

Background and Hypothesis

Growth (versus fixed) mindset in navigation ability refers to a person's implicit theory that their navigation ability can (or cannot) be improved. Previous studies have shown that people with growth mindset in general are more likely to approach challenges and value efforts so that they are more likely to have better achievements (Dweck, 1998; Dweck, 2006). This study aims to investigate the relations between the mindset in navigation ability, self-reported sense of direction, everyday navigation behaviors, and people's actual navigation abilities, including perspective-taking, constructing survey knowledge (estimating directions to destinations), and navigation efficiency (finding shortcut to navigate).

Hypotheses:

- **Mindsets:** People with a growth mindset are more likely to report a good sense of direction (self-evaluation/self-efficacy), feel less anxious during navigation (spatial anxiety).
- **Behaviors:** People with a growth mindset are more likely to explore new places (exploration tendency) and less likely to rely on GPS (GPS dependence).
- **Ability:** People with a growth mindset have better performance in perspective-taking tests, have better survey knowledge (less angular error in estimating directions in the real world), and show navigation efficiency (capacity of finding a short cut).

Materials

Navigation Mindsets (Questionnaires)

Growth Mindset in Navigation Ability (7-scale and 8 items)
 - Implicit theories about that their navigation ability can / cannot be improved.

- E.g.: I have a certain amount of navigational ability, and I can't really do much to change it.

Exploration Tendency (7-scale and 4 items)

- Attitude about exploring new places

- E.g.: If I have a chance, I would like to explore different routes to get to my destination

GPS Dependence (5-scale and 5 items)

- Tendency to use GPS in 5 scenarios

- E.g.: Finding my way to an appointment in an unfamiliar area of a city or town.

Growth Mindset in General (Castella & Byrne, 2015)

- Implicit theories about whether their intelligence can / cannot be improved.

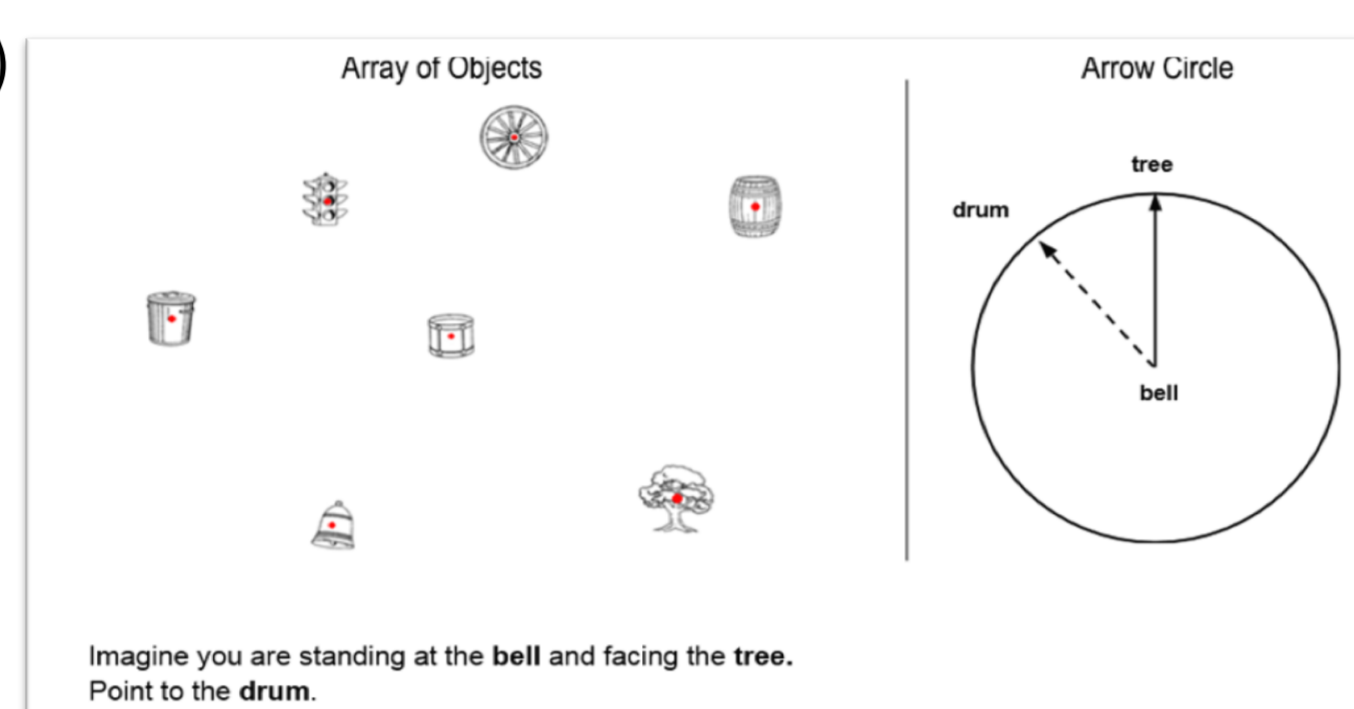
Santa Barbara Sense-of-Direction (Hegarty, Richardson, & Montello, 2002)

