

CURRICULUM VITAE

FIELD OF SPECIALIZATION:

I am a neuroscientist and a neurologist with an abiding interest in fundamental, basic, neuroscience of vision and cognition. I have been studying the neurobiology of decision making for over 20 years, and I have made fundamental contributions to this field by combining behavior, electrophysiology and computational methods. My research serves to elucidate the neural mechanisms that support normal cognitive operations that underlie inference from evidence, the tradeoff between the speed and accuracy of a decision, the assignment of confidence or certainty to a decision, and the capacity to combine and weigh evidence of varying degrees of reliability. These and other insights provide a window on wider aspects of higher brain function, such as reasoning, planning, strategizing and vacillating. I predict that the mechanisms we study in normal brains will constitute important *failure modes* that underlie a variety of cognitive disorders—despite the great diversity of their ultimate etiologies. I believe we will one day manipulate and restore these basic mechanisms to treat brain disorders affecting cognition. Thus, my research will ultimately help patients with disorders of higher cognitive functions affecting personality, ideation, volition, awareness and decision making.

OFFICE ADDRESS:

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Columbia University Medical Center
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New York, NY 10032
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ACADEMIC TRAINING:

1981 Brown University, B.A., Biology
1985 University of California, Berkeley, Ph.D., Neurobiology
“Neural Mechanisms of Stereoscopic Depth Perception”
Thesis Sponsor: Dr. Ralph D. Freeman
1988 Brown University, M.D.
07/88-06/89 Internship, Medicine, Kaiser Permanente Medical Center
07/89-06/92 Residency, Neurology, Stanford Medical School
08/85-06/86 Postdoc, University of California, Berkeley
Vision Sciences, Laboratory of Dr. Ralph D. Freeman
07/93-08/96 Postdoc, Stanford Medical School
Neurophysiology, Laboratory of Dr. William T. Newsome

ACCADEMIC APPOINTMENTS:

1991-1992 Chief Resident in Neurology- Stanford University, Stanford, CA
1993-1995 Clinical Instructor of Neurology- Stanford University, Stanford, CA
1995-2012 Core Staff Scientist- Primate Research Center, University of Washington
Seattle, WA

- 1995-2001** Assistant Professor- Department of Physiology and Biophysics, University of Washington, Seattle, WA
- 1997-2001** Adjunct Assistant Professor- Department of Neurology, University of Washington, Seattle, WA
- 2000-**
2001-2005 Investigator, Howard Hughes Medical Institute
- 2001-2005** Associate Professor- Department of Physiology and Biophysics, University of Washington, Seattle, WA
- 2001-2005** Adjunct Associate Professor- Department of Neurology, University of Washington, Seattle, WA
- 2002-2007** Co-Director, Graduate Program- Department of Neurobiology, University of Washington, Seattle, WA
- 2005-2012** Professor- Department of Physiology and Biophysics, University of Washington, Seattle, WA
- 2005-2012** Adjunct Professor- Department of Neurology, University of Washington, Seattle, WA
- 2012-**
2012- Affiliate Professor- Department of Physiology and Biophysics, University of Washington, Seattle, WA
- 2012-**
2012- Professor- Department of Neuroscience, Columbia University, NY, NY

PROFESSIONAL ORGANIZATIONS AND SOCIETIES (all active):

American Academy of Neurology
 Society for Neuroscience
 Association for Research in Vision and Ophthalmology
 American Association for the Advancement of Science
 Society for the Neural Control of Movement
 Vision Sciences Society
 Northwest Association for Biomedical Research
 American Physiological Society
 The Neuroscience Research Program
 Neuroethics Society
 Dana Foundation
 Kavli Institute for Brain Science
 Association for Psychological Sciences - Fellow
 International Neuropsychological Society
 Institute of Medicine (IOM) of the National Academies

HONORS AND FELLOWSHIPS:

