NEIR ESHEL, MD, PHD

Contact Information

Department of Psychiatry & Behavioral Sciences, Stanford University
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Clinical training

Psychiatry residency, research track, Stanford University 2016-2020

Education

M.D., Harvard Medical School 2016

Ph.D. in Neurobiology, Harvard University 2014

MSc. with Distinction in Clinical Neuroscience, Institute of Neurology, University College London 2008

A.B. *summa cum laude* in Molecular Biology and Neuroscience, Princeton University 2007

Research Experience

Stanford University 2016-
- With Prof. Rob Malenka, developing mouse models to probe the neurobiology of frustration and aggressive behavior
- With Prof. Amit Etkin, using fMRI to predict rTMS treatment response in patients with depression, and to identify neural markers of frustration and anger in patients with PTSD and TBI

Harvard University 2011-14
In the lab of Prof. Nao Uchida, used optogenetics in mice to dissect the dopamine circuit regulating reinforcement learning.

Institute of Cognitive Neuroscience, University College London 2007-09
-With Prof. Jon Driver, used TMS to study interhemispheric interactions underlying somatosensory detection.
-With Dr. Jonathan Roiser and Prof. Peter Dayan, created computational models of decision-making in depression.

American Association for the Advancement of Science *summer* 2007
Authored plain-language book on how people learn, integrating research from neuroscience, psychology, and cognitive science.

Princeton University 2004-07
With Prof. Jonathan Cohen, combined fMRI and TMS to examine dopamine-mediated signals that update working memory to reflect changing task demands.

World Health Organization *summer* 2005
Published a literature review on the efficacy of low-cost parenting interventions to enhance child health in developing countries.

National Institute of Mental Health *summers* 2001-05
With Drs. Daniel Pine and Monique Ernst, used fMRI and behavioral economics to study the development of reward processing and risk-taking in adolescence.

Service & Leadership

LGBT Advocacy

Co-chair, Stanford LGBT Housestaff and Allies 2016-
-Co-founded and raised funds for a Stanford-wide group of lesbian, gay, bisexual, and transgender (LGBT) housestaff

Member, Stanford Medicine Diversity Cabinet 2018-

Vice chair, Committee on LGBT Matters, Massachusetts Medical Society 2009-15
-On a state-wide committee, helped steer policy and education efforts to benefit Massachusetts' LGBT community

Co-President, Kinsey 2-6ers, Harvard Medical School 2009-10
-Crafted social and educational programming to develop a community of support for LGBT medical students and to fill a curricular gap on LGBT health disparities.

-Advocacy efforts resulted in the formation of an LGBT center with a paid coordinator, a committee to advise the dean, and revamped admissions procedures for the medical school.

Residency and Medical School Service

Founder, Stanford Psychiatry Clinician Scientists 2017-
-Convened all early-stage clinician scientists in the psychiatry department and raised funds to host regular community-building, mentorship, and resource-sharing meetings

Member, Stanford Psychiatry Program Evaluation Committee 2016-

Member, Stanford Psychiatry Diversity & Inclusion Committee 2017-

Co-President, Psychiatry Student Interest Group, HMS 2009-10

Committee member, HMS LCME accreditation process 2009-10

Committee member, HMS bioscience review 2015

Elected member, HMS Aesculapian Club 2012-present

Music

Treasurer, HMS Chamber Music Society 2009-13
Clarinetist, Longwood Symphony Orchestra 2011-15

Journalism

Managing Editor, The Daily Princetonian 2005-07

Grants & Fellowships

Stanford Department of Psychiatry Small Grant Award 2018
Awarded $12,000 to promote LGBTQ mental health.

