Nathaniel Daw
Assistant Professor, Center for Neural Science and Department of Psychology,
Affiliated Assistant Professor, Department of Computer Science
New York University
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updated 2/29/2012

Experience:

Affiliations:

Assistant professor (2007-present)
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, UK

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):

McKnight Scholar Award (Daw; 7/2009-7/2012)
"Decision making in structured, sequential tasks"

NIMH 1R01MH087882-01 (PI Daw; Co-investigator Pesaran; 9/2009-5/2014)
"Reinforcement learning in multi-dimensional action spaces"

NIDA 1R01DA027794-01 (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"

NINDS 1R01NS078784-01 (subcontract; PI Shohamy; Co-investigator Daw; 9/2011-9/2015)
"Goals vs. habits in the human brain: Cognitive and computational mechanisms"

McDonnell Foundation Scholar Award (Daw; 9/2011-9/2015)
"Dissecting learning: combining experimental and computational approaches"

Funding (completed):

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)

Funding to trainees, sponsored or co-sponsored:

NIMH Pre-Doctoral NRSA 1F31MH095501-01 (Aaron Bornstein, 2011)

Henry Wellcome Postdoctoral Fellowship (Steven Fleming, 2011)

Danish Agency for Science Technology and Innovation postdoctoral grant (Daniel Campbell-Meiklejohn, 2011)

Netherlands Organization for Scientific Research, Innovational Research Incentives Scheme Veni (Hanneke Den Ouden, 2011)

Swiss National Science Foundation Fellowship for Prospective Researchers PBSKP3-133357 (Mattia Rigotti, 2010)

Lundbeck Foundation grant (Daniel Campbell-Meiklejohn, 2010)

Awards:

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:

Journal articles:

1. Seymour, B., **Daw, N.D.**, Roiser, J., Dayan, P. and Dolan, R.J. (in press) Serotonin selectively modulates reward value in human decision making. *Journal of Neuroscience.*
2. Wimmer, G.E., **Daw, N.D.***, and Shohamy, D.* (in press) Generalization of value in reinforcement learning by humans. *European Journal of Neuroscience.*
3. Bornstein, A.M., and **Daw, N.D.** (in press) Dissociating hippocampal and striatal contributions to sequential prediction learning. *European Journal of Neuroscience.*
4. Roesch, M., Esber, G., Li, J., **Daw, N.D.**, and Schoenbaum, G. (in press) Surprise! Neural correlates of Pearce-Hall and Rescorla-Wagner coexist within the brain. *European Journal of Neuroscience.*
5. Gustafson, N., and **Daw, N.D.** (2011) Grid cells, place cells, and geodesic generalization for spatial reinforcement learning. *PLoS Computational Biology* 7:e1002235.
6. 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.
7. 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.
8. 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.
9. **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.
10. Cools, R., Nakamura, K., and **Daw, N.D.** (2011) Serotonin and dopamine: Unifying affective, activational, and decision functions, *Neuropsychopharmacology* 36:98-113.
11. 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.
12. 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.

13. 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.
14. 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.
15. 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.
16. 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.
17. Dayan, P., and **Daw, N.D.** (2008) Decision theory, reinforcement learning, and the brain, *Cognitive, Affective, and Behavioral Neuroscience* 8:429-453.
18. **Daw, N.D.*** and Shohamy, D.* (2008) The cognitive neuroscience of motivation and learning, *Social Cognition* 26: 593-620.
19. Wittmann, B.*, **Daw, N.D.***, Seymour, B., and Dolan, R. (2008) Striatal activity underlies novelty-based choice in humans, *Neuron* 58: 967-973.
20. 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.
21. 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.
22. Niv, Y., **Daw, N.D.**, and Dayan, P. (2007) Tonic dopamine: Opportunity costs and the control of response vigor, *Psychopharmacology* 191:507-520.
23. 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.
24. **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.
25. 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.
26. **Daw, N.D.**, Courville, A.C., and Touretzky, D. (2006) Representation and timing in theories of the dopamine system, *Neural Computation* 18:1637-1677.
27. **Daw, N.D.**, Niv, Y., and Dayan, P. (2005) Uncertainty-based competition between prefrontal and dorsolateral striatal systems for behavioral control, *Nature Neuroscience* 8:1704-1711.
28. McClure, S.M., **Daw, N.D.**, and Montague, P.R. (2003) A computational substrate for incentive salience, *Trends in Neurosciences* 26:423-428.
29. **Daw, N.D.**, and Touretzky, D.S. (2002) Long-term reward prediction in TD models of the dopamine system, *Neural Computation* 14:2567-2583.
30. **Daw, N.D.**, Kakade, S., and Dayan, P. (2002) Opponent interactions between serotonin and dopamine, *Neural Networks* 15:603-616.
31. 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. 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.
2. **Daw, N.D.**, and Courville, A.C. (2007) The pigeon as particle filter, *Advances in Neural Information Processing Systems* 20.
3. 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.

