Thomas C. Sprague

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Education & Professional Appointments

Postdoctoral Associate

- New York University, New York, NY (March 2016-present)
- Advisers: Clayton Curtis, Jonathan Winawer, Wei Ji Ma

PhD in Neurosciences, with a specialization in Computational Neurosciences

- University of California, San Diego, La Jolla, CA (September 2010 – February 2016)
- PhD adviser: John Serences
- Degree conferred: February 8, 2016
- Dissertation title: “Information content of visual representations depends on attentional priority and working memory load”
- Committee members: John Serences, Don MacLeod, Tim Gentner, Eric Halgren and Tatyana Sharpee

B.A. in Cognitive Science and Neuroscience with Honors

- Rice University, Houston, TX (August 2006-May 2010)

Publications

Vo, VA., **Sprague, T.C.**, and Serences, J.T. (in press). Spatial tuning shifts increase the discriminability and fidelity of population codes in visual cortex. *Journal of Neuroscience.* Preprint available at: http://biorxiv.org/content/early/2016/11/10/086892

Sprague, T.C., Ester, E.F., and Serences, J.T. (2016). Restoring latent visual working memory representations in human cortex. *Neuron.*

*Ester, E.F., *Rademaker, R.L. and ***Sprague, T.C.** (2016). How do visual and parietal cortex contribute to visual short-term memory? Peer-reviewed commentary on “Decoding the content of visual short-term memory under distraction in occipital and parietal areas” by Bettencourt & Xu, 2016 (* indicates equal contribution). *eNeuro*.

Samaha, J., **Sprague, T.C.**, and Postle, B.R. (2016). Decoding and reconstructing the focus of spatial attention from the topography of alpha-band oscillations. *Journal of Cognitive Neuroscience*.

Ester, E.F., **Sprague, T.C.**, and Serences, J.T. (2015). Parietal and frontal cortex encode stimulus-specific mnemonic representations during visual working memory. *Neuron.*

Sprague, T.C., Ester, E.F. and Serences, J.T. (2014). Reconstructions of information in visual spatial working memory degrade with memory load. *Current Biology.*

Itthipuripat S., Garcia, J.O., Rungratsameetaweemana, N. **Sprague, T.C.**, Serences, J.T. (2014). Changing the spatial scope of attention alters the pattern of neural gain in human cortex. *Journal of Neuroscience*.

Sprague, T.C. and Serences, J.T. (2013). Attention modulates spatial priority maps in human occipital, parietal and frontal cortices. *Nature Neuroscience*.

Reviews/Book chapters

Sprague, T.C., Saproo, S. and Serences, J.T. (2015). Attention mitigates information loss in small- and large-scale neural codes. *Trends in Cognitive Sciences.*

Sprague, T.C. and Serences, J.T. (2015). Using human neuroimaging to examine top-down modulations of visual perception. *An Introduction to Model-based Cognitive Neuroscience, eds. Birte Forstmann & E-J Wagenmakers.*

Manuscripts in preparation and under review

Sprague, T.C., Itthipuripat, S., Vo, V.A., and Serences, J.T. (submitted). Dissociable signatures of visual salience and behavioral relevance across attentional priority maps in human cortex.

*Itthipuripat, S., ***Sprague, T.C.**, and Serences, J.T. (in preparation). Within-participant differences in attention-related shifts in contrast response functions measured using EEG and fMRI. (*equal contribution)

Ester, E.F., **Sprague, T.C.**, and Serences, J.T. (in preparation). Task-specific feature-selective representations in human visual and parietal cortex.

Invited Talks

Sprague, T.C. (2016, January). Working memory representations measured with human fMRI degrade with load, but can be restored with attention. Invited Guest Lab Meeting, Princeton University, Princeton, NJ.

Sprague, T.C. (2015, November). Working memory representations measured with human fMRI degrade with load, but can be restored with attention. Cognitive Neural Systems Seminar Series, UC San Diego, La Jolla, CA.

Sprague, T.C. (2015, November). Working memory representations measured with human fMRI degrade with load, but can be restored with attention. Keck Center for Functional MRI Invited Seminar Speaker, UC San Diego, La Jolla, CA.