Stanford Society of Physician Scholars Grant 2018

Biological Psychiatry Travel Fellowship 2017

	ACNP Travel Fellowship	2015
	NIH F30 NRSA Predoctoral Fellowship (1F30MH100729) Awarded $81,118 for project entitled, "Neural circuits for computing dopamine prediction errors."	2013-15
	Sackler Scholarship in Psychobiology Awarded $33,000 to study the neural mechanisms of addiction.	2012-14
	COSYNE Travel Grant	2014
	Organization for Human Brain Mapping Trainee Abstract Award	2009
	Brain Travel Grant	2009
	Marshall Scholarship	2007-09
	Barry Goldwater Scholarship	2005-06
Honors & Awards	Outstanding Resident Award, National Institute of Mental Health	2018
	Grand Prize, *Science* and SciLifeLab Prize for Young Scientists Awarded $30,000, an invitation to publish an essay in *Science*, and a trip to Stockholm to participate in Nobel week. Chosen by the editors of *Science* from a global pool of recent PhD graduates.	2016
	Larry Katz Memorial Lectureship, Cold Spring Harbor Awarded to the graduate student worldwide who has done "the most original and significant work in the past two years on neuronal circuits"	2016
	Harvard University Certificate of Distinction in Teaching	2013
	National LGBT Health Achievement Award, American Medical Student Association & Gay and Lesbian Medical Association	2011
	Haymon Gorlov Prize for the top-ranked student in the MSc in Clinical Neuroscience, Institute of Neurology, University College London	2008
	Lindau Meeting of Nobel Laureates participant	2007
	Sigma Xi Book Award for best undergraduate research thesis in the Department of Molecular Biology, Princeton University	2007
	Phi Beta Kappa	2007
	Shapiro Prize for Academic Excellence, Princeton University	2004, 05
	First place, investigative reporting, New Jersey Press Association	2005
Teaching	Teaching fellow, MCB145: Neurobiology of Perception & Decision-Making. Awarded Certificate of Distinction in Teaching.	2012

Research reports & major reviews

Lally, N; Huys, Q; **Eshel, N**; Faulkner, P; Dayan, P; Roiser, J (2017). "The neural basis of aversive Pavlovian guidance during planning." *Journal of Neuroscience* 37: 10215-10229.

Watabe-Uchida, M*; **Eshel, N***; Uchida, N (2017). "Neural circuitry of reward prediction error." *Annual Review of Neuroscience* 40: 373-94. **Authors contributed equally*

Honigberg, MC; **Eshel, N**; Luskin, MR; Shaykevich, S; Lipsitz, SR; Katz, JT (2017). "Curricular Time, Patient Exposure, and Comfort Caring for Lesbian,

Gay, Bisexual, and Transgender Patients Among Recent Medical Graduates." *LGBT Health* 4, 3: 237-239.

Eshel, N; Tian, J; Bukwich, M; Uchida, N (2016). "Dopamine neurons share common response function for reward prediction error." *Nature Neuroscience* 19, 3: 479-86.

Eshel, N; Bukwich, M; Rao, V; Hemmelder, V; Tian, J; Uchida, N (2015). "Arithmetic and local circuitry underlying dopamine prediction errors." *Nature* 525, 7568: 243-6.

Huys, QJM; Lally, N; Faulkner, P; **Eshel, N**; Seifritz, E; Gershman, SJ; Dayan, P; Roiser, JP (2015). "The interplay of approximate planning strategies." *Proceedings of the National Academy of Sciences* 112, 10: 3098-103.

D'Ardenne, K; **Eshel, N**; Luka, J; Lenartowicz, A; Nystrom, LE; Montague, P.R.; Cohen, JD (2012). "A mechanistic account for context updating in working memory involving the prefrontal cortex and brainstem dopamine system." *Proceedings of the National Academy of Sciences* 109, 49: 19900-9.

Huys, QJM*; **Eshel, N***; O'Nions, E; Sheridan, L; Dayan, P; Roiser, JP (2012). "Bonsai trees in your head: how the Pavlovian system sculpts goal-directed choices by pruning decision trees." *PLoS Computational Biology* 8, 3: e1002410. **Authors contributed equally*

Eshel, N; Ruff, CC; Blankenburg, F; Driver, J (2010). "Effects of parietal TMS on somatosensory judgments challenge interhemispheric rivalry accounts." *Neuropsychologia* 48, 12: 3470-81.

