The Relationship Between Navigation Abilities and Mental Disorders

Nikki Hatamian, Robert F. Woodry, Bailey Tranquada-Torres, Andre Yee, Elizabeth R. Chrastil

Department of Neurobiology and Behavior; University of California, Irvine

BACKGROUND

• The link between navigational abilities and Alzheimer's disease has provided an early marker for detection of dementia in at-risk individuals.[1] However, it is unclear whether navigational abilities can be used to detect other neurological and mental disorders.
• Previous research has found links between some aspects of navigation and autism spectrum disorders as well as depression.[2,3]
• This study examines the relationship between three aspects of navigational ability and behavioral traits associated with various mental disorders.

METHODS

• Participants were recruited online through Amazon Mechanical Turk (MTurk).
• Participants completed two online spatial cognition tasks, the **Santa Barbara Sense of Direction Scale** (SBSOD), and a total of 10 standardized questionnaires.
• The **Spatial Orientation Task** (SOT, left) tests spatial perspective taking ability
  • Participants are told to imagine standing at one object and facing a second object and are then told to point to a third object.
• The **Open Field Task** (OFT, right) tests path integration and allocentric spatial learning.
  • Participants learn the locations of four hidden objects, then have to recall the locations and navigate to them.
  • This is done in an open field environment from a first person perspective.
• **Questionnaires:** O-LIFE (schizotypy), AUDIT (alcoholism), AQ-10 (autism), EAT-26 (eating attitudes), BIS-11 (impulsivity), AES (apathy), OCI-R (OCD), SDS (depression), STAI-TY2 (anxiety), and a video game questionnaire.
• A correlation matrix was developed based on data of 381 participants.
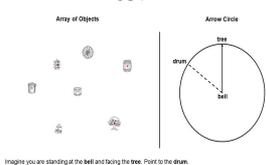

SOT / OFT
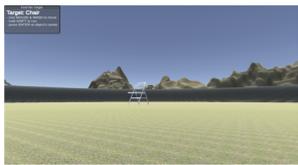
HYPOTHESIS

• We hypothesize that spatial perspective taking is associated with social perspective taking in certain disorders, such as autism spectrum disorders.
• We also suggest that navigational ability may utilize the same brain circuitry as certain mental disorders and thus may be a beneficial early marker for these disorders.

RESULTS

• Preliminary correlations indicate relationships between navigational ability and several mental disorders, particularly with impulsivity and spatial orientation angular error.

Correlation Matrix Between All Tasks and Questionnaires

n = 381

* = p < 0.05
** = p < 0.01
*** = p < 0.001

Correlation Between Angular Error and OCD
r = 0.36, p = 0.0000005

Correlation Between SBSOD and Schizotypy
r = -0.23, p = 0.00075

Correlation Between SBSOD and Depression
r = -0.35, p = 0.0000003

Correlation Between Angular Error and Impulsivity
r = 0.24, p = 0.00107
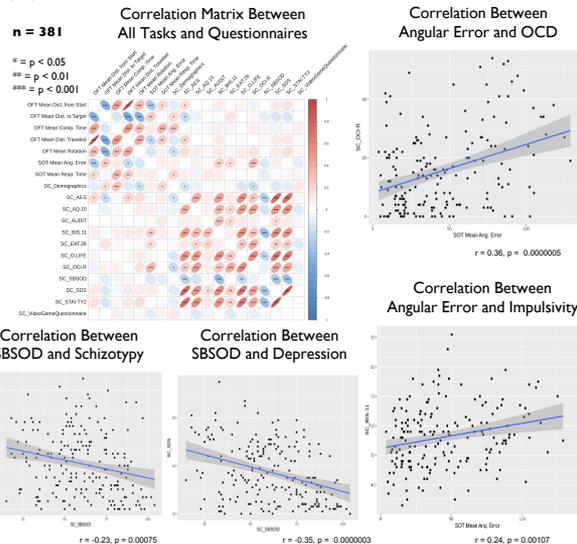
DISCUSSION

• AES (apathy) and EAT-26 (eating disorders) questionnaires are correlated with OFT distance to target.

• BIS-11 (impulsivity), OCD (obsessive-compulsive disorder), and EAT-26 (eating disorders) questionnaires are correlated with SOT angular error.

• The SBSOD (Santa Barbara Sense of Direction Scale) is correlated with multiple questionnaires, including apathy, autism, impulsivity, depression, anxiety, and schizotypy questionnaires.

• These findings suggest that those who show symptoms of impulsivity or OCD perform poorer on spatial cognition tasks.

• Interestingly, there does not seem to be any correlation between the video game questionnaire and OFT variables.

• We next want to z-score all of the variables and conduct multiple regression analysis to examine all factors in a single model.

REFERENCES & ACKNOWLEDGEMENTS

1. Allison, S. L., Fagan, A. M., Morris, J. C., & Head, D. (2016). Spatial Navigation in Preclinical Alzheimer's Disease. *Journal of Alzheimer's Disease* 52(1), 77–90. https://doi.org/10.3233/JAD-150855
2. Lind, S. E., Williams, D. M., Raber, J., Peel, A., & Bowler, D. M. (2013). Spatial navigation impairments among intellectually high-functioning adults with autism spectrum disorder: exploring relations with theory of mind, episodic memory, and episodic future thinking. *Journal of Abnormal Psychology*, 122(4), 1189–1199. https://doi.org/10.1037/a0034819
3. Gould, N. F., Holmes, M. K., Fantie, B. D., Luckenbaugh, D. A., Pine, D. S., Gould, T. D., Burgess, N., Manji, H. K., & Zarate, C. A., Jr (2007). Performance on a virtual reality spatial memory navigation task in depressed patients. *The American Journal of Psychiatry*, 164(3), 516–519. https://doi.org/10.1176/ajp.2007.164.3.516
4. Gillan, C. M., Kosinski, M., Whelan, R., Phelps, E. A., & Daw, N. D. (2016). Characterizing a psychiatric symptom dimension related to deficits in goal-directed control. *eLife*, 5, e11305. https://doi.org/10.7554/eLife.11305

UCI BioSci — Department of Neurobiology and Behavior

UCI CNLM | Center for the Neurobiology of Learning & Memory — Ayala School of Biological Sciences

nhatamia@uci.edu