

Nathaniel D. Daw

Huo Professor in Computational and Theoretical Neuroscience
Princeton Neuroscience Institute and Department of Psychology,
Princeton University
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updated 8/2020

Experience:

Appointments:

- Huo Professor in Computational and Theoretical Neuroscience (2019-)
Professor (2015-)
Princeton Neuroscience Institute and Department of Psychology
Princeton University
- Associate professor (2012- 2015)
Assistant professor (2007-2012)
Center for Neural Science and Department of Psychology; affiliated: Department of Computer Science
New York University
- Royal Society USA research fellow (2003-2006)
Gatsby Computational Neuroscience Unit
University College London

Visiting appointments:

- Nirit and Michael Shaoul Fellow (AY 2018-19)
Mortimer and Raymond Sackler Institute of Advanced Studies
Tel Aviv University
- Visiting scientist (Spring 2013)
Neuroscience Institute and Department of Psychology
Princeton University
- Visiting scientist (Fall 2012)
Department of Neurobiology
Weizmann Institute of Science

Education:

- Carnegie Mellon University, Pittsburgh, PA (1997-2003)
Advisor: David S. Touretzky
M.S., May 2000 (Computer Science)
Ph.D., Aug. 2003 (Computer Science with certification in Cognitive Neuroscience)
Thesis: "Reinforcement learning models of the dopamine system and their behavioral implications,"
- Columbia University, New York, NY (1992-1996)
B.A., *summa cum laude*, June 1996 (Philosophy of Science)

Funding & Awards:

Funding (ongoing):

- NIMH R01MH121093 (PI Shohamy, Co-I Daw, 9/1/2019-6/30/2023)
"Differentiating reward seeking and loss avoidance with reference-dependent learning models"
- NIH UL1 TR003017 (PI Panettieri; project PIs Daw, Cohen, Niv; 9/2019-8/2024) New Jersey Alliance for Clinical and Translational Science: NJACTS Special Option: Machine Learning Approaches to Mental Illness and Chronic Disease
- John Templeton Foundation grant 61454 (PI Cohen; Co-PIs Daw, Niv, Norman, Griffiths; 9/2019 – 9/2022)
"Toward a Scientific Understanding of the Human Capacity for Autonomy"
- NSF IIS-1822571 (PI Daw; Co-I Shohamy 10/1/2018-9/30/2021)
"Prioritization of Memory Reactivation for Decision-Making"

- U.S. Army Research Office ARO W911NF-16-1-0474 (PI Grafton, Co-I Daw; 09/1/2016-08/31/2021)
“Neural foundations of expertise based on optimal decision-making, physical control and response to stress”

Funding (completed):

- NIDA 1R01DA038891 (PI Daw; Co-PI Shohamy; 9/15/2014-6/30/2019 NCE)
“Computational and Neural Mechanisms of memory-guided decisions”
- Gift from Google DeepMind (PI Daw)
- NIMH 1R01MH109177 (Daw, Botvinick, Gershman, Konidaris; 9/1/2015-5/31/2018 NCE)
“CRCNS: Representational foundations of adaptive behavior in natural and artificial agents”
- John Templeton Foundation grant 57876 (PI Cohen; Co-PIs Daw, Niv, Norman, Turk-Browne; 12/2015 – 11/2018)
“Toward a Scientific Understanding of the Human Capacity for Cognitive Control”
- McDonnell Foundation Scholar Award (Daw; 9/2011-9/2015)
“Dissecting learning: combining experimental and computational approaches”
- NINDS 1R01NS078784 (subcontract; PI Shohamy; Co-investigator Daw; 9/2011-9/2015)
“Goals vs. habits in the human brain: Cognitive and computational mechanisms”
- NIMH 1R01MH087882 (PI Daw; Co-investigator Pesaran; 9/2009-5/2014)
“Reinforcement learning in multi-dimensional action spaces”
- NIDA 1R01DA027794 (subcontract; PI Wager; Co-investigators Daw, Hart, Lindquist, Shohamy; 9/2009-9/2014)
“Learning to avoid pain: Computational mechanisms and application to methamphetamine abuse”
- Human Frontiers Science Program Grant RGP0036/2009-C (PIs Nakamura, Daw, Cools; 12/2009-12/2012)
“Serotonin and decision making: Integrating interspecies experimental and computational approaches”
- McKnight Scholar Award (Daw; 7/2009-7/2012)
“Decision making in structured, sequential tasks”
- NARSAD Young Investigator Award (Daw; 1/2010-1/2012)
“Distinguishing associative processes for isolating psychiatric deficits”
- US-Israel Binational Science Foundation Grant #200528 (PIs Joel, Rivka, O'Doherty, Daw; Daw added year 2; 10/2006-10/2009)
“Deficient procedural learning in obsessive compulsive disorder: A functional MRI study”
- USA Research Fellowship, Royal Society (UK) (Daw; 2003-2006),
“Dopamine and the neural basis of decision-making”
- Graduate Research Fellowship, National Science Foundation (Daw; 1998-2001)

Awards:

- BPS Cognitive Psychology Section Award (2019)
Talmi, Lonas & Daw, “A retrieved context model for the emotional modulation of memory”
- Fellow, Association for Psychological Science (elected 2018)
- Nirit and Michael Shaoul Fellowship, Mortimer and Raymond Sackler Institute of Advanced Studies, Tel Aviv University (2018)
- Young Investigator Award, Society for Neuroeconomics (2012)
- McDonnell Foundation Scholar Award in Understanding Human Cognition (2011)
- McKnight Scholar Award (2009)
- NARSAD Young Investigator Award (2009)
- NIPS Outstanding Student Paper Award (2005)
Niv, Daw & Dayan, “How fast to work: Response vigor, motivation and tonic dopamine”
- NIPS Outstanding Student Paper Award (2004)
Courville, Daw & Touretzky, “Similarity and discrimination in classical conditioning”
- John Jay Scholar (1992)
Columbia University

Publications:

Preprints:

1. Piray, P., and **Daw, N.D.** (2019) Linear reinforcement learning: Flexible reuse of computation in planning, grid fields, and cognitive control. bioRxiv 856849

2. Hunter, L.E., Meer, E.A., Gillan, C.M., Hsu, M., and **Daw, N.D.** (2019) Excessive deliberation in social anxiety. *bioRxiv* 522433
3. Talmi, D., Kavaliauskaite, D., and **Daw, N.D.** (2018) In for a pound, in for a penny: How the opportunity to gain reward influences the competition for memory resources. *bioRxiv* 464388
4. Constantino, S.M., Dalrymple, J., Gilbert, R.W., Varenese, S., Di Rocco, A., and **Daw, N.D.** (2017) A neural mechanism for the opportunity cost of time. *bioRxiv* 173443

Journal articles:

