

# Sam Zorowitz

PHD CANDIDATE AT THE PRINCETON NEUROSCIENCE INSTITUTE

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## Education

### Princeton University

PHD CANDIDATE IN NEUROSCIENCE

Princeton, NJ

Sep. 2017 - Present

- Advisors: Yael Niv, Nathaniel Daw
- Cumulative GPA: 3.90
- Supported by National Science Foundation Graduate Research Fellowship (NSF GRF)

### Johns Hopkins University

BA IN PSYCHOLOGICAL & BRAIN SCIENCES

Baltimore, MD

Sep. 2010 - May 2014

- Cumulative GPA: 3.91
- Phi Beta Kappa, General University Honors

## Skills

<b>Quantitative</b>	Bayesian data analysis, cognitive modeling, item factor modeling, item response theory, psychometrics
<b>Programming</b>	Python, R, Matlab, HTML, JavaScript, CSS, Bash
<b>Software</b>	Stan, JAGS, Jax, Pytorch, jsPsych

## Research Experience

### Princeton University

PHD CANDIDATE IN NEUROSCIENCE

Princeton, NJ

Sep. 2017 - Present

- Developed a gamified and psychometrically-validated battery of reinforcement learning & decision-making tasks to characterize learning and choice strategies in healthy and clinical populations.
- Devising & validating Bayesian factor models for the joint analysis of task- and self-report symptom data in a sample of N=1000 adult participants who completed the aforementioned task battery.
- Formalized clinical theories on the origin and maintenance of anxiety using Bayesian decision theory, and designed behavioral experiments to test novel predictions resulting from our models.
- Utilized item response modeling to validate and refine clinically-relevant behavioral and self-report measures, including a non-proprietary version of the Raven's progressive matrices and a retrospective assessment of childhood maltreatment.
- Built and released multiple open source softwares for the behavioral scientists, including an application for collecting online data and a collection of gamified decision-making tasks programmed with jsPsych.

### Massachusetts General Hospital / Harvard Medical School

CLINICAL RESEARCH COORDINATOR

Boston, MA

Jun. 2014 - Jun. 2017

- Lead analyst on study investigating the effects of DBS on executive control in patients with severe depression. Found that DBS improved patients' performance on a Stroop-like task, which was indirectly predictive of patients' clinical response to DBS.
- Devised hierarchical Bayesian model of decision making conflict, integrating both choice and reaction time data, in an approach-avoidance gambling task for use in predicting conflict-related signals in fMRI & EEG neural data.
- Adapted Bayesian state space models of associative learning to a reversal learning paradigm and demonstrated its efficacy in improving fMRI signal-to-noise ratio.

## Publications

### JOURNAL ARTICLES

**Zorowitz, S.**, Tuominen, L. (under review). Confirmatory factor analysis of the Maltreatment and Abuse Chronology of Exposure (MACE) scale: Evidence for essential unidimensionality. <https://psyarxiv.com/uexgy/>

Bennett, D., Radulescu, A., **Zorowitz, S.**, Falso, V., Niv, Y. (under review). Affect-congruent attention drives changes in reward expectations. <https://psyarxiv.com/vu2cw>

**Zorowitz, S.**, Niv, Y., Bennett, D. (under review). Inattentive responding can induce spurious associations between task behavior and symptom measures. <https://psyarxiv.com/rynhk>

**Zorowitz, S.**, Chierchia, G., Blakemore, S. J., Daw, N. D. (in press). An item response theory analysis of the matrix reasoning item bank (MaRs-IB). Behavior Research Methods. <https://psyarxiv.com/j73af>