Eshel, N; Roiser, J (2010). "Reward and Punishment Processing in Depression." *Biological Psychiatry* 68, 2: 118-24.

Blankenburg, F; Ruff, CC; Bestmann, S; Bjoertomt, O; **Eshel, N**; Josephs, O; Weiskopf, N; Driver, J (2008). "Interhemispheric Effect of Parietal TMS on Somatosensory Response Confirmed Directly with Concurrent TMS-fMRI." *Journal of Neuroscience* 28, 49: 13202-8.

Eshel, N; Nelson, E; Blair, J; Pine, DS; Ernst, M (2007). "Neural substrates of choice selection in adolescents and adults: development of the ventrolateral prefrontal and anterior cingulate cortices." *Neuropsychologia* 45, 6: 1270-9.

Eshel, N; Daelmans, B; de Mello, MC; Martines, J (2006). "Responsive parenting: interventions and outcomes." *Bulletin of the World Health Organization* 84, 12: 991-8.

Ernst, M; Luckenbaugh, D; Moolchan, ET; Leff, MK; Allen, R; **Eshel, N**; London, ED; Kimes, A (2006). "Behavioral Predictors of Substance Use Initiation in Adolescents with and without Attention-Deficit/Hyperactivity Disorder." *Pediatrics* 117, 6: 2030-39.

Ernst, M; Dickstein, D; Munson, S; **Eshel, N**; Pradella, A; Jazbec, S; Pine, D; Leibenluft, E (2004). Reward-Related Processes in Pediatric Bipolar Disorder." *Journal of Affective Disorders* 82S: S89-S101.

Ernst, M; Nelson, E; McClure, E; Monk, C; Munson, S; **Eshel, N**; Zarahn, E; Leibenluft, E; Zametkin, A; Towbin, K; Blair, J; Charney, D; Pine, D (2004). "Choice Selection and Reward Anticipation: an fMRI Study." *Neuropsychologia* 42, 12: 1585-97.

Reviews, book chapters & commentary

Eshel, N; Steinberg, EE (in press). "Learning what to approach." *PLOS Biology*.

Shah, R; **Eshel, N**; McGlynn, L (2018). "LGBTQ Students." *University Student Mental Health: A guide for psychiatrists, psychologists, and leaders serving higher education*. Ed. Laura W. Roberts. American Psychiatric Association.

Eshel, N (2016). "Trial and Error: Optogenetic techniques offer insight into the dopamine circuit underlying learning." *Science* 354, 6315: 1108-9.

Uchida, N; Tian, J; **Eshel, N**. "Reward and Decision Encoding in Basal Ganglia: Insights from Optogenetics and Viral Tracing Studies in Rodents." *Decision Neuroscience: An Integrative Approach*, Ed. Dreher, J-C, & Tremblay, L. Waltham, MA: Academic Press (2016).

Eshel, N; Marcovitz, DE; Stern, TA (2016). "Psychiatric consultations in less-than-private places: Challenges and unexpected benefits of hospital roommates." *Psychosomatics* 57, 1: 97-101.

Eshel, N; Tian, J (2014). "Dopamine gates sensory representations in cortex." *Journal of Neurophysiology* 111, 11: 2161-3.

Uchida, N; **Eshel, N**; Watabe-Uchida, M (2013). "Division of labor for division: inhibitory interneurons with different spatial landscapes in the olfactory system." *Neuron* 80, 5: 1106-9.

Eshel, N; Tian, J; Uchida, N (2013). "Opening the black box: dopamine, predictions, and learning." *Trends in Cognitive Sciences* 17, 9:430-1.

Munson, S; **Eshel, N**; Ernst, M. "Chapter 7: Ethics of PET research in children." *Practical Pediatric PET Imaging*, Ed. Charron, M. Cambridge, MA: Springer, 2006. Pgs. 72-91.

