

CAITLIN SUSAN TENISON

Educational Testing Service

Research Scientist | ctenison@ets.org | www.ctenison.com

BIO

Dr. Caitlin Tenison has over 10 years' experience in the Cognitive and Learning Sciences studying the processes underpinning higher order cognition. Her research brings together her rigorous academic understanding of human learning and decision-making with her industry experience building technologies to support training across diverse learner populations. Broadly her work combines data and theory to model the state of the learner from the decisions they make and actions they take. From investigating student strategy use and proficiency in complex digital environments to capturing student preferences when applying to universities, Tenison draws inferences about cognition from user behavior. This approach of use-inspired foundational research builds knowledge that can be used to meet the immediate needs of the project while also contributing insights that can be generalized across contexts.

EMPLOYMENT

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| 2020 - Present | Research Scientist
Educational Testing Service, Princeton, NJ
Researcher conducting use-inspired foundational research to develop techniques and technologies that strengthen ETS's mastery of elicitation and interpretation of learning evidence. |
| 2019 - 2019 | Lead Scientist |
| 2017 - 2019 | Research Scientist
Soar Technology Inc, Ann Arbor, MI
Principle Investigator leading research projects and designing new technologies to meet the training and decision support needs of multiple DoD agencies. |

EDUCATION

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| 2016- 2017 | Postdoctoral Researcher
Carnegie Mellon University, Pittsburgh, PA
<i>Supervisor:</i> Dr. John R. Anderson |
| 2011- 2016 | Ph.D. in Psychology
Carnegie Mellon University, Pittsburgh, PA
<i>Advisor:</i> Dr. John R. Anderson
<i>Committee:</i> Dr. Robert Siegler & Dr. Marcel Just
<i>Affiliations:</i> Program for Interdisciplinary Education Research, Pittsburgh Science of Learning Center |
| 2005-2009 | B.A. in Psychology and Plan II Honors
University of Texas, Austin, TX
GPA 4.0 Cum Laude Ampla et Magna |

GRANTS and CONTRACTS

2020 - 2022	Air Force Phase II STTR AF18B-T001 (\$1M): CogTracer Toolkit for identifying cognitive state from neuroimaging data (PI)
2019 - 2019	Army Phase II SBIR A181-063 (\$1M): Intelligent System Architecture for Autonomous Care: Trauma Diagnosis System (PI)
2019 - 2019	Air Force Phase I STTR AF18B-T001 (\$150k): CogTracer Toolkit for identifying cognitive state from neuroimaging data (PI)
2018 - 2019	Navy Broad Agency Announcement N6134016R0008 (\$200k): Navy Readiness for Expeditionary Surgery (PI)
Sep 2018 - Apr 2019	Army Phase I SBIR A181-063 (\$100k): Intelligent System Architecture for Autonomous Care: Trauma Diagnosis System (PI)
Jun 2018 - Nov 2018	Office of Naval Research SBIR N181-076 (\$125k) Proficiency Amplified through Knowledge Sharing and Support for Informal Teaching (Co-PI with Dr. Kelly Neville)
Feb 2018 - Aug 2018	Defense Health Agency STTR 17C-001 (\$150k): Griffon Test Suite for physiological data management and metric evaluation (PI)
Mar 2017 - 2019	Defense Advanced Research Projects Agency (DARPA) Phase 2 SBIR (\$1.5M): Rapid Configuration of Heterogeneous Models (Took over as PI after project start)
Dec 2017 - 2019	DARPA Phase 2 SBIR N13A-T024 (\$1M): Cognitive Bias in Online Communication Activity (Took over as PI after project start)
2014 - 2015	National Science Foundation, Science of Learning Centers. (\$1k) Award No. SMA-1430662. <i>Conference: A Proposal to the National Science Foundation for Support of the Seventh Annual Inter-Science of Learning Centers (iSLC) Student / Postdoctoral Scholar Conference.</i> (Co-Author with Chris MacLellan and Audrey Kittredge)

PUBLICATIONS

Journal Articles

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- Tenison, C., Ling, G and MuCulla, L. (Under Review). *Supporting College Choice Among International Students Through Collaborative Filtering.*
- Tenison, C. and Sparks, J.R. (Under Review). *Combining cognitive theory and data driven approaches to examine students' search strategies in simulated digital environments*
- Forsyth, C. Tenison, C. and Arlsan, B. (In Press) The Current trends and opportunities for machine learning in learning analytics. *International Encyclopedia of Education*, 4th edition.