- Zorowitz, S.**, Niv, Y. (2023). Improving the reliability of cognitive task measures: A narrative review. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*. <https://doi.org/10.1016/j.bpsc.2023.02.004>
- Cox, J.M., Minerva, A.R., Fleming, W., Zimmerman, C.A., Hayes, C., **Zorowitz, S.**, Bandi, A., Ornelas, S., McMannon, B., Parker, N.F. and Witten, I.B. (2023). A neural substrate of sex-dependent modulation of motivation by value. *Nature Neuroscience*. <https://doi.org/10.1038/s41593-022-01229-9>
- Weber, I., **Zorowitz, S.**, Niv, Y., Bennett, D. (2022). The effects of induced positive and negative affect on Pavlovian-instrumental interactions. *Cognition and Emotion*, 1-18. <https://doi.org/10.1080/02699931.2022.2109600>
- Barbosa, J., Stein, H., **Zorowitz, S.**, Niv, Y., Summerfield, C., Soto-Faraco, S., Hyafil, A. (2022). A practical guide for studying human behavior in the lab. *Behavior Research Methods*. <https://doi.org/10.3758/s13428-022-01793-9>
- Zorowitz, S.**, Bennett, D., Choe, G., Niv, Y. (2021). A Recurring Reproduction Error in the Administration of the Generalized Anxiety Disorder Scale. *Lancet Psychiatry*. 8(3), P180-181. [https://doi.org/10.1016/S2215-0366\(21\)00001-8](https://doi.org/10.1016/S2215-0366(21)00001-8)
- Zorowitz, S.**, Momennejad, I., & Daw, N. D. (2020). Anxiety, avoidance, and sequential evaluation. *Computational Psychiatry*, 4, 1-17. [https://doi.org/10.1162%2Fcpsy\\_a\\_00026](https://doi.org/10.1162%2Fcpsy_a_00026)
- Zorowitz, S.**, Rockhill, A. P., Ellard, K. K., Link, K. E., Herrington, T., Pizzagalli, D. A., Widge, A. S., Deckersbach, T., Dougherty, D. D. (2019). The Neural Basis of Approach-Avoidance Conflict: A Model Based Analysis. *eNeuro*. 10.1523/ENEURO.0115-19.2019
- Langdon, A. J., Hathaway, B. A., **Zorowitz, S.**, Harris, C. B. W., Winstanley, C. A. (2019). Relative insensitivity to time-out punishments induced by win-paired cues in a rat gambling task. *Psychopharmacology*, 236(8), 2543-2556. <https://doi.org/10.1007/s00213-019-05308-x>
- Widge, A. S., **Zorowitz, S.**, Basu, I., Paulk, A. C., Cash, S. S., Eskandar, E. N., Deckersbach, T., Miller, E. K., Dougherty, D. D. (2019). Deep Brain Stimulation of the Internal Capsule Enhances Human Cognitive Control and Prefrontal Cortex Function. *Nature Communications*, 10(1), 1-11. <https://doi.org/10.1038/s41467-019-09557-4>
- Widge, A. S., Ellard, K. K., Paulk, A. C., Basu, I., Yousefi, A., **Zorowitz, S.**, ... Eskandar, E. N. (2017). Treating refractory mental illness with closed-loop brain stimulation: Progress towards a patient-specific transdiagnostic approach. *Experimental Neurology*, 287, 461-472. <https://doi.org/10.1016/j.expneurol.2016.07.021>
- Klein, E., Goering, S., Gagne, J., Shea, C. V., Franklin, R., **Zorowitz, S.**, ... & Widge, A. S. (2016). Brain-computer interface-based control of closed-loop brain stimulation: attitudes and ethical considerations. *Brain-Computer Interfaces*, 3(3), 140-148. <https://doi.org/10.1080/2326263X.2016.1207497>
- Rodriguez-Hart, C., Liu, H., Nowak, R. G., Orazulike, I., **Zorowitz, S.**, Crowell, T. A., ... Charurat, M. (2016). Serosorting and Sexual Risk for HIV Infection at the Ego-Alter Dyadic Level: An Egocentric Sexual Network Study Among MSM in Nigeria. *AIDS and Behavior*, 20(11), 2762-2771. <https://doi.org/10.1007/s10461-016-1311-3>
- Widge, A. S., Licon, E., **Zorowitz, S.**, Corse, A., Arulpragasam, A. R., Camprodon, J. A., ... Dougherty, D. D. (2016). Predictors of Hypomania During Ventral Capsule/Ventral Striatum Deep Brain Stimulation. *The Journal of Neuropsychiatry and Clinical Neurosciences*, 28(1), 38-44. <https://doi.org/10.1176/appi.neuropsych.15040089>
- Widge, A. S., **Zorowitz, S.**, Link, K., Miller, E. K., Deckersbach, T., Eskandar, E. N., & Dougherty, D. D. (2015). Ventral Capsule/Ventral Striatum Deep Brain Stimulation Does Not Consistently Diminish Occipital Cross-Frequency Coupling. *Biological Psychiatry*, 80(7), e59-e60. <https://doi.org/10.1016/j.biopsych.2015.10.029>
- Franklin, R., **Zorowitz, S.**, Corse, A. K., Widge, A. S., & Deckersbach, T. (2015). Lurasidone for the treatment of bipolar depression: an evidence-based review. *Neuropsychiatric Disease and Treatment*, 11, 2143-2152. <https://doi.org/10.2147%2FNDT.S50961>
- Lorince, J., **Zorowitz, S.**, Murdock, J., & Todd, P. M. (2015). The Wisdom of the Few? "Supertaggers" in Collaborative Tagging Systems. *The Journal of Web Science: Vol. 1: No. 1*, pp 16-32. <https://doi.org/10.1561/106.00000002>