1. Foerde, K., Schebendach, J., Davis, L., **Daw, N.D.**, Walsh, T., Shohamy, D., and Steinglass, J.E. (accepted) Restrictive eating across a spectrum from healthy to unhealthy: Behavioral and neural mechanisms. *Psychological Medicine*
2. Foerde, K., **Daw, N.D.**, Rufin, T., Walsh, B.T., Shohamy, D., and Steinglass, J. (accepted) Deficient goal-directed control in a population characterized by extreme goal pursuit. *Journal of Cognitive Neuroscience*
3. Garrett, N., and **Daw, N.D.** (2020) Biased belief updating and suboptimal choice in foraging decisions. *Nature Communications* 11:3417
4. Dundon, N.M., Garrett, N., Babenko, V., Cieslak, M., **Daw, N.D.**, and Grafton, S.T. (2020) Sympathetic and parasympathetic involvement in time constrained sequential foraging. *Cognitive Affective and Behavioral Neuroscience* 20:730-745
5. Piray, P., and **Daw, N.D.** (2020) A simple model for learning in volatile environments. *PLoS Computational Biology* 16:e1007963
6. Zorowitz, S., Momennejad, I., and **Daw, N.D.** (2020) Anxiety, avoidance, and sequential evaluation. *Computational Psychiatry* 4:1-17.
7. Jaffe-Dax, S., Boldin, A.M., **Daw, N.D.**, and Emberson, L.L. (2020) A computational role for top-down modulation from frontal cortex in infancy. *Journal of Cognitive Neuroscience* 32:508-514.
8. Gillan, C.M., Kalanthroff, E., Evans, M., Weingarden H.M., Jacoby, R.J., Gershkovich, M., Snorrason, I., Campeas R. Cervoni C., Crimarco, N., Sokol, Y., Garnaat, S.L., Mclaughlin, N., Phelps, E.A., Pinto, A., Boisseau, C.L., Wilhelm, S., **Daw, N.D.**, and Simpson, H.B. (2020) Comparison of the association between goal-directed planning and self-reported compulsivity vs. obsessive-compulsive disorder diagnosis. *JAMA Psychiatry* 77:77-85.
9. Wyckmans, F., Otto, A.R., Sebold, M., **Daw, N.**, Bechara, A., Saeremans, M., Kornreich, C., Chatard, A., Jaafari, N., Noël, X. (2019) Reduced model-based decision-making in gambling disorder. *Scientific Reports* 9:19625.
10. Kane, G.A., Bornstein, A.M., Shenhav, A., Wilson, R.C., **Daw, N.D.**, and Cohen, J. (2019) Rats exhibit similar biases in foraging and intertemporal choice tasks. *eLife* pii: e48429.
11. Piray, P., Dezfouli, A., Heskes, T., Frank, M., and **Daw, N.D.** (2019) Hierarchical Bayesian inference for concurrent model fitting and comparison for group studies. *PLoS Computational Biology* 15:e1007043
12. Lee, R.S., Mattar, M.G., Parker, N.F., Witten, I.B., and **Daw, N.D.** (2019) Reward prediction error does not explain movement selectivity in DMS-projecting dopamine neurons. *eLife* pii: e42992.
13. Fung, B., Qi, S., Hassibis, D., **Daw, N.D.**, and Mobbs, D. (2019) Slow escape decisions are driven by trait anxiety. *Nature Human Behavior* 3:702-708.
14. Engelhard, B., Finkelstein, J., Cox, J., Fleming, W., Jang, H.J., Ornelas, S., Koay, S., Thiberge, S., **Daw, N.D.**, Tank, D., and Witten, I. (2019) Specialized coding of sensory, motor, and cognitive variables in midbrain dopamine neurons. *Nature* 570: 509-513.
15. Dunsmoor, J.E., Kroes, M.C.W., Li, J., **Daw, N.D.**, Simpson, H.B., and Phelps, E.A. (2019) Role of human ventromedial prefrontal cortex in learning and recall of enhanced extinction. *Journal of Neuroscience* 39: 3264-3276.
16. Vikbladh, O.M., Meager, M.R., King, J., Blackmon, K., Devinsky, O., Shohamy, D., Burgess, N., and **Daw, N.D.** (2019) Hippocampal contributions to model-based planning and spatial memory. *Neuron* 102:683-693.
17. Baker, S.C., Konova, A.B., **Daw, N.D.**, and Horga, G. (2019) A distinct inferential mechanism for delusions in schizophrenia. *Brain* 142:1797-1812.

18. Talmi, D., Lohanas L., and **Daw, N.D.** (2019) A retrieved context model of the emotional modulation of memory. *Psychological Review* 126: 455-485.
19. Otto, A.R., and **Daw, N.D.** (2019) The opportunity cost of time modulates cognitive effort. *Neuropsychologia* 123:92-105.
20. Momennejad, I., Otto, A.R., **Daw, N.D.**, and Norman, K. (2018) Offline replay supports planning in human reinforcement learning. *eLife* pii: e32548.
21. Mattar, M.G., and **Daw, N.D.** (2018) Prioritized memory access explains planning and hippocampal replay. *Nature Neuroscience* 21:1609-1617.
22. Duncan, K., Doll, B.B., **Daw, N.D.**, and Shohamy, D. (2018), More than the sum of its parts: a role for hippocampus in configural reinforcement learning. *Neuron* 98:645-657.
23. Ledoux, J., and **Daw, N.D.** (2018) Surviving threats: neural circuit and computational implications of a new taxonomy of defensive behavior. *Nature Reviews Neuroscience* 19:269-282.
24. Qi, S., Hassabis, D., Sun, J., Guo, F., **Daw, N.D.**, and Mobbs, D., (2018) How cognitive and reactive fear circuits optimize escape decisions in humans. *Proceedings of the National Academy of Sciences* 115:3186-3191.
25. Fleming, S.M., van der Puten, E.J., and **Daw, N.D.** (2018) Neural mediators of changes of mind about perceptual decisions. *Nature Neuroscience* 21:617-624.
26. Cassidy, C.M., Balsam, P.D., Weinstein, J.J., Rosengard, R.J., Slifstein, M., **Daw, N.D.**, Abi-Dargham, A., and Horga, G. (2018) A perceptual inference mechanism for hallucinations linked to striatal dopamine. *Current Biology* 28:503-514.
27. Russek, E.M., Momennejad, I., Botvinick, M.M., Gershman, S.J., and **Daw, N.D.** (2017) Predictive representations can link model-based reinforcement learning to model-free mechanisms. *PLoS Computational Biology* 13:e1005768
28. Momennejad, I.; Russek, E.; Cheong, J.; Botvinick, M., **Daw, N.D.**, and Gershman, S.J. (2017) The successor representation in human reinforcement learning. *Nature Human Behavior* 1, 680–692.
29. Kane, G.A., Vazey, E.M., Wilson, R.C., Shenhav, A., **Daw, N.D.**, Aston-Jones, G., and Cohen, J.D (2017) Increased locus coeruleus tonic activity causes disengagement from a patch-foraging task. *Cognitive Affective and Behavioral Neuroscience* 17:1073-1083.
30. Bornstein, A.M., Khaw, M.W., Shohamy, D., and **Daw, N.D.** (2017) What's past is present: Reminders of past choices bias decisions for reward in humans. *Nature Communications* 8:15958.
31. Lenow, J.K, Constantino, S.M., **Daw, N.D.**, and Phelps, E.A. (2017) Chronic and acute stress promote overexploitation in serial decision making. *Journal of Neuroscience* 37:5681-5689.
32. Goldfarb, E.V., Shields, G.S., **Daw, N.D.**, Slavich, G.M., and Phelps, E.A. (2017) Low lifetime stress exposure is associated with reduced stimulus-response memory. *Learning and Memory* 24:162-168.
33. Norton, E.H., Fleming, S.M., **Daw, N.D.**, and Landy, M.S. (2017) Suboptimal criterion learning in static and dynamic environments. *PLoS Computational Biology*: 13:e1005304.
34. Fleming, S., and **Daw, N.D.** (2017) Self-evaluation of decision-making: A general Bayesian framework for metacognitive computation. *Psychological Review* 124:91-114.
35. Campbell-Meikeljohn, D., Simonsen, A., Frith, C., and **Daw, N.D.** (2017) Independent neural computation of value from other people's confidence. *Journal of Neuroscience* 37:673-684.
36. Culbreth, A.J., Westbrook, A., **Daw, N.D.**, Botvinick., N.D., and Barch, D.M (2016) Reduced model-based decision making in schizophrenia. *Journal of Abnormal Psychology* 125:777-87.
37. Atlas, L.Y., Doll, B.B., Li, J., **Daw, N.D.**, and Phelps, E.A. (2016) Instructed knowledge shapes feedback-driven aversive learning in striatum and orbitofrontal cortex, but not the amygdala. *eLife* 5. pii: e15192.
38. Parker, N.F, Cameron, C.M., Taliaferro, J.P., Lee, J., Choi, J.Y., Davidson, T.J., **Daw, N.D.**, and Witten, I.B. (2016) Reward and choice encoding in terminals of midbrain dopamine neurons depends on striatal target. *Nature Neuroscience* 19:845-54.
39. Reinen, J.M., Van Snellenberg, J.X., Horga, G., Abi-Dargham, A., **Daw, N.D.***, and Shohamy, D.S.* (2016)

Motivational context modulates prediction error response in schizophrenia. *Schizophrenia* 42:1467-1475.

