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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 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 three 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?

Experiment 1

- 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) = 242.63, 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)

Experiment 2

- 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 = .878
  - 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 = .526 (6 m)

Experiment 3

- 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) = 20, 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)

Results

- Forward Facing Target Comparison
  - Significant main effect of Experiment on distance walked when viewing forward facing targets
    - F(2, 54) = 7.79, p = .001
  - Compared to Experiment 1, distance walked in Experiments 2 and 3 was significantly less to all target distances

- Backward Facing Target Comparison
  - Significant main effect of Experiment on distance walked when viewing backward facing targets
    - F(2, 54) = 5.99, p = .004
  - Compared to Experiment 1, distance walked in Experiments 2 and 3 was significantly less to all target distances

Conclusion 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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