Sprague, T.C. (2014, August). Reconstructions of spatial information in human cortex under different task conditions. Invited Guest Lab Meeting, Princeton University, Princeton, NJ.

Sprague, T.C., Ester, E.F., and Serences, J.T. (2014, January). Reconstructing representations of information under different task conditions. Wa! Seminar Series, UCSD Cognitive Science

Sprague, T.C. Modulations of information representations in human cortex under different cognitive demands. (2014, May). UCSD Neurosciences Graduate Program Annual Retreat, Student-invited speaker.

Sprague, T.C., Ester, E.F., and Serences, J.T. (2013, December). Reconstructing representations of information under different task conditions. Brain Talks Seminar Series, Multimodal Imaging Lab, UCSD Radiology.

Sprague, T.C. (2012, January). Measuring sensory and oculomotor information coding across human visual, parietal and frontal cortex. Cognitive Neural Systems Seminar Series, UCSD.

Sprague, T.C. and Eagleman, D.M. (2009, July). Color-motion asynchrony depends on stimulus repetition. RIKEN BSI Summer Program, Tokyo, Japan.

Sprague, T.C. and Eagleman, D.M. (2009, July). The perceived duration of a stimulus depends on temporal context. Tohoku University 2nd Annual Brain Science Retreat, Sendai, Japan.

Selected Conference Presentations (full list available upon request)

Sprague, T.C., Rahmati, M., Yoo, A., Ma, W.J., and Curtis, C.E. (2017, May). Decoding visual spatial working memory uncertainty from human cortex. Poster to be presented at the Vision Sciences Society Annual Meeting, St Petersburg, FL.

Vo, V.A., Sutterer, D., Foster, J., **Sprague, T.C.**, Awh, E., and Serences, J.T. (2017, May). Neural representations of spatial position recalled from long-term and short-term memory diverge across the cortical hierarchy. Talk to be presented at the Vision Sciences Society Annual Meeting, St Petersburg, FL.

Sprague, T.C., Itthipuripat, S., Vo, V.A., and Serences, J.T. (2016, November). Graded representations of stimulus salience and attentional priority across visually-responsive cortex. Talk presented at the Society for Neuroscience Annual Meeting as part of a nano-symposium on Spatial Attention and Working Memory (organizer: **TC Sprague**). San Diego, CA.

Vo., V.A., **Sprague, T.C.**, and Serences, J.T. (2016, November). Spatial attention modulates voxel receptive fields to boost the fidelity of multi-voxel stimulus representations. Talk presented at the Society for Neuroscience Annual Meeting as part of a nano-symposium on Spatial Attention and Working Memory. San Diego, CA.

Samaha, J., **Sprague, T.C.**, Voytek, B., Gazzaley, A., Postle, B.R. Preparatory encoding of the location and scope of human spatial attention. Talk presented at the Society for Neuroscience Annual Meeting as part of a nano-symposium on Spatial Attention and Working Memory. San Diego, CA.

Sprague, T.C., Ester, E.F., and Serences, J.T. (2016, May). Visual and parietal spatial working memory representations are robust to brief irrelevant distracters. Poster presented at the Vision Sciences Society Annual Meeting, St Petersburg, FL.

Chunharas, C., Itthipuripat S., **Sprague, T.C.**, Ester, E.F., Serences, J.T. (2016, May). Individual differences in depth discrimination predicts differences in visual working memory for stimuli rendered in 3D. Poster presented at the Vision Sciences Society Annual Meeting, St Petersburg, FL.

Henderson, M.M., Chunharas, C., Vo, V.A., **Sprague, T.C.**, Serences, J.T. Reconstructing 3D stimuli using BOLD activation patterns recovers hierarchical depth processing in human visual and parietal cortex. Poster presented at the Vision Sciences Society Annual Meeting, St Petersburg, FL.

Sprague, T.C., Itthipuripat, S. and Serences, J.T. (2015, October). Different population-level measurements and analysis techniques enable complementary insights into attentional modulation of visual responses. Poster presented at the Society for Neuroscience Annual Meeting, Chicago, IL.

