

<http://aaron.bornstein.org/>

2019- Assistant Professor, Department of Cognitive Sciences
Faculty, Institute for Mathematical Behavioral Sciences
Fellow, Center for the Neurobiology of Learning and Memory
University of California, Irvine

2018 Associate Research Scholar, Princeton Neuroscience Institute
2013-2018 Postdoctoral Research Associate, Princeton Neuroscience Institute
2007-2013 Graduate researcher, New York University
2006 Research assistant, Deicken lab, UCSF/VA
2005-2007 Research assistant, Wagner lab, Stanford

2013 Ph.D., Cognition & Perception, **New York University**
 2003 S.B., Mathematics (additional concentration in Economics)
Massachusetts Institute of Technology

2023-2028 NIMH R01MH128306 (Co-I; PI MA Yassa)
 “Testing a memory-based hypothesis for anhedonia”
 2022-2027 NINDS R01NS119468 (Co-I; PI ER Christil)
 “Cognitive graphs, active decision making, and brain network dynamics”
 2022-2025 NIMH P50MH096889 (Co-I; PI TZ Baram)
 “Fragmented early-life experiences, aberrant circuit maturation, emotional vulnerabilities”
 2022-2025 UK MRC MR/W028476/1 (Collaborator; PI M Field)
 “Reinforcer-specific value-based decision-making in persistence of and recovery from alcohol use disorder”
 2021-2024 NIA R21AG072673 (PI)
 “Improving multi-step planning in aging by overcoming deficits in memory encoding”
 2021-2023 **BBRF** NARSAD Young Investigator award (PI)
 “Determining the role of episodic memory in substance use disorder”
 2020-2021 NIMH P50MH096889 (seed grant; PI TZ Baram)
 “Early life adversity effects on event segmentation”
 2011-2013 NIMH F31MH095501 (PI)
 “Computational mechanisms of goal-directed control”

To lab members

2024	Indow Fellowship for Research Excellence (Jungsun Yoo)
2024	NIA/SRNDNA Summer Research award (Melisa Azimihashemi)
2024	NIA/SRNDNA Summer Research award (Ami Yamamoto)
2024	UROP Research Experience Fellowship (Ami Yamamoto)
2023-2026	Hewitt Foundation postdoctoral fellowship (Dale Zhou)
2023-2025	NIMH F31MH134620 (Nora Harhen)
2023-2025	NIMH T32MH119049 (Ari Khoudary)
2023	CNLM Jared M. Roberts Graduate Student Award (Ari Khoudary)
2023	CNLM Jared M. Roberts Graduate Student Award (Nidhi Banavar)
2022	UCI Summer Undergraduate Research Fellowship (Gloria Cheng)
2022	Lambert prize in Foundations of Science (Nidhi Banavar)
2022-2025	NIA F32AG072836 (Sharon Noh)
2020-2023	National Defense Science & Engineering Graduate fellowship (Nora Harhen)
2019	UCI Summer Undergraduate Research Fellowship (Brianna Sarcos)

PUBLICATIONS

(* = *Equal contribution*; + = *UCI Lab member*.)

Preprints

- PP7 Banavar NV+, **Bornstein AM**. Variability in Complex Constructs: Inferring risk preference and temporal discounting. *PsyArXiv*.
[doi:10.31234/osf.io/zdq5v](https://doi.org/10.31234/osf.io/zdq5v)
- PP6 Banavar NV+, **Bornstein AM**. Independent, not irrelevant: Trial order causes systematic misestimation of economic choice traits. *PsyArXiv*.
[doi:10.31234/osf.io/a8gz3](https://doi.org/10.31234/osf.io/a8gz3)
- PP5 Banavar NV+, Noh SM+, Wahlheim CN, Cassidy BS, Kirwan CB, Stark CEL, **Bornstein AM**. A response time model of the three-choice Mnemonic Similarity Task provides stable, mechanistically interpretable individual-difference measures. *PsyArXiv*.
[doi:10.31234/osf.io/yvdae](https://doi.org/10.31234/osf.io/yvdae)
- PP4 Hadj-Amar B, **Bornstein AM**, Vannucci M, Guindani M. Sparse Gaussian Graphical Modeling of High-Dimensional Time Series with Discrete Autoregressive Process.
- PP3 Hunter LE*, **Bornstein AM***, Hartley CA. A common deliberative process underlies model-based planning and patient intertemporal choice. *bioRxiv*.
[doi:10.1101/499707](https://doi.org/10.1101/499707)
- PP2 Noh SM+, Cooper KW, Kerr T, Stark CEL, **Bornstein AM**. Multi-step inference can be improved across the lifespan with individualized memory interventions. *PsyArXiv*.
[doi:10.31234/osf.io/3mhj6](https://doi.org/10.31234/osf.io/3mhj6)
- PP1 Yoo J+, Chrastil ER, **Bornstein AM**. Cognitive graphs: Representational substrates for planning. *PsyArXiv*.
[doi:10.31234/osf.io/jpq8b](https://doi.org/10.31234/osf.io/jpq8b)

