The Effect of Context Upon the Perception of Egocentric Distance Using a Walkable Human Müller-Lyer Illusion

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Introduction

The Müller-Lyer illusion is a well-known geometric illusion in which pairs of lines of the same length are perceived to be different because of forms (e.g., “fins”) at the ends of the lines.

This influence of context upon the perception of line length is well-established for 2-D illusions but has also been demonstrated in larger-scale, three-dimensional spatial tasks (Wraga, Creem, & Proffitt, 2000). Blind-walking, or walking without vision to previously seen targets, is a technique commonly used to measure distance perception (Loomis, Da Silva, Fujita, & Fukusima, 1992).

Accurate blind-walking is likely to involve spatial updating, the process of keeping track of locations of objects relative to one’s own spatial position while walking (Rieser et al., 1990).

Studies have demonstrated that blind-walking tasks are resistant to the illusory effects of a walkable Müller-Lyer illusion whereas verbal reports of perceived distance are affected (Wraga, Creem, & Proffitt, 2000).

Across 3 experiments, we utilized a large-scale, walkable variation of the Müller-Lyer illusion to examine the effect of context upon the perception of egocentric distances. Whereas the traditional Müller-Lyer illusion utilizes geometric forms at the end of the lines to manipulate the context of the line, we employed human forms to manipulate context.

General Method

- View a target person, create a mental image of the target person in the surrounding environment, and walk the perceived distance to the location of the target person or call out perceived distance.
- Blind-walking to forward-facing and backward-facing targets
  - 9 trials to 3, 4.5 & 6 meters for each facing target direction
- Experiment 1: Is blind-walking with spatial updating affected by a human Müller-Lyer illusion?
- Experiment 2: Is blind-walking without spatial updating affected by a human Müller-Lyer illusion?
- Experiment 3: Are verbal reports of perceived distance affected by a human Müller-Lyer illusion?

Blind-walking with Spatial Updating

- Participants spatially updated as they walked to the targets
- Target facing direction blocked, counterbalanced; N = 22
- No effect of target facing direction
  - F(1, 20) = 10, p = .762
- Significant difference in meters walked between target distances
  - F(2, 40) = 242.99, p < .0001
- Distance walked increased with target distance
  - p < .0001
- Accurate walking to target distances
  - p = .065 (3 m), p = .799 (4.5 m), and p = .526 (6 m)

Results

Blind-walking without Spatial Updating

- Participants rotated 180° and walked in the opposite direction
- Target facing direction blocked, counterbalanced; N = 20
- No effect of target facing direction
  - F(1, 18) = .77, p = .888
- Significant difference in meters walked between target distances
  - F(2, 36) = 282.94, p < .0001
- Distance walked increased with target distance
  - p < .0001
- Significantly undershot target distances
  - p < .0001 (3 m), p < .0001 (4.5 m), and p = .002 (6 m)

Verbal Reports

- Participants report perceived distance to the targets
- Target facing direction blocked, counterbalanced; N = 15
- No effect of target facing direction
  - F(1, 13) = .29, p = .597
- Significant difference in meters walked between target distances
  - F(2, 26) = 126.63, p < .0001
- Distance walked increased with target distance
  - p < .0001
- Significantly undershot target distances
  - p < .0001 (3 m), p = .001 (4.5 m), and p = .005 (6 m)

Conclusions and Discussion

- Across all three experiments, there was no significant effect of the target person’s facing direction on distance judgments for both blind-walking and verbal report tasks. Contrary to the hypothesis, even verbal reports showed no effect of a human Müller-Lyer illusion.
- When participants employed the spatial updating strategy, blind-walking performance was accurate for all distances, regardless of the target person’s facing direction.
- Distance perception was significantly less accurate (significantly underestimated) for all distances, regardless of the target person’s facing direction, when not using the spatial updating strategy and when giving verbal reports.
- Future experiments will assess a possible influence of a human Müller-Lyer illusion on other estimates of distance.

References


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