- Anderson, J. R., Borst, J. P., Fincham, J. M., Ghuman, A. S., Tenison, C., & Zhang, Q. (2018). The Common Time Course of Memory Processes Revealed. *Psychological science*, 29(9), 1463-1474.
- Popov, V., Ostarek, M., & Tenison, C. (2018). Practices and pitfalls in inferring neural representations. *NeuroImage*, 174, 340-351.
- Tenison, C., Fincham, J., & Anderson, J. (2016). Phases of learning: How skill acquisition impacts cognitive processing. *Cognitive Psychology*, 87, 1-28.
- Jolles, D., Supekar, K., Richardson, J., Tenison, C., Ashkenazi, S., Rosenberg-Lee, M., Fuchs, L., & Menon, V. (2016). Reconfiguration of parietal circuits with cognitive tutoring in elementary school children. *Cortex*, 83, 231-245
- Jolles, D., Wassermann D., Chokani, R., Richardson, J., Tenison, C., Bammer, R., Supekar, K., Menon, V. (2016). Plasticity of left perisylvian white-matter tracts is associated with individual differences in math learning. *Brain Structure and Function*, 221(3), 1337-1351.
- Tenison, C., & Anderson, J. (2015). Modeling the distinct phases of skill acquisition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42(5), 749-767.
- Iuculano, T., Rosenberg-Lee, M., Richardson, J., Tenison, C., Fuchs, L., Supekar, K., & Menon, V. (2015). Cognitive tutoring induces widespread neuroplasticity and remediates brain function in children with mathematical learning disabilities. *Nature Communications*, 6.
- Tenison, C., Fincham, J., & Anderson, J. (2014). Detecting math problem solving strategies. An investigation into the use of retrospective self-reports, latency and fMRI data. *Neuropsychologia*, 54, 41-52.
- Supekar, K., Swigart, A., Tenison, C., Jolles, D., Rosenberg-Lee, M., Fuchs, L., & Menon, V. (2013). Neural predictors of individual differences in response to math tutoring in primary-grade school children. *PNAS*, 11(20), 8230-8235.
- White, M. P., Shirer, W. R., Molfino, M. J., Tenison, C., Damoiseaux, J. S., & Greicius, M. D. (2013). Disordered reward processing and functional connectivity in trichotillomania: a pilot study. *Journal of Psychiatric Research*, 47(9), 1264-1272.
- Ashkenazi, S., Rosenberg-Lee, M., Tenison, C., & Menon, V. (2012). Weak task-related modulation and stimulus representations during arithmetic problem solving in children with developmental dyscalculia. *Developmental Cognitive Neuroscience*, 2(1), 152-166.

Peer-Reviewed Conference Papers

- Tenison, C., and Arslan, B. (2020 July) *Characterizing pause behaviors in a science inquiry task*. In: Stewart, T.C. (Ed.). Proceedings of the 18th International Conference on Cognitive Modeling, Applied Cognitive Science Lab, Penn State, University Park, PA, pp. 283–298
- Collins, M. G., Tenison, C., Gluck, K. A., & Anderson, J. (2020). Detecting Learning Phases to Improve Performance Prediction. Proceedings of the 18th International Conference on Cognitive Modeling, Applied Cognitive Science Lab, Penn State, University Park, PA, pp. 283–298
- Tenison, C., & Anderson, J. (2017, July). *Impact of practice frequency on learning and retention*. Presented at the 39th Conference of the Cognitive Science Society, London, UK
- Popov, V., Ostarek, M. & Tenison, C. (2017, July). *Inferential pitfalls in decoding neural representations*. Presented at the 39th Conference of the Cognitive Science Society, London, UK

- Tenison, C. (2016, June). *Modeling the phases of skill acquisition*. Presented at the 4th annual Advances in Cognitive Systems: Students of Cognitive Systems Workshop, Evanston, IL.
- Tenison, C., & MacLellan, C. J. (2015, June). *The Impact of Instructional Intervention and Practice on Help-Seeking Strategies within an ITS*. In Proceedings of the 8th International Conference on Educational Data Mining, Madrid, Spain.
- Tenison, C. & Anderson, J. (2014, July). *Detecting Changes in Math Strategy During Learning*. In Proceedings of the 36th Conference of the Cognitive Science Society, Quebec City, Canada.
- Tenison, C., & MacLellan, C. J. (2014, June). *Modeling Strategy Use in an Intelligent Tutoring System: Implications for Strategic Flexibility*. In Proceedings of the 12th International Intelligent Tutoring Systems, Honolulu, HI.
- Tenison, C., & Anderson, J. (2014, June). *An Exploration of Two Methods for using fMRI to identify Student Problem Solving Strategies*. In Proceedings of Workshop "Utilizing EEG Input in Intelligent Tutoring Systems" at the 12th International Intelligent Tutoring Systems, Honolulu, HI.