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

4. Courvile, 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.
5. 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.
6. **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.
7. **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.
8. 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.
9. **Daw, N.D.**, and Touretzky, D.S. (2001) Operant behavior suggests attentional gating of dopamine system inputs, *Neurocomputing* 38-40:1161-1167.
10. **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. Gershman, S., and **Daw, N.D.** (in press) Perception, action and utility: the tangled skein, in: Rabinovich, M., Friston, K,. and Varona, P., (eds.) *Principles of Brain Dynamics*, MIT Press.
2. **Daw, N.D.** (in press) 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.
3. 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.
4. 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.
5. **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.
6. Constantino, S.M., and **Daw, N.D.**, (2010) A closer look at choice, *Nature Neuroscience* 13:1153-1154.
7. **Daw, N.D.**, and Frank, M.J. (2009) Reinforcement learning and higher level cognition: Introduction to the special issue, *Cognition* 113:259-6.
8. Becker, S., and **Daw, N.D.** (2009) Computational cognitive neuroscience: Preface to the special issue, *Brain Research* 1299:1-2.
9. 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.
10. 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.
11. **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.
12. **Daw, N.D.**, (2007) Dopamine: at the intersection of reward and action *Nature Neuroscience* 10: 1505-1507.
13. **Daw, N.D.**, and Doya, K. (2006) The computational neurobiology of learning and reward, *Current Opinion in Neurobiology* 16:199-204.
14. **Daw, N.D.**, Niv, Y., and Dayan, P. (2006) Actions, values, policies and the basal ganglia, chapter in E. Bezard, ed., *Recent Breakthroughs in Basal Ganglia Research*, New York: Nova Science Publishers, pp. 111-130.
15. Niv, Y., **Daw, N.D.**, and Dayan, P. (2006) Choice values, *Nature Neuroscience* 9:987-988.
16. **Daw, N.D.**, and Dayan, P. (2004) Matchmaking, *Science* 304:1753-1754.

Abstracts in conference proceedings:

1. Zhang, H., **Daw, N.D.**, and Maloney, L.T. (2012) The motor error distribution implicit in planning of movement in a speeded reaching task compared to the true error distribution, *Vision Sciences Society*.

