

Stanford



Tirin Moore

Professor of Neurobiology

CONTACT INFORMATION

- **Alternate Contact**

Susan Matthews - Administrative Assistant

Email susanmat@stanford.edu

Tel (650) 723-7109

Bio

ACADEMIC APPOINTMENTS

- Professor, Neurobiology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Wu Tsai Neurosciences Institute

HONORS AND AWARDS

- Elected Member, National Academy of Medicine (2017)
- Investigator, Howard Hughes Medical Institute (2014-)
- Early Career Scientist, Howard Hughes Medical Institute (2009-2014)
- Troland Award, National Academy of Sciences (2009)
- CAREER Award, National Science Foundation (2006-2011)
- McKnight Scholar Award, McKnight Endowment Fund (2006-2009)
- Pew Scholar, Pew Charitable Trust (2004-2008)

PROFESSIONAL EDUCATION

- Ph.D., Princeton , Neuroscience (1995)
- Postdoc, M.I.T. , Neuroscience

LINKS

- MooreLab Webpage: <https://www.moorelabstanford.com>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

We study neural mechanisms of visual-motor integration and the neural basis of cognition (e.g. attention). We study the activity of single neurons in visual and motor structures within the brain, examine how perturbing that activity affects neurons in other brain structures, and also how it affects the perceptual and motor performance of behaving animals. Questions currently addressed by our group include:

- (1) How are the signals conveyed by visual cortical neurons used to guide eye movements?
- (2) How does oculomotor feedback affect processing in visual cortex?
- (3) What is the impact of planned movements on visual perception?
- (4) What are the neural circuits and neural computations that control selective attention?

Our laboratory is also driven to develop more powerful approaches to systems-level neurobiological questions.

Teaching

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Amelia Christensen, Jessica Verhein, Megan Wang

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Bioengineering (Phd Program)
- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **Laminar segregation of sensory coding and behavioral readout in macaque V4.** *Proceedings of the National Academy of Sciences of the United States of America*
Pettine, W. W., Steinmetz, N. A., Moore, T.
2019
- **Exploration Disrupts Choice-Predictive Signals and Alters Dynamics in Prefrontal Cortex** *NEURON*
Ebitz, R., Albarran, E., Moore, T.
2018; 97 (2): 450+
- **Spatial working memory alters the efficacy of input to visual cortex** *NATURE COMMUNICATIONS*
Merrikhi, Y., Clark, K., Albarran, E., Parsa, M., Zirnsak, M., Moore, T., Noudoost, B.
2017; 8
- **Neural Mechanisms of Selective Visual Attention.** *Annual review of psychology*
Moore, T., Zirnsak, M.
2017; 68: 47-72
- **Selective Modulation of the Pupil Light Reflex by Microstimulation of Prefrontal Cortex.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*