## CONFERENCE PROCEEDINGS

- Zorowitz, S.**, Momennejad, I., & Daw, N. D. (2019). Anxiety, avoidance, and sequential evaluation. *Reinforcement Learning and Decision Making*. Langdon, A. J., Hathaway, B. A., **Zorowitz, S.**, Harris, C. B. W., Winstanley, C. A. Insensitivity to time-out punishments induced by win-paired cues in a rat gambling task. *Reinforcement Learning and Decision Making*.
- Lorince, J., **Zorowitz, S.**, Murdock, J., & Todd, P. M. (2014). Supertagger behavior in building folksonomies. In *Proceedings of the 2014 ACM conference on Web science* (pp. 129-138). ACM.

## CONFERENCE POSTERS

- Zorowitz, S.**, Tuominen, L. (2022). Adverse Childhood Events and Negative Symptoms in the General Population. Presented at Schizophrenia International Research Society.
- Zorowitz, S.**, Lane, P. L., Daw, N. D. (2021). The value of free choice in anxiety. Presented at Society of Biological Psychiatry.
- Paredes, N., **Zorowitz, S.**, Niv, Y. (2021). The psychometric properties of the Pavlovian Instrumental Transfer task in an online adult sample. Presented at Society of Biological Psychiatry.

Zaller, I., **Zorowitz, S.**, Niv, Y. (2021). Information seeking on the horizons task does not predict anxious symptomatology. Presented at Society of Biological Psychiatry.

Paredes, N., **Zorowitz, S.**, Niv, Y. (2021). The psychometric properties of the Pavlovian Instrumental Transfer task in an online adult sample. Presented at Society for Neuroscience Global Connectome.

Zaller, I., **Zorowitz, S.**, Niv, Y. (2021). Information seeking on the horizons task does not predict anxious symptomatology. Presented at Society for Neuroscience Global Connectome.

**Zorowitz, S.**, Bennett, D., Niv, Y. (2020). The Relation between Probability Weighting and Subclinical Anxiety in Decisions under Uncertainty. Presented at Society for Biological Psychiatry. New York City, New York.

Bennett, D., Radulescu, A., **Zorowitz, S.**, Niv, Y. (2019). Assessing mood's effects on attention in value-based decision making. Presented at Society for Affective Science. Boston, Massachusetts.

Widge, A. S., **Zorowitz, S.**, Afzal, A., Farnes, K., Paulk, A. C., Miller, E. K., Deckersbach, T., Cash, S. S., Dougherty, D. D. (2016). Deep Brain Stimulation of Striatal White Matter Alters Top-Down Control Signals in Cingulate and Prefrontal Cortices. Presented at the American College of Neuropsychopharmacology, Hollywood, Florida.

Sitnikova, T. A., **Zorowitz, S.**, Afzal, A., Gilmour, A. L., Ellard, K. K., Herrington, T. M., ... Deckersbach, T. (2016). Oscillatory synchronization enables dynamic information processing to resolve reward seeking vs. risk avoidance conflict. Poster presented at the Society for Neuroscience, San Diego, CA.

**Zorowitz, S.**, Afzal, A., Deckersbach, T., Ellard, K. K., Gilmour, A. L., Dougherty, D. D., Eskandar, E. N., Widge, A. W. (2016). Bayesian State-Space Modeling of Reversal Learning. Poster presented at the Society for Neuroscience, San Diego, CA.

Afzal, A., **Zorowitz, S.**, Ellard, K. K., Widge, A. S., Gilmour, A. L., Dougherty, D. D., Eskandar, E. N., Deckersbach, T. Neural Correlates of Approach-Avoidance Behavior in Decision Making. Poster presented at the Society for Neuroscience, San Diego, CA.