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| Fight for Sight Citation, Association for Research in Vision and Ophthalmology | 1985 |
| Epilepsy Mini-Fellow, Bowman Gray School of Medicine | 1990 |
| Sandoz Award for Recognition in Neurology and Neuroscience | 1992 |
| Dana Fellowship award for Basic Research in Neurological Sciences | 1992-1995 |
| Howard Hughes Medical Research Institute Physician/Scientist Award | 1992-1995 |
| Teaching commendation, Basic Neuroscience, Stanford Medical School | 1994 |
| Teaching commendation, Basic Neuroscience, Stanford Medical School | 1995 |
| McKnight Scholars Award | 1995-1998 |

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| Appointed to Howard Hughes Medical Research Institute | 2000 |
| New Investigator Science in Medicine Lecture, University of Washington | 2001 |
| Member, Faculty of 1000 | 2003-2008 |
| Elected Associate of the Neuroscience Research Program | 2006 |
| Mind Brain Lecture, Schwarz Foundation and SUNY Stony Brook | 2007 |
| Visiting Fellow Commoner, Trinity College, Cambridge, UK | 2007 |
| Special Lecture, Society for Neuroscience Annual Meeting | 2008 |
| Alden Spencer Prize, Columbia University | 2009 |
| Dana Alliance for Brain Initiatives | 2010 |
| Heller Lectures in Computational Neuroscience, Hebrew University | 2010 |
| Stephen R. Max Memorial Lecture, University of Maryland | 2011 |
| Golden Brain, Minerva Foundation | 2012 |
| Elected Member, The International Neuropsychological Symposium | 2013 |
| Elected to National Academy of Medicine | 2014 |
| Elected to AAAS Fellows | 2015 |

GRANT REVIEW PANEL AND ADVISORY BOARDS:

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|---|-----------|
| National Science Foundation (Ad Hoc) | 1999 |
| NINDS Study Section, Neurological Sci & Disorders Special Emphasis (Ad Hoc) | 1999 |
| NIMH Intramural Laboratory Review | May 2001 |
| Sloan and Schwartz Foundation | |
| NEI Study Section, Central Visual Processing (Ad Hoc) | 2003 |
| NEI Advisory Panel, 5 year plan: Strabismus, Amblyopia and Visual Processing | 2003 |
| Committee on Animal in Research, Society for Neuroscience | 2004-2007 |
| McKnight Foundation, Tech Innovations in Neurosci Awards Committee | 2004-2009 |
| Steering Committee, Neurobiology Training Grant, U. of Washington | 2005- |
| HHMI, Clinical Investigator Competition | 2007 |
| Selection Committee, Science Educator Award, Society for Neuroscience | 2007-2009 |
| HHMI, Early Investigator Competition | 2009 |
| McKnight Foundation, Technology Board | 2004-2009 |
| Washington University IGERT Advisory Board | 2004-2009 |
| John Merck Scholars Program, Biol. Develop. Disabilities in Children | 2007-2011 |
| Duke School of Medicine, Neurobiology Department External Review | 2010 |
| Neurobiology and Behavior Internal Advisory Committee, Columbia Univ. | 2012- |
| HHMI Medical Fellows Panel | 2013 |
| Scientific Advisory Board, Max Planck Institute of Neurobiology | 2013- |
| Physical and Mathematical Principles of Brain Structure and Function, NSF Panel | 2013 |
| Edmond and Lily Safra Center for Brain Sciences, Review Committee | 2013 |
| Young Investigator Award, Selection Committee, Society for Neuroscience | 2012-2014 |
| Grant Review Board, Life Sciences Research Foundation | 2014 |
| Ralph W. Gerard Prize in Neuroscience Selection Committee, Soc. Neuroscience | 2015- |
| Wellcome Trust Science Interview Panel | 2015 |

COURSES TAUGHT:

Note on abbreviations. All courses with designation UW are University of Washington. Most but not all are in the School of Medicine. Course numbers ≥ 500 are graduate level.

“Course leader” also includes lectures; “Instructor” implies a lecture module of 1-3 weeks (typically 2); “Lectures” implies 2 or more lectures and discussions, whereas “Lecture” implies one guest lecture. NB = Graduate Program in Neurobiology & Behavior; P BIO = Department of Physiology & Biophysics.