40. Decker, J.H., Otto, A.R., **Daw, N.D.**, and Hartley, C.A. (2016) From creatures of habit to goal-directed learners: Tracking the developmental emergence of model-based reinforcement learning. *Psychological Science* 27:848-58.
41. Gillan, C.M., Kosinski, R.W., Phelps, E.A., and **Daw, N.D.** (2016) Characterizing a psychological dimension related to deficits in goal-directed control. *eLife* 5 pii: e11305.
42. Doll, B.B., Bath, K.G., **Daw, N.D.***, and Frank, M.J.* (2016) Variability in dopamine genes dissociates model-based and model-free reinforcement learning. *Journal of Neuroscience* 36:1211-22.
43. Wong, Y.T., Fabiszak, M.M., Novikov, Y., **Daw, N.D.**, and Pesaran, B. (2016) Coherent neural ensembles are rapidly recruited when making a look-reach decision. *Nature Neuroscience* 19:327-34.
44. Morris, L.S., Kundu, P., Dowell, N., Mechelmans, D.J., Favre, P., Irvine, M.A., Robbins, T.W., **Daw, N.D.**, Bullmore, E.T., Harrison, N.A., and Voon, V. (2015) Fronto-striatal organization: Defining functional and microstructural /substrates of behavioral flexibility. *Cortex* 74:118-133.
45. Boureau, Y.-L., Sokol-Hessner, P., and **Daw, N.D.** (2015) Deciding how to decide: self-control and meta-decision making. *Trends in Cognitive Sciences* 19:700-710.
46. Dunsmoor, J.E., Niv, Y., **Daw, N.D.**, and Phelps, E.A. (2015) Rethinking extinction. *Neuron* 88:47-63.
47. Sharp, M.E., Foerde, K., **Daw, N.D.**, and Shohamy, D. (2016) Dopamine selectively remediates model-based reward learning: a computational approach. *Brain* 139:355-64.
48. Voon, V., Back, K., Enander, J., Worbe, Y., Morris, L.S., Harrison, N.A., Robbins, T.W., Ruck, C., and **Daw, N.D.** (2015) Motivation and value influences in the relative balance of goal-directed and habitual behaviours in obsessive-compulsive disorder. *Translational Psychiatry* 5:e670.
49. Zhang, H., **Daw, N.D.**, and Maloney, L.T. (2015) Human representation of visuo-motor uncertainty as mixtures of orthogonal basis distributions. *Nature Neuroscience* 18: 1152-1158.
50. Constantino, S., and **Daw, N.D.** (2015) Learning the opportunity cost of time in a patch foraging task. *Cognitive, Affective and Behavioral Neuroscience* 15:837-53.
51. Worbe, Y., Savulich, G., **Daw, N.D.**, Emilio, F.-E., Robbins, T.W., Voon, V., and Palminteri, S. (2015) Valence-dependent influence of serotonin depletion on model-based choice strategy. *Molecular Psychiatry* 21:624-9
52. Gillan, C.M., Otto, A.R., Phelps, E.A., and **Daw, N.D.** (2015) Model-based learning protects against forming habits. *Cognitive, Affective and Behavioral Neuroscience* 15: 523-536.
53. Doll, B.B., Duncan, K.D., Simon, D.A., Shohamy, D.S., and **Daw, N.D.**, (2015) Model-based choices involve prospective neural activity. *Nature Neuroscience* 18:767-72.
54. Huys, Q.J., **Daw, N.D.**, and Dayan, P. (2015) Depression: A decision theoretic analysis. *Annual Reviews of Neuroscience* 8:1-23.
55. Roy, M., Shohamy, D., **Daw, N.D.**, Jepma, M., Wimmer, G.E., and Wager, T.D., (2014) Representation of aversive prediction errors in the human periaqueductal gray. *Nature Neuroscience* 17:1607-12.
56. Wimmer, G.E, Braun, E.K., **Daw, N.D.**, and Shohamy, D. (2014) Episodic memory encoding interferes with reward learning and decreases striatal prediction errors. *Journal of Neuroscience* 34:14901-12.
57. Otto, A.R., Skatova, A., Madlon-Kay, S., and **Daw, N.D.** (2014) Cognitive Control Predicts Use of Model-Based Reinforcement-Learning. *Journal of Cognitive Neuroscience* 27, 319–333.
58. **Daw, N.D.** and Dayan, P. (2014) The algorithmic anatomy of model-based evaluation. *Philosophical Transactions of the Royal Society B* 369: 20130478.
59. Voon, V., Derbyshire, K., Ruck, C., Irvine, M., Worbe, Y., Enander, J., Schrieber, L., Gillan, C., Fineberg, N., Sahakian, B., Robbins, T., Harrison, N., Wood, J., **Daw, N.D.**, Dayan, P., Grant, J., and Bullmore, E., (2015) Disorders of compulsivity: a common bias towards learning habits. *Molecular Psychiatry* 20:345-352.
60. Doll, B, Shohamy, D., and **Daw, N.D.**, (2014) Multiple memory systems as substrates for multiple decision systems. *Neurobiology of Learning and Memory* 117:4-13.

61. Otto, A.R., Raio, C.M., Chiang, A., Phelps, E.A., and **Daw, N.D.**, (2013) Working-memory capacity protects model-based learning from stress. *Proceedings of the National Academy of Sciences* 110:20941-6.
62. Bornstein, A.M., and **Daw, N.D.**, (2013) Cortical and hippocampal correlates of deliberation during model-based decisions for rewards in humans. *PLoS Computational Biology* 9:e1003387.
63. Fleming, S., Maloney, L., and **Daw, N.D.**, (2013) The irrationality of categorical perception. *Journal of Neuroscience* 33:19060-70.
64. Den Ouden, H., **Daw, N.D.**, Fernandez, G., Elshout, J., Rijpkema, M., Hoogman, M., Franke, B., and Cools, R., (2013) Dissociable effects of dopamine and serotonin on reversal learning. *Neuron* 80:1090-100.
65. Skatova, A, Chan, P.A., and **Daw, N.D.** (2013) Extraversion differentiates between model-based and model-free strategies in a reinforcement learning task. *Frontiers in Human Neuroscience* 7:525.
66. Rigotti, M., Barak, O., Warden, M.R., Wang, X., **Daw, N.D.**, Miller, E.K., and Fusi, S. (2013) The importance of mixed selectivity in complex cognitive tasks. *Nature*: 497:585-90.
67. Zhang, H., **Daw, N.D.**, and Maloney, L.T. (2013) Testing whether humans have an accurate model of their own motor uncertainty in a speeded reaching task. *PLoS Computational Biology* 9: e1003080.
68. Otto, A.R., Gershman, S.J., Markman, A.M, and **Daw, N.D.** (2013) The curse of planning: Dissecting multiple reinforcement learning systems by taxing the central executive. *Psychological Science* 24:751-761.
69. Madlon-Kay, S., Pesaran, B., and **Daw, N.D.** (2013) Action selection in multi-effector decision making. *Neuroimage* 70:66-79.
70. Landy, M., Trommershauser, J., and **Daw, N.D.** (2012) Dynamic estimation of task-relevant variance in movement under risk. *Journal of Neuroscience* 32:12702-11.
71. Kovach, C.K.*, **Daw N.D.***, Rudrauf, D., Tranel, D., O'Doherty, J.P., and Adolphs, R. (2012) Anterior prefrontal cortex contributes to action selection through tracking of recent reward trends. *Journal of Neuroscience* 32: 8434-42.
72. Seymour, B., **Daw, N.D.**, Roiser, J., Dayan, P. and Dolan, R.J. (2012) Serotonin selectively modulates reward value in human decision making. *Journal of Neuroscience* 32:5833-42.
73. Wimmer, G.E., **Daw, N.D.***, and Shohamy, D.* (2012) Generalization of value in reinforcement learning by humans. *European Journal of Neuroscience* 35:1092-1104.
74. Bornstein, A.M., and **Daw, N.D.** (2012) Dissociating hippocampal and striatal contributions to sequential prediction learning. *European Journal of Neuroscience* 35: 1011-1023.
75. Roesch, M., Esber, G., Li, J., **Daw, N.D.**, and Schoenbaum, G. (2012) Surprise! Neural correlates of Pearce-Hall and Rescorla-Wagner coexist within the brain. *European Journal of Neuroscience* 35: 1190-1200.
76. Gustafson, N., and **Daw, N.D.** (2011) Grid cells, place cells, and geodesic generalization for spatial reinforcement learning. *PLoS Computational Biology* 7:e1002235.
77. Li, J. Schiller, D., Schoenbaum, G., Phelps, E.A. and **Daw, N.D.** (2011) Differential roles of human striatum and amygdala in associative learning. *Nature Neuroscience* 14:1250-1252.
78. Li, J., and **Daw, N.D.** (2011) Signals in human striatum are appropriate for policy update rather than value prediction. *Journal of Neuroscience* 31:5504-5511.
79. Simon, D.A., and **Daw, N.D.** (2011) Neural correlates of forward planning in a spatial decision task in humans. *Journal of Neuroscience* 31:5526-5539.
80. **Daw, N.D.**, Gershman, S.J., Seymour, B., Dayan, P., and Dolan, R.J. (2011) Model-based influences on humans' choices and striatal prediction errors. *Neuron* 69:1204-1215.
81. Cools, R., Nakamura, K., and **Daw, N.D.** (2011) Serotonin and dopamine: Unifying affective, activational, and decision functions, *Neuropsychopharmacology* 36:98-113.
82. Beeler, J.A., **Daw, N.D.**, Frazier, C,R,M, and Zhuang, X. (2010), Tonic dopamine modulates exploitation of reward learning *Frontiers in Behavioral Neuroscience* 4:170.
83. Gläscher, J., **Daw, N.D.**, Dayan, P., and O'Doherty, J.P. (2010), States versus rewards: Dissociable neural prediction error signals underlying model-based and model-free reinforcement learning, *Neuron* 66:585-595.