Vo, V.A., **Sprague, T.C.**, and Serences, J.T. (2015, October). Linking attentional modulations of single-voxel population receptive fields and region-level spatial reconstructions. Poster presented at the Society for Neuroscience Annual Meeting, Chicago, IL.

Ester, E.F., **Sprague, T.C.** and Serences, J.T. (2015, October). Category learning biases representations of orientation in early human visual cortex. Talk presented at the Society for Neuroscience Annual Meeting, Chicago, IL.

Sprague, T.C., Ester E.F., and Serences, J.T. (2015, May). Recovery of degraded information in visuospatial working memory representations in human occipital, parietal and frontal cortex. Talk presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Ester, E.F., **Sprague, T.C.** and Serences, J.T. (2015, May). Visual working memory representations are distributed throughout human cortex. Talk presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Smith, M.E., **Sprague, T.C.**, and Serences, J.T. (2015, May). Univariate frontoparietal BOLD does not track the magnitude of attentional modulations in visual cortex. Poster presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Sprague, T.C., Ester, E.F., and Serences, J.T. (2015, March). Attention to items in working memory improves fidelity of population codes in human cortex. Poster presented at COSYNE 2015, Salt Lake City, UT

Sprague, T.C., Ester, E.F., and Serences, J.T. (2014, November). Mnemonic representations in human occipital, parietal and frontal cortex index visuospatial working memory acuity. Talk presented at the Society for Neuroscience Annual Meeting, Washington, DC.

Vo, V.A., **Sprague, T.C.**, and Serences, J.T. (2014, November). The effects of spatial attention on voxel-level population receptive fields and spatial information content. Poster presented at the Society for Neuroscience Annual Meeting, Washington, DC.

Sprague, T.C., Itthipuripat, S. and Serences, J.T. (2014, May). Within-participant differences in attention-related shifts in contrast response functions measured using EEG and fMRI. Poster presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Kaye, K.E., **Sprague,T.C.**, Itthipuripat, S. Prado, E. and Serences, J.T. (2014, May). Steady-state sensory-evoked responses are enhanced prior to occulomotor execution. Poster presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Garcia, J.O., Kaye, K.E., Williams, D., **Sprague, T.C.**, and Serences, J.T. (2014, May). The phase of intrinsic oscillations modulates feature and space-based visual attention. Talk presented at the Vision Sciences Society Annual Meeting, St. Petersburg, FL.

Sprague, T.C., Ester, E.F, and Serences, J.T. (2013, November). Delay period spatial representations of remembered visual stimuli in human occipital, parietal and frontal cortex depend on memory load. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

Itthipuripat S., Garcia, J.O., Rungratsameetaweemana, N. **Sprague, T.C.**, Serences, J.T. (2013, November). Manipulating attention strategy alters patterns of neural gain in human cortex. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

Garcia, J.O., Kaye, K.E., **Sprague, T.C.**, and Serences, J.T. (2013, November). Near real-time spatial reconstructions of visual stimuli with EEG: Exploring the dynamics of spatial attention. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

Sprague, T.C., Ester E.F. and Serences, J.T. (2013, May). Reconstructing delay-period representations of remembered visual stimuli in visual, parietal and frontal cortex. Poster presented at the Vision Sciences Society Annual Meeting, Naples, FL.

Sprague, T.C. and Serences, J.T. (2012, October). Using a forward encoding model for spatial visual information reveal effects of attention across different cortical regions. Poster presented at the Society for Neuroscience Annual Meeting, New Orleans, LA.

Sprague, T.C and Serences, J.T. (2012, May). Reconstructing spatial maps in occipital, parietal and frontal cortex using an encoding model of spatial receptive fields. Poster presented at the Vision Sciences Society Annual Meeting, Naples, FL.

Sprague, T.C. and Serences, J.T. (2011, November). Estimating motion and saccade direction-selective responses in human visual, parietal and frontal cortex. Poster presented at the Society for Neuroscience Annual Meeting, Washington, D.C.

