

Timothy J. Buschman

Contact Information

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Education

- 2008 **Massachusetts Institute of Technology**
 Ph.D. in Neuroscience under the supervision of Dr. Earl K. Miller
- 2001 **California Institute of Technology**
 B.S. in Biology

Current Positions

- 2013- **Princeton University**
 Assistant Professor, Princeton Neuroscience Institute and Department of Psychology

Past Positions

- 2010-2013 **Massachusetts Institute of Technology**
 Postdoctoral Fellow with Dr. Christopher I. Moore
- 2011-2013 **Massachusetts Institute of Technology**
 Postdoctoral Fellow with Dr. Ed Boyden
- 2008-2010 **Massachusetts Institute of Technology**
 Postdoctoral Associate with Dr. Earl K. Miller
- 2001-2002 **National Institute of Mental Health**, Laboratory of Neurophysiology
 Postbaccalaureate Intramural Research Training Award (IRTA) under the supervision of Drs.
 Robert Desimone, Pascal Fries and Elizabeth Buffalo.
- 2000-2001 **California Institute of Technology**
 Undergraduate research under the supervision of Dr. Christof Koch.
- 1994-1999 **Walter Reed Army Institute of Research**
 Research assistant under the supervision of Dr. Victor W. Macdonald.

Committees, Advisory Boards, and Other Professional Positions

- 2010- Consultant, BBN Technologies on neurally-plausible, brain-based computational architectures for
 'sense-making' of satellite imagery.

Professional Societies

- 2002- **Society for Neuroscience**
2008- **Faculty of 1000**

Editorial Activities

Ad hoc Reviewer for:

Science
Journal of Neuroscience
Journal of Neurophysiology
Frontiers in Human Neuroscience
Biological Reviews
Computational and Systems Neuroscience (COSYNE) 2012 and 2013 Meeting

Awards, Honors and Prizes

- 2010 **Awarded K99/R00, Pathway to Independence Award by National Institute of Mental Health**
 NIMH/1 K99 MH092715-01 – Pathway to Independence Award
- 2009 **Buschman and Miller, *Science*, 2007 designated a Hot Paper by Thompson ISI**
 Designation was highlighted in [The Scientist](http://www.the-scientist.com/2009/10/1/57/1/) - <http://www.the-scientist.com/2009/10/1/57/1/>
- 2004 **Team Award for Outstanding Teaching**
 For teaching in Undergraduate Brain Lab in the department of Brain and Cognitive Science, MIT
- 1997 **FEEA/Blue Cross Blue Shield Special Distinction Scholarship**
 Assistance with undergraduate tuition; awarded for research at Walter Reed Army Institute of Research.

Patents

- 2011 Earl Keith Miller and **Timothy Joseph Buschman**. 2011. *Method And Apparatus Accounting for Independent Cognitive Capacities in the Right vs. Left Half of Vision*. U.S. Patent 61/492,877, filed June 3, 2011. Method for increasing information processing in visual displays. Based on neurophysiological and psychophysical understanding of our limited capacity to process information in visual displays. Method allows for display systems to dynamically adjust how, when, and where information is presented in order to maximize perceptual processing.

Report of Scholarship

Peer-Reviewed Publications

Top-down versus bottom-up control of attention in the prefrontal and posterior parietal cortices

Buschman TJ and Miller EK.
Science 2007; 315 (5820): 1860-1862.

Serial, covert shifts of attention during visual search are reflected by the frontal eye fields and correlated with population oscillations

Buschman TJ and Miller EK.
Neuron 2009; 63 (3): 386-96.

Shifting the spotlight of attention: evidence for discrete computations in cognition

Buschman TJ and Miller EK.
Frontiers in Human Neuroscience 2010; 4: 194. doi: 10.3389/fnhum.2010.00194

Comparison of primate prefrontal and premotor cortex neuronal activity during visual categorization

Cromer JA, Roy JE, **Buschman TJ** and Miller EK
Journal of Cognitive Neuroscience, in press. Available online, doi:10.1162/jocn_a_00032

Neural substrates of cognitive capacity limitations

Buschman TJ, Siegel M, Roy JE and Miller EK.
Proceedings of the National Academy of Sciences USA 2011; 108(27) 11252-11255, doi: 10.1073/pnas.1104666108

Laminar differences in gamma and alpha coherence in the ventral stream

Buffalo E, Fries P, Landman R, **Buschman TJ** and Desimone R

Proceedings of the National Academy of Sciences USA 2011; 108(27) 11262-11267, doi: 10.1073/pnas.1011284108

Dynamic Networks in Prefrontal Cortex Support Flexibility to Switch Between Rules

Buschman TJ, Denovellis E, Diogo C, Brandon D, Miller EK

Neuron, in press.

Cortical circuits for the control of attention

Miller EK and **Buschman TJ**

Current Opinion in Neurobiology, in press.

Non-peer reviewed scientific or medical publications/materials in print or other media

Bootstrapping Your Brain: How Interactions Between the Frontal Cortex and Basal Ganglia May Produce

Organized Actions and Lofty Thoughts

Miller EK and **Buschman TJ**

Raymond P. Kesner and Joe L. Martinez (Eds.), *Neurobiology of learning and memory* (2nd edition, pp. 339 - 354). 2007. Oxford, UK: Elsevier.

Rules through Recursion: How Interactions between the Frontal Cortex and Basal Ganglia May Build Abstract, Complex Rules from Concrete, Simple Ones

Miller EK and **Buschman TJ**

Silvia A. Bunge and Jonathan D. Wallis (Eds.), *Neuroscience of rule-guided behavior* (1st edition, pp. 419 - 440). 2007. New York, NY: Oxford University Press.