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|---|-----------|
| Neurology review course, Stanford (course leader) | 1991-1992 |
| Basic and Clinical Neuroscience, Stanford (lectures) | 1991-1995 |
| Ethics and Human Neurobiology, Stanford University (lectures) | 1994-1995 |
| Neuroanatomy (UW Conj511; instructor) | 1995 |
| Neurophysiology (UW P BIO 506; instructor) | 1995 |
| Computational Neurosci: Vision, Cold Spring Harbor Labs (course leader) | 1996,1998 |
| Neuroanatomy (NB 502; instructor) | 1997 |
| Systems Neuroscience (UW NB 503; course leader) | 1997-2005 |
| Proseminar (UW NB 565; lectures) | 1997 |
| Structure, Function and Development of the Visual System, Cold Spring Harbor Labs (lectures; alternate years) | 1999- |
| Resident/Student bedside teaching, Neurology, Puget Sound VA Hosp | 1999-2012 |
| Computational Neurosci: Vision, Cold Spring Harbor Labs (lectures) (alt. years) | 2000- |
| Physiology Seminar (UW P BIO 511) (lectures) | 2000-2011 |
| Computational Neuroscience (UW Computer Science, CSE 590RR) (lecture) | 2002 |
| Quantitative Methods (UW P BIO 545) (course leader, with F. Rieke) (alt. years) | 2003- |
| Computational Neuroscience, Okinawa, Japan (lectures) | 2004 |
| Neurobiology of Decision-Making, Cold Spring Harbor Labs (lecture) | 2005 |
| Cognitive Neuroscience, Institute of Physics & Mathematics, Tehran Iran | 2005 |
| Cognitive and Integrative Neuroscience (UW NB 503) (course leader) | 2006-2012 |
| Cognitive and Brain Sciences, Delmenhorst, Germany (lectures) | 2006 |
| Computational Neuroscience, Woods Hole (lecturer) | 2009 |
| Cognition, Brain and Technology Summer School, Barcelona (lectures) | 2009 |
| Beliefs and Decisions: of Minds and Machines, Budapest (lectures) | 2009 |
| Computational & Cognitive Neuroscience, Suzhou, China (lectures) | 2009 |
| Primate Neurology summer course, WaNPRC (course leader) | 2009 |
| Biostatistics Workshop (UW NB 511) (course leader) | 2009 |
| Computational Neuroscience (UW NB 528) (lecture) | 2011 |
| Neurology Grand Rounds, Columbia University (lecture) | 2013 |
| Casual Neuroscience, Bologna (lecture) | 2013 |
| Bangalore Cognition Workshop, Bangalore, India (lecture) | 2013 |
| Psychology Pro-Seminar (guest lecture) | 2014 |
| FENS –Hertie Winter School “The Neuroscience of Decision Making (lectures) | 2015 |
| Neuroscience of Neurological and Psychiatric Disorders (G4100) | 2015 |
| Neuroscience of Neurological and Psychiatric Disorders (guest lecture) | 2015 |

EDITORIAL BOARDS:

1999-2009 *Journal of Neurophysiology*

2000-present *Neuron*

2001-present *Neuroscience Research*

2003-2009 *Journal of Vision* (reviewing editor)
 2003-2011 *Trends in Neuroscience*
 2004-2009 *Journal of Neuroscience*
 2005-present *Cerebral Cortex*
 2008-present *Current Biology*
 2011-present *Neuroscience Bulletin*
 2015-present *Current Opinion in Neurobiology*

DEPARTMENT AND UNIVERSITY COMMITTEES:

1997-2012 Search Committee, Associate Director, University of Washington Regional Primate Research Center
 1998-1999 Search Committee, Neurosciences Systems Appointment University of Washington, Department of Physiology and Biophysics
 1997-2001 Faculty Lecture Series Committee, University of Washington, Department of Physiology and Biophysics
 1999-2012 Chair, Search Committee, University of Washington, Department of Physiology and Biophysics
 2001-2007 Co-Director, Graduate Program in Neurobiology and Behavior
 2002-2012 Chair, Search Committee, Computational Neuroscience, Department of Physiology and Biophysics
 2002-2012 Lamport Lecture Selection Committee, Hille Lecturer Selection Committee
 2003 Search Committee, Systems Neuroscience, Molecular Physiology and Biophysics
 2004-2012 Search Committee, Primate Neuroscience, Departments of Physiology and Biophysics, Biological Structure and Washington National Primate Research Center
 2005-2007 Chair, Graduate and Joint/Affiliate Faculty Nominations Committee, Department of Physiology and Biophysics
 2009-2012 Selection Committee, Wayne Crill Award
 2008-2012 Promotions Committees (2)
 2010 Committee on Recruitment of Under Represented Minority Students
 2012- Steering Committee, Grossman Center for the Statistics of Mind, Columbia University Medical Center
 2012- Search Committee, Director of Neuroimaging, Columbia University
 2012- Search Committee, Department of Neuroscience, Columbia University Medical Center
 2014- Presidential Scholars in Society and Neuroscience Advisory Committee
 2015 Search Committee, Institute for Comparative Medicine (ICM), Columbia University Medical Center

TRAINEES:

Graduate Students (PhD) Supervised

1996-2002 Jamie Roitman
 1997-2004 Mark Mazurek

| | |
|--------------|-----------------|
| 2003-2009 | Tim Hanks |
| 2005-2009 | Roozbeh Kiani |
| 2006-2014 | Peter Milstrup |
| 2009-2014 | Shinichiro Kira |
| 2012-present | Huyang Yul Kang |
| 2013-present | Naomi Odean |

Postdoctoral Fellows Supervised

| | |
|--------------|----------------------------|
| 1996-1998 | Jong-Nam Kim, DVM, Ph.D. |
| 1996-2001 | Matthew Leon, Ph.D. |
| 1997 | Bhavin Sheth, Ph.D. |
| 1997-2002 | Joshua Gold, Ph.D. |
| 2000-2003 | Jochen Ditterich, Ph.D. |
| 2001-2004 | Alex Huk, Ph.D. |
| 2001-2004 | Peter Janssen, M.D., Ph.D. |
| 2001-2003 | Steven Rude, Ph.D. |
| 2003-2008 | Tianming Yang, Ph.D. |
| 2004-2008 | Anne Churchland, Ph.D. |
| 2007-2010 | Victor de Lafuente, Ph.D. |
| 2007-2013 | Mehrdad Jazayeri, Ph.D. |
| 2009-2010 | Tim Hanks, Ph.D. |
| 2010-present | Christopher Fetsch, Ph.D. |
| 2010-present | Shushruth, Ph.D. |
| 2011-present | NaYoung So, Ph.D. |
| 2011-present | Luke Woloszyn, Ph.D. |
| 2013-present | Mehdi Sanayei, Ph.D. |
| 2013-present | Ariel Zylberberg, Ph.D. |
| 2014-present | Herbert (Zheng) Wu, Ph.D. |
| 2015-present | Danique Jeurissen, Ph.D. |

Undergraduate Research

| | |
|-----------|---------------------|
| 2000-2001 | Rebecca Hendrickson |
| 2002-2004 | Ruchi Kapoor |
| 2003-2004 | Marcel Tam |

EXROP Summer Students

| | |
|------|---------------------|
| 2009 | Leah Corthell |
| 2011 | Nitzy Bustamante |
| 2013 | Javier How |
| 2014 | Claudia Varela |
| 2015 | Nicholas Singletary |

Qualifying Exam Committees

Department of Physiology and Biophysics, University of Washington:

| | |
|-----------|-----------|
| 1998-2002 | Kerry Kim |
| 1998-2004 | Jo Hopp |

2001-2004 Greg Fielf
1998 Deborah Dlugosch

Program in Neurobiology and Behavior, University of Washington:

1998-2005 Tom Knight
1998-2001 Mitch Roitman
1998-2007 Mark Ruffo
2000-2004 Jamie Theobald
2001-2006 Kimberley Craven
1998-2001 Scott Votaw
2001-2005 Francisco Perez
2001-2005 Sarah Allred
2003-2007 Abigail Person
2004-2007 Felice Dunn
2007-2011 Andrew Hart
2008-2012 Charlie Hass
2008 Philip Harding
2008-2009 Erick Chastain
2010-2012 Nicholas Hollon