Books

Eshel, N. *Learning: The Science Inside*. Washington, D.C.: American Association for the Advancement of Science, 2007.

Invited presentations

Eshel, N (2017). "Effects of rTMS on resting-state functional connectivity in patients with major depression." Poster at Biological Psychiatry, San Diego, CA.

Eshel, N (2017). "LGBT Health: Terminology and Concepts." Stanford Psychiatry Residency Didactics, Stanford, CA.

Eshel, N (2016). "Dopamine and the neural circuit underlying learning." *Science* and SciLifeLab Symposium, Stockholm, Sweden.

Eshel, N (2016). "Dopamine prediction errors: arithmetic and local circuitry." Larry Katz Memorial Lecture, Neuronal Circuits meeting, Cold Spring Harbor.

Eshel, N (2016). "Dopamine and the neural circuit underlying learning." Affective Brain Lab, University College London (online lecture).

Eshel, N; Bukwich, M; Rao, V; Hemmelder, V; Tian, J; Uchida, N (2015). "Arithmetic and local circuitry underlying dopamine prediction errors." Hot Topics oral presentation at the American College of Neuropsychopharmacology, Hollywood, Florida.

Eshel, N (2015). "Dopamine and the neural circuit underlying learning." Invited talk at Columbia Psychiatry, New York.

Eshel, N (2015). "Dopamine and the neural circuit underlying learning." Invited talk at Stanford Psychiatry, California.

Eshel, N (2015). "Dopamine and the neural circuit underlying learning." Invited talk at TBI Research Workgroup, Spaulding Hospital, Boston.

Eshel, N; Uchida, N (2015). "Neural circuit mechanism underlying dopamine prediction errors." Invited talk at Biological Psychiatry, Toronto, Canada.

Matsui, J; **Eshel, N**; Honigberg, M; Connelly, M (2015). "Convening a Task Force to Assess the Needs of LGBT Constituents at Harvard Medical School." Poster presentation at Association of American Medical Colleges Conference, San Juan, Puerto Rico.

Eshel, N; Tian, J.; Uchida, N. (2014). "Arithmetic of dopamine prediction errors: subtraction with scaled inhibition." Invited talk at Computational and Systems Neuroscience (COSYNE), Salt Lake City, Utah.

Eshel, N; Uchida, N. (2013). "VTA GABA neurons support dopamine prediction error calculations." Invited talk at Assembly and Function of Neuronal Circuits, Ascona, Switzerland.

Eshel, N; Honigberg, M. (2013). "Supporting LGBT Students and LGBT Health." Invited talk at *Healing Healthcare Disparities Through Education*, a Harvard Medical School Continuing Medical Education conference.

Eshel, N; Uchida, N. (2013). "Testing the role of VTA GABA neurons in dopamine prediction error calculations." Poster presentation at Gordon Conference on Catecholamines, Mt Snow, Vermont.

Eshel, N (2013). "Testing the role of VTA GABA neurons in dopamine prediction error calculations." Neurolunch talk at Center for Brain Sciences, Harvard University.

Eshel, N (2013). "Arithmetic of dopamine prediction errors: subtraction with scaled inhibition." Computational neuroscience seminar at Center for Brain Sciences, Harvard University.

Eshel, N; Honigberg, M (2012). "LGBT Affairs in Medical Education." Invited talk at *Healing Healthcare Disparities Through Education*, a Harvard Medical School Continuing Medical Education conference.

Eshel, N (2011). "To prune or not to prune: Pavlovian influences on goal-directed decision-making." Invited talk at Nathaniel Daw's lab, NYU Center for Neural Science.

Eshel, N; Honigberg, M (2011). "LGBT Affairs in Medical Education." Invited talk at *Healing Healthcare Disparities Through Education*, a Harvard Medical School Continuing Medical Education conference.