- Self-efficacy about "sense of direction"

Spatial Anxiety (Lawton & Kallai, 2002)

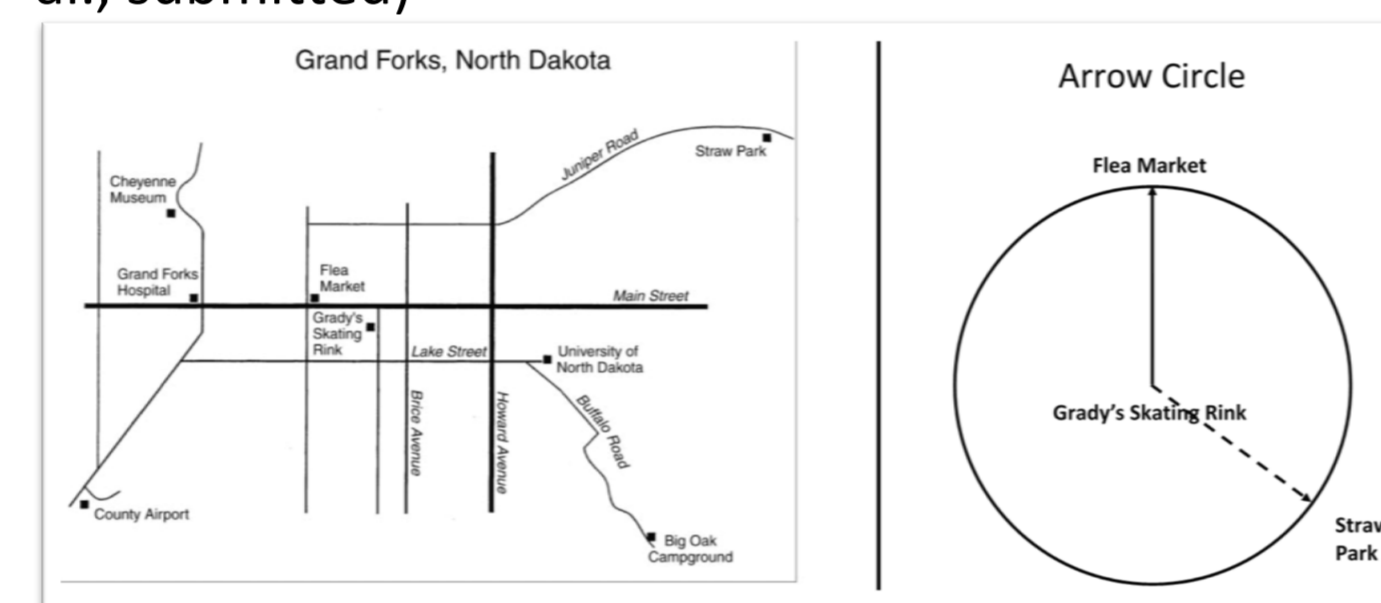
- Extent of feeling anxious during navigation