Department of Engineering and Biostructure, University of Washington:

1998-2001 David Bailey

Department of Applied Mathematics, University of Washington:

2009-2012 Nicholas Cain

Department of Neurobiology, Baylor College of Medicine (external):

2008-2012 James Cotton

Department of Biomedical Engineering, Columbia University:

2013-present Bin Lou

Department of Neuroscience, Columbia University:

2013-present Martin Vignovich
2013-present Scott Bolkan
2014-present Jalal Baruni

OUTREACH:

2000 Summer Institute for Middle School Teachers, UW (lecture)
1995-2007 High School & Middle School demonstrations
1996 Medical volunteer, Jacmel, Haiti
2009 HHMI EXROP mentor
2012 Fall Brain Series (lecture)
2013 Mind Brain Behavior, Panel Leader Economics and Value
2013-present HHMI EXROP mentor

2014, 2015 NYCity Regional Brain Bee (MC)
 2015 Jazz in the Brain: A Dialogue of Sounds and Science
 2015 Center for Jazz Studies: Improvisation in the Sciences

GRANTS AND CONTRACTS:

Current awards

HOWARD HUGHES MEDICAL INSTITUTE, 2000-present

Supports all research and laboratory infrastructure. The HHMI does not identify specific aims. All aims of the awards below are supported by HHMI, and the budgets of these grants are small, thanks to HHMI support.

NEURAL MECHANISMS OF VISUAL PERCEPTION, NIH R01EY11378, 1996-present.

M. Shadlen (PI)

The major goals of this project are to study the mechanisms that underlie formation of a decision about a visual stimulus. The experiments investigate response properties of single neurons during performance of a motion discrimination task near psychophysical threshold. Our current emphasis is on the extension of the mechanisms we have discovered in simple 2-choice tasks to more complex settings: more options, more complex inference.

HOW EPISODIC MEMORY GUIDES DECISIONS: NEURAL MECHANISMS AND IMPLICATIONS FOR MEMORY LOSS, THE McKNIGHT ENDOWMENT FUND FOR NEUROSCIENCE, 2016-2019.

D. Shomany (PI). M. Shadlen (Consultant)

The grant aims to test how memories are sampled to guide value-based decisions, using a combination of functional MRI, behavior, and computational modeling in healthy human participants and in patients with memory impairments.

Past awards

DECIDING AND REVISING: A UNIFYING FRAMEWORK FOR DECISION MAKING AND MOTOR CONTROL, INTERNATIONAL HUMAN FRONTIERS RESEARCH PROGRAM, 2011-2015

M. Shadlen (co-PI). D. Wolpert (PI)

This is a collaborative proposal to formulate and test experimentally principles common to decision-making and the optimal control of limb movement. These principles include the tradeoff between speed and accuracy, sampling cost and revision of an action or choice after initiation.

NEURAL CODING OF VISION, NIH RR00166, 1997-2012

M. Shadlen (PI)

This is a P51 grant to the Washington National Primate Research Center. The major goal of this project is to record ensemble neural activity from multiple neurons in extrastriate area MT and the lateral intraparietal area during a motion discrimination task.

NEURAL BASIS OF BAYESIAN INFERENCE AND DECISION MAKING, JAMES S. McDONNELL FOUNDATION, 2006-2011.

M. Shadlen (PI) A. Pouget (co-PI)

The major goal of this project is to develop theoretical tools to study probabilistic population codes in a variety of contexts.

CRCNS: BAYESIAN DECISION MAKING WITH PROBABILISTIC POPULATION CODES, NIH R01DA022780, 2007-2010.

M. Shadlen (PI). A. Pouget (co-PI)

Collaborative Research in Computational Neuroscience (CRCNS). The project examines the role of probabilistic population encoding by neurons in the parietal cortex.

