velocity information were manipulated across conditions. Observers viewed either a straight path or one of two upward or two downward paths. The observer's task was to indicate the direction of curvature (up or down) in each scene.

Factors

- Curvature indicated by size, velocity, or both
- Amount of curvature
- Direction of curvature: up, down, or straight

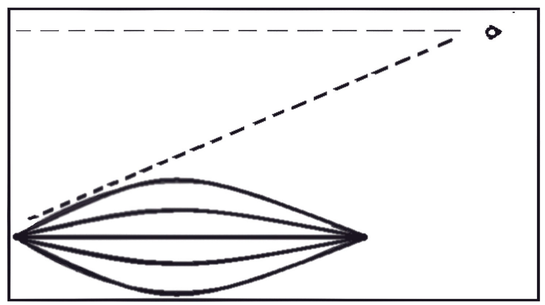

Figure 2: Different possible curved paths seen by observers.

Results

A significant main effect was found for the direction of curvature $F(2,7) = 7.31$, $p < 0.05$ and the type of information presented: size change, velocity change or both, $F(2,7) = 5.32$, $p < 0.05$. Observers were more accurate at detecting curvature using velocity information rather than size change information.

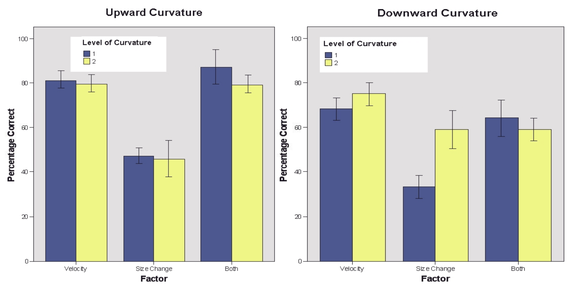

Figure 3: Different effects of size change information on correct judgments of curvature. 1 and 2 indicate the level of curvature with higher numbers representing a more highly curved path.

Experiment 2: Discriminating amount of upward curvature

Method

A paired comparison task was used to compare a straight and upward curved path. Each trial consisted of two displays shown in sequence. Size and velocity changes corresponded to a straight path or one of six levels of upward curvature. Observers were asked to select the scene in which the path of the ball displayed the most upward curvature.

Factors

- Curvature, indicated by size, velocity, or both
- Amount of curvature

Results

For upward curvature, the type of information made available to observers had a significant effect on discrimination of curvature, $F(2,7) = 4.24$, $p < 0.05$. There was also a significant effect of curvature level on accuracy of judgment, $F(5,4) = 6.23$, $p < 0.001$ and the observers' success rate was significantly better when both size change and velocity information were made available to observers. Observers performed equally well when only given size change or velocity information alone.

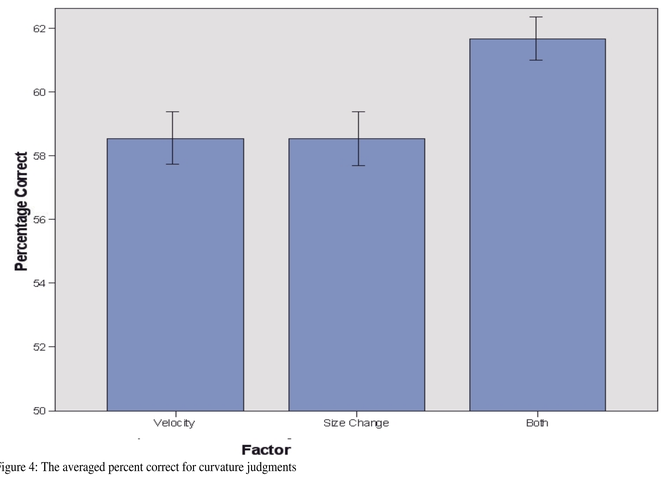

Figure 4: The averaged percent correct for curvature judgments

Conclusions

-Observers showed greater accuracy in discriminating upward from downward curvature using velocity information rather than size change.

-Observers discriminate amount of upward curvature more accurately using both size change and velocity information together.

References

Todd, J. T. (1984). *Perception & Psychophysics*, *36,* 97-103.

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