Shuchen Wu

Research Fellow — Computational Neuroscience, Cognitive Science, and Artificial Intelligence

Seattle, WA, USA | Email | GitHub | Twitter | Website

Research Interests

Principles of chunking, abstraction, and compositional representation across humans, animals, and machines.
The emergence of concrete and abstract mental primitives.
Chunking as a bridge between cognition, neuroscience, and interpretable artificial intelligence.

Employment

2025–present	**Shanahan Foundation Fellow** Allen Institute & University of Washington Advisors: Rajesh Rao, Stefan Mihalas, Carl Schoonover	USA
2024–2025	**Visiting Researcher** Institute of Explainable Machine Learning, Helmholtz Münich Advisor: Zeynep Akata	Germany

Education

2020–2024	**Ph.D. Computational Neuroscience** Max Planck Institute for Biological Cybernetics, Tübingen Advisors: Eric Schulz, Peter Dayan, Felix Wichmann; Magna Cum Laude	Germany
2017–2019	**M.Sc. Neural Systems and Computation** Institute of Neuroinformatics, University of Zürich & ETH Zürich	Switzerland
2013–2017	**B.A. Physics; B.S. Applied Mathematics; B.A. Computer Science** University of Rochester, Rochester, NY ΦBK; ΣΠΣ; Magna Cum Laude; Highest Distinction	USA

Publications

2026 Tekker, N., Rui, X., Akata, Z., and **Wu, S. C. What is the Color of RED? Vision Language Models Prefer to Read Rather Than See**. *Submitted.*

2025 **Wu, S. C.**, Alaniz, S., Dayan, P., Schulz, E., and Akata, Z. **Concept-guided Interpretability via Neural Chunking**. *NeurIPS.*

2025 **Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., and Schulz, E. **Building, Reusing, and Generalizing Abstract Representations from Concrete Sequences**. *ICLR.*

2025 **Wu, S. C. Learning Patterns and Abstractions from Perceptual Sequences**. *Ph.D. Thesis.*

2025 **Wu, S. C.**, Thalmann, M., and Schulz, E. **Two Types of Motifs Enhance Human Recall and Generalization of Long Sequences**. *Communications Psychology.*

2025 Binz, M., *et al.*, **Wu, S. C.**, and Schulz, E. **Centaur: A Foundation Model of Human Cognition**. *Nature.*

2023 **Wu, S. C.**, Éltető, N., Dasgupta, I., and Schulz, E. **Chunking as a Rational Solution to the Speed-Accuracy Trade-off in a Serial Reaction Time Task**. *Scientific Reports.*

2023 Schreiber, A., **Wu, S. C.**, Wu, C. X., Schulz, E., and Indiveri, G. **Biologically-plausible Hierarchical Chunking on Mixed-signal Neuromorphic Hardware**. *NeurIPS Workshop on Machine Learning with New Compute Paradigms.*

2022 **Wu, S. C.**, Éltető, N., Dasgupta, I., and Schulz, E. **Learning Structure from the Ground-up—Hierarchical Representation Learning by Chunking**. *NeurIPS.*

In prep. Chattoraj, A., Lange, R., **Wu, S. C.**, and Haefner, R. **A neural sampling-based model of early visual processing based on leaky integrate-and-fire neurons**. *In preparation.*