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- Ebitz, R. B., Moore, T.
2017; 37 (19): 5008–18
- **Selective modulation of cortical state during spatial attention** *SCIENCE*
Engel, T. A., Steinmetz, N. A., Gieselmann, M. A., Thiele, A., Moore, T., Boahen, K.
2016; 354 (6316): 1140-1144
 - **Eye movement preparation modulates neuronal responses in area v4 when dissociated from attentional demands.** *Neuron*
Steinmetz, N. A., Moore, T.
2014; 83 (2): 496-506
 - **Visual space is compressed in prefrontal cortex before eye movements.** *Nature*
Zirnsak, M., Steinmetz, N. A., Noudoost, B., Xu, K. Z., Moore, T.
2014; 507 (7493): 504-507
 - **Prefrontal Contributions to Attention and Working Memory.** *Current topics in behavioral neurosciences*
Bahmani, Z., Clark, K., Merrikhi, Y., Mueller, A., Pettine, W., Isabel Vanegas, M., Moore, T., Noudoost, B.
2019
 - **The interdependence of attention, working memory and gaze control: behavior and neural circuitry.** *Current opinion in psychology*
Jonikaitis, D., Moore, T.
2019; 29: 126–34
 - **Both a Gauge and a Filter: Cognitive Modulations of Pupil Size** *FRONTIERS IN NEUROLOGY*
Ebitz, R., Moore, T.
2019; 9
 - **Dopamine Receptor Expression Among Local and Visual Cortex-Projecting Frontal Eye Field Neurons.** *Cerebral cortex (New York, N.Y. : 1991)*
Mueller, A., Krock, R. M., Shepard, S., Moore, T.
2019
 - **Robust Online Spike Recovery for High-Density Electrode Recordings using Convolutional Compressed Sensing**
Weingartner, S., Chen, X., Akcakaya, M., Moore, T., IEEE
IEEE.2019: 1015–20
 - **Visions for the Future of Neuroscience** *NEURON*
Moore, T., Chestek, C., Polley, D., Chen, A., Hippenmeyer, S., Anikeeva, P.
2018; 98 (3): 464–65
 - **Dissonant Representations of Visual Space in Prefrontal Cortex during Eye Movements** *CELL REPORTS*
Chen, X., Zirnsak, M., Moore, T.
2018; 22 (8): 2039–52
 - **Differential Expression of Dopamine D5 Receptors across Neuronal Subtypes in Macaque Frontal Eye Field** *FRONTIERS IN NEURAL CIRCUITS*
Mueller, A., Shepard, S. B., Moore, T.
2018; 12: 12
 - **Both a Gauge and a Filter: Cognitive Modulations of Pupil Size.** *Frontiers in neurology*
Ebitz, R. B., Moore, T.
2018; 9: 1190
 - **Linking ADHD to the Neural Circuitry of Attention** *TRENDS IN COGNITIVE SCIENCES*
Mueller, A., Hong, D. S., Shepard, S., Moore, T.
2017; 21 (6): 474-488
 - **Social and attention-to-detail subclusters of autistic traits differentially predict looking at eyes and face identity recognition ability** *BRITISH JOURNAL OF PSYCHOLOGY*
Davis, J., McKone, E., Zirnsak, M., Moore, T., O’Kearney, R., Apthorp, D., Palermo, R.
2017; 108 (1): 191-219
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- **Does the Superior Colliculus Control Perceptual Sensitivity or Choice Bias during Attention? Evidence from a Multialternative Decision Framework.** *journal of neuroscience*
Sridharan, D., Steinmetz, N. A., Moore, T., Knudsen, E. I.
2017; 37 (3): 480-511
- **Two Types of Receptive Field Dynamics in Area V4 at the Time of Eye Movements?** *Frontiers in systems neuroscience*
Hartmann, T. S., Zirnsak, M., Marquis, M., Hamker, F. H., Moore, T.
2017; 11: 13-?
- **Visual sensitivity of frontal eye field neurons during the preparation of saccadic eye movements** *JOURNAL OF NEUROPHYSIOLOGY*
Krock, R. M., Moore, T.
2016; 116 (6): 2882-2891
- **Copula Regression Analysis of Simultaneously Recorded Frontal Eye Field and Inferotemporal Spiking Activity during Object-Based Working Memory** *JOURNAL OF NEUROSCIENCE*
Hu, M., Clark, K. L., Gong, X., Noudoost, B., Li, M., Moore, T., Liang, H.
2015; 35 (23): 8745-8757
- **Combined contributions of feedforward and feedback inputs to bottom-up attention** *FRONTIERS IN PSYCHOLOGY*
Khorsand, P., Moore, T., Soltani, A.
2015; 6
- **The What and Where of Visual Attention.** *Neuron*
Moore, T., Zirnsak, M.
2015; 88 (4): 626-28
- **Copula regression analysis of simultaneously recorded frontal eye field and inferotemporal spiking activity during object-based working memory.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*
Hu, M., Clark, K. L., Gong, X., Noudoost, B., Li, M., Moore, T., Liang, H.
2015; 35 (23): 8745-57
- **Saccades and shifting receptive fields: anticipating consequences or selecting targets?** *TRENDS IN COGNITIVE SCIENCES*
Zirnsak, M., Moore, T.
2014; 18 (12): 621-628
- **Persistent Spatial Information in the FEF during Object-based Short-term Memory Does Not Contribute to Task Performance** *JOURNAL OF COGNITIVE NEUROSCIENCE*
Clark, K. L., Noudoost, B., Moore, T.
2014; 26 (6): 1292-1299
- **Global selection of saccadic target features by neurons in area v4.** *journal of neuroscience*
Burrows, B. E., Zirnsak, M., Akhlaghpour, H., Wang, M., Moore, T.
2014; 34 (19): 6700-6706
- **Latency of chromatic information in area V4.** *Journal of physiology, Paris*
Chang, M., Xian, S., Rubin, J., Moore, T.
2014; 108 (1): 11-17
- **Distinguishing bias from sensitivity effects in multialternative detection tasks.** *Journal of vision*
Sridharan, D., Steinmetz, N. A., Moore, T., Knudsen, E. I.
2014; 14 (9)
- **The Influence of Gaze Control on Visual Perception: Eye Movements and Visual Stability.** *Cold Spring Harbor symposia on quantitative biology*
Krock, R. M., Moore, T.
2014; 79: 123-130
- **Distinguishing bias from sensitivity effects in multialternative detection tasks.** *Journal of vision*
Sridharan, D., Steinmetz, N. A., Moore, T., Knudsen, E. I.
2014; 14 (9)