Peer-reviewed journal articles

- JP19 Chen J, **Bornstein AM** (in press). The causal structure and computational value of narratives. *Trends in Cognitive Sciences*.
- JP18 Harhen NC+, **Bornstein AM** (2024). Interval timing as a computational pathway from early life adversity to affective disorders. *Topics in Cognitive Science*, 16(2024):92-112
[doi:10.1111/tops.12701](https://doi.org/10.1111/tops.12701)
- JP17 Noh SM+, Singla UK, Bennett IJ, **Bornstein AM** (2023). Memory precision and age differentially predict the use of decision-making strategies across the lifespan. *Scientific Reports*, 13:17014
[doi:10.1038/s41598-023-44107-5](https://doi.org/10.1038/s41598-023-44107-5)
- JP16 **Bornstein AM**, Aly M, Feng SF, Turk-Browne NB, Norman KA, Cohen JD (2023). Associative memory retrieval modulates upcoming perceptual decisions. *Cognitive, Affective, & Behavioral Neuroscience*, 23:645665
[doi:10.3758/s13415-023-01092-6](https://doi.org/10.3758/s13415-023-01092-6)
[doi:10.18112/openneuro.ds001614.v1.0.1](https://doi.org/10.18112/openneuro.ds001614.v1.0.1)
- JP15 Harhen NC+, **Bornstein AM** (2023). Overharvesting in human patch foraging reflects rational structure learning and adaptive planning. *Proceedings of the National Academy of Sciences*, 120(13):e2216524120.
[doi:10.1073/pnas.2216524120](https://doi.org/10.1073/pnas.2216524120)
- JP14 Otto AR, Devine S, Schultz E, **Bornstein AM***, Louie K* (2022). Context-dependent choice and evaluation in real-world consumer behavior. *Scientific Reports*, 12:17744.
[doi:10.1038/s41598-022-22416-5](https://doi.org/10.1038/s41598-022-22416-5)
[doi:10.17605/OSF.IO/EC5DX](https://doi.org/10.17605/OSF.IO/EC5DX)
- JP13 Rmus M, Ritz H, Hunter LE, **Bornstein AM***, Shenhav A* (2022). Humans can navigate complex graph structures acquired during latent learning. *Cognition*, 225:105103.
[doi:10.1016/j.cognition.2022.105103](https://doi.org/10.1016/j.cognition.2022.105103)
- JP12 Wang S, Feng SF, **Bornstein AM** (2021). Mixing memory and desire: How decisions for reward depend on the dynamics and content of memory reinstatement. *Wiley Interdisciplinary Reviews: Cognitive Science*, e1581.
[doi:10.1002/wcs.1581](https://doi.org/10.1002/wcs.1581)
- JP11 Rouhani N, Norman KA, Niv Y, **Bornstein AM** (2020). Reward prediction errors create event boundaries in memory. *Cognition*, 203:104269.
[doi:10.1016/j.cognition.2020.104269](https://doi.org/10.1016/j.cognition.2020.104269)
- JP10 **Bornstein AM***, Pickard H* (2020). Chasing the first high: Memory sampling in drug choice. *Neuropsychopharmacology*, 45(6):907-915.
[doi:10.1038/s41386-019-0594-2](https://doi.org/10.1038/s41386-019-0594-2)
- JP9 Kane GA, **Bornstein AM**, Shenhav A, Wilson RC, Daw ND, Cohen JD (2019). Rats exhibit similar biases in foraging and intertemporal choice tasks. *eLife*, 8:e48429.
[doi:10.7554/eLife.48429](https://doi.org/10.7554/eLife.48429)
- JP8 Millner AJ, den Ouden HEM, Gershman SJ, Glenn CR, Kearns J, **Bornstein AM**, Marx BP, Keane TM, Nock MK (2019). Suicidal thoughts and behaviors are associated with an increased decision-making bias for active responses to escape aversive states. *Journal of Abnormal Psychology*, 128(2):106-118.
[doi:10.1037/abn0000395](https://doi.org/10.1037/abn0000395)