Talks

2026	The emergence of entities from perceptual sequences, **Institute of Neuroscience (ION), Chinese Academy of Science**	China
2025	The emergence of entities from perceptual sequences, **Neural AI Conference**	USA
2024	Hierarchical Representations in Cognitive, Artificial, and Biological Intelligence, **NSF AI Institute for Artificial and Natural Intelligence (ARNI)**	Online
2024	Chunks, Abstractions, Motifs — Towards a Generalized Framework of Cognitive Factorization, **Allen Institute and University of Washington**	Online
2023	Chunks, Abstractions, Motifs, **Chris Summerfield Lab, University of Oxford**	UK
2023	Chunks, Abstractions, Motifs, **Tim Behrens Lab, Sainsbury Wellcome Centre**	UK
2023	Hierarchical Representation Learning by Chunking, **Memory and Neuromodulation Lab, NYU Langone**	Online
2023	Man's Search for Patterns, **Institute of Biophysics, Chinese Academy of Science**	China
2023	Abstract Motifs Facilitate Learning and Out-of-Distribution Transfer, **Institute of Neuroscience (ION), Chinese Academy of Science**	China
2023	Man's Search for Patterns, **Institute of Neuroscience (ION), Chinese Academy of Science**	China
2023	Man's Search for Patterns, **Aier Eye Hospital**	China
2022	Man's Search for Patterns, **NeuroSpin UNICOG Dehaene Lab Meeting**	France
2022	Learning Representations from the Ground-Up—Hierarchical Representation Learning by Chunking, **Conference on Neural Information Processing Systems (NeurIPS)**	USA
2021	Learning Representations from the Ground-Up—Hierarchical Representation Learning by Chunking, **Explainable Machine Learning Lab**	Germany
2021	E pluribus unum but how? Chunking as a rational solution to speed-accuracy tradeoff in a serial reaction time task, **NeuroCode + HIP + CPI Joint Lab Meeting**	Germany
2021	Mental Framing Theory, **Studiumfichti**, Tübingen	Germany
2020	Chunking as a Way of Learning Representations, **CPI-Doeller Joint Meeting**	Germany
2020	Tyranny of the Majority—Sparsity change in the hidden layer reveals a mechanism of adversarial attack, **Machine Learning Summer School (MLSS Tübingen)**	Online
2015	Measurement of the Primary D-T and D-D Ion Temperature Using Neutron Time of Flight Spectra in Inertial Confinement Fusion Experiments, **Laboratory for Laser Energetics**	USA

Reviewing

2025 -	**Reviewer**, *Proceedings of the National Academy of Sciences* (PNAS)	—
2025 -	**Reviewer**, International Conference on Learning Representations (ICLR)	—
2025 -	**Reviewer**, Conference on Neural Information Processing Systems (NeurIPS)	—
2024 -	**Reviewer**, *PLOS ONE*	—
2024 -	**Reviewer**, *Open Mind*	—
2023 -	**Reviewer**, Conference on Cognitive Computational Neuroscience (CCN)	—
2023 -	**Reviewer**, Cognitive Science Society (CogSci)	—
2022 -	**Reviewer**, *Developmental Cognitive Neuroscience*	—

Organizing & Service

2026	**Co-organizer**, Shanahan Speaker Series, Allen Institute & University of Washington	USA
2026	**Co-organizer**, CoNECTOME Symposium, University of Washington	USA
2020–2022	**Co-organizer**, Reinforcement Learning and Decision Making Seminar Series, Max Planck Institute for Biological Cybernetics	Germany
2020–2021	**Organizer**, Classics in Cognitive Science Journal Club, Max Planck Institute for Biological Cybernetics	Germany
2020	**Organizer**, Sutton and Barto Reading Group, Max Planck Institute for Biological Cybernetics	Germany
2023	**PhD Representative**, Max Planck Institute for Biological Cybernetics	Germany
2022	**CaCTüS Internship Buddy**, Max Planck Institute for Biological Cybernetics	Germany
2019	**Student Representative**, Professional Appointment Committee, Institute of Neuroinformatics	Switzerland

Supervision

2026	Sami Fawcett, Shanahan Postbac Fellowship, Discovering concept hierarchies in LLMs	USA
2026	Zeynep Toprakbasti, Independent Project, Identifying bias-encoding chunks in LLMs' embeddings	USA
2025	Nurbüke Teker, M.Sc. Thesis, Evaluating and manipulating visual saliencies of VLMs with conflicting cues, Technical University of Münich	Germany
2025	Emre Demirci, M.Sc. Thesis, Curriculum learning effect of VLMs learning compositional tangram images; co-supervised with Prof. Emre Akbas at Technical University of Münich	Germany
2023	Mehmet Yörüten, M.Sc. Thesis, Studying the dynamics of visual perception by normalized-cut, University of Tübingen	Germany
2022	Atilla Schreiber, B.Sc. Thesis, Neuromorphic implementation of sequence chunking; co-supervised with Chenxi Wu at Institute of Neuroinformatics, ETH & University of Zürich	Switzerland

