SHIWALI MOHAN

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RESEARCH INTERESTS

- Collaborative Human-AI systems
- Hybrid AI architectures
- Cognitive architectures & agents
- Human cognition: decision making, behavior, and learning
- AI for social good and public welfare

EDUCATION

2009-2015 Doctor of Philosophy, Computer Science & Engineering, University of Michigan, Ann Arbor
Dissertation: *From Verbs to Tasks: An Integrated Account of Learning Task Knowledge from Situated Interactive Instruction*
Committee: John Laird (Chair), Edmund Durfee, Edwin Olson, Rick Lewis, Andrea Thomaz (external member)

2008-2009 Master of Science & Engineering, Computer Science & Engineering
University of Michigan, Ann Arbor

2003-2007 Bachelor of Engineering, Instrumentation & Control Engineering
Netaji Subhas Institute of Technology, Delhi University, New Delhi

EMPLOYMENT

2019-present Senior Member of Research Staff, Palo Alto Research Center

2015-2019 Member of Research Staff, Palo Alto Research Center

2014-2015 Postdoctoral Researcher, Palo Alto Research Center

2007-2008 Software Engineer, Yahoo! Research & Development, India

FUNDING

Total funding as PI or co-PI: $7*M*

2021-2023 *Proposed:* Department of Energy (DoE) - Connected Communities $7*M*
Key Personnel, *The India-Basin Community Project*

2021-2022 *Proposed:* Defense Advance Research Projects Agency (DARPA) - Grounded Artificial Intelligence Language Acquisition - Phase III (GAILA) $700*K*
Principal Investigator, *Advanced Cognitive Learning for Embodied Language* (AILEEN)

2021- *Proposed:* National Science Foundation (NSF) - National Artificial Intelligence Research Institutes (Theme 1 - *Human-AI Interaction and Collaboration*)
Collaborator, *Advancing Human-AI Collaboration through Longitudinal Interaction*

2021-2022 Xerox Corporation - AI Initiative $375*K*
Principal Investigator, Embodied Reasoning for Collaborative Learning (EMBRACE)

2020-2023 Defense Advanced Research Projects Agency (DARPA) - Science of Artificial Intelligence and Learning for Open-world Novelty (SAIL-ON) $4*M*
Principal Investigator, *Hypothesis-Guided Model Revision over Multiple Aligned Representations* (HYDRA).

2019-2021 Defense Advanced Research Projects Agency (DARPA) - Grounded Artificial Intelligence Language Acquisition (GAILA) $1*M*
Principal Investigator, *Advanced Cognitive Learning for Embodied Language* (AILEEN)

2018-2019	Air Force Office of Scientific Research (AFOSR) Co-Principal Investigator, *Levels of Learning in Natural and Artificial Agents*	$300K
2015-2018	Advanced Research Projects Agency-Energy (ARPA-E) Key Personnel, *Collaborative Optimization and Planning for Transportation Energy Reduction* (COPTER)	$2.18M
2016-2017	Xerox Innovation Group (Xerox XIG) Principal Investigator, *A Cognitive Approach to Long-Living Process Systems*	$750K

AWARDS & HONORS

2018	Blue Sky Award, 32^{nd} AAAI Conference on Artificial Intelligence
2014	HRI Pioneer
2013	AAAI Travel Grant
2012	AAAI Doctoral Consortium Cohort
2011-2013	Rackham Travel Scholarship
2008	Best Paper Award, 9^{th} International Conference on Computational Linguistics and Intelligent Text Processing
2003-2007	Scholarship for Academic Excellence, Delhi University

PUBLICATIONS

Journal Articles

[J1] **Shiwali Mohan** A Neuro-Cognitive System Approach to Embodied Language Processing in Physical Agents. *(in preparation)*

[J2] **Shiwali Mohan**. Exploring the Role of Common Model of Cognition in Designing Adaptive Coaching Interactions for Health Behavior Change *(in press)*. ACM Transactions on Interactive Intelligent Systems. 2021.

[J3] **Shiwali Mohan**, Matt Klenk, Matthew Shreve, Aaron Ang, Kent Evans, John Maxwell. Analogical Concept Memory for Architectures Implementing the Common Model of Cognition. *(in press)*. *Advances in Cognitive Systems*. 2020.