- JP7 Hoskin AN, **Bornstein AM**, Norman KA, Cohen JD (2018). Refresh my memory: Episodic memory reinstatements intrude on working memory maintenance. *Cognitive, Affective, & Behavioral Neuroscience*, 19:338-354.
doi:10.3758/s13415-018-00674-z
doi:10.18112/openneuro.ds001576.v1.0.0
- JP6 **Bornstein AM**, Khaw MW, Shohamy D, Daw ND (2017). Reminders of past choices bias decisions for reward in humans. *Nature Communications*, 8:15958.
doi:10.1038/ncomms15958
- JP5 **Bornstein AM**, Norman KA (2017). Reinstated episodic context guides sampling-based decisions for reward. *Nature Neuroscience*, 20:997-1003.
doi:10.1038/nn.4573
doi:10.18112/openneuro.ds001607.v1.0.1
- JP4 **Bornstein AM**, Daw ND (2013). Cortical and hippocampal correlates of deliberation during model-based decisions for rewards in humans. *PLoS Computational Biology*, 9(12):e1003387.
doi:10.1371/journal.pcbi.1003387
- JP3 **Bornstein AM**, Daw ND (2012). Dissociating hippocampal and striatal contributions to sequential prediction learning. *European Journal of Neuroscience*, 35:1011-1023.
doi:10.1111/j.1460-9568.2011.07920.x
- JP2 **Bornstein AM**, Daw ND (2011). Multiplicity of control in the basal ganglia: computational roles of striatal subregions. *Current Opinion in Neurobiology*, 21(3):374-380.
doi:10.1016/j.conb.2011.02.009
- JP1 Preston AR, **Bornstein AM**, Hutchinson JB, Gaare ME, Glover GH, Wagner AD (2010). High-resolution fMRI of content-sensitive subsequent memory responses in human medial temporal lobe. *Journal of Cognitive Neuroscience*, 22:156-173.
doi:10.1162/jocn.2009.21195

Peer-reviewed articles in conference proceedings

- CP11 Khoudary A+, Peters MAK*, **Bornstein AM*** (2022). Precision-weighted evidence integration predicts time-varying influence of memory on perceptual decisions. *Cognitive Computational Neuroscience*.
- CP10 Banavar NV+, **Bornstein AM** (2022). Response time modeling provides stable and mechanistically interpretable measures of individual differences in behavioral pattern separation. *Proceedings of the 20th International Conference on Cognitive Modeling*.
Selected for a talk.
- CP9 Harhen NC+, **Bornstein AM** (2022). Learning to expect change: Volatility during early experience alters reward expectations in a model of interval timing. *Proceedings of the 20th International Conference on Cognitive Modeling*.
Selected for a talk and a best paper award.
- CP8 Banavar NV+, **Bornstein AM** (2022). Decision difficulty modulates the re-use of computations across trials in non-sequential decision tasks. *Proceedings of the 5th Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM 2022)*
- CP7 Harhen NC+, **Bornstein AM** (2022). Humans adapt their foraging strategies and computations to environment complexity. *Proceedings of the 5th Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM 2022)*

