

# Sam Zorowitz

CLINICAL BIOSTATISTICIAN AT THE NATIONAL INSTITUTES OF MENTAL HEALTH

Porter Neuroscience Building, National Institutes of Health, Bethesda, MD

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## Research Experience

### National Institutes of Mental Health

Bethesda, MD

CLINICAL BIOSTATISTICIAN

Aug. 2023 - Present

- Lead the design and analysis of human behavioral research in the Unit on the Neural Computations in Learning.
- Utilize computerized adaptive testing to design reliable assessments of cognitive ability that are personalized to each study participant.
- Develop Bayesian statistical models to jointly analyze multiple streams of experimental data including behavior, self-report, and sensor time series data.
- Collaborate with other members of the NIH intramural research program including other data scientists, machine learning engineers, clinicians, and animal researchers.

### Princeton University

Princeton, NJ

PHD IN COGNITIVE NEUROSCIENCE

Sep. 2017 - Aug. 2023

- Designed and validated reliable battery of digital assessments of learning & decision-making for use in clinical phenotyping and in tracking changes in cognition during clinical trials.
- Used item response models (graded response model, MIMIC models) to evaluate and validate survey measures of internalizing disorder symptoms and experiences with childhood maltreatment.
- Applied Bayesian additive multilevel item structure models to calibrate and validate a novel measure of executive functioning in adult samples.
- Summarized and communicated analysis results in manuscripts and in presentations to diverse audiences including engineers, clinicians, patients, and other stakeholders.

### Massachusetts General Hospital / Harvard Medical School

Boston, MA

CLINICAL RESEARCH COORDINATOR

Jun. 2014 - Jun. 2017

- Lead analyst in clinical study of severely depressed patients wherein I performed nonparametric time series regression to uncover neural origins of cognitive control deficits.
- Developed hierarchical Bayesian models to produce quantitative indicators of approach/avoidance behaviors for use in neuroimaging analyses.
- Extended Bayesian state space models to measure sudden changes in performance in clinical assays of executive functioning.

## Skills

<b>Quantitative</b>	Bayesian data analysis, generalized linear models, time series analysis, item response models, structural equation models
<b>Programming</b>	Python, R, Julia, SQL, HTML, JavaScript, CSS, Bash
<b>Software</b>	Stan, JAGS, lavaan, blavaan, psych, Jax, Pytorch, jsPsych

## Education

### Princeton University

Princeton, NJ

PHD IN COGNITIVE NEUROSCIENCE

Sep. 2017 - Aug. 2023

- Advisors: Yael Niv, Nathaniel Daw
- Dissertation: The Factor Structure of Reinforcement Learning Behaviors
- Supported by a National Science Foundation Graduate Research Fellowship

### Johns Hopkins University

Baltimore, MD

BA IN PSYCHOLOGICAL & BRAIN SCIENCES

Sep. 2010 - May 2014

- Phi Beta Kappa, General University Honors

## Publications

### PREPRINTS

**Zorowitz, S.**, Karni, G., Paredes, N., Daw, N. D., Niv, Y. (under review). Improving the reliability of the Pavlovian go/no-go task.

<https://psyarxiv.com/eb697>

**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>

### JOURNAL ARTICLES

Bennett, D., Radulescu, A., **Zorowitz, S.**, Felso, V., Niv, Y. (2023). Affect-congruent attention modulates generalized reward expectations. PLOS Computational Biology. <https://doi.org/10.1371/journal.pcbi.1011707>

- Zorowitz, S.**, Solis, J., Niv, Y., Bennett, D. (2023). Inattentive responding can induce spurious associations between task behavior and symptom measures. *Nature Human Behavior*. <https://doi.org/10.1038/s41562-023-01640-7>
- Zorowitz, S.**, Chierchia, G., Blakemore, S. J., Daw, N. D. (2023). An item response theory analysis of the matrix reasoning item bank (MaRs-IB). *Behavior Research Methods*. <https://doi.org/10.3758/s13428-023-02067-8>
- 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. (2019). 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

Golway, N., Solomyak, L., Karni, G., **Zorowitz, S.**, ..., Eldar, E., Niv, Y., Hartley, C. (2023). Reliability of a Reinforcement-Learning Task Battery for Computational Phenotyping of Decision-Making in Adolescent Psychopathology. Presented at Computational Psychiatry Conference.

**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.

## Invited Talks

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- 2023 **National Institute of Mental Health**, Data Science and Sharing Team (Oct 2023)
- 2023 **University of Tokyo**, IRCN science salon (September 2023)
- 2023 **Tel Aviv University**, Workshop for online neuroscience experiments (May 2023)
- 2023 **National Institute of Mental Health**, Neural Computations in Learning Lab meeting (March 2023)
- 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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2023 **Esha Dadbhawala**, Postbaccalaureate research at National Institute of Mental Health  
2023 **Ashley Lo**, Postbaccalaureate research at National Institute of Mental Health  
2023 **Allison Yang**, Junior project and senior thesis at Princeton University (co-advised with Nathaniel Daw)  
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