2. Bornstein, A.M., Geib, T.A., and **Daw, N.D.** (2012) A hippocampal-cortical network underlies model-based planning in humans. *Computational and Systems Neuroscience CoSYNE* 2012.
3. Skatova, A., Madlon-Kay, S., and **Daw, N.D.** (2012) Executive control and arbitration in reinforcement learning. *Computational and Systems Neuroscience CoSYNE* 2012.
4. Madlon-Kay, S., Pesaran, B., and **Daw, N.D.** (2012) Action valuation in multi-effector decision-making. *Computational and Systems Neuroscience CoSYNE* 2012.
5. Rigotti, M., Rubin, D.B.D., **Daw, N.D.**, and Fusi, S. (2012) An adaptive spiking neural network for decision making in partially observable environments. *Computational and Systems Neuroscience CoSYNE* 2012.
6. Pesaran, B., Wong, Y.T., Fabsiczak, M.M., Madlon-Kay, S., Gershman, S., and **Daw, N.D.**, (2011) Effector-specific decision making in human and non-human primates. *Collaborative Research in Computational Neuroscience.*
7. Zhang, H., **Daw. N.D.**, and Maloney, L.T. (2011) Testing whether humans have an accurate model of their own motor uncertainty in a speeded reaching task. *Advances in Computational Motor Control.*
8. Fabiszak, M.M., Wong, Y.T., Madlon-Kay, S., **Daw, N.D.**, and Pesaran, B. (2011) Effector specific valuation systems for eye-hand decisions. *Soc. Neurosci. Abstracts* 40.
9. Bornstein, A.M., and **Daw, N.D.** (2011) Neural substrates of planning in a model-based decision task. *Soc. Neurosci. Abstracts* 40.
10. Doll, B.B., **Daw, N.D.**, and Frank, M.J. (2011) Genetic components of model-based and model-free decision making in humans. *Soc. Neurosci. Abstracts* 40.
11. Gustafson, N. and **Daw, N.** (2011) Reinforcement learning under state uncertainty. *Soc. Neurosci. Abstracts* 40.
12. Zhang, H., **Daw, N.D.**, and Maloney, L.T. (2011) Testing subjects' knowledge of their motor uncertainty in a speeded reaching task, *Vision Sciences Society*.
13. Li, J., Schiller, D., Schoenbaum, G., Phelps, E.A., and **Daw, N.D.** (2010) Differential roles of human striatum and amygdala in associative learning, *Society for Neuroeconomics* 2010.
14. Bornstein, A.B. and **Daw, N.D.** (2010) Memory-based decision making: hippocampally-linked representations underlie behavior in a rewarded choice task, *Society for Neuroeconomics* 2010.
15. Kovach, C.K., **Daw, N.D.**, Rudrauf, D., Tranel, D., O'Doherty, J.P. and Adolphs, R., Frontopolar cortex contributes to choice exploration by tracking recent payoff trends,*Society for Neuroeconomics* 2010.
16. Li, J., Schiller, D., Schoenbaum, G., Phelps, E.A., and **Daw, N.D.** (2010) Differential roles of human striatum and amygdala in associative learning, *Soc. Neurosci. Abstracts* 39.
17. Yan, Y.T., **Daw, N.D.**, and Pesaran, B. (2010) Effector-specific reward value learning in the posterior parietal cortex, *Soc. Neurosci Abstracts* 39*.*
18. Bornstein, A.B. & Daw, **N.D.**, (2010) From memory to decisions: hippocampally-linked learning predicts choice in humans performing a goal-directed decision making task, *Soc. Neurosci. Abstracts* 39.
19. Green, C.S., Zhang, P., **Daw, N.**, Kersten, D., He, S., and Schrater, P. (2010) Striatal activity consistent with model-based, rather than model-free prediction errors, *Computational and Systems Neuroscience COSYNE* 2010.
20. Simon, D., and **Daw, N.D.** (2009) Model-based learning and planning in a spatial navigation task (oral presentation) Computational Cognitive Neuroscience Conference CCNC 2009.
21. Beeler, J.A., **Daw, N.D.**, Frazier, C.R.M., and Zhuang, X. (2009) Decision-making in hyperdopaminergic mice is less influenced by recent reward information in a novel, home-cage free operant choice task, *Soc. Neurosci. Abstracts* 38.
22. Trommershauser, J., **Daw, N.D.**, and Maloney, L.T. (2009) Learned and prior structure in the selection of movements, *Soc. Neurosci. Abstracts* 38.
23. Bornstein A., and **Daw, N.D.** (2009) Neural correlates of transition funciton learning in unrewarded sequences, *Soc. Neurosci. Abstracts* 38.
24. Bornstein, A., and **Daw, N.D.** (2009) Learning sequential predictions absent explicit reward: A model-based fMRI study. *Organization for Human Brain Mapping* 15.
25. Den Ouden, H.E.M, Daunizeau, J., Roiser, J., **Daw, N.D.**, Friston, K.J., and Stephan, K.E. (2009) Striatal prediction error activity drives cortical connectivity changes during associative learning. *Organization for Human Brain Mapping* 15.
26. Glascher, H., **Daw, N.D.**, Dayan, P., and O'Doherty, J. (2009) The human brain computes two different prediction errors. *Computational and Systems Neuroscience COSYNE* 2009.

27. Chastain, E., and **Daw N.D.**, Value function uncertainty as a cognitive map for reinforcement learning. *Computational and Systems Neuroscience COSYNE* 2009.