- CP6 Yoo J+, **Bornstein AM** (2022). Two-stage task with increased state space complexity to assess online planning. *Proceedings of the 5th Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM 2022)*
- CP5 Banavar NV+, Lee MD, **Bornstein AM** (2021). Sequential effects in non-sequential tasks. *Proceedings of the 19th International Conference on Cognitive Modeling*.
- CP4 Harhen NC+, **Bornstein AM** (2021). Structure learning as a mechanism of overharvesting. *Proceedings of the 19th International Conference on Cognitive Modeling*.
- CP3 Harhen NC+, Hartley CA, **Bornstein AM** (2021). Model-based foraging using latent-cause inference. *Proceedings of the 43rd Annual Conference of the Cognitive Science Society*.
doi:10.31234/osf.io/dfztu
<https://github.com/uciccnl/CogSci2021-HarhenHartleyBornstein>
- CP2 Kane GA, **Bornstein AM**, Shenhav A, Wilson RC, Daw ND, Cohen JD (2017). Mechanisms of overharvesting in patch foraging. *Proceedings of the 39th Annual Conference of the Cognitive Science Society*, 637-642.
- CP1 Floares A, Jakary A, **Bornstein A**, Deicken R (2006). Neural networks and classification and regression trees are able to distinguish females with major depression from healthy controls using neuroimaging data. *Proceedings of the IEEE International Joint Conference of Neural Networks, 2006*, 4605-4611.
doi:10.1109/ijcnn.2006.247090

Commentaries & Book Chapters

- RP6 Zhou D+, **Bornstein AM** (in press). Expanding horizons in reinforcement learning for curious exploration and creative planning (Commentary on Ivancovsky et al). *Behavioral and Brain Sciences*. doi:10.1017/S0140525X23003394
- RP5 Banavar NV+, **Bornstein AM** (in press). Multi-plasticities: Distinguishing context-specific habits from complex perseverations. In Y. Vandaele (Ed.). *Habits - Their Definition, Neurobiology and Role in Addiction*. Cham, Switzerland: Springer Nature.
- RP4 **Bornstein AM***, Constantino SM* (2017). Nudge back: Towards a taxonomy of scientific rationalities. *London Conference in Critical Thought*.
- RP3 **Bornstein AM**, Miller KJ, Shenhav A (2015). Walking bundles of habits (and Response-Outcome associations). *European Journal of Neuroscience*, 41:1356-1357.
doi:10.1111/ejn.12906
- RP2 **Bornstein AM** (2014). Functions of the hippocampal memory system in instrumental control (Doctoral dissertation).
Available from ProQuest Dissertations & Theses Global (3614853).
- RP1 **Bornstein AM**, Nylen EL, Steele SA (2011). Unblocking the neural substrates of model-based value. *Journal of Neuroscience*, 31(28):10117-10118.
doi:10.1523/jneurosci.1883-11.2011

Accepted conference abstracts (since 2019)

- CA26 Harhen NC+, Noh SM+, Stough-Lacking S, **Bornstein AM** (2023). Suboptimal or locally rational? Foraging as a window onto the universal mechanisms of decisions under uncertainty. *Healing the Brain: Bridging the Gap in Low-and Middle-Income Countries*.

