Heading in the right direction: Initial heading direction and spatial memory flexibility.

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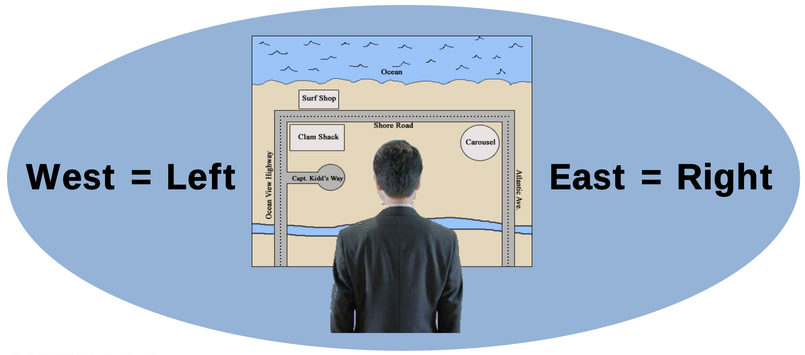
Introduction

MOTIVATION

• Spatial information can be learned from a **survey** (allocentric) perspective, using absolute reference terms (e.g., *north*, *south*), or from a **route** (egocentric) perspective using relative reference terms (e.g., *straight ahead*, *to your right).*

• Data regarding the nature of the **mental representations** constructed from route and survey information are ubiquitous. Some maintain that spatial memories are ***perspective-invariant***, and maintain the point of view adopted during learning (e.g., Roskos-Ewoldsen, McNamara, Shelton, & Carr, 1998; Wang & Spelke, 2000, 2002). Others argue that they are ***abstracted, perspective-flexible*** representations, referred to as **spatial mental models** (e.g., Burgess, 2006; Mou, McNamara, Valiquette, & Rump, 2004; Taylor & Tversky, 1992).

Primary Questions:
• Do we spontaneously construct allocentric models during egocentric learning?
• Will aligning *absolute* reference terms (e.g., cardinal directions) with *relative* reference terms (e.g., left, right) facilitate construction of perspective-flexible spatial representations?



METHODS

Experiment 1 (Spatial Descriptions):

• 48 undergraduates (31 female, mean age = 20.27±1.7 years)
• **Read descriptions** of 16 environments in **survey or route** perspective one sentence at a time, self-paced.
• After each environment, completed a **statement verification task**, which required drawing inferences from both survey and route perspectives.
• Route descriptions: navigator entered heading north, south, east, or west.
• Survey descriptions: conveyed layout heading north, south, east, or west.

Route Perspective
(Southward: Heading South)
"Avondale is a typical small beach town. The town's population triples in the summer when tourists come. To reach Avondale, drive south along Atlantic Ave. to where the road crosses the Pawcatuck River. Continuing straight on Atlantic Ave. for another half mile you see the ocean straight ahead. You turn left onto Shore Rd. from Atlantic Ave., and see the Ocean on your right. After a few blocks Shore Rd. ends. You are forced to make a left onto Ocean View Highway, heading back to the Pawcatuck River. Traveling down Atlantic Ave. towards the ocean, Shore Rd. is ahead to your left…"

Survey Perspective
(Southward: Beginning in North)
"Avondale is a typical small beach town. The town's population triples in the summer when tourists come. Avondale and the surrounding areas are bordered by four major landmarks: the Pawcatuck River, Atlantic Ave., Ocean View Highway, and the Ocean. The Pawcatuck River makes up the northern border. Running north-south along the western border of this region is Atlantic Ave. The eastern border is made up of Ocean View Highway. The ocean forms the southern border of the town, and Shore Rd. runs parallel to the coast. Shore Rd. connects Atlantic Ave. and Ocean View Highway…"

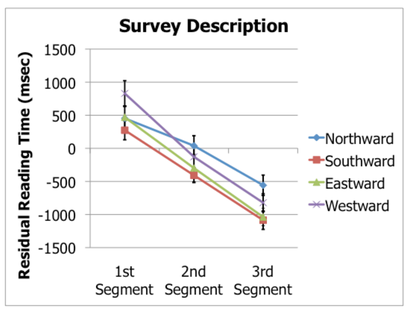
Methods & Results

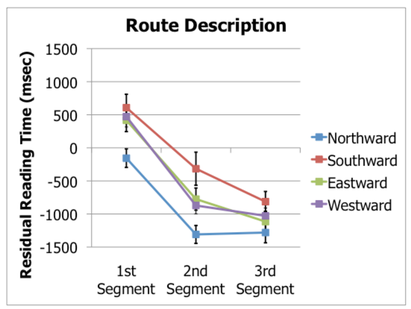
Experiment 2 (Virtual Environments):