Sprague, T.C. and Eagleman, D.M. (2009, May). The perceived duration of a stimulus depends on temporal context. Poster presented at the Vision Sciences Society Annual Meeting, Naples, FL.

Sprague, T.C. and Eagleman, D.M. (2009, February). Neural latencies are not equivalent to perceptual latencies. Poster presented at the Baylor College of Medicine Department of Neuroscience Annual Form, The Woodlands, TX.

Sprague, T.C. and Eagleman, D.M. (2008, November). Perceptual asynchrony depends on stimulus predictability. Poster presented at the Society for Neuroscience Annual Meeting, Washington, D.C.

Funding

- NYU Visual Neuroscience NIH Training Grant (beginning March 2017)
- UCSD Institute for Neural Computation NIH Training Grant (Fall 2014-Spring 2015).
- National Science Foundation Graduate Research Fellow (Fall 2011-Summer 2014)

Awards

- Leon Thal Award for Outstanding Neurosciences Graduate Student (Spring 2015)
- Vision Sciences Society Student Travel Award (2015)
- Fine Science Tools Travel Award (2012)
- National Science Foundation Graduate Research Fellowship (Spring 2010)
- Outstanding Graduate in Cognitive Sciences at Rice University (Spring 2010)
- Voted Outstanding Oral Presentation, 2nd Annual Tohoku University Brain Sciences Retreat, Sendai, Japan (Summer 2009)
- National Merit Scholar (2006)

Research mentorship

- Connor Williams (New York University, undergraduate, winter 2017-present)
- Gaoyang Gui (New York University, masters student, winter 2017-present)
- Grace Hallenbeck (New York University, PhD student; summer 2016-present)
- Helena Palmeri (New York University, undergraduate, fall 2016-present)
- Haider Al-Hakeem (UC San Diego; undergraduate research assistant; winter 2014-summer 2015)
- Jon MacLeod (William & Mary University; undergraduate summer volunteer; summer 2013)
- Zoe Kohl (Rice University; undergraduate summer volunteer; summer 2012)

Research Experience

Postdoctoral Associate, Curtis Lab, NYU, advised by Clayton Curtis and Jon Winawer (March 2016-present)

Graduate Student, Perception and Cognition Lab, UCSD, advised by John Serences (June 2011-February 2016)

Undergraduate Research Assistant, Laboratory for Perception and Action, Baylor College of Medicine, advised by David Eagleman (February 2007-August 2010)

Teaching Experience

Lecturer – Invited Workshop on Inverted Encoding Models (March 2015), single-topic workshop at Bernstein Center for Computational Neuroscience in Berlin, attended by graduate students, post-doctoral researchers and faculty

- Develop course materials, including datasets and analysis code (available at bit.ly/IEM_tutorial)
- Lead participants through interactive analysis exercises

Course organizer – UCSD Vision Journal Club (Winter 2015), seminar course attended by faculty, post-doctoral researchers and graduate students from multiple departments, faculty oversight by Karen Dobkins

- Organized thematic content (“visual population codes”)
- Led discussion: “mixed vs. fixed selectivity in population codes during decision-making”
- Assisted with planning weekly discussion topics and readings

Co-Lead Computational Neuroscience Teaching Assistant, Project Leader – UCSD Neurosciences Graduate Program “Boot Camp” (2011-2014), intensive 2-week introduction to electrophysiology, imaging, and computational methods, organized by Bill and Kathy Kristan (2011-2013), Stefan Leutgeb and Jing Wang (2014)

- Assist students with data analysis using MATLAB and Python
- Design and lead computational data analysis student projects (2012: multivariate analyses of fMRI data, reconstructing images based on brain activation patterns; 2014: 2-photon calcium imaging of sensory systems)
- Design and assist with computational modeling student projects (2011: synaptic model of working memory; 2013: conductance-based model of attention)

Lecturer - Analytical Methods in Computational Neuroscience (Spring 2014), student team-taught course, faculty oversight by Tatyana Sharpee

- Taught lecture and developed/graded problem set: “Methods in functional magnetic resonance imaging”