- CA25 Harhen NC+, **Bornstein AM** (2023). Temporal representation optimization provides a computational link between early life adversity and anhedonia. *Computational Psychiatry*.
- CA24 Banavar NV+, **Bornstein AM** (2023). Decomposing behavioral pattern separation: A model-based analysis. *Learning and Memory meeting*.
- CA23 Harhen NC+, **Bornstein AM** (2023). Temporal representation adaptation as a computational link between early life unpredictability and anhedonia. *Learning and Memory meeting*.
- CA22 Khoudary A+, Peters MAK*, **Bornstein AM*** (2023). Characterizing dynamic effects of memory on perceptual decisions. *Learning and Memory meeting*.
- CA21 Noh SM+, **Bornstein AM** (2023). Memory encoding ability interacts with training interventions to improve memory-guided inference decisions *Learning and Memory meeting*.
- CA20 Yoo J+, **Bornstein AM** (2023). Humans build configural representations for planning in complex environments *Learning and Memory meeting*.
- CA19 Stout DM, Harhen NC+, **Bornstein AM**, Vinograd M, Spadoni A, Simmons AN, Yassa MA, Davis EP, Glynn LM, Baram TZ, Baker DG, Risbrough VB (2023). Unpredictable early-life experiences moderate the effect of anhedonia and PTSD symptoms on neural measures of reward learning in adulthood. *Anxiety and Depression Association of America*.
- CA18 Harhen NC+, **Bornstein AM** (2023). Interval timing as a computational framework for examining the pathway from early life unpredictability to affective disorders. *Conte Center annual symposium*.
Best abstract award. Selected for a short talk.
- CA17 Khoudary A+, **Bornstein AM***, Peters MAK* (2023). Perceptual decisions result from dynamic precision-weighted integration of memory and visual information. *Association of Scientific Studies of Consciousness*.
Selected for a talk.
- CA16 Kapogianis T, **Bornstein AM**, Chrastil ER (2022). Graph Metrics and Non-Spatial Navigational Learning. *Society for Neuroscience Annual Meeting*.
- CA15 Harhen NC+, Hartley CA*, **Bornstein AM*** (2022). Memory-guided decision-making develops alongside model-based planning. *The Flux Society Congress for Integrative Developmental Neuroscience*.
- CA14 Harhen NC+, **Bornstein AM** (2022). Representation learning & adaptation in human foraging. *CNLM annual meeting*.
Selected for a short talk.
- CA13 Yoo J+, **Bornstein AM** (2022). Task complexity and experience modulate the use of online planning. *CNLM annual meeting*.
- CA12 Noh SM+, Stark CEL, **Bornstein AM** (2022). Mnemonic Discrimination Ability Predicts Optimal Training Condition for Memory-Guided Inference Decisions. *Annual meeting of the Cognitive Neuroscience Society*.
Selected for a short talk.
- CA11 Yoo J+, **Bornstein AM** (2021). Task complexity and experience dictate the use of online, versus offline, planning in humans. *Annual meeting of the Society for Neuroeconomics*.

- CA10 Noh SM+, Kerr T, Bennett IA*, **Bornstein AM*** (2021). Age-related differences in memory-guided decisions are driven by a trade-off between multiple decision systems. *Society for Neuroscience Annual Meeting*.
- CA9 Noh SM+, Kerr T, **Bornstein AM** (2021). Pattern Separation Predicts Which Memories Are Sampled During Decisions for Reward *Psychonomics*.
- CA8 Noh SM+, **Bornstein AM** (2021). Pattern separation mediates the types of memories sampled during decisions for reward. *CNLM annual meeting*.
- CA7 Banavar NV+, **Bornstein AM** (2021). Deliberative evaluation in intertemporal choice is shaped by experiment structure. *Annual meeting of the Society for Neuroeconomics* Selected for a short talk.
- CA6 Devine SM, Otto AR, **Bornstein AM***, Louie K* (2021). Context-dependent choice and evaluation in real-world consumer behavior *Mathematical Psychology*
- CA5 Harhen NC+, Yassa MA, Baram TZ, **Bornstein AM** (2021). Exploring a latent cause model of substance use disorder symptoms. *Biological Psychiatry*
[doi:10.1016/j.biopsych.2021.02.479](https://doi.org/10.1016/j.biopsych.2021.02.479)
- CA4 Cooper KW+, Li L, Agostinelli F, Saraf M, Elias GA, Baldi P, **Bornstein AM**, Shahbaba B, Fortin N (2021). Theta-associated nonspatial sequence coding in hippocampus. *Society for Neuroscience Global Connectome*.
- CA3 Harhen NC+, Hartley CA, **Bornstein AM** (2020). Foraging behavior adjusts to multiple scales of context. *Annual meeting of the Society for Neuroeconomics* Selected for a talk.
- CA2 Vlasceanu M, Morais MJ, Zhao Z, **Bornstein AM**, Norman KA, Coman AC (2020). Self-Other Similarity Modulates the Socially-Triggered Context-Based Prediction Error Effect on Memory. *41st Annual Conference of the Cognitive Science Society*
- CA1 Rouhani N, Norman KA, Niv Y, **Bornstein AM** (2019). Reward prediction errors create event boundaries in memory *Psychonomics*