Perspective-Taking Tests



Object Version

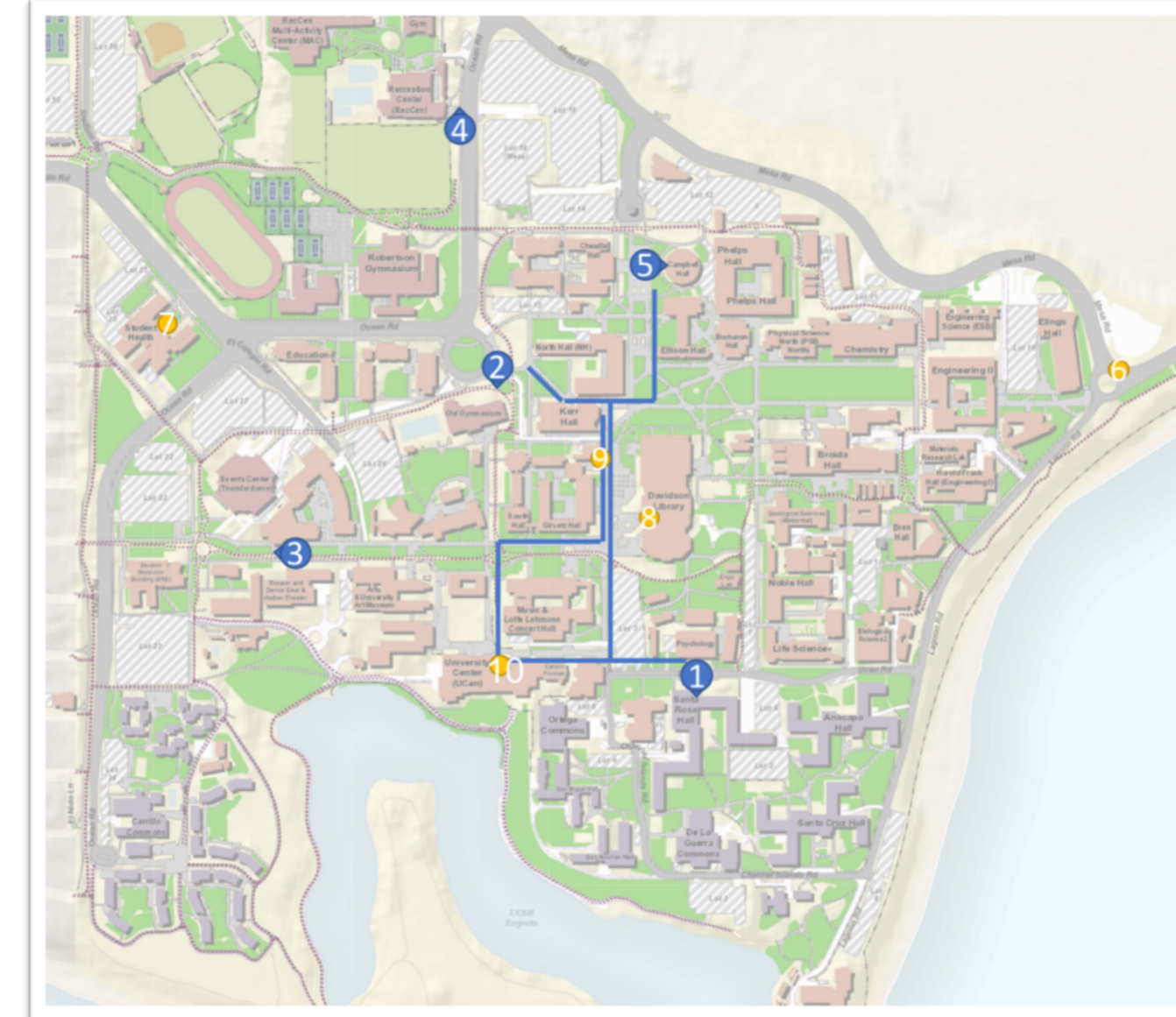
-12 trials. (Hegarty & Waller, 2004; Friedman et al., submitted)



Map Version

-12 trials. (Developed based on Montello, et al., 1999)

