Caitlin Susan Tenison

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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

2020 - Present	**Research Scientist** **Educational Testing Service**, Princeton, NJ Researcher conducting use-inspired foundational research to develop insights and technologies to support innovative assessments.
2019 - 2019 2017 - 2019	**Lead Scientist** **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.
2016 - 2017	**Postdoctoral Researcher** **Carnegie Mellon University**, Pittsburgh, PA *Supervisor*: Dr. John R. Anderson

EDUCATION

2011- 2016	**Ph.D. in Psychology** **Carnegie Mellon University**, Pittsburgh, PA *Advisor*: Dr. John R. Anderson *Committee:* Dr. Robert Siegler & Dr. Marcel Just *Affiliations:* 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). Funding applied for when working at SoarTech, received sub-contract to continue work at ETS.

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. *Conference: A Proposal to the National Science Foundation for Support of the Seventh Annual Inter-Science of Learning Centers (iSLC) Student / Postdoctoral Scholar Conference.* (Co-Author with Chris MacLellan and Audrey Kittredge)

Ober, T., Phelps, G. and **Tenison, C.** (Under Review). Translating Praxis into Practice: Generating Insights on Topic Difficulty from Praxis Elementary Multisubjects Exams to Support Future Educators.

Arslan, B. and **Tenison, C.** (Under Review). Adapting to Prior and Developing Knowledge. *Handbook of Personalized Learning.*

Arslan, B., Lehman, B., **Tenison, C.,** Sparks, J.R., Lopez, A., Gu, L., and Zapata-Rivera, D., (2024). Opportunities and Challenges of Using Generative AI to Personalize Educational Assessment. *Frontiers in Artificial Intelligence. 7, 1460651.*

Sparks, J.R., Ober, T., **Tenison, C.,** Arslan, B., Roll, I. Deane, P., Zapata-Rivera, D., Gooch, R., and O'Reilly, T., (2024). Measuring Digital Literacies in the Age of AI. *ETS Research Reports.*

Tenison, C. and Sparks, J.R. (2023). Combining cognitive theory and data driven approaches to examine students' search strategies in simulated digital environments. *Large-scale Assessments in Education*, *11*(1), 28.

Arslan, B., **Tenison**, C. & Finn, B. (2023). Going beyond observable actions: A cognition-centered approach to interpreting pauses represented in process data. European Journal of Psychological Assessment. *European Journal of Psychological Assessment.*

Forsyth, C. **Tenison**, C. and Arlsan, B. (2023) The Current trends and opportunities for machine learning in learning analytics. In: Tierney, R.J., Rizvi, F., Erkican, K. (Eds.), International Encyclopedia of Education, vol. 14. Elsevier, pp. 404–416.

Tenison, C., Ling, G and MuCulla, L. (2022). Supporting College Choice Among International Students Through Collaborative Filtering. *International Journal of Artificial Intelligence in Education.* https://doi.org/10.1007/s40593-022-00307-0

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 pittfalls 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.

Refereed Conference Presentations

Tenison, C., Ober, T. M., & Phelps G. (2025). *Predicting Success: Joint Modeling of Retake Behaviors in Teacher Licensure Assessment.* Paper accepted for presentation at the Annual Meeting of the National Council on Measurement in Education, Denver, CO, 2025.

Ober, T. M., Tenison, C. & Phelps G. (2025). *Praxis to Inform Practice: Generating Insights on Topic Difficulty to Support Teachers.* Paper accepted for presentation at the Annual Meeting of the National Council on Measurement in Education, Denver, CO, 2025.

Ober, T. M., Tenison, C. & Sparks, J. (2024, April). *Don't know about 'I Don't Know'?: Handling such responses in Likert scales.* Paper accepted for presentation at the Annual Meeting of the National Council on Measurement in Education, Philadelphia, PA, April 11th–14th, 2024.

Ober, T. M. & C. Tenison. (2023, October). Evaluating methods for modeling students' reading comprehension in a theoretically grounded and culturally contextualized way. In J. Sparks & M. Russell (Chairs), *Toward culturally responsive personalized learning and caring assessment.* Paper presented in a symposium at the 7th Annual International Conference of the Center for Culturally Responsive Evaluation and Assessment (CREA), University of Illinois Urbana-Champaign, Chicago, IL, October 4th–6th, 2023.

Tenison, C., Ling, G and MuCulla, L. (July, 2023). *Supporting College Choice Among International Students Through Collaborative Filtering.* International Conference on Artificial Intelligence in Education, Tokyo, Japan.

Tenison, C. and Arslan, B. (2022, July). *Modeling Student Problem Solving Behavior Using Mixed Types of Response Process Data.* The International Meeting of the Psychometrics Society, Bologna, Italy.

Tenison, C. and Arslan, B. (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.

Klugman, E., Ling, G., and Tenison, C. (2022, April). *An Exploration of Test Optional Policy's Impact on International Students' Applications.* Annual Meeting of the National Council for Measurement in Education, San Diego, CA.

Tenison, C. and Sparks, J.R. (2022, April). *Clustering student strategies in a simulated web search environment.* Annual Meeting of the American Educational Research Association, 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 automization: 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

2020 - Present ETS Research Institute
Educational Testing Service
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.

2017-2019 Intelligent Training Group
Soar Technology Inc.
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.

2011-2017 ACT-R Laboratory
Carnegie Mellon University
Dr. John R. Anderson, Principal Investigator
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

2009-2011 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

SKILLS

Analysis Packages R, Python, and Matlab

Statistical Skills Data mining techniques (e.g., clustering), time-series analysis (e.g., e.g., hidden Markov modeling, survival analysis), regression, hierarchical linear modeling, Recommender Systems (Collaborative Filtering and Hybrid approaches)

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.

HONORS AND AWARDS

2024	**ETS SPOT Award** In recognition of supporting the organization and successful execution of the 2023 Personalization in Service of Equity Convening. This event supported valuable knowledge sharing, identified ETS as an important voice in the conversation on personalized assessment and has helped establish partnerships with scholars outside ETS actively working in this space.
2021	**ETS High-five** *ETS Inside Now* In recognition of providing invaluable thought leadership and general support to both Professional Educator Programs (PEP) and our external partners to inform the design of the Praxis Learning Paths (PLP) platform and to build in components that will support future research and improvement of PLP. Given ETS's new focus on becoming a learning company, her contributions have the potential to inform sophisticated learning platforms across many areas of work at ETS.
2018	**Speaker for Institute of Neuroscience Seminar Series** *University of Oregon* Presented research on cognitive foundations of skill acquisition.

SERVICE

2020-Present	**Reviewer** *Conference on Educational Data Mining, AIED, L@S* Provide reviews annually for conferences on educational technology.
2020-2022	**Program Committee Member** *Conference on Educational Data Mining* Served as PC member reviewing papers for EDM.