Teaching

2025	**Teaching Assistant**, Summer Workshop on the Dynamical Brain	USA
2018	**Instructor**, TechSpark Academy Coding Camp	Switzerland
2017	**Teaching Intern**, Computation & Consciousness, University of Rochester	USA
2015	**Teaching Intern**, Electricity & Magnetism (PHY 114), University of Rochester	USA
2014	**Teaching Intern**, Engineering Mechanics (PHY 121), University of Rochester	USA

Summer Schools

2024	**Summer Workshop on the Dynamical Brain**, Allen Institute and the University of Washington	USA
2020	**Machine Learning Summer School** (MLSS), Max Planck Institute for Intelligent Systems	Germany
2018	**Cellular, Cognitive and Computational Neuroscience Summer School**, Princeton University	USA
2017	**Computational Neuroscience School**, Max Planck Institute for Dynamics and Self-Organization	Germany
2016	**Summer School in Computational Sensory-Motor Neuroscience**, University of Minnesota	USA

Conference Abstracts and Posters

2025	**Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., and Schulz, E. Concept-guided Interpretability via Neural Chunking, *Conference on Neural Information Processing Systems (NeurIPS)*	San Diego, USA
2025	**Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., Schulz, E., Rao, R., and Mihalas, S. Decomposing High-Dimensional Neural Activations Into Cognitive Chunks, *Society for Neuroscience (SfN)*	San Diego, USA
2025	**Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., Schulz, E., Rao, R., and Mihalas, S. Decomposing High-Dimensional Neural Activations Into Cognitive Chunks, *Lakes Conference*	Renton, USA
2025	**Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., and Schulz, E. Building, Reusing, and Generalizing Abstract Representations from Concrete Sequences, *Janelia Grounding Cognition in Mechanistic Insight Workshop*	Ashburn, USA
2025	**Wu, S. C.**, Thalmann, M., Dayan, P., Akata, Z., and Schulz, E. Building, Reusing, and Generalizing Abstract Representations from Concrete Sequences, *International Conference on Learning Representations (ICLR)*	Singapore
2024	**Wu, S. C.**, Thalmann, M., and Schulz, E. Learning, from Concrete to Abstract, Simple to Complex, *Cognitive Science Society Conference (CogSci)*	Amsterdam, Netherlands
2024	**Wu, S. C.**, Yörüten, M., Wichmann, F. A., and Schulz, E. Normalized Cuts Characterize Visual Recognition Difficulty of Amorphous Image Sub-parts, *Computational and Systems Neuroscience (CoSyNe)*	Lisbon, Portugal
2023	**Wu, S. C.**, Thalmann, M., and Schulz, E. A Taxonomy of Sequence Motifs Which Facilitate Memorization and Out-of-distribution Transfer, *Conference on Cognitive Computational Neuroscience (CCN)*	Oxford, UK
2023	Yörüten, M., **Wu, S. C.**, Wichmann, F. A., and Schulz, E. Characterizing the Dynamics of Visual Hierarchical Grouping, *Systems Vision Science Symposium*	Tübingen, Germany
2023	Schreiber, A., **Wu, S. C.**, Wu, C. X., Schulz, E., and Indiveri, G. Biologically-plausible Hierarchical Chunk Learning on Mixed-signal Neuromorphic Hardware, *International Conference on Neuromorphic, Natural and Physical Computing (NNPC)*	Hanover, Germany
2022	**Wu, S. C.**, Éltető, N., Dasgupta, I., and Schulz, E. Learning Structure from the Ground-up—Hierarchical Representation Learning by Chunking, *Conference on Neural Information Processing Systems (NeurIPS)*	New Orleans, USA
2020	**Wu, S. C.**, Éltető, N., Dasgupta, I., and Schulz, E. Chunking as a Rational Solution to Speed-Accuracy Trade-off in a Serial Reaction Time Task, *Cognitive Science Society Conference (CogSci)*	Online
2019	**Wu, S. C.**, Geirhos, R., and Wichmann, F. A. An Early Vision-Inspired Visual Recognition Model Improves Robustness Against Image Distortions Compared to a Standard Convolutional Neural Network, *EPFL Neuro Symposium*	Lausanne, Switzerland
2019	**Wu, S. C.**, Geirhos, R., and Wichmann, F. A. An Early Vision-Inspired Visual Recognition Model Improves Robustness Against Image Distortions Compared to a Standard Convolutional Neural Network, *Bernstein Conference on Computational Neuroscience (BCCN)*	Berlin, Germany
2019	Chattoraj, A., **Wu, S. C.**, Lange, D., and Haefner, R. A Probabilistic Population Code Based on Neural Sampling, *Bernstein Conference on Computational Neuroscience (BCCN)*	Berlin, Germany
2018	Chattoraj, A., **Wu, S. C.**, Lange, D., and Haefner, R. A Probabilistic Population Code Based on Neural Sampling, *Computational and Systems Neuroscience (CoSyNe)*	Denver, USA