28. Seymour, B., **Daw, N.D.**, Dayan, P., Roiser, J., and Dolan, R. (2009) Serotonin modulates choice stickiness through an outcome-independent striatal mechanism. *Computational and Systems Neuroscience COSYNE* 2009.

29. Gershman, S.K., Pesaran, B., and **Daw, N.D.** (2008) Human reinforcement learning exploits structured action spaces, *Soc. Neurosci. Abstracts* 37.

30. Wimmer, G.E., **Daw, N.D.**, and Shohamy, D. (2008) Learning and generalization in human reinforcement learning, *Soc. Neurosci. Abstracts* 37.

31. Schönberg, T. , **Daw, N.D.**, Inzelberg, R., Joel, D., and O'Doherty, J.P. (2008) 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, *Soc Neurosci. Abstracts* 37.

32. Schönberg T**., Daw N.D.**, Inzelberg R., Joel D., O'Doherty J.P. (2008) Selective impairment of prediction error signals in human dorsolateral striatum but not in ventral striatum of Parkinson's disease patients: evidence from a model-based fMRI study. *Israeli Human Brain Mapping 2008*.

33. Gustafson, N.J., and **Daw, N.D.** (2008) Entorhinal grid cell responses as basis functions for spatial RL,"(oral presentation), *Computational and Systems Neuroscience COSYNE 2008.*

34. Bolikal, P., Myers, C.E., Patel, R., Ropp, L., **Daw N.D.**, and Gluck, M.A. (2007) Punishment-based learning correlates with a putative index of serotonin in healthy young adults. *Cognitive Neuroscience Society Annual Meeting Program* F148.

35. Schonberg, T., **Daw, N.D.**, Joel, D., and O'Doherty, J.P. (2006) Dorsal striatum activity distinguishes learners from nonlearners in an instrumental reward task. *Organization for Human Brain Mapping / Neuroimage* S57.

36. den Ouden, H.E.M., Friston, K.J., **Daw, N.D**., McIntosh, A.R., Stephan, K.E. (2006) Learning of statistical relations among stimuli without awareness. *Organization for Human Brain Mapping / Neuroimage* S38.

37. Schönberg T., **Daw N.D.**, Joel D., O'Doherty J.P. (2006) Dorsal striatum activity distinguishes learners from non-learners in an instrumental conditioning task. *Israeli Human Brain Mapping 2006.*

38. Seymour, B., **Daw, N.D.**, Dayan, P., Singer, T., and Dolan, R.J. (2006) Different subregions of human striatum encode appetitive and aversive outcomes in mixed prospect predictive learning of money. *Computational and Systems Neuroscience COSYNE 2006*.

39. Niv, Y., **Daw, N.D.**, and Dayan, P. (2005) The effects of motivation on rates of responding: a reinforcement learning approach. *37th Annual General Meeting, European Brain and Behaviour Society*.

40. **Daw, N.D.**, Niv, Y., and Dayan, P. (2005) Uncertainty-based competition between prefrontal and striatal systems for behavioural control, *Computational and Systems Neuroscience COSYNE 2005*.

41. Niv, Y., **Daw, N.D.**, Joel, D., and Dayan, P. (2005) Motivational effects on behaviour: Towards a reinforcement learning model of rates of responding, *Computational and Systems Neuroscience COSYNE 2005*.

42. Courville, A.C., **Daw, N.D.**, and Touretzky, D.S. (2004) A Bayesian framework for configural conditioning, *37th Meeting of the Society for Mathematical Psychology/Journal of Mathematical Psychology*.

43. **Daw, N.D.**, Touretzky, D.S., and Skaggs, W.E. (2004) Contrasting neuronal correlates between dorsal and ventral striatum in the rat, *CSH Meeting on Computational and Systems Neuroscience*.

44. **Daw, N.D.**, Touretzky, D.S., and Skaggs, W.E. (2002) Representation of reward type and action choice in ventral and dorsal striatum in the rat. *Soc. Neurosci. Abstracts* 28: 765.11.

45. Courville, A.C., **Daw, N.D.**, and Touretzky, D.S. (2002) A semi-Markov model of how the dopamine system handles variability in event timing. *Soc. Neurosci. Abstracts* 28: 280.10.