Huys, Q; **Eshel, N**; Dayan, P; Roiser, J (2010). "Bonsai Trees: How the Pavlovian system sculpts sequential decisions." Poster presentation at Computational and Systems Neuroscience (COSYNE) 2010, Salt Lake City, Utah.

Eshel, N; Honigberg, M. (2010). "Cultural Competence in Caring for LGBT Individuals." Children's Hospital Boston Grand Rounds.

Eshel, N; Ruff, CC; Blankenburg, F; Driver, J (2009). "Parietal TMS reveals excitatory interhemispheric interactions during somatosensory processing." Invited talk at the 15th annual Organization for Human Brain Mapping conference, San Francisco, California.

Eshel, N; Huys, QJ; Dayan, P; Roiser, J (2009). "Serotonin, pruning, and depression: a computational approach." Invited talk at the Dutch Endo-Neuro-Psycho meeting, Doorwerth, Netherlands.

Eshel, N (2009). "Hemispheres in the balance: TMS reveals bilateral influences on somatosensation." Invited talk at the Institute of Cognitive Neuroscience, University College London.

Eshel, N (2008). "Transiently disrupting right prefrontal cortex interferes with updating of working memory." Invited talk at the 2008 Neuroscience and Cognitive Control conference, Ghent, Belgium.

Eshel, N; Luka, J; Lenartowicz, A; Nystrom, LE; Cohen, JD (2008). "Transiently disrupting right prefrontal cortex interferes with updating of working memory." Poster at the 2008 Human Brain Mapping conference, Melbourne, Australia.

Lenartowicz, A; **Eshel, N**; Luka, J; Nystrom, LE; Cohen, JD (2007). "Disrupting activity in right prefrontal cortex interferes with task updating in cognitive control." Poster at the 2007 Society for Neuroscience conference, San Diego, California.

Ernst, M; **Eshel, N** (2004). "Adolescence: Vulnerable Reward System as a Risk Factor for Psychopathology." Presentation at the October, 2004 conference of the American Association of Child and Adolescent Psychiatry.

Ernst, M; Pine, D; Nelson, E; Monk, C; McClure, E; **Eshel,** N; Leibenluft, E; Charney, D; Hoberman, A; Montgomery, LA; Munson, S (2003). "Anxiety and reward circuitry." *Biological Psychiatry* 53, 8: 7S. Society of Biological Psychiatry abstracts.

Nelson, E; Monk, C; McClure, E; Zarahn, E; Leibenluft, E; Munson, S; **Eshel,** N; Charney, D; Pine, D; Ernst, M (2003). "Risky business: Event-related fMRI of decision, anticipation and attainment in a reward task." *Biological Psychiatry* 53, 8: 97S. Society of Biological Psychiatry abstracts.

Three posters at NIH Summer Poster Days:

2003: "Developmental Effects on Human Reward Systems: an fMRI study"
2002: "Modulation of Pro- and Anti-Saccades by Reward: a Novel Task"
2001: "Effect of Age on Performance on a Risk-Taking Task"

Scientific reviewing	Ad hoc reviewer, *Current Biology, PLOS Biology, JAMA Psychiatry, Biological Psychiatry, Social Cognitive and Affective Neuroscience, Neuroscience and Biobehavioral Reviews*, and *Psychophysiology*
	Associate faculty member, Faculty of 1000 Biology
	Abstract reviewer, Organization for Human Brain Mapping
Mentoring	Undergraduates: Elise Molnar, Candice (Korleki) Akiti, Zane Norville
	Graduate rotation students: Minh Vong, Kee Wui Huang, Mike Bukwich
	Medical students: Jassi Pannu, Marija Kamceva
Professional Affiliations	*Medicine:* American Medical Association, Massachusetts Medical Society, Gay & Lesbian Medical Association
	Psychiatry: American Psychiatric Association, Northern California Psychiatric Society, American College of Neuropsychopharmacology, Society of Biologic Psychiatry, Association of Gay & Lesbian Psychiatrists
	Neuroscience: Society for Neuroscience, Faculty of 1000