[J4] John Laird and **Shiwali Mohan**. A Case Study of Knowledge Integration Across Multiple Memories in Soar. Common Model of Cognition Bulletin, 1(1), 32-38. (Reprint in 2020)

[J5] **Shiwali Mohan**, Anusha Venkatakrishnan, Andrea Hartzler. Designing an AI Health Coach and Studying its Utility in Promoting Regular Aerobic Exercise. ACM Transactions on Interactive Intelligent Systems. 2020.

[J6] **Shiwali Mohan**, Hesham Rakha, Matthew Klenk. Acceptable Planning: Influencing Individual Behavior to Reduce Transportation Energy Expenditure of a City. Journal of Artificial Intelligence Research. 2019.

[J7] Aaron Springer, Anusha Venkatakrishnan, **Shiwali Mohan**, Les Nelson, Michael Silva, Peter Pirolli. Leveraging Self-Affirmation to Increase mHealth Behavior Change. *Journal of Medical Information Research*. 2018.

[J8] Peter Pirolli, **Shiwali Mohan**, Anusha Venkatakrishnan, Len Nelson, Michael Silva, Aaron Springer. *Journal of Medical Information Research*. 2017.

[J9] John E Laird, Kevin Gluck, John Anderson, Kenneth D Forbus, Odest Chadwicke Jenkins, Christian Lebiere, Dario Salvucci, Matthias Scheutz, Andrea Thomaz, Greg Trafton, Robert E Wray, **Shiwali Mohan**, James R Kirk. Interactive Task Learning. *IEEE Intelligent Systems*, Volume 32, Issue 4, IEEE 2017.

[J10] **Shiwali Mohan**, Aaron Mininger, and John Laird. Towards an Indexical Model of Situated Comprehension for Real-World Cognitive Agents. *Advances in Cognitive Systems 3*, ACS 2014.

[J11] John Laird and **Shiwali Mohan**. A Case Study of Knowledge Integration Across Multiple Memories in Soar. *Biologically Inspired Cognitive Architectures* (invited), BICA 2014.

[J12] **Shiwali Mohan**, Aaron Mininger, James Kirk, and John Laird. Acquiring Grounded Representations of Words with Situated Interactive Instruction. *Advances in Cognitive Systems 2*, ACS 2012.

Book Chapters

[B1] John Laird, **Shiwali Mohan**, James Kirk, Aaron Mininger. The Learning Problem in Interactive Task Learning. *Ernst Strunngman Forum - Interactive Task Learning Agents, Robots, and Humans and Acquiring New Tasks through Natural Interaction. Eds. Kevin Gluck and John Laird*. 2019.

[B2] Dario Salvucci, John Laird, Franklin Chang, Kenneth Forbus, Parisa Kordjamshidi, Tom Mitchell, **Shiwali Mohan**, Michael Spranger, Suzanne Stevenson, Andrea Stocco, Gregory Trafton. Learning in Interactive Task Learning. *Ernst Strunngman Forum - Interactive Task Learning Agents, Robots, and Humans and Acquiring New Tasks through Natural Interaction. Eds. Kevin Gluck and John Laird*. 2019.

Conference

[C1] Preeti Ramaraj, Charlie Ortiz, Matthew Klenk, **Shiwali Mohan**. Unpacking Human Teachers Intentions to Design Robust Interactive Task Learning Systems. *(under review)* International Symposium on Robot and Human Interactive Communication (RO-MAN) 2021.

[C2] **Shiwali Mohan**, Matthew Klenk, Matthew Shreve, Aaron Ang, Kent Evans, John Maxwell. Characterizing a Concept Memory for Architectures Implementing the Common Model of Cognition. In Proceedings of the 8^{th} Annual Conference on Advances in Cognitive Systems. 2020.

[C3] Matthew Klenk, Wiktor Piotrowsky, Roni Stern, **Shiwali Mohan**, and Johan de Kleer. Model-Based Novelty Adaptation for Open-World AI. In Proceedings of the 8^{th} Annual Conference on Advances in Cognitive Systems. 2020.