84. Schönberg, T., O'Doherty, J.P., Joel, D., Inzelberg, R., Segev, Y., and **Daw, N.D.** (2010) Selective impairment of prediction error signaling in human dorsolateral but not ventral striatum in Parkinson's disease patients: evidence from a model-based fMRI study, *Neuroimage* 49:772-81.
85. Gershman, S.J., Pesaran, B., and **Daw, N.D.** (2009) Human reinforcement learning subdivides structured action spaces by learning effector-specific values, *Journal of Neuroscience* 29:13524-13531.
86. Bodi, N., Keri, S., Nagi, H., Moustafa, A., Myers, C., **Daw, N.D.**, Dibo, G., Takats, A., Bereczi, D., and Gluck, M.A. (2009) Reward learning and the novelty seeking personality: A between and within-subjects study of the effects of dopamine agonists on young Parkinson's patients, *Brain* 132: 2385-2395.
87. Den Ouden H.E.M., Friston K.J., **Daw, N.D.**, McIntosh, A.R., and Stephan, K.E. (2009) A dual role for prediction error in associative learning, *Cerebral Cortex* 19:1175-1185.
88. Dayan, P., and **Daw, N.D.** (2008) Decision theory, reinforcement learning, and the brain, *Cognitive, Affective, and Behavioral Neuroscience* 8:429-453.
89. **Daw, N.D.**^{1*} and Shohamy, D.* (2008) The cognitive neuroscience of motivation and learning, *Social Cognition* 26: 593-620.
90. Wittmann, B.*, **Daw, N.D.***, Seymour, B., and Dolan, R. (2008) Striatal activity underlies novelty-based choice in humans, *Neuron* 58: 967-973.
91. Schönberg, T., **Daw, N.D.**, Joel, D., and O'Doherty, J.P. (2007) Reinforcement learning signals in the human striatum distinguish learners from non-learners during reward-based decision making, *Journal of Neuroscience* 27:12860-12867.
92. Seymour, B., **Daw, N.D.**, Dayan, P., Singer, T., and Dolan, R. (2007) Differential encoding of losses and gains in the human striatum, *Journal of Neuroscience* 27:4826-4831.
93. Niv, Y., **Daw, N.D.**, and Dayan, P. (2007) Tonic dopamine: Opportunity costs and the control of response vigor, *Psychopharmacology* 191:507-520.
94. Dayan, P., Niv, Y., Seymour, B., and **Daw, N.D.** (2006) The misbehavior of value and the discipline of the will, *Neural Networks* 19:1153-1160.
95. **Daw, N.D.***, O'Doherty, J.P.*, Dayan, P., Seymour, B., and Dolan, R.J. (2006) Cortical substrates for exploratory decisions in humans, *Nature* 441:876-879.
96. Courville, A.C.*, **Daw, N.D.***, and Touretzky, D.S. (2006) Bayesian theories of conditioning in a changing world, *Trends in Cognitive Sciences*: 10:294-300.
97. **Daw, N.D.**, Courville, A.C., and Touretzky, D. (2006) Representation and timing in theories of the dopamine system, *Neural Computation* 18:1637-1677.
98. **Daw, N.D.**, Niv, Y., and Dayan, P. (2005) Uncertainty-based arbitration between prefrontal and dorsolateral striatal systems for behavioral control. *Nature Neuroscience* 8:1704-1711.
99. McClure, S.M., **Daw, N.D.**, and Montague, P.R. (2003) A computational substrate for incentive salience, *Trends in Neurosciences* 26:423-428.
100. **Daw, N.D.**, and Touretzky, D.S. (2002) Long-term reward prediction in TD models of the dopamine system, *Neural Computation* 14:2567-2583.
101. **Daw, N.D.**, Kakade, S., and Dayan, P. (2002) Opponent interactions between serotonin and dopamine, *Neural Networks* 15:603-616.
102. Cardinal, R., **Daw, N.D.**, Robbins, T.W., and Everitt, B.J. (2002) Local analysis of behavior in the adjusting delay task for assessing choice of delayed reinforcement, *Neural Networks* 15:617-634.

Conference proceedings (full length articles, competitively peer-reviewed):

1. Geana, A., Wilson, R., **Daw, N.D.**, and Cohen, J. (2016) Boredom, information-seeking and exploration. *Proceedings of the 38th Annual Conference of the Cognitive Science Society*: 1751-1756.

* These authors contributed equally to these articles and ordering was determined arbitrarily.