Real-World Pointing Test & Short Cutting Test



- ⑤ Main Landmarks: Pointing location
- ⑥ Other Landmarks
- ▶ Perspectives taken by participants
- "Learning" Route

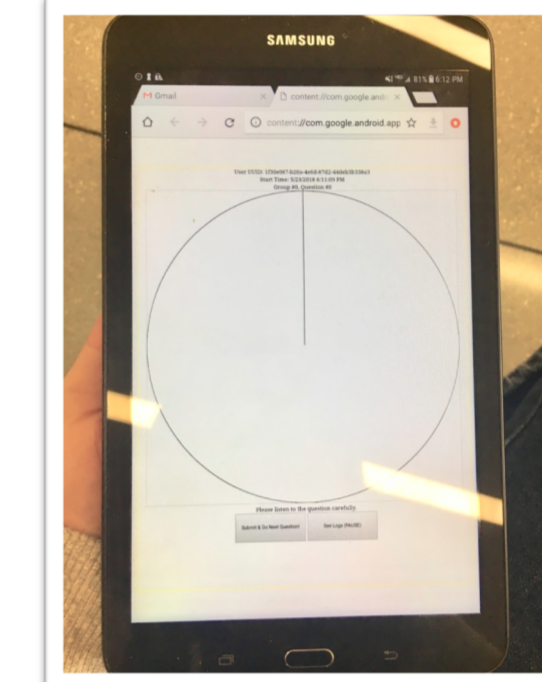


Figure 1. Real-World Pointing Test

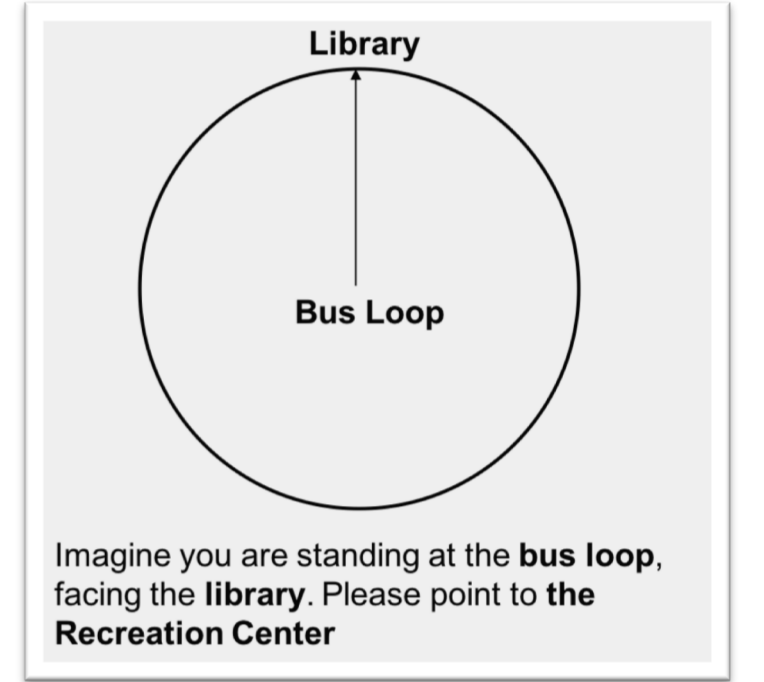


Figure 2. Imaginary Pointing Test

Real-World Pointing Test:

- Point to 5 places out of all 10 landmarks one by one at each pointing location.

Real-World Short-Cutting Test:

- After finishing pointing test at each location, participants will be asked to "Take the shortest route to the next place."