- **Prefrontal contributions to visual selective attention.** *Annual review of neuroscience*
Squire, R. F., Noudoost, B., Schafer, R. J., Moore, T.
2013; 36: 451-466
- **Parietal and prefrontal neurons driven to distraction.** *Nature neuroscience*
Noudoost, B., Moore, T.
2013; 16 (1): 8-9
- **Persistent Spatial Information in the Frontal Eye Field during Object-Based Short-Term Memory** *JOURNAL OF NEUROSCIENCE*
Clark, K. L., Noudoost, B., Moore, T.
2012; 32 (32): 10907-10914
- **Lumping and Splitting the Neural Circuitry of Visual Attention** *NEURON*
Steinmetz, N. A., Moore, T.
2012; 73 (3): 410-412
- **Dissociation of Response Variability from Firing Rate Effects in Frontal Eye Field Neurons during Visual Stimulation, Working Memory, and Attention** *JOURNAL OF NEUROSCIENCE*
Chang, M. H., Armstrong, K. M., Moore, T.
2012; 32 (6): 2204-2216
- **The role of neuromodulators in selective attention** *TRENDS IN COGNITIVE SCIENCES*
Noudoost, B., Moore, T.
2011; 15 (12): 585-591
- **Selective Attention from Voluntary Control of Neurons in Prefrontal Cortex** *SCIENCE*
Schafer, R. J., Moore, T.
2011; 332 (6037): 1568-1571
- **Probing neural circuitry and function with electrical microstimulation** *PROCEEDINGS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES*
Clark, K. L., Armstrong, K. M., Moore, T.
2011; 278 (1709): 1121-1130
- **A reliable microinjectrode system for use in behaving monkeys** *JOURNAL OF NEUROSCIENCE METHODS*
Noudoost, B., Moore, T.
2011; 194 (2): 218-223
- **Top-down control of visual attention** *CURRENT OPINION IN NEUROBIOLOGY*
Noudoost, B., Chang, M. H., Steinmetz, N. A., Moore, T.
2010; 20 (2): 183-190
- **Stimulus onset quenches neural variability: a widespread cortical phenomenon** *NATURE NEUROSCIENCE*
Churchland, M. M., Yu, B. M., Cunningham, J. P., Sugrue, L. P., Cohen, M. R., Corrado, G. S., Newsome, W. T., Clark, A. M., Hosseini, P., Scott, B. B., Bradley, D. C., Smith, M. A., Kohn, et al
2010; 13 (3): 369-U25
- **Changes in the Response Rate and Response Variability of Area V4 Neurons During the Preparation of Saccadic Eye Movements** *JOURNAL OF NEUROPHYSIOLOGY*
Steinmetz, N. A., Moore, T.
2010; 103 (3): 1171-1178
- **Selection and Maintenance of Spatial Information by Frontal Eye Field Neurons** *JOURNAL OF NEUROSCIENCE*
Armstrong, K. M., Chang, M. H., Moore, T.
2009; 29 (50): 15621-15629
- **Influence and Limitations of Popout in the Selection of Salient Visual Stimuli by Area V4 Neurons** *JOURNAL OF NEUROSCIENCE*
Burrows, B. E., Moore, T.
2009; 29 (48): 15169-15177
- **Dynamic sensitivity of area V4 neurons during saccade preparation** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*

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- Han, X., Xian, S. X., Moore, T.
2009; 106 (31): 13046-13051
- **Presaccadic discrimination of receptive field stimuli by area V4 neurons** *Buenos Aires Workshop on Visual Attention*
Moore, T., Chang, M. H.
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 - **Attention governs action in the primate frontal eye field** *NEURON*
Schafer, R. J., Moore, T.
2007; 56 (3): 541-551
 - **Electrical signals propagate unbiased in cortex** *NEURON*
Gilja, V., Moore, T.
2007; 55 (5): 684-686
 - **Temporal patterning of saccadic eye movement signals** *JOURNAL OF NEUROSCIENCE*
Kimmel, D. L., Moore, T.
2007; 27 (29): 7619-7630
 - **Rapid enhancement of visual cortical response discriminability by microstimulation of the frontal eye field** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Armstrong, K. M., Moore, T.
2007; 104 (22): 9499-9504
 - **Changes in visual receptive fields with microstimulation of frontal cortex** *NEURON*
Armstrong, K. M., Fitzgerald, J. K., Moore, T.
2006; 50 (5): 791-798
 - **The neurobiology of visual attention: finding sources** *CURRENT OPINION IN NEUROBIOLOGY*
Moore, T.
2006; 16 (2): 159-165
 - **Visual and oculomotor selection: links, causes and implications for spatial attention** *TRENDS IN COGNITIVE SCIENCES*
Awh, E., Armstrong, K. M., Moore, T.
2006; 10 (3): 124-130
 - **Representations of faces and body parts in macaque temporal cortex: A functional MRI study** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Pinsk, M. A., DeSimone, K., Moore, T., Gross, C. G., Kastner, S.
2005; 102 (19): 6996-7001
 - **Methods for functional magnetic resonance imaging in normal and lesioned behaving monkeys** *JOURNAL OF NEUROSCIENCE METHODS*
Pinsk, M. A., Moore, T., Richter, M. C., Gross, C. G., Kastner, S.
2005; 143 (2): 179-195
 - **A map of complex movements in motor cortex of primates** *1st Behavioural Brain Sciences Symposium*
Graziano, M. S., Taylor, C. S., Cooke, D. F., Moore, T.
PSYCHOLOGY PRESS.2005: 211-232
 - **Homeland defense begins in precentral cortex. Focus on "Sensorimotor integration in the precentral gyrus: Polysensory neurons and defensive movements"** *JOURNAL OF NEUROPHYSIOLOGY*
Moore, T.
2004; 91 (4): 1456-1456
 - **Distribution of hand location in monkeys during spontaneous behavior** *EXPERIMENTAL BRAIN RESEARCH*
Graziano, M. S., Cooke, D. F., Taylor, C. S., Moore, T.
2004; 155 (1): 30-36
 - **Visually guided behavior after V1 lesions in young and adult monkeys and its relation to blindsight in humans.** *Progress in brain research*
Gross, C. G., Moore, T., Rodman, H. R.
2004; 144: 279-294