AWARDS

2024	CNLM Exceptional Mentor Award
2023	Election to the Memory Disorders Research Society
2020	Association for Psychological Science “ Rising Star ” Award
2020	Brain and Behavior Research Foundation NARSAD Young Investigator Award
2005,6,8	Honorable mention, NSF Graduate Research Fellowship
2000	Runner up, MIT \$50k Business Plan competition

TALKS

Invited

Feb 2024	University of California Los Angeles
Dec 2023	Brown University
May 2023	Future of Foraging seminar series

Apr 2023	Johns Hopkins University
Mar 2023	Northeastern University
Feb 2023	Center for the Neurobiology of Learning & Memory
Dec 2022	City University of New York
Feb 2021	University of California Los Angeles
Feb 2021	Context and Affective Memory meeting
Aug 2020	University of California Los Angeles
Mar 2020	Claremont Colleges
Feb 2020	University of California Riverside
Sep 2019	Facebook Research Labs
May 2019	University of California Los Angeles
Apr 2019	Brown University
Jan 2019	National Institute of Drug Abuse
Dec 2017	Cambridge University
Oct 2017	Johns Hopkins University
Feb 2015	Mount Sinai School of Medicine
Jun 2014	Weill-Cornell Medical College
Jun 2011	Memory and Decisions meeting, Stanford University
Jan 2011	Parallel Distributed Processing meeting, Princeton University
Jan 2011	Kavli Institute, Harvard University

Contributed

May 2022	Center for the Neurobiology of Learning and Memory Annual Meeting
Apr 2021	Society of Biological Psychiatry symposium “Advancing Treatment of Substance Use Disorders Through Computational Modeling”
Jan 2020	Winter Conference on the Neurobiology of Learning and Memory symposium “Mnemonic contributions to reinforcement learning and decision making”
Mar 2018	Cosyne workshop “Hippocampal computations and interactions supporting statistical learning and decision-making”
Nov 2015	SFN symposium “Understanding Goal-Directed Decision-Making in Humans: Computations and Circuits”
Mar 2014	Workshop on the Neurobiology of Prediction and Surprise, Rutgers University

TEACHING/SERVICE

UC Irvine

Spring 2023	Memory (Undergraduate)
Spring 2023	Decision making (Graduate)
Spring 2021-22	Decision making & Problem solving (Graduate; with Prof. Zygmunt Pizlo)
Spring 2020	Topics in Reinforcement Learning (Graduate; with Prof. Mimi Liljeholm)
Spring 2019-22	Research in Exp Psych (Undergraduate; with Prof. Nadia Chernyak)
Winter 2019-22	Advanced Experimental Psychology (Undergraduate)

Other teaching/mentorship

Fall 2020	Neuromatch academy mentor
Summer 2020	Neuromatch academy group leader
Summer 2020	GSMI Cientifico Latino
2019	MEET alumni mentor
Summer 2018	Computational & Cognitive Neuroscience Summer School, Suzhou, China
2016-2018	Princeton Prison Teaching Initiative
Summer 2007,08	MIT Middle East Education through Technology (MEET), Jerusalem

University/Department service

2022-2024	CogSci Colloquium committee, faculty advisor
2021-	Irvine Faculty Association, Executive board member; 2023-, Treasurer
2021	CNLM Spring meeting program co-chair
2020	CNLM “Evening to Remember” organizational committee
2019-	First generation Faculty Initiative
2019-	UCI Prison Education Program, advisory board, curriculum committee
2019,23	Cognitive Sciences faculty search committee
2018,20,22	Cognitive Sciences PhD admissions committee

Organizational service

2023	UCI Conte Center annual symposium, organized with the Conte Center Team.
2022	NSF/Simons NeuroDataScience workshop, Co-Organizer (with Norbert Fortin and Babak Shahbaba)
2021	Center for Neurobiology of Learning and Memory Spring Meeting Co-organizer (with Lulu Chen)
2018	Princeton Neuroscience Institute “Inside-Out” seminar series Co-organizer (with Ahmed El Hady)
2018	“Goal-Directed Decision Making: Computations and Circuits” <i>Elsevier</i> Co-editor (with Richard Morris & Amitai Shenhav)
2015	COSYNE Workshop “Memory in action: The role(s) of the hippocampus in decisions for reward” Co-organizer (with G. Elliott Wimmer)