Imaginary Pointing Test:

- After finishing all real-world tests, participants will be asked to do a computer-based pointing test about the learning environment without a map

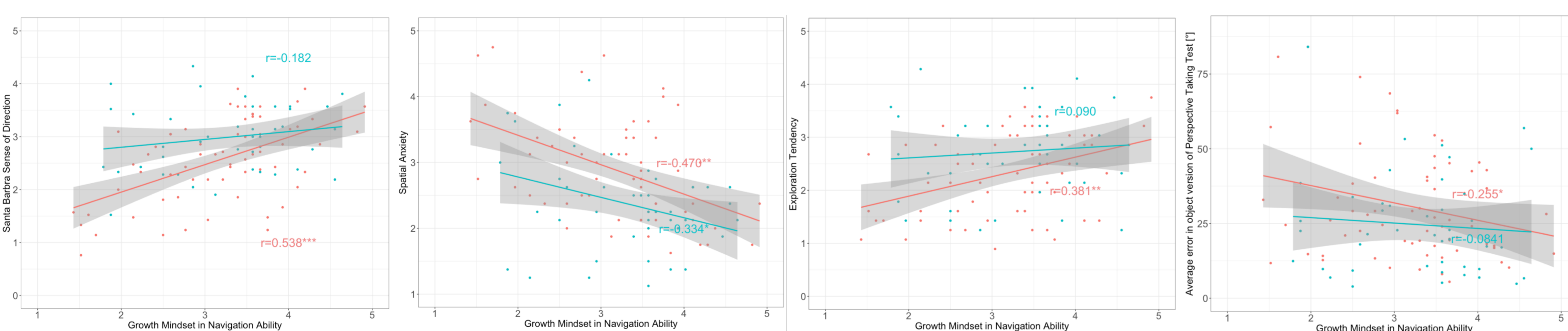
Results

Study 1

109 undergraduate (68 females & 41 males) students from subject pool

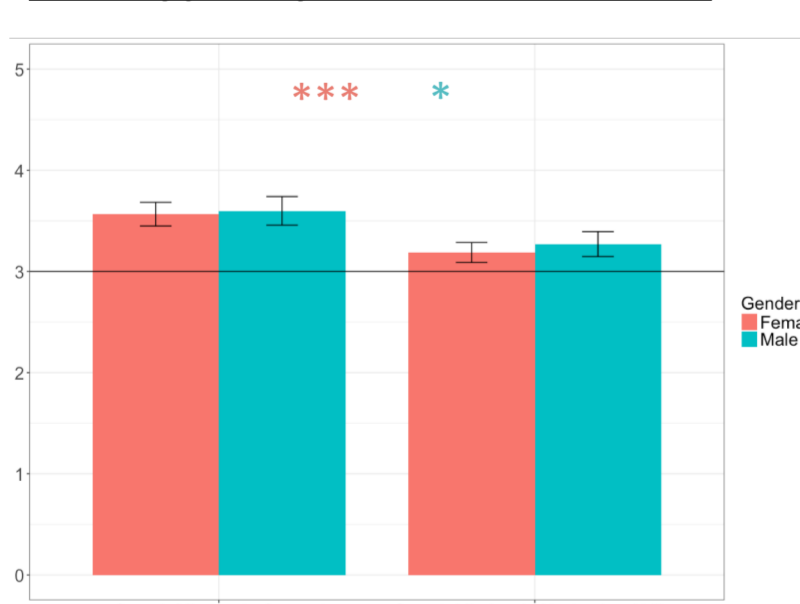


Growth Mindset in Navigation Ability



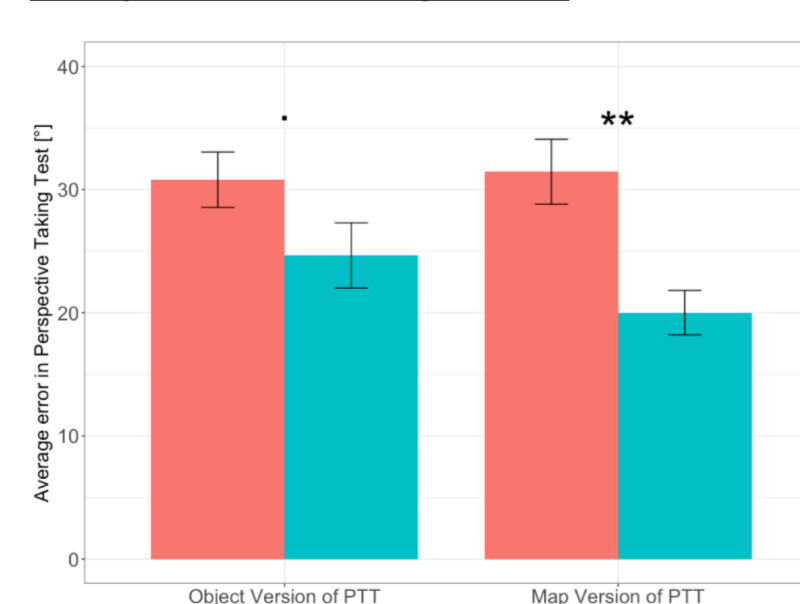
- The results show that people with growth mindset are more likely to report a good sense of direction, feel less anxious during navigation, and are more likely to explore new places. They also have better performance in perspective-taking tests