Honors & Awards

2025–2028	**Shanahan Foundation Fellowship**, Allen Institute; awarded annually to three researchers worldwide to develop innovative methods for studying neural data	USA
2025	**Top Reviewer**, NeurIPS; top 8% of reviewers	—
2024	**Ph.D. with Magna Cum Laude**, Max Planck Institute for Biological Cybernetics / University of Tübingen	Germany
2018–2019	**SMARTSTART I Computational Neuroscience Fellowship**; top 15 students awarded a travel budget of 1000 euros and mentorship working with Prof. Felix Wichmann and Robert Geirhos	Germany
2017	**Phi Beta Kappa**, ΦBK Academic Honors Society, elected	USA
2017	**Sigma Pi Sigma**, ΣΠΣ Physics Honors Society, elected	USA
2013–2017	**Dean's Scholarship**, University of Rochester	USA
2014–2017	**Continuing Student Scholarship**, University of Rochester	USA
2013–2017	**Dean's List**, University of Rochester	USA
2016	**URMC Summer Scholar**, University of Rochester Medical Center	USA
2015, 2016	**Golden Key Scholar Nomination**, National Society of Collegiate Scholars	USA
2015	**Discover Grant for Undergraduate Research**, University of Rochester	USA
2012	**All State Musician**, New York State School Music Association (NYSSMA)	USA

Other Activities

2020–2024	**Johannes-Gottlieb Fichtehaus (Democratic Living Project)**, community self-governance across Repair, Culture, Garden, Communication, and Sustainability committees; co-organized a 500+ person fundraiser; helped operate a cooperative organic grocery shop	Germany
2023	**Application Committee**, Johannes-Gottlieb Fichtehaus; candidate screening and interview	Germany
2021–2022	**VertrauensFichti**, Johannes-Gottlieb Fichtehaus; conflict mediator for 72 residents	Germany
2019–2020	**Coding Camp Instructor**, TechSpark Academy	Switzerland
2019–2020	**Technical Writer**, Synced AI Review	—
2016–2017	**Co-Captain**, University of Rochester Women's Squash Team	USA
2013–2017	**Ladder Player**, University of Rochester Women's Squash Team	USA
2014–2015	**Flutist**, University of Rochester Chamber Orchestra	USA
2013–2014	**Flutist**, New York Empire State Youth Orchestra (ESYO)	USA

Languages

Mandarin Native **English** Professional **German** Fluent