Response demands do not influence perceived illusory motion in cognitive-based tasks

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Last year (VSS 2008), we demonstrated a method for measuring responses from the dorsal and ventral visual pathways via the Duncker Illusion.

The Duncker Illusion is perceived when a target traveling in a straight trajectory across a field of laterally moving distracters appears deflected in the direction opposite to that of the distracters.

We asked subjects to locate the target in a field of moving solid disks in two separate ways (visuomotor and cognitive). Responses indicated perception of the illusion in the cognitive task but not in the visuomotor task.

We posited that this was due to the specific properties of two visual pathways, consistent with the Action-versus-Perception Hypothesis of Milner and Goodale (1995). Given this, we would be able to study the two pathways through our method.

However, if was later suggested that our method could be vulnerable to “relational momentum” (Franz, 2004). Relational momentum is defined as an over-extrapolation towards where a target is headed as it passes through (or behind) an occlusion. We had our target disappear just before entering a response window.

To correct for this, we developed two ways in which the subject could respond using a cognitive mechanism:

Draw-The-Line - We asked subjects to draw a line parallel to the trajectory of the target after the display had concluded. In this experiment, we compared the slope of the perceived target trajectory to that of the true target trajectory.

Last Remembered - We asked subjects to select the location on the display where they remembered the target’s position before the display concluded.

Note: each perceptual task was paired with visuomotor task, where the subject responded to a target by “stabbing” the target before the display concluded.

At VSS 2008, we showed that subjects could not perceive the Duncker Illusion in the visuomotor task.

References


Methods

- Subjects responded to a target (an open, black circle) traversing a field of leftward or rightward moving distracters (solid black disks).
- Two horizontal, parallel lines were centered on the display.
- All tasks used a stylus for response.
- Between trials subjects clicked a circular fixation symbol to indicating readiness for the next trial.

Cognitive Task - Draw the Line

- After conclusion of the display, the subject drew the slope of the trajectory that the target appeared to travel by drawing a line between two points (see figure below).
- The arithmetic difference between the angle of the subject’s line and the angle of the true trajectory was interpreted as the magnitude of the illusory effect for each trial.

Cognitive Task - Last Remembered

- The subject clicked the location on the display they last perceived the target to be before the display concluded.
- The horizontal distance between the subject’s guess and the target’s true ending position is interpreted as the magnitude of the illusory effect for each trial.

Results

In the graph, positive differences in error represent displacement of perceived target in a direction opposite to the motion of the distractors. It is the difference between errors from leftward and rightward-moving distractors.

Discussion

- We have demonstrated two additional perceptual methods for measuring responses from the Duncker Illusion.
- We have shown that the Illusion is demonstrable in cognitive tasks that are functionally identical to visuomotor tasks that do not show the Illusion.
- Our method allows for the comparison of properties in the two visual systems in normal subjects.
- In future experiments, we will increase fMRI in hopes of achieving statistical significance, and decrease the angle at which the target travels to minimize the oblique effect.
- We will also examine how each system’s variability is affected by extrinsic noise.

Apparatus

1. Subjects looking through viewing port to keep head steady.
2. Port was pointed toward a mirror which reflected a 19” monitor.
3. Subject’s hand was below the mirror such that the display appeared to be on the same plane as the subject’s hand.
4. A virtual hand could appear on the display.

General Task

- Subjects were asked to “stab” the target before it reached the two parallel lines.
- The display vanished when the subject “struck” the target.
- The subject clicked the location on the display where they remembered the target’s position before the display concluded.

1. We asked subjects to select the location on the display in which the target disappeared just before entering a response window.

Draw the Line

- We asked subjects to draw a line parallel to the trajectory of the target after the display had concluded. In this experiment, we compared the slope of the perceived target trajectory to that of the true target trajectory.

Last Remembered

- We also show results including only target trajectories that are vertical (orthogonal to the distracter trajectories - figure to right).
- Because a significant positive mean error was recorded, these data suggest all subjects perceived the Duncker illusion in this task.