Judgments of Egocentric Distance Within Indoor and Outdoor Environments: Context Matters with Restricted and Unrestricted Fields of View

Daniel A. Gajewski, Sandra Mihelič, Courtney P. Wallin, & John W. Philbeck*

Department of Psychology, The George Washington University

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

Background

Impaired distance judgments with a restricted field of view have been shown to be alleviated with near-to-far scanning of the ground plane, suggesting an important role for the sequential integration of surface information (Wu et al., 2004).

Recent findings from our lab suggest that the extraction of nearby ground information is not critical, at least indoors where alternate surfaces (walls and ceiling) are available to inform the scale of the space (Gajewski et al., 2014; see also Creem-Regehr et al., 2005).

The present study aimed to reconcile these outcomes by matching designs and manipulations used in indoor and outdoor settings.

General Methods

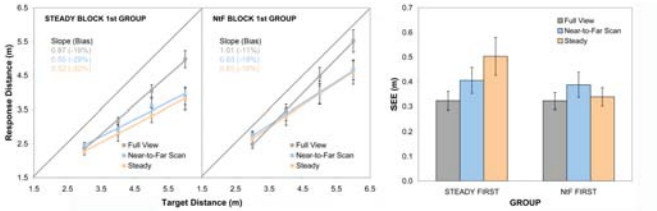
- Distance judgments to targets made via blindwalking
- Ground-level targets previewed monocularly for 5 seconds
- Restricted viewing conditions employed goggle with ~14°x17° aperture
- 3 possible restricted viewing conditions (varied across experiments):

  FtN: Far-to-Near scan w/goggle (eye level to feet)
  NtF: Near-to-Far scan w/goggle (feet to eye level)
  STEADY: Gaze w/goggle (head declination locked toward target)

- Unrestricted condition: **FULL** (free view but w/head declination locked)
- Environments: Indoor laboratory space and/or outdoor grassy field
- Analysis considered **Sensitivity** (slopes relating response to target distance), **Bias** (mean signed error), and **Precision** (standard error of the estimate for each best-fitting regression line)

Experiment 1**: Near-to-Far Scanning Benefit Indoors?

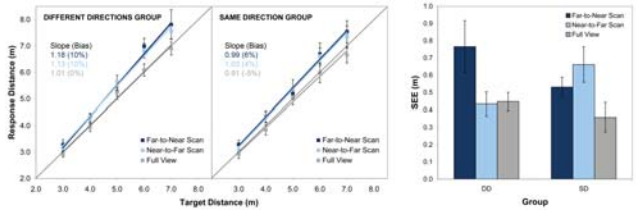
- **Block design employed to control for familiarity effects**
- **2 Groups (n=14 ea): STEADY 1st Block / NtF 1st Block (FULL always 3rd Block)**



FULL more sensitive and less biased than STEADY and NtF conditions. No differences between STEADY and NtF and no effects on precision.

Experiment 2: Near-to-Far Scanning Benefit Outdoors?

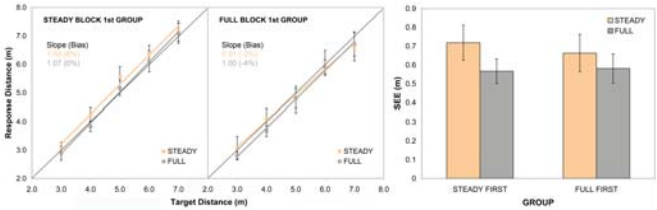
- **Randomized design to parallel Wu et al. w/view-familiarity manipulation added**
- **2 groups (n=14 ea): Viewing from Same Direction (SD) or Different Directions (DD)**



Sensitivity & overestimation bias greater for both scan conditions. FtN less precise for DD group and FULL more precise than NtF for SD group.

Experiment 3: Familiarity-Dependence Outdoors?

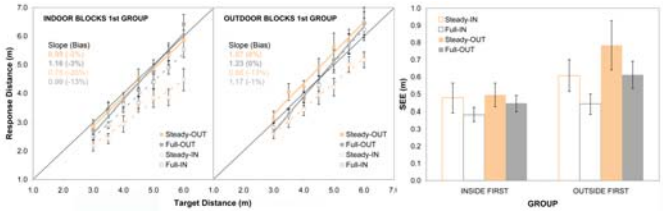
- **Block design employed to control for familiarity effects**
- **2 Groups (n=12 ea): STEADY 1st Block or FULL 1st Block**



STEADY marginally more biased toward overestimation. No effects on sensitivity or precision. No effects of block order.

Experiment 4: Context Effects FOV-dependent?

- **Context manipulated within-participants**
- **Viewing condition in blocks (STEADY always before FULL)**
- **2 Groups (n=14 ea): INDOOR 1st or OUTDOOR 1st**



Sensitivity greater for FULL and OUTDOOR. Effect of viewing condition on bias depended on context (Trend toward greater responses with STEADY OUTDOOR; greater responses with FULL INDOOR). Precision greater for FULL INDOOR and for INDOOR FIRST GROUP.

Summary of Results

- **Near-to-far scanning not beneficial in either context**
- **Direction of FOV effect depends on context (over outdoors, under indoors)**
- **Restricted FOV less detrimental outdoors and independent of view/scene familiarity**
- **Underestimation bias with Full View greater indoors than outdoors**

Discussion

The failure to find a near-to-far benefit (over steady and far-to-near) in either context is inconsistent with the sequential integration framework. Instead, performance may depend on the ability to apprehend the greater context more generally. Although context effects on distance judgments have been reported with unrestricted (full-cue) viewing conditions (Lappin et al., 2006; Witt et al., 2007), these data suggest context matters even when the field of view is restricted. While texture differences may have enhanced perception of the ground surface local to the object outdoors, the cue basis for restricted-view performance was nearly identical across contexts. We therefore suggest that observers' distance judgments are influenced by assumptions about the scale of the space.

References

Creem-Regehr, S. H., Willemsen, P., Gooch, A. A., & Thompson, A. A. (2005). The influence of restricted viewing conditions on egocentric distance perception: Implications for real and virtual indoor environments. *Perception, 34*, 191-204.

Gajewski, D.A., Wallin, C.P., & Philbeck, J.W. (2014). Gaze behavior and the perception of egocentric distance. *Journal of Vision, 14*(1):20, 1-19.

Lappin, J. S., Shelton, A. L., & Reiser, J. J. (2006). Environmental context influences visually perceived distance. *Perception & Psychophysics, 68*, 571-581.

Witt, J. K., Stefanucci, J. K., Reiner, C. R., & Proffitt, D. R. (2006). Seeing beyond the target: Environmental context affects distance perception. *Perception, 36*, 1752-1768.

Wu, B., Ooi, T. L., & He, Z. J. (2004). Perceiving distance accurately by a directional process of integrating ground information. *Nature, 428*, 73-77.

This research was supported by NIH Grant R01EY021771 to JWP and NSF fellowship DGE-1246908 to CPW.
*** JWP is now affiliated with the School of Psychology, University of Wollongong, Wollongong, Australia**
**** Reported as Experiment 5 in Gajewski et al., (2014)**
For correspondence, e-mail: gajewsk1@gwu.edu