2. Geana, A., Wilson, R., **Daw, N.D.**, and Cohen, J. (2016) Information-seeking, learning and the marginal value theorem: A normative approach to adaptive exploration. *Proceedings of the 38th Annual Conference of the Cognitive Science Society*: 1793-1798.
3. Simon, D.A., and **Daw, N.D.** (2011) Environmental statistics and the trade-off between model-based and TD learning in humans *Advances in Neural Information Processing Systems* 24.
4. **Daw, N.D.**, and Courville, A.C. (2007) The pigeon as particle filter, *Advances in Neural Information Processing Systems* 20.
5. Niv, Y., **Daw, N.D.**, and Dayan, P. (2005) How fast to work: Response vigor, motivation and tonic dopamine, *Advances in Neural Information Processing Systems* 18.
6. Courville, A.C., **Daw, N.D.**, and Touretzky, D.S. (2004), Similarity and discrimination in classical conditioning: A latent variable account, *Advances in Neural Information Processing Systems* 17:313-320.
7. Courville, A.C., **Daw, N.D.**, Gordon, G.J., and Touretzky, D.S. (2003) Model uncertainty in classical conditioning, *Advances in Neural Information Processing Systems* 16:977-984.
8. **Daw, N.D.**, Courville, A.C., and Touretzky, D.S. (2003) Timing and partial observability in the dopamine system, *Advances in Neural Information Processing Systems* 15:99-106.
9. **Daw, N.D.**, Courville, A.C., and Touretzky, D.S. (2002) Dopamine and inference about timing, *Proceedings of the Second International Conference on Development and Learning*, pp. 271-276, IEEE Computer Society.
10. Touretzky, D.S., **Daw, N.D.**, and Tira-Thompson, E.J. (2002) Combining configural and TD learning on a robot, *Proceedings of the Second International Conference on Development and Learning*, pp. 47-52, IEEE Computer Society.
11. **Daw, N.D.**, and Touretzky, D.S. (2001) Operant behavior suggests attentional gating of dopamine system inputs, *Neurocomputing* 38-40:1161-1167.
12. **Daw, N.D.**, and Touretzky, D.S. (2000) Behavioral results suggest an average reward TD model of the dopamine system, *Neurocomputing* 32:679-684.

Commentaries, invited reviews, and book chapters:

1. Langdon, A.J. and **Daw, N.D.** (2020) Beyond the average view of dopamine. *Trends in Cognitive Sciences* 24:499-501.
2. **Daw, N.D.** (2018) Are we of two minds? *Nature Neuroscience* 21(11):1497-1499.
3. Cohen, J.D., **Daw, N.D.**, Engelhardt, B., Hasson, U., Li, K., Niv, Y., Norman, K.A., Pillow, J., Ramadge, P.J., Turk-Browne, N.B., Wilke, T.L. (2017) Computational approaches to fMRI analysis. *Nature Neuroscience* 20:304-313.
4. Gershman, S.J., and **Daw, N.D.** (2017) Reinforcement learning and episodic memory in humans and animals: an integrative framework. *Annual Review of Psychology* 68:101-128.
5. Gillan, C.M., and **Daw, N.D.**, (2016) Taking psychiatry research online. *Neuron* 91:19-23.
6. **Daw, N.D.** (2016) Reinforcement learning in Arbib, M., and Bonaiuto, J., ed., *From Neuron to Cognition via Computational Neuroscience*, MIT press.
7. Doll, B.B., and **Daw, N.D.** (2016) The expanding role of dopamine. *eLife* pii: e15963.
8. **Daw, N.D.** (2015) Of goals and habits. *Proceedings of the National Academy of Sciences* 112:13749-50.
9. Shohamy, D., and **Daw, N.D.** (2015) Integrating memories to guide decisions. *Current Opinion in Behavioral Sciences* 5:85-90.
10. Shohamy, D., and **Daw, N.D.** (2014) Habits and reinforcement learning, in Gazzaniga, M., ed., *The Cognitive Neurosciences* 5th ed.
11. **Daw, N.D.** and Tobler, P (2013) Value learning through reinforcement: The basics of dopamine and reinforcement learning, in Glimcher, P. and Fehr, E., eds., *Neuroeconomics: Decision making and the brain*, 2nd edition, Elsevier.
12. **Daw, N.D.**, (2013) Advanced reinforcement learning, in Glimcher, P., and Fehr, E., eds., *Neuroeconomics: Decision making and the brain*, 2nd edition, Elsevier.

13. **Daw, N.D.**, and O'Doherty, J.P. (2013) Multiple systems for value learning in Glimcher, P. and Fehr, E., eds., *Neuroeconomics: Decision making and the brain*, 2nd edition, Elsevier.
14. Doll, B.B, Simon, D.A., and **Daw, N.D.** (2012) The ubiquity of model-based reinforcement learning, *Current Opinion in Neurobiology*, 22:1075-81.
15. **Daw, N.D.** (2012) Model-based reinforcement learning as cognitive search: neurocomputational theories, in: Todd, P.M., and Robbins, T.R., eds., *Cognitive Search: Evolution, Algorithms and the Brain*, MIT Press.
16. Gershman, S., and **Daw, N.D.** (2012) Perception, action and utility: the tangled skein, in: Rabinovich, M., Friston, K., and Varona, P., (eds.) *Principles of Brain Dynamics*, MIT Press.
17. Simon, D.A. and **Daw, N.D.** (2011) Dual-system learning models and drugs of abuse in: Ahmed, S., and Gutkin, B., eds. *Computational Neuroscience of Addiction*, Springer-Verlag.
18. Bornstein, A., and **Daw, N.D.** (2011) Multiplicity of control in the basal ganglia: Computational roles of striatal subregions, *Current Opinion in Neurobiology* 21:374-80.
19. **Daw, N.D.** (2011) Trial-by-trial data analysis using computational models, in: Delgado M., Phelps E.A., and Robbins T.W. (eds.) *Decision Making, Affect, and Learning, Attention and Performance XXIII*, Oxford University Press.
20. Constantino, S.M., and **Daw, N.D.**, (2010) A closer look at choice, *Nature Neuroscience* 13:1153-1154.
21. **Daw, N.D.**, and Frank, M.J. (2009) Reinforcement learning and higher level cognition: Introduction to the special issue, *Cognition* 113:259-6.
22. Becker, S., and **Daw, N.D.** (2009) Computational cognitive neuroscience: Preface to the special issue, *Brain Research* 1299:1-2.
23. Dayan, P., **Daw, N.D.**, and Y Niv. (2009) Theoretical and computational neuroscience: Learning, action, inference and neuromodulation, chapter in L. Squire, ed., *Encyclopedia of Neuroscience*, Amsterdam: Elsevier.
24. Balleine, B.W., **Daw, N.D.**, and O'Doherty, J.P. (2008) Multiple forms of value learning and the function of dopamine, chapter in Glimcher, P.W. et al., eds., *Neuroeconomics*, Amsterdam: Elsevier.
25. **Daw, N.D.**, Courville, A.C., and Dayan, P. (2008) Semi-rational models of conditioning: The case of trial order, chapter in N. Chater & M. Oaksford, eds., *The Probabilistic Mind: Prospects for Rational Models of Cognition*, Oxford: Oxford University Press.
26. **Daw, N.D.**, (2007) Dopamine: at the intersection of reward and action *Nature Neuroscience* 10: 1505-1507.
27. **Daw, N.D.**, and Doya, K. (2006) The computational neurobiology of learning and reward, *Current Opinion in Neurobiology* 16:199-204.
28. **Daw, N.D.**, Niv, Y., and Dayan, P. (2006) Actions, values, policies and the basal ganglia, chapter in E. Bezdard, ed., *Recent Breakthroughs in Basal Ganglia Research*, New York: Nova Science Publishers, pp. 111-130.
29. Niv, Y., **Daw, N.D.**, and Dayan, P. (2006) Choice values, *Nature Neuroscience* 9:987-988.
30. **Daw, N.D.**, and Dayan, P. (2004) Matchmaking, *Science* 304:1753-1754.