[C4] **Shiwali Mohan**, Frances Yan, Victoria Bellotti, Hesham Rakha, Matthew Klenk, On Influencing Individual Behavior for Reducing Transportation Energy Expenditure in a Large Population. *In Proceedings of the* 2^{nd} *AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society*. AIES 2019.

[C5] John Laird and **Shiwali Mohan**. Learning Fast and Slow: Levels of Learning in General Autonomous Intelligent Agents. *In Proceedings of the* 32^{nd} *AAAI Conference on Artificial Intelligence*. AAAI 2018. Blue Sky Award.

[C6] **Shiwali Mohan**, Anusha Venkatakrishnan, Michael Silva, and Peter Pirolli. On Designing a Social Coach to Promote Regular Aerobic Exercise. *In the Proceedings of the 29th Annual Conference on Innovative Applications of Artificial Intelligence/AAAI*, IAAI 2017.

[C7] Justin Li, Steven Jones, **Shiwali Mohan**, and Nate Derbinksy. Architectural Mechanisms for Mitigating Uncertainty during Long-Term Declarative Knowledge Access. *In the Proceedings of the 4th Annual Conference on Advances in Cognitive Systems*, ACS 2016.

[C8] Andrea L Hartzler*, Anusha Venkatakrishnan*, **Shiwali Mohan**, Michael Silva, Paula Lozano, James D Ralston, Evette Ludman, Dori Rosenberg, Katherine M Newton, Lester Nelson, Peter Pirolli. Acceptability of a Team-Based Mobile Health (mHealth) Application for Lifestlye Self-Management in Individuals with Chronic Illnesses. *In* 38^{th} *Annual International Conference of the Engineering in Medicine and Biology Society (EMBC)*, IEEE. 2016.

[C9] **Shiwali Mohan** and John Laird. Learning Goal-Oriented Hierarchical Tasks from Situated Interactive Instruction. *In the Proceedings of the* 28^{th} *AAAI Conference*, AAAI 2014.

[C10] **Shwali Mohan!**, Aaron Mininger, and John Laird. Towards an Indexical Model of Situated Language Comprehension for Real-World Cognitive Agents. *In Proceedings of the Second Annual Conference on Advances in Cognitive Systems*. 2013.

[C11] **Shiwali Mohan**, James Kirk, and John Laird. A Computational Model of Situated Task Learning with Interactive Instruction. *In Proceedings of the* 17^{th} *International Conference on Computational Modeling*, ICCM 2013.

[C12] **Shiwali Mohan**, James Kirk, Aaron Mininger, and John Laird. Acquiring Grounded Representations of Wordswith Situated Interactive Instruction. *In Proceedings of the First Annual Conference on Advances in Cognitive Systems*. 2012.

[C13] Mandar Joshi, Rakesh Khobragade, Saurabh Sarda, Umesh Deshpande, and **Shiwali Mohan**. Object-Oriented Representation and Hierarchical Reinforcement Learning in Infinite Mario. *In Proceedings of the* 24^{th} *IEEE International Conference on Tools with Artificial Intelligence*, ICTAI 2012.

[C14] **Shiwali Mohan** and John Laird. An Object-Oriented Approach to Reinforcement Learning in an Action Game. *In Proceedings of the 7th Artificial Intelligence for Interactive Digital Entertainment Conference*, AIIDE 2011.

[C15] Niladri Chatterjee and **Shiwali Mohan**. Discovering Word Senses from Text using Random Indexing. *In Proceedings of the 9th International Conference on Computational linguistics and Intelligent Text Processing*, CICLing 2008. Best Paper Award.

[C16] Niladri Chatterjee and **Shiwali Mohan**. Extraction-based Single-Document Summarization Using Random Indexing. *In Proceeding of the 19th IEEE International Conference on Tools with Artificial Intelligence*, ICTAI 2007.

Symposia, Workshops

[W1] Ion Matei, Johan deKleer, and **Shiwali Mohan**. Interpretable Machine Learning Models: A Physics-Based View. *In Papers from the AAAI Fall Symposium Series on Physics-Guided AI*. 2020.

[W2] Preeti Ramaraj, Matthew Klenk, **Shiwali Mohan**. Understanding Intentions in Human Teaching to Design Interactive Task Learning Robots. *In Workshops at Robotic Science and Systems*. 2020.