Course Organizer; Lecturer – Analytical Methods in Computational Neuroscience (Spring 2013), student team-taught course, faculty oversight by EJ Chichilnisky and Tatyana Sharpee

- Graduate-level computational neuroscience course
- Upper-year computational neuroscience students give lectures highlighting a data-driven analysis technique
- Taught lecture and developed/graded problem set: “Encoding and Decoding in Systems Neuroscience”
- Organized thematic content of course and recruited lecturers from UCSD Computational Neuroscience student community

Guest lecturer – Neurodynamics, taught by Gert Cauwenbergh (Fall 2011, 2012)

- Graduate-level engineering course for computational neurosciences students
- Developed and taught tutorial on using BRIAN network simulation package for Python

Teaching Assistant – Introduction to Computational Neuroscience, taught by Pamela Reinagel (Fall 2011)

- Graduate-level course for students interested in understanding methods in computational neuroscience, but little or no mathematical background
    - Topics: Poisson processes, information theory, Fourier analysis, cross- and autocorrelations, clustering analyses, Markov processes, Bayesian inference, random walks & diffusion processes, dimensionality reduction (PCA & ICA)
    - Guest lectures by EJ Chichilnisky & Terrance Sejnowski (Salk Institute)
- Taught weekly review section
- Planned course readings & lecture topics

Academic Service

SFN 2016 Nanosymposium organizer (Spatial Attention and Working Memory)

- Invited speakers from nonhuman primate and human labs studying different aspects of visual spatial cognition
- Developed nanosymposium application and coordinated talk order
- Chair: Clayton Curtis

UCSD Neurosciences Curriculum Committee (2010-2014)

- Identified course topics with student interest
- Recruited faculty to develop student-initiated courses
- Represent student body in discussions of curriculum efficacy

UCSD Neurosciences Computational Neuroscience Committee (2010-2015)

- Worked with faculty program directors to improve breadth and depth of computational neurosciences courses
- Leadership role in developing a seminar course taught by students

NSF Graduate Funding Panel

- Presented advice for optimizing NSF Graduate Research Fellowship applications
- Assisted students with edits to application documents

Neurosciences Graduate Program new student recruitment

- Organized or assisted with organizing non-academic activities for prospective students (2011-2013)
- Present posters during recruitment poster sessions (2012-2015)
- Lead cognitive neuroscience lab tour (2013-2015)

Ad-hoc reviewer

Cerebral Cortex; Cognitive, Affective and Behavioral Neuroscience; Frontiers in Systems Neuroscience; Journal of Cognitive Neuroscience; Journal of Experimental Psychology: Human Perception and Performance; Journal of Neuroscience; Journal of Neurophysiology; Nature Communications; Neuroimage; PLoS Computational Biology; PNAS; Scientific Reports

Academic Memberships

- Society for Neuroscience (2007-present)
- Vision Sciences Society (2008-present)

Academic Lecture Courses/Summer Schools

- Summer Institute for Cognitive Neuroscience, “Visual Attention and Emotional Cognition” (Santa Barbara, CA; Summer 2014)
- Cold Spring Harbor Laboratory Summer Course, “Computational Neuroscience: Vision” (Long Island, NY; Summer 2012)
- RIKEN Brain Science Institute Summer Lecture Course, “Interacting Brains” (Tokyo, Japan; Summer 2009)

Additional Activities

- UCSD Neuroscience Outreach Program volunteer (visit local middle and high schools to teach neuroscience, Fall 2010–Winter 2016)
- Writer and Blogger, Catalyst: Rice Undergraduate Science and Engineering Review (Fall 2009-Spring 2010)
- Building Rice Academics in Neuroscience (BRAiN), a student/faculty initiative for implementing an undergraduate neuroscience program and increasing community neuroscience awareness, co-founder and co-president (Fall 2008-Spring 2010)
- Rice Undergraduate Scholars Program Research Fellow (Fall 2008–Spring 2009)
- Scientia, an institute for the history of science and culture; C.P. Snow Student Fellow (Fall 2008-Spring 2009)
- Gulf Coast Consortia for Theoretical and Computational Neuroscience NSF REU Research Fellow (summer 2008)