Talks and seminars:

Invited:

- Invited symposium, BRAIN initiative investigators meeting (1 June 2020)
- Virtual Dopamine Conference, online (22 May 2020)
- Psychology Colloquium, University of Wisconsin, Madison (20 Feb 2020)
- Neurobiology colloquium, Northwestern University (21 Jan 2020)
- Pioneers in Biomedical Research Seminar, Virginia Tech (23 Nov 2019)
- Neural Theories of Cognition meeting, Aspen (9 Oct 2019)
- Center for the Neural Basis of Cognition colloquium, Pittsburgh (3 Oct 2019)
- Keynote address, Conference on Cognitive Computational Neuroscience, Berlin (16 Sept 2019)
- Donders Center for Cognition Lecture, Nijmegen, Netherlands (25 June 2019)
- Psychology Department Colloquium, Hebrew University, Jerusalem (20 June 2019)
- Faculty of Industrial Engineering and Management seminar, Technion, Haifa (2 June 2019)

- EMBO EMBL Symposium: Probing Neural Dynamics with Behavioural Genetics, Heidelberg (12 Apr 2019)
- Minisymposium on decision making, Tel Aviv University (31 Mar 2019)
- Keynote address, Expert Meeting on Fear, Pain, and Avoidance, Leuven Belgium (28 Mar 2019)
- Keynote address, Israeli Society for Biological Psychiatry (13 Mar 2019)
- Workshop on “beyond trial-based choice,” COSYNE 2019 Workshops, Portugal (5 Mar 2019)
- Workshop on “dopamine updated,” COSYNE 2019 Workshops, Portugal (4 Mar 2019)
- Brain research center colloquium, Bar Ilan University, Israel (25 Feb 2019)
- Neurobiology seminar, Weizmann institute, Rehovot Israel (12 Feb 2019)
- ELSC seminar, Hebrew University, Jerusalem (15 Jan 2019)
- Radcliffe Institute Seminar, Harvard (10 Jan 2019)
- Cognitive Psychology, Brain and Cognition Colloquium, Tel Aviv University (17 Dec 2018)
- School of Psychology, Trinity College Dublin (29 Nov 2018)
- Invited presentation, Symposium on “From intelligent animals to intelligent machines,” Institute of Neuroscience, Universite Catholique de Louvain, Belgium (16 Nov 2018)
- Keynote, Flexible Learning Under Stress, Hamburg (21 Sep 2018)
- Keynote, Australian Learning Group, Katoomba, New South Wales (11 July 2018)
- Featured talk, UCI addiction symposium, Irvine (12 June 2018)
- Social and Affective Neuroscience Society meeting, New York (5 May 2018)
- Computational Neuroscience of Prediction, FENS Spring Brain Conference, Copenhagen (18 Apr 2018)
- Keynote presentation, Neuroeconomics talks, Maastricht University (13 Apr 2018)
- Center for Cognitive Science Colloquia, Rutgers University (10 Apr 2018)
- Keynote presentation, Computational models of decision making across scales symposium, Institute for Advanced Studies, Paris (2 Feb 2018)
- Computational neuroscience seminar, University of Chicago (2 Nov 2017)
- Neuroscience seminar, University of Manchester (20 Oct 2017)
- 44th Naito Conference, Sapporo Japan (5 Oct 2017)
- Computational Neuroscience Initiative, University of Pennsylvania (8 May 2017)
- Inaugural symposium, Rutgers-Princeton Center for Computational Neuro-Psychiatry (5 May 2017)
- Clinical, Cognitive and Computational Neuroscience seminar, Columbia University School of Medicine (3 May 2017)
- Templeton meeting on Survival Circuits, NYU (26 Apr, 2017)
- Conference on New Insights into Affective and Behavioral Regulatory Processes, Rutgers (15 Apr 2017)
- Cognitive Science Colloquium, Indiana University (23 Jan 2017)
- Neural basis of decision making, UNSW, Sydney (13 Dec 2016)
- Computational Psychiatry Symposium, Donders Institute, Nijmegen (30 Nov 2016)
- Control Processes Conference, San Diego (10 Nov 2016)
- Center for Perceptual Systems seminar, University of Texas, Austin (3 Oct 2016)
- Neuroeconomics seminar series, University of Zurich, Department of Economics (1 Sep 2016)
- Workshop on attention, value and decision making, Marburg, Germany (20 July 2016)
- Frontiers in memory research, Florence (28 June 2016)
- Invitational Choice Symposium, Alberta (15 May 2016)
- Addiction in Theory workshop, University College London (10 May 2016)
- Data Science seminar series, Rutgers University (6 May 2016)
- 38th International Symposium of the GNSRC: Neuroscience of Decision Making, University of Montreal (2 May 2016)
- Current Works in Behavior, Genetics, and Neuroscience series, Yale University (22 Apr 2016)
- Center for Brain Science, Harvard University (12 Apr 2016)
- Center for Cognitive Computational Neuropsychiatry, Rutgers University (3 Feb 2016)
- Multidisciplinary Brain Research Center, Bar Ilan University, Israel (4 Jan 2016)
- International Symposium on Prediction and Decision Making, Tokyo (1 Nov 2015)
- Group for Neural Theory, ENS, Paris (6 Oct 2015)
- Advances in Memory Systems symposium, NYU (29 May 2015)
- Association for Psychological Science convention, New York (22 May 2015)
- Workshop on Perception and Choice, Columbia University (8 May 2015)
- Behavioral and Cognitive Neuroscience Colloquium, CUNY (27 Mar 2015)

- Okinawa Institute of Science and Technology, Japan (19 Mar 2015)
- Workshop on hippocampus and decisions, COSYNE, Snowbird (10 Mar 2015)
- Department of Psychology, Princeton (10 Feb 2015)
- Grand Rounds, Department of Psychiatry, Columbia University (28 Jan 2015)
- Brain Meeting, Wellcome Trust Centre for Neuroimaging, UCL (5 Dec 2014)
- Swiss Computational Neuroscience Seminar, Bern (30 Oct 2014)
- Center for the Neural Basis of Cognition 20th Anniversary Celebration (18 Oct 2014)
- International Workshop on Neuroeconomics: Recent Advances and Future Directions, Erice (June 20, 2014)
- Fourth Symposium on the Biology of Decision Making, Paris (May 26, 2014)
- Cognitive Science 2.0: Implications for Intelligence Analysis, intelligence agencies briefing, Maryland (May 9 2014)
- Psychology Department seminar series, Hunter College (2 Apr 2014)
- Workshop on Computational Psychiatry, COSYNE, Snowbird (3 Mar 2014)
- Winter Conference on Neural Plasticity, Vieques (24 Feb 2014)
- Cognitive Brown Bag, Princeton University (19 Feb 2014)
- Functional MRI speaker series, University of Michigan (11 Feb 2014)
- Implications of Bayesian Cognitive Modeling for the Intelligence Community (13 Dec 2013)
- Interfacing Models with Brain Signals to Investigate Cognition, Irvine (7 Nov 2013)
- Learning to Attend, Attending to Learn, San Diego (6 Nov 2013)
- First Conference on Reinforcement Learning and Decision Making, Princeton (26 Oct 2013)
- First Conference on Computational Psychiatry, Miami (22 Oct 2013)
- Department of Neurobiology and Behavior, SUNY Stony Brook, (19 Sep 2013)
- Society for Mathematical Psychology, Potsdam (6 Aug 2013)
- Emotion Club, UCL (6 June 2013)
- Seminar on Parallel Distributed Processing, Princeton University (31 May 2013)
- Theoretical Neuroscience Seminar, Columbia University (10 May 2013)
- Neuroscience Seminar, Cold Spring Harbor Laboratory (6 May 2013)
- Kavli Futures Symposium on Neuroeconomics and Urban Big Data, New Paltz, NY (22 April 2013)
- Conference on Theoretical Organizational Models, New York (19 April 2013)
- Swartz Symposium on Neural Circuits for Decision Making and Reinforcement Learning, Yale (12 April 2013)
- Princeton Neuroscience Institute Seminar, Princeton (11 April 2013)
- Advances in Memory Systems Symposium, NYU (4 April 2013)
- Tamagawa/Caltech meeting on Reward and Decision Making, Hawaii (8 March 2013)
- International Conference on Applications of Neuroimaging to Alcoholism, Yale (18 Feb 2013)
- Department of Neurobiology symposium, Weizmann Institute of Science, Rehovot, Israel (4 Dec 2012)
- Department of Neurobiology symposium, University of Haifa, Israel (19 Nov 2012)
- Symposium on model-based decision making, Comprehensive Brain Science Network meeting, Sendai, Japan (27 July, 2012)
- Society for Philosophy and Psychology, Annual Meeting, Boulder CO (22 June, 2012)
- Sixteenth International Conference on Cognitive and Neural Systems, Boston (1 June, 2012)
- Affective Brain Lab Online Talk Series, University College London (29 May, 2012)
- Science Meeting, Sackler Institute for Developmental Psychobiology, New York (10 May, 2012)
- Meeting on Canonical Neural Computation, Florence (May 3, 2012)
- Center for Molecular and Behavioral Neuroscience Colloquium, Rutgers Newark (11 April, 2012)
- Department of Neuroscience seminar series, Johns Hopkins University School of Medicine (Apr 5, 2012)
- Neural and Behavioral Science Seminar Series, SUNY Downstate, New York (Oct 19, 2011)
- Army Research Office Workshop on Augmenting Human Choice, Evanston (Sep 29, 2011)
- John B. Pierce Laboratory, Yale (Sep 19, 2011)
- Workshop on the Psychophysiology and Neuroscience of Experience-Based Decisions, Technion, Haifa (Jun 16, 2011)
- Cognitive Systems Area/Imaging Center talk series, University of Texas, Austin (Apr 22, 2011)
- IRCS/Computational Neuroscience Seminar, University of Pennsylvania (Nov 5, 2010)
- Neuroeconomics Seminar Series, Duke (Oct 21, 2010)
- Symposium on Machine Learning and the Brain, APA Annual Convention, San Diego (Aug 12, 2010)
- Cognitive Neuroscience Seminar, Taub and Sergievsky Institutes, Columbia University, NY (June 24, 2010)