Conference Presentations

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- Tenison, C. (2022, April). *Incorporating Pauses in Process Data Modeling with Heterogeneous Hidden Markov Models*. Annual Meeting of the National Council for Measurement in Education, San Diego, CA.
- Tenison, C. and Sparks J (2021, Oct). *Identifying Cognitive and Metacognitive Aspects of Digital Inquiry from Process Data*. Presented at Beyond Results 2021 Workshop.
- Tenison C. (2021, Feb). *Supporting College Choice Among International Students Through Collaborative Filtering*. Presented at ETS Canada's Women in AI Summit.
- Tenison, C., MacLellan, C., English, B., Cowell, T., and Sheline, R. (2019, July). *Curating Educational Content: Unsupervised Modeling of Users Behavior on Pinterest*. Presented at the 52nd Annual Meeting of the Society for Mathematical Psychology, Montreal, CA.
- Tenison, C., & Anderson, J. (2016, August). *From computation to automatization: How practice alters initial neural response to familiar arithmetic problems*. Presented at the 38th Conference of the Cognitive Science Society, Philadelphia, PA.
- Tenison, C., & Anderson, J. (2015, May). *Exploring skill acquisition with cognitive and brain-based models*. Paper presented at the 8th annual Inter-Science of Learning Center Student and Post-Doc Conference, San Diego, CA.
- Tenison, C., & Anderson, J. (2013, June). *Detecting math problem solving strategies using retrospective self-reports, latency, and fMRI data*. Presented at the Organization for Human Brain Mapping, Seattle, WA.
- Tenison, C., & Anderson, J. (2013, February). *Assessing strategy use in a fMRI study of arithmetic training*. Presented at the Inter-Science of Learning Center Student and Post-Doc Conference, Philadelphia, PA.
- Rosenberg-Lee, M., Escovar, E., Tenison, C., Khouzam, A., & Menon, V. (2012, October). *Dynamic changes in brain response and connectivity associated with arithmetic fact learning in children*. Presented at Society for Neuroscience, New Orleans, LA.
- Jolles, D., Rosenberg-Lee, M., Ashkenazi, S., Supekar, K., Tenison, C., Duan, X., Uddin, L., Fuchs, L., & Menon, V. (2012, October). *Math training strengthens intrinsic connectivity of parietal cortex in children*. Presented at Society for Neuroscience, New Orleans, LA.

- Rosenberg-Lee, M., Escovar, E., Tenison, C., Khouzam, A., & Menon, V. (2012, August). *How do children learn math facts?* Presented at EARLI SIG Neuroscience and Education, London, UK.
- Jolles, D., Rosenberg-Lee, M., Supekar, K., Tenison, C., Ashkenazi, S., Duan, X., & Menon, V. (2012, August). Math training changes intrinsic brain connectivity of the intraparietal sulcus. Presented at EARLI SIG Neuroscience and Education, London, UK.
- Rosenberg-Lee, M., Young, C., Tenison, C., Geary, D., & Menon, V. (2010, June). *Neural Correlates of Developmental Dyscalculia in Children: Univariate and Multivariate Analysis*. Presented at Human Brain Mapping Annual Meeting, Barcelona, SP.
- Pacheco, J., Dailey, N., Olivares, M., Tenison, C., & Schnyer, D. (2009, March) *An fMRI examination of the Effects of Aging on Memory Monitoring for Source and Item Recognition*. Presented at Cognitive Neuroscience Society Meeting, San Francisco, CA.
- Trujillo, L., Tenison, C., Dailey, D., & Schnyer, D. (2009, March). An ERP Examination of the *Differential Effects of Sleep Deprivation on Endogenously Cued and Exogenously Cued Attention*. Presented at Cognitive Neuroscience Society Meeting, San Francisco, CA.
- Goldwater, M., Schnyer, D., Markman, A., Williams, V., Tenison, C., & Dailey, N. (2008, April) *An Event Related Potential Analysis of Novel Denominal Verb Interpretation*. Presented at Cognitive Neuroscience Society Meeting, San Francisco, CA.