[W3] **Shiwali Mohan**, Matthew Klenk, Victoria Belloti. Exploring How to Personalize Travel Mode Recommendations For Urban Transportation. *In Joint Proceedings of the ACM IUI 2019 Workshops - Workshop on Theory-Informed User Modeling for Tailoring and Personalizing Interfaces (HUMANIZE)*. 2019.

[W4] **Shiwali Mohan**, Kalai Ramea, Bob Price, Matthew Shreve, Hoda Eldardiry. Building JARVIS: A Learner-Aware Conversational Trainer. *In Joint Proceedings of the ACM IUI 2019 Workshops - Workshop on User-Aware Conversational Agents (user2agent)*. 2019.

[W5] Filip Dvorak, **Shiwali Mohan**, Victoria Bellotti, Matthew Klenk. Collaborative Optimization and Planning for Transportation Energy Reduction. *ICAPS Proceedings of the 6th Workshop on Distributed and Multi-Agent Planning*. 2018.

[W6] **Shiwali Mohan**, Anusha Venkatakrishnan, Daniel Bobrow, Peter Pirolli. Health Behavior Change: A Motivating Domain for Human-Aware AI Research. *In Proceeding of the AAAI 2017 Workshops*. AAAI 2017.

[W7] Matthew Klenk, **Shiwali Mohan**, Johan de Kleer, Daniel Bobrow, Tom Hinrichs, Ken Forbus. Collaborative Autonomy Through Analogical Comic Graphs. *In Proceedings of AAAI 2017 Workshops*. AAAI 2017.

[W8] **Shiwali Mohan**, James Kirk, Aaron Mininger, John Laird. Agent Requirements for Effective and Efficient Task-Oriented Dialog. *In Papers from the AAAI Fall Symposium Series on Artificial Intelligence for Human-Robot Interaction*, 2015.

[W9] John E. Laird and **Shiwali Mohan**. A Case Study of Knowledge Integration Across Multiple Memories in Soar. *In Papers from the AAAI Fall Symposium Series on Integrated Cognition*, 2013.

[W10] **Shiwali Mohan***, Aaron Mininger*, James Kirk*, and John Laird. Learning Grounded Language Through Situated Interactive Instruction. *In Papers from the AAAI Fall Symposium Series on Robots Learning Interactively from Human Teachers*, 2012.

[W11] John Laird, Keegan Kinkade, **Shiwali Mohan**, and Joseph Xu. Cognitive Robotics Using the Soar Cognitive Architecture. *In Proceedings of the 8th International Cognitive Robotics Workshop*, 2012.

[W12] **Shiwali Mohan** and John Laird. Situated Comprehension of Imperative Sentences in Embodied, Cognitive Agents. *In Papers from the AAAI Workshop on Grounding Language for Physical Systems*, 2012.

[W13] **Shiwali Mohan** and John Laird. Towards Situated, Interactive, Instructable Agents in a Cognitive Architecture. *In Papers from the AAAI Fall Symposium Series on Advances in Cognitive Systems*, 2011.

Extended Abstracts

[A1] Peter Pirolli, **Shiwali Mohan**, Rong Yang, Anusha Venkatakrishnan, Michael Silva, Michael Youngblood, Ashwin Ram and Les Nelson. User Modeling and Planning for Improving

Self-efficacy and Goal Adherence in mHealth. *Frontiers Public Health. Conference Abstract: 2nd Behaviour Change Conference: Digital Health and Wellbeing.*, 2016.

[A2] **Shiwali Mohan**, and John E. Laird. Learning New Tasks for Situated Interactive Instruction. *In the 2014 HRI Pioneers Workshop at Human-Robot Interaction*, 2014.

[A3] Mandar Joshi, Rakesh Khobragade, Saurabh Sarda, Umesh Deshpande, and **Shiwali Mohan**. Hierarchical Action selection for Reinforcement Learning in Infinite Mario. *In Proceedings of the 6th Starting Artificial Intelligence Research Symposium at European Conference on Artificial Intelligence*, STAIRS 2012.

[A4] **Shiwali Mohan** and John Laird. Learning Actions and Action Verbs from Human-Agent Interaction. *In Proceedings of the 26th AAAI Conference on Artificial Intelligence*, AAAI 2012.