TEMPORAL INTEGRATION AND WORKING MEMORY, THE McKNIGHT ENDOWMENT FUND FOR NEUROSCIENCE, 1996-1999

M. Shadlen (PI)

Inactive. This project established a connection between frontal lobe mechanisms supporting working (short-term) memory and decision making.

PUBLICATIONS:

1. van den Berg R, Anandalingam K, Zylberberg A, Kiani R, Shadlen MN, Wolpert DM (2016) A common mechanism underlies changes of mind about decisions and confidence. *eLife*. In Press
2. Jazayeri M, Shadlen MN (2015) A neural mechanism for sensing and reproducing a time interval. *Curr Biol*. PMID: PMC4618078
3. Finnerty, G. T., Shadlen, M. N., Jazayeri, M., Nobre, A. C., & Buonomano, D. V. (2015) Time in Cortical Circuits. *The Journal of Neuroscience: the Official Journal of the Society for Neuroscience*, 35(41), 13912–13916. PMID: PMC4604229
4. de Lafuente V, Jazayeri M, Shadlen MN (2015) Representation of accumulating evidence for a decision in two parietal areas. *J Neurosci* 35:4306-4318 PMID: PMC4355201
5. Kira S, Yang T, Shadlen MN (2015) A neural implementation of Wald's sequential probability ratio test. *Neuron* 85:861-873 PMID: PMC4365451
6. Kiani R, Corthell L, Shadlen MN (2014) Choice certainty is informed by both evidence and decision time. *Neuron* 84:1329-1342. PMID: PMC4271191
7. Hanks T, Kiani R, Shadlen MN (2014) A neural mechanism of speed-accuracy tradeoff in macaque area LIP. *eLife*:e02260. PMID: PMC4054775
8. Fetsch CR, Kiani R, Newsome WT, Shadlen MN (2014) Effects of cortical microstimulation on confidence in a perceptual decision. *Neuron* 83:797-804. PMID: PMC4141901
9. Burk D, Ingram JN, Franklin DW, Shadlen MN, Wolpert DM (2014) Motor effort alters changes of mind in sensorimotor decision making. *PLoS ONE* 9:e92681. PMID: PMC3961398
10. Kiani R, Churchland AK, Shadlen MN (2013) Integration of direction cues is

- invariant to the temporal gap between them. *J Neuroscience* 33:16483-16489. PMCID: PMC3797371
11. Cain N, Barreiro A, Shea-Brown E, Shadlen MN (2013) Neural integrators for decision making: A favorable tradeoff between robustness and sensitivity. *J Neurophysiol* PMCID: PM3653050
 12. Huang Y, Friesen AL, Hanks TD, Shadlen MN, Rao RPN (2012) How prior probability influences decision making: A unifying probabilistic model. In: *Advances in Neural Information Processing Systems*: MIT Press.
 13. Shadlen MN, Roskies AL (2012) The neurobiology of decision-making and responsibility: reconciling mechanism and mindedness. *Front Neurosci* 6:56.1-12. PMCID: PMC3332233
 14. Drugowitsch J, Moreno-Bote R, Churchland AK, Shadlen MN, Pouget A (2012) The cost of accumulating evidence in perceptual decision making. *J Neurosci* 32:3612-3628. PMCID: PMC3329788
 15. Selen LP, Shadlen MN, Wolpert DM (2012) Deliberation in the motor system: reflex gains track evolving evidence leading to a decision. *J Neurosci* 32:2276-2286. PMCID: PMC3299561
 16. Hedges JH, Gartshteyn Y, Kohn A, Rust NC, Shadlen MN, Newsome WT, Movshon JA (2011) Dissociation of neuronal and psychophysical responses to local and global motion. *Curr Biol* 21:2023–2028. PMCID: PMC3241977
 17. Hanks TD, Kiani R, Mazurek M, Hopp E, Shadlen MN (2011) Elapsed decision time affects the weighting of prior probability in a perceptual decision task. *J Neurosci* 31:6339-52. PMCID: PMC3356114
 18. Churchland AK, Kiani R, Chaudhuri R, Wang XJ, Pouget A, Shadlen MN (2011) Variance as a signature of neural computations during decision-making. *Neuron*: 69:818-31. PMCID: PMC3066020
 19. Jazayeri M, Shadlen MN (2010). Temporal context calibrates interval timing. *Nature Neurosci* 13:1020-6. PMCID: PMC2916084
 20. Resulaj A, Kiani R, Wolpert DM, Shadlen MN (2009) Changes of Mind in Decision-Making. *Nature* 461:263-266. PMCID: PMC2875179
 21. Kiani R, Shadlen MN (2009) Representation of confidence associated with a decision by neurons in the parietal cortex. *Science* 324:759-764. PMCID: PMC2738936
 22. Kiani R, Hanks TD, Shadlen MN (2008) Bounded integration in parietal cortex underlies decisions even when viewing duration is dictated by the environment. *J Neurosci* 28:3017-3029. PMID: 18354005
 23. Ganguli S, Bisley JW, Roitman JD, Shadlen MN, Goldberg ME, Miller KD (2008) One-dimensional dynamics of attention and decision making in LIP. *Neuron* 58:15-25. PMID: 18400159
 24. Churchland AK, Kiani R, Shadlen MN (2008) Decision-making with multiple alternatives. *Nat Neurosci* 11:693-702. PMCID: PMC2453226
 25. Beck JM, Ma WJ, Kiani R, Hanks T, Churchland AK, Roitman J, Shadlen MN, Latham PE, Pouget A (2008) Probabilistic population codes for Bayesian decision making. *Neuron* 60:1142-1152. PMID: 19109917
 26. Gold JI, Shadlen MN (2007) The Neural Basis of Decision Making. *Annu Rev Neurosci* 30:535-574. PMID: 17600525