RESEARCH EXPERIENCE

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| 2020 - Present | <p>Cognitive and Learning Science Group
Educational Testing Service</p> <p>Conduct use-inspired foundational research to understand and develop techniques that strengthen ETS's mastery of elicitation and interpretation of learning evidence. Translate this research into actionable recommendations and scalable technologies. Work closely with several cross functional teams, to design and build AI enabled educational technologies that are sensitive and responsive to the needs of the individual learner.</p> |
| 2017-2019 | <p>Intelligent Training Group
Soar Technology Inc.</p> <p>Principle Investigator on multiple DoD funded projects. Wrote proposals, set scientific vision for projects, and led teams of engineers and scientists to successfully complete projects. Managed relationships with DoD program managers, subcontractors, and met contractual deliverables. Translated research advances into technology to solve problems faced by the modern warfighter.</p> |
| 2011-2017 | <p>ACT-R Laboratory
Carnegie Mellon University</p> <p>Dr. John R. Anderson, Principal Investigator</p> <p>Researched methods for modeling cognition by combining multiple sources of data with specific focus on detecting cognitive changes due to skill acquisition using brain and behavioral data</p> |

2009-2011	<p>Stanford Cognitive and Systems Neuroscience Laboratory Stanford University Dr. Vinod Menon, Principal Investigator Designed and conducted an NIH-funded study of the neural effects of math remediation on children with math learning disabilities</p>
2008-2009	<p>Honors Program University of Texas at Austin Dr. Charles Holahan and Dr. David Schnyer, Advisors Designed and implemented experiment investigating the interdependence between the neural networks of music and language through priming word recognition using familiar songs</p>

SKILLS

Analysis Packages	R, Python, Matlab, and SPSS.
Statistics and Machine Learning	Machine Learning and Data Analytic methods (e.g., hidden Markov modeling, linear discriminant analysis, principal components analysis), Statistical Methods (e.g., regression, hierarchical linear modeling, bayesian modeling), Recommender Systems (Collaborative Filtering and Hybrid approaches), Natural Language Processing.
Research Methods	Designing experiments, administering and scoring neuropsychological evaluations, working with participants between ages 7 – 80 years old, recruiting and scheduling subjects, cognitive task analysis, managing lab, overseeing and mentoring research assistants. Experience running studies in laboratory, classroom, and online environments. Experience with diverse design methods: contextual inquiry, storyboarding, ethnographic interviews.
Brain Imaging Methods	<p>Collecting functional, structural and diffusion tensor imaging (DTI) scans using a G.E. 3.0-tesla MRI magnet Collecting magnetoencephalography (MEG) data Analyzing fMRI data using software packages: AFNI and FSL and SPM Analyzing MEG data using MNE 72-channel electrophysiology (EEG) recording with the BioSemi System</p>

HONORS AND AWARDS

- 2018 Speaker for Institute of Neuroscience Seminar Series
University of Oregon
Presented research on cognitive foundations of skill acquisition.
- 2016 Bobby Klatzky Graduate Student Publication Award
Carnegie Mellon University
Given annually for outstanding performance in scholarly research and writing.
- 2015 Latin American School for Education, Cognitive, and Neural Sciences
The James S. McDonnell Foundation
Selected to attend a two-week international meeting of students and faculty to discuss bridging between education and brain sciences.
- 2015 Dick Hayes Graduate Student Service Award
Carnegie Mellon University
Given annually to the graduate student who contributes time and service to the department
- 2011 San Francisco Regional MENSA Scholarship
San Francisco Regional MENSA
Funding provided for attending graduate school
- 2008-2009 The Undergraduate Research Fellowship & Undergraduate Honors Research Grant
University of Texas at Austin
Provides research funding for undergraduate research projects
- 2005-2009 Terry Scholar
University of Texas at Austin
Full academic scholarship for four years of college

SERVICE

- 2020-Present Program Committee Member
Conference on Educational Data Mining
Served as PC member reviewing papers for EDM.
- 2015-2016 PIER Graduate Student Representative
Program for Interdisciplinary Education Research
Represented the graduate students at the Steering Committee meetings
- 2013-2014 Conference Organizer
Inter-Science of Learning Center Student and Postdoc Conference
Organized and hosted the 7th Annual iSLC conference in Pittsburgh bringing together students from Science of Learning Centers from across the United States

- 2013-2014 Organizer of Brain and Machine Learning Meetings
Collaboration between Psychology and Machine Learning
Organized series of talks to foster dialogue between Machine Learning and Psychology Departments
- 2013-2014 PIER Speaker Series Organizer
Program for Interdisciplinary Education Research
Invited and organized guest speakers series
- 2012-2013 President
Pittsburgh Science of Learning Center Student Group
Organized meetings, professional development, and attended executive committee meetings as representative for graduate students of the PSLC
- 2011-2012 Student Committee Member
Carnegie Mellon University - Human Computer Interaction Institute
Involved in planning curricula and requirements for the Masters in Educational Technology and Applied Learning Science program