46. **Daw, N.D.**, Touretzky D.S., and Skaggs, W.E. (2001) Parallel recordings in rat dorsal striatum and nucleus accumbens during a cued T-maze task. *Soc. Neurosci. Abstracts* 27: 514.7.

47. **Daw, N.D.** and Touretzky, D.S. (2000) Behavioral insights into attentional function in the dopamine system. *Soc. Neurosci. Abstracts*, 26: 1743.

48. Kakade, S., **Daw, N.D.**, and Dayan, P. (2000) Opponent interactions between serotonin and dopamine for classical and operant conditioning. *Soc. Neurosci. Abstracts*, 26: 1763.

49. **Daw, N.D.**, Strelow, D., and Goldstein, S. (2000) Embedded compilation for multimedia applications. *Symposium on Field-Programmable Custom Computing Machines* (extended abstract).

50. **Daw, N.D.**, and Touretzky, D.S. (1999) An average reward TD model of dopamine cell function connects physiological and behavioral theories. *Soc. Neurosci. Abstracts*, 25: 1385.

Talks and seminars:

Invited:

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:

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 & service:

Courses taught (NYU):

Special topics: Neuroeconomics and decision making V80.0302/V89.0300 (Spring 2011)

Neuroeconomics G80.3410/G89.3394 (Spring 2010)

Cognitive Neuroscience V89.0025 (Fall 2009)

Special topics: Decision making, neural and behavioral basis V80.0302/V89.0300 (Fall 2007, Spring 2009)

Reinforcement learning G80.3042/G89.3406 (Spring 2008)

Math tools for neural science and psychology G80.2207/G89.2211 (Fall 2008, Fall 2011)

Courses taught (summer schools and other visiting teaching):

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:

Samuel Gershman (2007-8; co-advised with Bijan Pesaran)

Seth Madlon-Kay (2009-present)

Doctoral trainees:

Sara Constantino (NYU Cognition & perception, 2009-present)

Dylan Simon (NYU Cognition & Perception, 2007-present)

Aaron Bornstein (NYU Cognition & Perception, 2007-present)

Nicholas Gustafson (NYU CNS, 2007-present)

Postdoctoral trainees:

Jian Li (NYU Cognition & Perception, 2007-present; co-advised with Elizabeth Phelps)

Mattia Rigotti (2010-present)

Daniel Campbell-Meiklejohn (2011-present)

Hanneke Den Ouden (2011-present)

Stephen Fleming (2011-present)

Bradley Doll (2011-present)

Doctoral thesis committees, completed:

Brian Lau (reader; advisor: Paul Glimcher, 2007)

Shei-Wei Wu (thesis committee chair; advisor: Laurence Maloney, 2008)

Annemieke Apergis-Schoute (reader; advisor: Liz Phelps, 2008)

Tari Awipi (reader; advisor: Lila Davachi, 2009)

Peter Sokol-Hessner (reader; advisor: Liz Phelps, 2010)

Robb Ruttledge (reader; advisor: Paul Glimcher, 2010)

Stephanie Lazzaro (thesis committee member, advisor: Paul Glimcher, 2011)

Catherine Hartley (thesis committee chair, advisor: Liz Phelps, 2011)

Katherine Duncan (reader; advisor: Lila Davachi, 2011)

Doctoral thesis or advisory committees, ongoing:

NYU Center for Neural Science: Kevin Jarrett; Deep Ganguli

NYU Cognition & Perception: John Ackermann; Katrin Hermann; Shannon Tubridy; Craig Glaser; Kyeong-Jin Tark; Eric DeWitt

Elsewhere: Hyungil Ahn (MIT)

Departmental service (NYU):

CBI pilot token review committee (2011-present)

CNS colloquium committee (2007-present)

CBI steering committee (academic years 2008-10)

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 (NYU):

Dean's undergraduate research fund committee (2011-present)

Phi Beta Kappa selection committee (2009-present)

Organizational and editorial service:

Co-organizer, Workshop on Computations, Decisions, and Movement, Germany (May 2010).

Co-editor (with Sue Becker) special issue of *Brain Research* on computational cognitive neuroscience (2009)

Co-editor (with Michael Frank) special issue of *Cognition* on reinforcement learning and higher cognition (2009)

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