Top-Down Control of Attention by Rhythmic Neural Computations

Miller EK and **Buschman TJ**

Posner, M.I. (ed) *Cognitive Neuroscience of Attention* New York: Guilford Press

Neural mechanisms for the executive control of attention

Miller EK and **Buschman TJ**

Kastner S and Nobre K(ed); *Oxford's Handbook of Attention*, Oxford University Press, in press

Invited Lectures and Presentations

Regional

2012 **Visual Attention Seminar Series**, Harvard University, Cambridge, MA

2009 **Visual Attention Seminar Series**, Harvard University, Cambridge, MA

National

2012 **California Institute of Technology**, Pasadena, CA; March, 2012

Princeton University, Princeton, NJ; March, 2012

Stanford University, School of Medicine, Palo Alto; February, 2012

New York University, New York, NY; January, 2012

University of Wisconsin, Madison, Madison, WI; January, 2012

2010 **Dynamics of Cortico-Cortical Interactions**, Chico, MT

2008 **NSF Science of Learning Annual Meeting**, Washington, DC

International

2012 **Visual Search and Selective Attention**, Munich, Germany, July, 2012

University of Tubingen, Tubingen, Germany, July, 2012

2010 **Workshop on Computational Properties of Prefrontal Cortex**, Vancouver, BC Canada

Thesis

Comparison of frontal and parietal cortices in the control of visual attention

Advisor: Earl K. Miller

Massachusetts Institute of Technology; Dept. of Brain and Cognitive Sciences

URI: <http://hdl.handle.net/1721.1/42082>

Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings

- 2012** **Dynamic, synchronous, sub-networks in prefrontal cortex encode stimulus-response rules**
Society for Neuroscience Annual Meeting, 2012
Buschman TJ, Denovellis EL, Diogo C, Bullock D, Miller EK
- Point process models of anterior cingulate and dorsolateral prefrontal cortical neurons during cognitive control**
Society for Neuroscience Annual Meeting, 2012
Denovellis EL, **Buschman TJ**, Diogo C, Bullock D, Miller EK
- Prefrontal cortex neurons reflect decisions about ambiguous stimuli.**
Society for Neuroscience Annual Meeting, 2012
Roy JE, **Buschman TJ**, Miller EK
- Neural recoding from the prefrontal network during the update of working memory**
Society for Neuroscience Annual Meeting, 2012
Rose JM, **Buschman TJ**, Miller EK
- In vivo optogenetic neural circuit control using 3-D microfabricated optical waveguide arrays**
Society for Neuroscience Annual Meeting, 2012
Zorzos AN, Monahan PE, **Buschman TJ**, Scholvin J, Acker L, Fonstad CG, Boyden ES
- Dynamic networks in frontal cortex support the cognitive flexibility to switch between rules**
Computational and Systems Neuroscience (Cosyne) 2012
Buschman TJ, Denovellis EL, Diogo C, Bullock D, Miller EK
- Neural recoding from the prefrontal network during the update of working memory**
8th Federation of European Neuroscience Societies (FENS) Forum of Neuroscience
Rose J, **Buschman TJ**, Miller EK
- 2011** **Investigating cortico-cortical interactions in the mouse somatosensory system using electrophysiological and optogenetic techniques**
Society for Neuroscience Annual Meeting
Buschman TJ, Voigts J, Siegle J, Vierling-Classen D, Moore CI
- Tasking Switching in the Prefrontal and Anterior Cingulate Cortex**
Society for Neuroscience Annual Meeting
Denovellis EL, **Buschman TJ**, Diogo C, Bullock D, Miller EK
- Evidence from Capacity Limitations for a Dual-Model of Working Memory**
Society for Neuroscience Annual Meeting
Rose J, **Buschman TJ**, Yorgan VR, Miller EK
- 2010** **Neural Correlates of Working Memory Capacity Limitations in Primate Prefrontal and Parietal Cortices**
Society for Neuroscience Annual Meeting
Buschman TJ, Yorgan V, Siegel M, and Miller EK
- 2008** **The Role of Synchrony and Oscillations in the Control of Visual Attention in Monkey Cortex**
Society for Neuroscience Annual Meeting
Buschman TJ and Miller EK
- 2007** **Shared and Distinctive Mechanisms in Primate Frontal and Parietal Cortex During Internal and External Control of Attention**

- Society for Neuroscience Annual Meeting
Buschman TJ and Miller EK
- 2006** **Comparison of AND, OR, and XOR rules in monkeys**
Society for Neuroscience Annual Meeting
Buschman TJ, Machon M, and Miller EK
- 2005** **Roles of monkey prefrontal and parietal cortices in exogenous and endogenous control of visual attention**
Society for Neuroscience Annual Meeting
Buschman TJ and Miller EK
- 2004** **Different timecourses for visual target selection in the monkey prefrontal vs. parietal cortex**
Society for Neuroscience Annual Meeting
Buschman TJ and Miller EK
- 2002** **Modulation of neuronal synchronization in area V2 by selective visual attention**
Society for Neuroscience Annual Meeting
Buffalo EA, **Buschman TJ**, Fries P, Desimone R

Teaching

- 2011 Guest lecturer on “Basal Ganglia and the Prefrontal Cortex: From Habits to Cognition” in PGY2 Clinical Neuroscience Lecture Series, MGH.
- 2011 Guest lecturer on “Working Memory and Executive Control” in Neural Basis of Learning and Memory, 9.03, Undergraduate Course, MIT.
- 2005-2006 Teaching Assistant for 9.011, Introductory to Systems Neuroscience Graduate Course, Dept. Brain and Cognitive Science at MIT.
- 2004 Teaching Assistant for 9.02, Undergraduate Brain Lab in Dept. Brain and Cognitive Sciences at MIT.