- Emotion Club, Wellcome Trust Centre for Neuroimaging, UCL (May 27, 2010)
- Gatsby Computational Neuroscience Unit, UCL (May 25, 2010)
- Symposium on “Dopamine and Adaptive Memory,” Cognitive Neuroscience Society Meeting, Montreal (Apr 20, 2010)
- 5th Barbados Workshop on Reinforcement Learning, Bellairs Institute (Apr 7, 2010)
- COSYNE workshop on “Decision Making: Beyond the Basics,” Salt Lake City (March 2, 2010)
- COSYNE workshop on “Is Optimality Reaching a Dead End,” Salt Lake City (March 1, 2010)
- Batsheva Seminar on Reward and Decision Making in the Brain, Jerusalem (Feb 16, 2010)
- Workshop on “Goal-directed decision-making”, Princeton (Oct 24, 2009)
- Donders Centre for Neuroimaging, Nijmegen (Aug 28, 2009).
- Institute for Empirical Research in Economics, University of Zurich (Aug 25, 2009).
- Gordon Research Conference on Catecholamines (Aug. 11 2009).
- Janelia Farm (July 30 2009).
- IARPA workshop on “Integrated Cognitive Architectures for Understanding Sensemaking,” DC (July 22 2009).
- Medical Department, Brookhaven National Laboratory (July 16 2009).
- First Symposium on “The Biology of Decision Making,” Bordeaux (June 10 2009).
- Workshop on “Future of cognitive science,” UC Merced (May 29 2009).
- Computational Neuroscience Research Seminar Series, University of Chicago (May 5 2009)
- BCS colloquium, MIT (3 April 2009).
- Psychology department colloquium, Rutgers University (27 March 2009)
- Science Focus Day, NYU (23 March 2009)
- CELEST Science of Learning Seminar, Boston University (21 Nov, 2008).
- Workshop on “Open problems in the neuroscience of decision making,” Okinawa, Japan (Oct 2008).
- Conference on Addiction Research, Kunming, China (Oct 2008).
- MURI workshop on “Statistical learning and transfer of learning,” Washington DC (Oct 2008).
- International Symposium on Attention & Performance, Vermont (14 July 2008).
- Club Neuron, New York Medical College (25 June 2008).
- Neuroscience of Social Decision Making series, Princeton University (21 May 2008).
- National Academy study panel on “Opportunities in neuroscience for future Army applications” (12 Feb 2008).
- Cognitive lunch, Columbia University (4 Feb 2008).
- Workshop on Neural Mechanisms of the Social Mind, Machida, Tokyo (8 Dec 2007).
- Theoretical Neuroscience Seminar Series, Columbia University (9 Nov 2007).
- Mathematical Biology Seminar Series, New Jersey Institute of Technology (23 Oct 2007).
- Champalimaud workshop on serotonin, Lisbon (6 Oct 2007).
- Neurofinance Symposium, Swiss Banking Institute, University of Zurich (7 July 2007).
- Association for Psychological Science, annual convention, Washington, DC (25 May 2007).
- Swartz Theoretical Neurobiology series, Yale University (18 May 2007).
- Brain, Mind and Society series, California Institute of Technology (8 March 2007).
- Symposium on “Is reinforcement learning coming of cognitive age?” Psychonomic Society, Houston, TX (16 Nov 2006).
- Symposium on “Basal ganglia, dopamine and learning,” meeting of the Pavlovian Society, Philadelphia PA (16 Sept 2006).
- Workshop on “The probabilistic mind: prospects for rational models of cognition,” London, UK (28 June 2006).
- Symposium on statistical learning and brain plasticity, Center for Visual Science, University of Rochester (2 June, 2006).
- Workshop on associative learning and reinforcement learning, Society for the Study of Artificial Intelligence and the Simulation of Behaviour meeting, Bristol, UK (3 April 2006).
- Neuroeconomics workshop series, Stanford University, Palo Alto, CA (3 March 2006).
- School of Computing and Technology, University of Sunderland, Sunderland, UK (6 Feb. 2006).
- London Judgement and Decision Making group (24 Jan. 2006).
- Workshop on models of behavioral learning, NIPS meeting, Whistler, BC (10 Dec. 2005).
- Neuroeconomics seminar series, NYU, New York (8 Nov. 2005).
- Brain Meeting, UCL/Wellcome Dept. of Imaging Neuroscience, London, UK (22 July 2005).
- Workshop on Basal Ganglia, Dopamine and Learning, Jerusalem, Israel (27 June 2005).
- Annual meeting, Society for Neuroeconomics, Kiawah Island, SC (17 Sept. 2004).

- Centre for Cognitive Neuroscience and Cognitive Systems, University of Kent, Canterbury UK (15 July 2004).
- Workshop on Dopamine and Memory: Integrating Computational and Empirical Approaches, Newark, NJ (March 2003).

Contributed:

- CRCNS PI meeting (13 June 2018)
- Memory Disorders Research Society, Princeton (1 Oct 2016)
- Pavlovian Society, Jersey City (30 Sep 2016)
- Panel on hippocampus and model-based processing, Eastern Psychological Association, New York (2 Mar 2013)
- Symposium on Using models and fMRI, Cognitive Science Society (23 July 2011)
- Minisymposium on Model based neuroimaging and decision neuroscience, SFN (17 Nov 2010)
- Advances in Neural Information Processing Systems, Vancouver, spotlight (6 Dec 2007).
- Minisymposium on Serotonin and Decision Making, Society for Neuroscience, San Diego (6 Nov 2007).
- Gatsby Foundation Workshop on motivation and action selection in conditioned behavior, London, UK (20 June 2005).
- Computational and Systems Neuroscience COSYNE, Salt Lake City, Utah (20 Mar. 2005).
- Second International Conference on Development and Learning, Cambridge, MA (June 2002).
- Computational Neuroscience CNS*02 meeting, Chicago, IL, featured contributed talk (July 2002).
- Computational Neuroscience CNS*99 meeting, Pittsburgh, PA, featured contributed talk (July 1999).