Two Types of Growth Mindsets



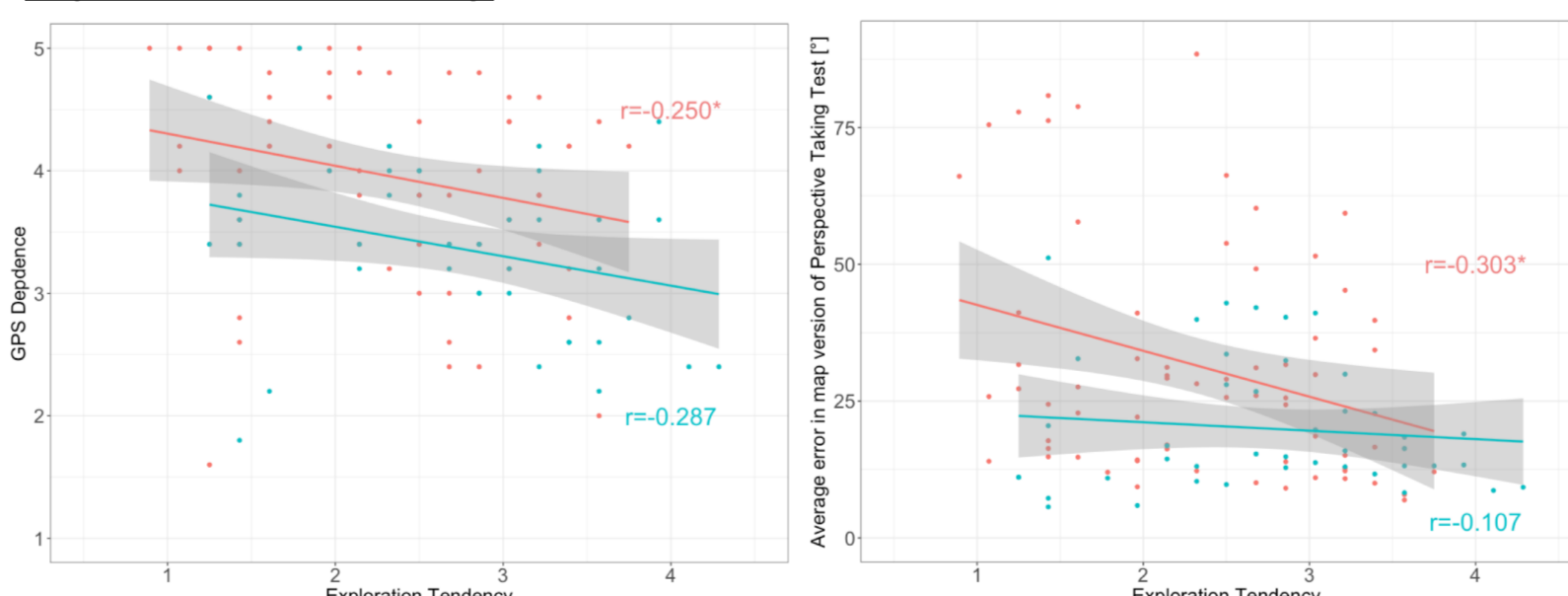
- Highly Correlated to each other
- Significantly different