[A5] **Shiwali Mohan** and John Laird. Exploring Mixed-Initiative Interaction for Learning with Situated Instruction in Cognitive Agents. *In Proceedings of the 26th AAAI Conference on Artificial Intelligence*, AAAI 2012.

[A6] **Shiwali Mohan** and John Laird. Relational Reinforcement Learning in Infinite Mario. *In Proceedings of the 24th AAAI Conference on Artificial Intelligence*, AAAI 2010.

Inclusive Communities for Better Science & Technology

May 2021 Invited Speaker, RAISO: Responsible Artificial Intelligence Student Organization, Northwestern Universities

April 2021 ECSEL+ roundtable, University of Michigan, Ann Arbor

March 2021 Panelist on the International Women's Day Panel at The Women's Alliance, Xerox Corporation.

February 2021 Mentor, Women's mentoring event (*Breakfast with Champions*) at AAAI 2021

Invited Talks, Workshops, & Panels

August 2021 *Design and Analysis of Collaborative Human-AI Systems* Technology and Society in the Next Generation: Growth, Security, and Well-Being.

May 2021 *A Cognitive Approach to Interactive Robot Design.* Talking Robotics.

April 2021 *Designing an AI Health Coach and Studying its Utility in Promoting Regular Aerobic Exercise.* ACM Intelligent User Interfaces.

February 2021 *Humans of AI: Modeling Humans for Designing Effective Collaborative AI Systems*. Computer Science Colloquium, Northwestern University.

February 2021 *AILEEN - A Neuro-Cognitive Approach to Interactive Task Learning Systems*. AAAI 2021 Workshop on Hybrid Artificial Intelligence

October 2020 *Incorporating Behavioral Economics in AI Systems for Effective Human-AI Collaborative Behavior*, Aggregate Intellect.

September 2020 *Humans of AI*, Soar Technology Incorporated.

July 2020 *Humans of AI*, AI Seminar at USC Information Sciences Institute

June 2020 *Common Model of Cognition and Health Behavior Change*, Virtual International Symposium on Cognitive Architectures (VISCA 2020)

January 2020 *Augmented Reality for Task Training*, Electronic Imaging 2020

May 2019 *Human-Aware AI Systems*, Machine Learning and User Experience + Ladies that UX meetup group

November 2017 NSF Workshop on Interactive Cognitive Assistants

May 2017 Ernst Strunngmann Forum on Interactive Task Learning

September 2015 *On Designing a Programmable Cognitive Assistant*, IBM Cognitive Systems Institute

December 2013 *Learning Hierarchical Tasks with Situated Interactive Instruction*, Institute of Creative Technologies, University of Southern California, Information Science Institute, University of Southern California

Students and Interns Mentored

2020 Supervising Preeti Ramaraj in an ongoing internship at PARC. Currently a graduate student at University of Michigan, Ann Arbor. [publications: C1, W2]

2019 Supervised Aarathi Venkatesan as an intern at PARC. Currently, a scientist and research manager at Vida Health Inc.

2019 Mentored Naman Shah as an intern at PARC. Currently, a graduate student at Arizona State University.

2014 Advised Anant Mittal's undergraduate research at Indraprastha University, New Delhi, India. Currently a Ph.D. student at University of Washington.

2011 Advised Mandar Joshi's undergraduate research at National Institute of Technology, Nagpur, India. Currently a Ph.D. candidate at University of Washington. [publications: C13, A3]

Teaching Experience

2020 Guest Lecturer, *Human Modeling for Artificial Intelligence*, Vanderbilt University

2020 Guest Lecturer, *Interactive Task Learning a Challenge Problem for Knowledge Representation and Reasoning*, Occidental College.

2014 Guest Lecturer, *EECS 498 - Intelligent Interactive Systems*, University of Michigan, Ann Arbor

2012 Graduate Student Instructor, *EECS 492 - Introduction to Artificial Intelligence*, University of Michigan, Ann Arbor.

Service

AI Community

2020-2021 Co-Chair AAAI Doctoral Consortium (AAAI-DC) 2021
Raised funds from National Science Foundation (NSF). Lead transition to an online format. Supported AAAI DC outreach to Latin and South American countries through dedicated, strategic efforts. The 2021 cohort had participants from more than 6 countries and was gender balanced.