• 16 undergraduates (7 female, age M = 19.63±1.59 years, video gaming frequency M = 1.3/4)
• **Navigated 4 large-scale virtual environments** (created using Unreal Tournament) for 7 min each. All environments began with an entrance hallway, where a **compass rose** appeared on the center right of the screen (approx. 10 sec.), displaying N, S, E, or W.
• Following navigation of each environment, completed **a survey statement verification task** to test participants' allocentric knowledge of the environment learned from the first-person viewpoint.

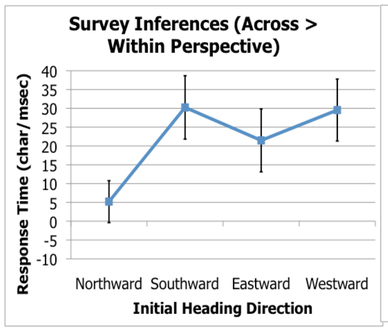
RESULTS

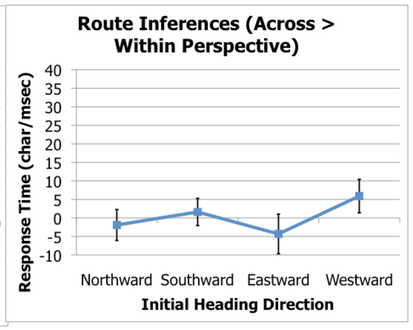
Experiment 1 (Spatial Descriptions):
• Collapsed across all sentences, **route** descriptions that entered **heading north** were **read faster** than the other 3 heading directions (NvS $t(35)=5.25$, $p<0.01$, $d=.88$; NvE $t(35)=2.49$, $p=0.017$, $d=.41$; NvW $t(35)=2.53$, $p<0.01$, $d=.59$), all other directions p's > 0.11.
• **Survey** descriptions were **read faster** when **heading south** (starting in the north) (SvN $t(35)=3.31$, $p<0.01$, $d=.55$; SvW $t(35)=3.16$, $p<0.01$, $d=.53$).





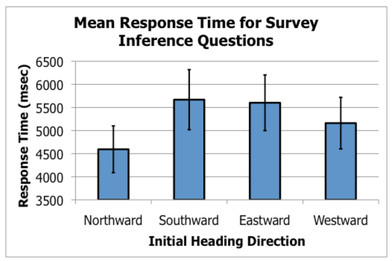
• After reading **route** descriptions, **faster to verify survey inference** statements if had entered the environment **heading north** ($F(3,33)=4.491$, $p<0.01$; post-hoc t-tests p's < 0.05).
• No difference in route inference response times after reading survey descriptions (p's > 0.05).





Results & Discussion

Experiment 2 (Virtual Environments):



Faster to verify survey statements after entering the environment **heading north.**

($F(3,45) = 3.94$, $p = 0.01$)

N v S, $t(15) = 2.62$, $p = 0.019$
N v E, $t(15) = 2.59$, $p = 0.020$
N v W, $t(15) = 1.86$, $p = 0.080$

CONCLUSIONS

• When reading spatial descriptions, entering an environment **heading northward** facilitated language comprehension in the form of **faster reading times**, and aided in developing spatial memories that afford **across-perspective (i.e., survey) inferencing**.

• **Survey** descriptions were **read fastest** when the layout was described from **north to south**, similar to typical Western **visual scanning paths** (e.g., Pollatsek et al., 1981; Spalek & Hammad, 2005).

• Beginning virtual environment navigation with an **initial north-heading** direction results in **faster verification of survey inference statements.**

• **Aligning absolute** reference terms (i.e., cardinal directions) with **relative** reference terms (e.g., *left, right*) while learning environments from the first-person (route) perspectives **facilitates construction of perspective-flexible spatial memories**, integrating ego- and allocentric information.

Present findings provide evidence that readers and navigators use allocentric cues to structure their memory for environments learned from an egocentric perspective.

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