- **Microstimulation of the frontal eye field and its effects on covert spatial attention** *JOURNAL OF NEUROPHYSIOLOGY*
Moore, T., Fallah, M.
2004; 91 (1): 152-162
- **Visuomotor origins of covert spatial attention** *NEURON*
Moore, T., Armstrong, K. M., Fallah, M.
2003; 40 (4): 671-683
- **Complex movements evoked by microstimulation of the ventral intraparietal area** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Cooke, D. F., Taylor, C. S., Moore, T., Graziano, M. S.
2003; 100 (10): 6163-6168
- **Selective gating of visual signals by microstimulation of frontal cortex** *NATURE*
Moore, T., Armstrong, K. M.
2003; 421 (6921): 370-373
- **Visually guided behavior after V1 lesions in young and adult monkeys and its relation to blindsight in humans** *Conference on the Roots of Visual Awareness*
Gross, C. G., Moore, T., Rodman, H. R.
ELSEVIER SCIENCE BV.2003: 279-294
- **The cortical control of movement revisited** *NEURON*
Graziano, M. S., Taylor, C. S., Moore, T., Cooke, D. F.
2002; 36 (3): 349-362
- **Probing cortical function with electrical stimulation** *NATURE NEUROSCIENCE*
Graziano, M. S., Taylor, C. S., Moore, T.
2002; 5 (10): 921-921
- **Complex movements evoked by microstimulation of precentral cortex** *NEURON*
Graziano, M. S., Taylor, C. S., Moore, T.
2002; 34 (5): 841-851
- **Eye movements modulate visual receptive fields of V4 neurons** *NEURON*
Tolias, A. S., Moore, T., Smirnakis, S. M., Tehovnik, E. J., Siapas, A. G., Schiller, P. H.
2001; 29 (3): 757-767
- **Control of eye movements and spatial attention** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Moore, T., Fallah, M.
2001; 98 (3): 1273-1276
- **Direction of motion discrimination after early lesions of striate cortex (V1) of the macaque monkey** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Moore, T., Rodman, H. R., Gross, C. G.
2001; 98 (1): 325-330
- **Shape representations and visual guidance of saccadic eye movements** *SCIENCE*
Moore, T.
1999; 285 (5435): 1914-1917
- **Visual representations during saccadic eye movements** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Moore, T., Tolias, A. S., Schiller, P. H.
1998; 95 (15): 8981-8984
- **Man, monkey, and blindsight** *NEUROSCIENTIST*
Moore, T., Rodman, H. R., Gross, C. G.
1998; 4 (4): 227-230
- **Man, Monkey and Blindsight.** *The Neuroscientist*

Moore, T., Rodman, H.R., Gross, C.G.
1998; 4: 227-230

- **Greater residual vision in monkeys after striate cortex damage in infancy** *JOURNAL OF NEUROPHYSIOLOGY*

Moore, T., Rodman, H. R., REPP, A. B., Gross, C. G., Mezrich, R. S.
1996; 76 (6): 3928-3933

- **LOCALIZATION OF VISUAL-STIMULI AFTER STRIATE CORTEX DAMAGE IN MONKEYS - PARALLELS WITH HUMAN BLINDSIGHT** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*

Moore, T., Rodman, H. R., REPP, A. B., Gross, C. G.
1995; 92 (18): 8215-8218