Perspective Taking Tests



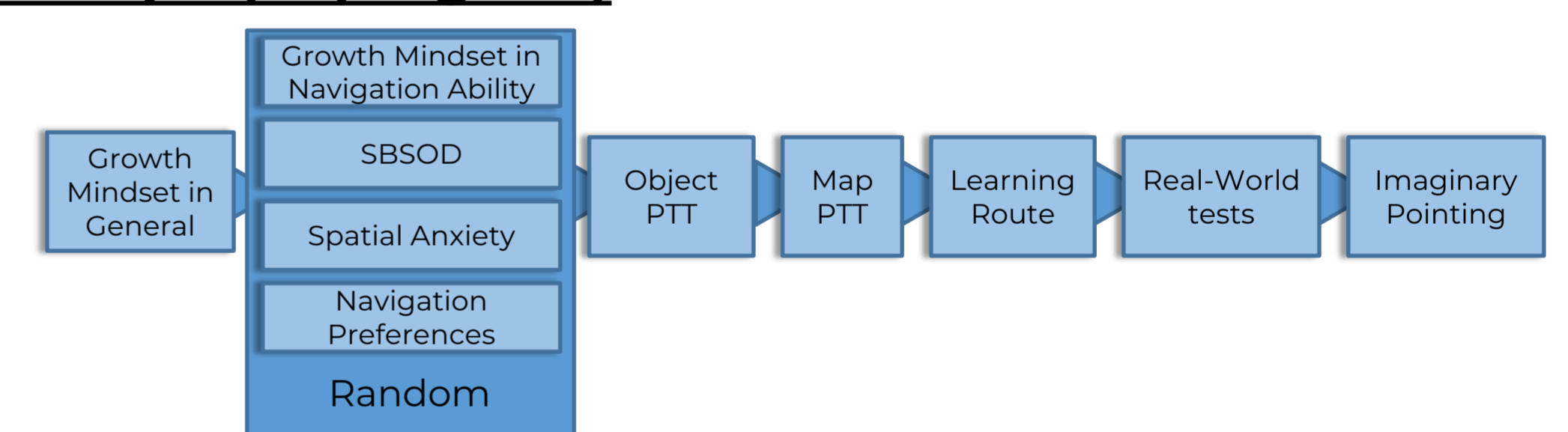
- Highly Correlated to each other
- Not significantly different

Exploration Tendency



Note: Significance codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1

Study 2 (in progress)



Real-world Short Cutting Test



Conclusions

In study 1:

- People with a growth mindset are more likely to report a good sense of direction, feel less anxious during navigation, and are more likely to explore new places. They also have better performance in perspective-taking tests.
- People who report a good sense of direction are less likely to rely on GPS, whereas those with high anxiety during navigation are more likely to rely on GPS.
- In terms of gender differences, the results of perspective taking tests replicate the prior findings favoring males. In addition, females are more likely to report a poor sense of direction and high spatial anxiety, replicating previous research. Females are also less likely to explore new places or use new routes, and more likely to rely on GPS.

References

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological review*, 95(2), 256.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House Incorporated.

De Castella, K., & Byrne, D. (2015). My intelligence may be more malleable than yours: The revised implicit theories of intelligence (self-theory) scale is a better predictor of achievement, motivation, and student disengagement. *European Journal of Psychology of Education*, 30(3), 245-267.

Hegarty, M., Richardson, A. E., Montello, D. R., Lovelace, K., & Subbiah, I. (2002). Development of a self-report measure of environmental spatial ability. *Intelligence*, 30(5), 425-447.

Lawton, C. A., & Kallai, J. (2002). Gender differences in wayfinding strategies and anxiety about wayfinding: A cross-cultural comparison. *Sex Roles*, 47(9-10), 389-401.

Hegarty, M., & Waller, D. (2004). A dissociation between mental rotation and perspective-taking spatial abilities. *Intelligence*, 32(2), 175-191.

Montello, D. R., Lovelace, K. L., Golledge, R. G., & Self, C. M. (1999). Sex-related differences and similarities in geographic and environmental spatial abilities. *Annals of the Association of American geographers*, 89(3), 515-534.