Teaching, training & service:

Courses taught (Princeton):

- Neuroeconomics: NEU/PSY 340 (2017, 2020)
- Quantitative methods for psychology: PSY 503 (2016, 2017, 2018)

Courses taught (NYU):

- Math tools for neural science and psychology G80.2207/G89.2211 (2008, 2011, 2013, 2014, 2015)
- Neuroeconomics and decision making (former title: Decision making, neural and behavioral basis) V80.0302/V89.0300 (2007, 2009, 2011, 2014)
- Neuroeconomics G80.3410/G89.3394 (2010, Neurl-GA 3042/Psych-GA 3404: 2012, 2015)
- Cognitive neuroscience V89.0025 (2009)
- Reinforcement learning G80.3042/G89.3406 (2008)

Courses taught (summer schools and other visiting teaching):

- Computational Psychiatry Summer Course, New York (2019)
- Advanced Summer School in Neuroeconomics, Shanghai (2019, 2017, 2015)
- Neurotechnologies for analysis of neural dynamics, Princeton (2018, 2017, 2016)
- Kavli Summer Institute in cognitive neuroscience, UCSB (2017)
- Science education intensive course for rabbinical trainees, Hebrew Union College (2017)
- Third Symposium and Advanced Course on Computational Psychiatry and Ageing Research, Bavaria (2016)
- Computational Psychiatry Course, ETH Zurich (2016)
- Tutorial on brain and behavior, 2nd Multidisciplinary Conference on Reinforcement Learning and Decision Making, Edmonton (2015)
- Workshop on computational models and fMRI, Scientific Research Network on Decision Neuroscience and Aging conference, Miami (2015)
- FENS-Hertie Winter School on the neuroscience of decision making, Obergurgl, Austria (2015)
- MBL Methods in Computational Neuroscience, Woods Hole (2014)
- PhD Program in Neuroscience, Champalimaud Center, Portugal (2012)
- MPS-UCL symposium and advanced course on computational psychiatry and aging research, Ringberg Castle (2012)
- Brains and Minds: The perceptual and computational bases of higher cognitive processes, Central European University (2011)
- Reinforcement learning in humans and other animals, NIPS tutorial, Vancouver (2010)

- Animal learning and decision making minicourse, Weizmann Institute (Summer 2010, with Y. Niv)
- Reinforcement learning, Hebrew University ICNC (Spring 2009, with H. Bergman and Y. Niv)
- EU Advanced Course in Computational Neuroscience, Freiburg, Germany (2008, 2009)
- PhD Program in Neuroscience, Gulbenkian Institute for Science, Portugal (2008, 2009)
- PhD Program in Computational Biology, Gulbenkian Institute for Science, Portugal (2007)
- IPAM summer school: Probabilistic Models of Cognition, UCLA (2007)
- Okinawa Computational Neuroscience Course, Okinawa, Japan (2005, 2007)
- Cognitive Neuroscience Course, Organization for Human Brain Mapping (2006, 2007)
- First Summer School in Neuroeconomics, Stanford (2006).

Predoctoral research trainees / lab managers, completed:

- Yoel Sanchez Araujo (2017-2019)
- Samuel Gershman (2007-8; co-advised with Bijan Pesaran)
- Seth Madlon-Kay (2009-2012)
- Patricia Chan (2012-2013; co-advised with Todd Gureckis)
- Lindsay Hunter (2015-2016)
- Elana Meer (2016-2017)

Predoctoral research trainees / lab managers, ongoing:

- Sean Allen (2019-present)

Doctoral trainees, completed:

- Oliver Vikbladh (NYU CNS, 2013-2019)
- Evan Russek (NYU CNS, 2013-2017)
- Sara Constantino (NYU Cognition & Perception, 2009-2016)
- Dylan Simon (NYU Cognition & Perception, 2007-2012)
- Aaron Bornstein (NYU Cognition & Perception, 2007-2013)
- Nicholas Gustafson (NYU CNS, 2007-2013)

Doctoral trainees, ongoing:

- Lindsay Hunter (Princeton Psychology, 2016-present)
- Laura Bustamente (PNI, 2016-present, co-advised with Jon Cohen)
- Sarah-Jo Venditto (PNI, 2018-present; co-advised with Carlos Brody)
- Rachel Lee (PNI, 2018-present; co-advised with Ilana Witten)
- Sam Zorowitz (PNI, 2018-present; co-advised with Yael Niv)
- Yotam Sagiv (PNI, 2019-present, co-advised with Ilana Witten)
- Carlos Correa (PNI, 2019-present; co-advised with Tom Griffiths)
- Yoel Sanchez Araujo (PNI, 2020-present; co-advised with Jonathan Pillow)

Postdoctoral trainees, completed:

- Jian Li (2007-2012; co-advised with Elizabeth Phelps)
- Daniel Campbell-Meiklejohn (2011-2013)
- Hanneke Den Ouden (2011-2013; co-advised with Roshan Cools)
- Mattia Rigotti (2010-2013; co-advised with Stefano Fusi)
- Stephen Fleming (2011-2015)
- Y-Lan Boureau (2012-2015)
- Ross Otto (2012-2016)
- Peter Sokol-Hessner (2013-2016; co-advised with Elizabeth Phelps)
- Bradley Doll (2011-2016; co-advised with Daphna Shohamy)
- Claire Gillan (2013-2016; co-advised with Elizabeth Phelps)
- Kevin Lloyd (2017-2019; co-advised with Jon Cohen)
- Neil Garrett (2016-2020)
- Marcelo Gomes Mattar (2016-2020)

Postdoctoral trainees, ongoing:

- Payam Piray (2018-present)
- Flora Bouchacourt (2017-present; co-advised with Tim Buschman and Jon Cohen)
- Dylan Rich (2016-present; co-advised with David Tank)
- Ari Kahn (2020-present)

Departmental service:

- Numerous tenure, promotion, and third-year review committees (Psych dept. and PNI; 2015-present)
- PNI faculty search committee (chair, 2016; chair, cog neuro subcommittee, 2017; chair, 2020)
- PNI graduate admissions committee (2015; 2016; 2017)
- CV Starr Committee (2016-present)
- CBI steering committee (academic years 2008-10; 2013-15)
- CBI pilot token review committee (2011-13)
- CNS colloquium committee (2007-2015)
- Psychology education & undergraduate honors committee (academic year 2007-8)
- Psychology personnel and awards committee (academic year 2008-9)
- CNS faculty search committee (Learning & Memory, academic year 2008-9)
- Psychology faculty search committee (Cognition & Perception, academic year 2011-12)

University service:

- Fellow, Whitman College (2016-)
- NYU Committee on Information Technology and Library Services (2014-15)
- NYU Dean's Undergraduate Research Fellowship selection committee (2014-15)
- NYU Phi Beta Kappa selection committee (2009-15)

Editorial service:

- Consulting editor, *Behavioral Neuroscience* (2013-)
- Associate editor, *Cognitive, Affective and Behavioral Neuroscience* (2015-2018)
- Co-editor, special issue of *Brain Research* on computational cognitive neuroscience (2009)
- Co-editor, special issue of *Cognition* on reinforcement learning and higher cognition (2009)

Organizational service:

- Awards committee, Society for Neuroeconomics (2020)
- Co-director, Advanced Summer Institute in Neuroeconomics, Shanghai (July 2019, July 2017; July 2015)
- Executive committee, Reinforcement Learning and Decision Making, Montreal (June 2019)
- Program co-chair, Reinforcement Learning and Decision Making, Ann Arbor (June 2017)
- Co-organizer, Symposium on Advances in Memory Systems (NYU, March 2015)
- Program committee member, Reinforcement Learning and Decision Making (Edmonton, June 2015)
- Co-organizer, Rumelhart Symposium in honor of Peter Dayan, Cognitive Science Society, Sapporo (August 2012)
- Co-organizer, Workshop on Computations, Decisions, and Movement, Germany (May 2010).
- Area chair (Cognitive Science & Neuroscience), Neural Information Processing Systems (NIPS) 2008 & 2009.
- Organizing committee, Computational Cognitive Neuroscience Conference (CCNC; 2007-present)
- Co-organizer, "Machine learning meets human learning" workshop, NIPS 2008 meeting.
- Co-organizer, "Motivation and action selection in conditioned behaviour," Gatsby Foundation Workshop, June 2005, London
- Co-organizer, "Reinforcement learning and the brain: Beyond the dopamine system," workshop, NIPS 2004 meeting