27. Yang T, Shadlen MN (2007) Probabilistic reasoning by neurons. *Nature* 447:1075-1080. PMID: 17546027
28. Wong KF, Huk AC, Shadlen MN, Wang XJ (2007) Neural circuit dynamics underlying accumulation of time-varying evidence during decision-making. *Frontiers in Computational Neurosci* 1:1-11. PMCID: PMC2525934
29. Hanks TD, Ditterich J, Shadlen MN (2006) Microstimulation of macaque area LIP affects decision-making in a motion discrimination task. *Nat Neurosci* 9:682 - 689. PMCID: PMC2770004
30. Palmer J, Huk AC, Shadlen MN (2005) The effect of stimulus strength on the speed and accuracy of a perceptual decision. *Journal of Vision* 5:376-404. PMID: 16097871
31. Janssen P, Shadlen MN (2005) A representation of the hazard rate of elapsed time in macaque area LIP. *Nat Neurosci* 8:234-241. PMID: 15657597
32. Huk AC, Shadlen MN (2005) Neural activity in macaque parietal cortex reflects temporal integration of visual motion signals during perceptual decision making. *J Neurosci* 25:10420-10436. PMID: 16280581
33. Mazurek ME, Roitman JD, Ditterich J, Shadlen MN (2003) A role for neural integrators in perceptual decision making. *Cereb Cortex* 13:1257-1269. PMID: 14576217
34. Leon MI, Shadlen MN (2003) Representation of time by neurons in the posterior parietal cortex of the macaque. *Neuron* 38:317-327. PMID: 12718864
35. Gold JI, Shadlen MN (2003) The influence of behavioral context on the representation of a perceptual decision in developing oculomotor commands. *J Neurosci* 23:632-651. PMID: 12533623
36. Ditterich J, Mazurek M, Shadlen MN (2003) Microstimulation of visual cortex affects the speed of perceptual decisions. *Nat Neurosci* 6:891-898. PMID: 12858179
37. Roitman JD, Shadlen MN (2002) Response of neurons in the lateral intraparietal area during a combined visual discrimination reaction time task. *J Neurosci* 22:9475-9489. PMID: 12417672
38. Mazurek ME, Shadlen MN (2002) Limits to the temporal fidelity of cortical spike rate signals. *Nat Neurosci* 5:463-471. PMID: 11976706
39. Gold JI, Shadlen MN (2002) Banburismus and the brain: decoding the relationship between sensory stimuli, decisions, and reward. *Neuron* 36:299-308. PMID: 12383783
40. Shadlen MN, Newsome WT (2001) Neural basis of a perceptual decision in the parietal cortex (area LIP) of the rhesus monkey. *J Neurophysiol* 86:1916-1936. PMID: 11600651
41. Gold JI, Shadlen MN (2001) Neural computations that underlie decisions about sensory stimuli. *Trends Cogn Sci* 5:10-16. PMID: 11164731
42. Gold JI, Shadlen MN (2000) Representation of a perceptual decision in developing oculomotor commands. *Nature* 404:390-394. PMID: 10746726
43. Leon MI, Shadlen MN (1999) Effect of expected reward magnitude on the response of neurons in the dorsolateral prefrontal cortex of the macaque. *Neuron* 24:415-425. PMID: 10571234
44. Kim JN, Shadlen MN (1999) Neural correlates of a decision in the dorsolateral