Afzal, A., **Zorowitz, S.**, Ellard, K. K., Widge, A. S., Gilmour, A. L., Dougherty, D. D., Eskandar, E. N., Deckersbach, T. Neural Correlates of Approach-Avoidance Behavior in Decision Making. Poster presented at the Society of Biological Psychiatry, Atlanta, GA.

**Zorowitz, S.**, Franklin, R., Kunwar, P. S., Greve, D. N., Block, S., Moran, L. R., Schwartz, C. E. (2016). A High-reactive Temperamental Profile in 4 Month-Old Infants Predicts Reduced Amygdala Volume and Increased Amygdala Reactivity in Adults. Poster presented at the Society of Biological Psychiatry, Atlanta, GA.

Widge, A. S., **Zorowitz, S.**, Tang, W., Miller, E. K., Deckersbach, T., & Dougherty, D. D. (2015). Behavioral and neural biomarkers of improved top-down control mediate clinical response to ventral capsule/ventral striatum deep brain stimulation in major depression. Poster presented at the Society of Biological Psychiatry, Toronto, Canada.

## Teaching

### Princeton University

Princeton, NJ

#### GRADUATE STUDENT BOOTCAMP INSTRUCTOR

Summer 2021

- Designed and taught lecture on fMRI principles.

#### GRADUATE STUDENT BOOTCAMP LEADER

Summer 2020

- Organized and oversaw 3 week long math and programming bootcamp for incoming graduate students.
- Lectured on python programming, model fitting, and significance testing.

#### ASSISTANT INSTRUCTOR FOR LABORATORY IN PRINCIPLES OF NEUROSCIENCE

Spring 2020

- Taught scientific python programming to undergraduate students.
- Designed in-class exercises and problems sets on fMRI preprocessing and mass univariate analysis.

#### GRADUATE STUDENT BOOTCAMP INSTRUCTOR

Summer 2019

- Designed and taught a three day Intro to Python for Neuroscience series for the PNI Graduate Bootcamp.
- Bootcamp materials covered core Python, numeric computing, statistics, and vizualization.

#### ASSISTANT INSTRUCTOR FOR GRADUATE METHODS IN COGNITIVE NEUROSCIENCE

Spring 2019

- Designed lecture materials for teaching neuroimaging analysis (fMRI, EEG) in python.
- Designed novel problem sets for teaching neuroimaging analysis and computational reproducibility.

#### ASSISTANT INSTRUCTOR FOR FUNDAMENTALS OF NEUROSCIENCE

Fall 2018

- Taught three undergraduate precepts per week.
- Co-designed lecture materials, wrote exam questions, and organized review sessions.

### Columbia University

New York City, NY

#### WORKSHOP ORGANIZER

Summer 2017

- Designed and taught a two-week Intro to Python for Data Science workshop for the QMSS Masters Program.
- Workshop materials covered scientific computing, machine learning, statistical analysis, and webscraping.

## Invited Talks

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- 2022 **McGill University**, Psychiatric epidemiology journal club (October 2022)
- 2022 **Yale University**, Rutledge Lab meeting (June 2022)
- 2022 **Alena**, Science team meeting (May 2022)
- 2021 **University of Cambridge**, Blakemore Lab meeting (December 2021)
- 2021 **University of Amsterdam**, Theory Construction Lab meeting (October 2021)
- 2021 **Princeton University**, Parallel Distributed Processes meeting (March 2021)
- 2021 **Transcontinental Computational Psychiatry Workgroup**, (March 2021)

## Mentoring

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- 2022 **Jen No**, Junior project and senior thesis at Princeton University (co-advised with Laura Bustamante)
- 2020 **Kiersten Marr**, Junior project and senior thesis at Princeton University
- 2020 **Livia Qoshe**, Junior project and senior thesis at Princeton University
- 2020 **Isabel Zaller**, Independent work at Princeton University
- 2020 **Natalie Paredes**, Summer internship at Princeton University
- 2017 **Katherine Link**, Summer internship at Harvard Medical School

## Fellowships & Awards

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- 2019 **Graduate Research Fellowship**, National Science Foundation
- 2019 **Student Travel Award**, Conference on Reinforcement Learning & Decision Making
- 2017 **Centennial Fellowship**, Princeton University
- 2016 **Top Poster in Translational Research**, Society of Biological Psychiatry