2020 Co-Chair Advances in Cognitive Systems (ACS)
Led transition to an online format. Doubled conference attendance through dedicated outreach. Introduced student mentoring sessions with early career researchers and academics. Introduced academia panel to motivate community effort and resources on teaching cognitive systems topics. Introduced best student paper award for the first time.

2020 Co-Chair AAAI Doctoral Consortium (AAAI-DC) 2020-2021
Achieved gender parity in the 2020 cohort for the first time in over two decades. Raised funds from National Science Foundation (NSF) and Artificial Intelligence Journal (AIJ).

2020-present Senior Program Committee, International Joint Conference on Artificial Intelligence (IJCAI)

2016-present Program Committee, Association for the Advancement of Artificial Intelligence (AAAI)

2016 Program Committee, International Joint Conference on Artificial Intelligence (IJCAI)

2018-present Program Committee, ACM Annual Conference on Intelligent User Interfaces (ACM IUI) 2018-present

2018 Program Committee, International Conference on Robotics and Automation (ICRA)

2018 Program Committee, ACM Annual Conference on Human-Robot Interaction (HRI)

2018-present Program Committee, Association for the Advancement of Artificial Intelligence, Doctoral Consortium (AAAI DC)

2018-present Program Committee, Annual Conference on Advances in Cognitive Systems (ACS)

2018-present Reviewer, Advances in Cognitive Systems

2019 Reviewer, Autonomous Robots

2018 Reviewer, ACM Transactions of Intelligent Interactive Systems

2015 Organizing Committee, Students of Cognitive Systems, Annual Conference on Advances in Cognitive Systems (ACS).

PARC	2020	Founding Member: Diversity, Equity, and Inclusion Initiative
	2017-present	Peer mentor
	2016-present	Pink and red reviewer for proposal activity to DARPA - DSO, I2O, TTO; ONR; NASA; NIH
	2020	Founder: Integrated Intelligent Systems Reading Group: a PARC wide, cross-lab discussion group
	2016-2017	Member of the committee managing PARC's Employee-Led Intellectual Property Investment portfolio $\$3M$/year
U. Michigan	2012, 2013	Founding member and co-chair, Special Interest Group - Faculty
	2011	Vice-president, CSE Graduate Organization
	2010,2011	Social Chair, Indian Students Association
	2010	DCO Representative, CSE Graduate Organization

Patents

2020	Shiwali Mohan, Matt Klenk, Matthew Shreve, Aaron Ang, Kent Evans, John Maxwell. *"A System and a Method for Language Processing in Intelligent Machines Collaborating with Humans on Physical Tasks.* Invention Submission.
2018, USA	Robert Price, Shiwali Mohan, *Rule-based Augmentation Of Perceptions To Augment And Filter Perceptions Of Observed Systems*. Application number 16/237,241, Publication date: 2020/7/2
2018, USA	Matthew Klenk, Shiwali Mohan, Victoria Bellotti, *User Behavior in Transportation Influence*. Application number 16/181152. Publication date: 2020/5/7
2018, USA	Matthew Klenk, Victoria M Bellotti, Filip Dvorak, Shiwali Mohan. *Generating collaboratively optimal transport plans*. Application number 16/024,208. Publication date: 2020/1/2
2017, European	Ashwin Ram, Gregory Michael Youngblood, Lester D Nelson, Anusha Venkatakrishnan, Peter L Pirolli, Michael K Silva, Shiwali Mohan. *System and Method to Create, Monitor, and Adapt Individualized Multidimensional Health Programs*. Application number: 17165632.5 Publication date: 2017/04/07.
2016, USA	Ashwin Ram, Gregory Michael Youngblood, Lester D Nelson, Anusha Venkatakrishnan, Peter L Pirolli, Michael K Silva, Shiwali Mohan. *System and Method to Create, Monitor, and Adapt Individualized Multidimensional Health Programs*. Application number: 15/130,770. Publication date: 2016/4/15.

Media

2021	*Are Digital Humans the Next Step in Human-Computer Interaction?*. Interview. IEEE Spectrum.
2017	*Could a Bot Coach You to a New PR? Artificial intelligence is making its way into fitness apps*. Interview. Outside magazine

May 7, 2021