- prefrontal cortex of the macaque. *Nat Neurosci* 2:176-185. PMID: 10195203
45. Shadlen MN, Newsome WT (1998) The variable discharge of cortical neurons: implications for connectivity, computation and information coding. *J Neurosci* 18:3870-3896. PMID: 9570816
 46. Olshen RA, Shadlen MN (1997) Discussion of "Non-linear Fourier time series analysis for human brain mapping" by N. Lange and S.L. Zeger. *Journal of the Royal Statistical Society (Series C)* 46:22.
 47. Shadlen MN, Newsome WT (1996) Motion perception: seeing and deciding. *Proc Natl Acad Sci (USA)* 93:628-633. PMID: PMC40102
 48. Shadlen MN, Britten KH, Newsome WT, Movshon JA (1996) A computational analysis of the relationship between neuronal and behavioral responses to visual motion. *J Neurosci* 16:1486-1510. PMID: 8778300
 49. Britten KH, Newsome WT, Shadlen MN, Celebrini S, Movshon JA (1996) A relationship between behavioral choice and the visual responses of neurons in macaque MT. *Visual Neurosci* 13:87-100. PMID: 8730992
 50. Zohary E, Shadlen MN, Newsome WT (1994) Correlated neuronal discharge rate and its implications for psychophysical performance. *Nature* 370:140-143. PMID: 8022482
 51. Shadlen MN, Newsome WT (1994) Noise, neural codes and cortical organization. *Curr Opin Neurobiol* 4:569-579. PMID: 7812147
 52. Engel S, Rumelhart D, Wandell B, Lee A, Glover G, Chichilnisky E, Shadlen M (1994) fMRI of human visual cortex. *Nature* 369:525. PMID: 8031403
 53. Carney T, Shadlen MN (1993) Dichoptic activation of the early motion system. *Vision Res* 33:1977-1995. PMID: 8249314
 54. Britten KH, Shadlen MN, Newsome WT, Movshon JA (1993) Responses of neurons in macaque MT to stochastic motion signals. *Vis Neurosci* 10:1157-1169. PMID: 8257671
 55. Britten KH, Shadlen MN, Newsome WT, Movshon JA (1992) The analysis of visual motion: a comparison of neuronal and psychophysical performance. *J Neurosci* 12:4745-4765. PMID: 1464765
 56. Ramoa AS, Shadlen MN, Freeman RD (1987) Dark-reared cats: Unresponsive cells become visually responsive with micro-iontophoresis of an excitatory amino acid. *Exp Brain Res* 65:658-665. PMID: 3556492
 57. Carney T, Shadlen M, Switkes E (1987) Parallel processing of motion and colour information. *Nature* 328:647-649. PMID: 3614368
 58. Shadlen M, Carney T (1986) Mechanisms of human motion perception revealed by a new cyclopean illusion. *Science* 232:95-97. PMID: 3952502
 59. Ramoa AS, Shadlen MN, Skottun BC, Freeman RD (1986) A comparison of inhibition in orientation and spatial frequency selectivity of cat visual cortex. *Nature* 321:237-239. PMID: 3713805

REVIEWS, CHAPTERS, EDITORIALS:

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