

Leanne Miller Hirshfield

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Professional Preparation

Hamilton College	Clinton, NY	Computer Science	BA, 2002
Colorado School of Mines	Golden, CO	Computer Science	MS, 2005
Tufts University	Medford, MA	Computer Science	PhD, 2010

Appointments

- 06/18-present *Associate Research Professor*, Institute of Cognitive Science, University of Colorado, Boulder CO.
- 09/20-present *Senior Personnel, Co-Lead of Research Strand 2*, NSF AI Institute on Student AI-Teaming, University of Colorado, Boulder, CO.
- 09/12-08/19 *Associate Research Professor*, Newhouse School, Syracuse University, Syracuse NY.
- 06/13 – 08/13 *Visiting Faculty Researcher*, Applied Neurosciences, Air Force Research Lab, Dayton, OH
- 01/10 – 09/12 *Research Associate*, Dept of Computer Science, Hamilton College, Clinton, NY

Select Publications

Refereed Conference Proceedings:

2. Goss, W., I. Dey, D. Dickler, L. Hirshfield, M. Tissenbaum, and S. Puntambekar. *Developing Dynamic Dashboards for Facilitating Classroom Orchestration*. in *The International Society of Learning Sciences*. 2022.
3. Reddy, G.S.R., C.A. Spencer, K. Durkee, B. Cox, O. Fox Cotton, S. Galbreath, S. Meyer, M. Natali, T. Seech, G. Severe-Valsaint, G. Zimmerman, and L. Hirshfield. *Estimating Cognitive Load and Cybersickness of Pilots in VR Simulations via Unobtrusive Physiological Sensors*. in *Virtual, Augmented and Mixed Reality: Applications in Education, Aviation and Industry*. 2022. Cham: Springer International Publishing.
4. Wang, J., G. Baocheng, L. Hirshfield, T. Grant, and S. Velipasalar, *Taking a Deeper Look at the Brain: Predicting Visual Perceptual and Working Memory Load from High-Density fNIRS Data*. IEEE Journal of Biomedical and Health Informatics, 2022

Tran, N., T. Grant, T. Phung, **L. Hirshfield**, C. Wickens, and T. Williams, *Get This!?! Mixed Reality Improves Robot Communication Regardless of Mental Workload*, in Companion of the

2021 ACM/IEEE International Conference on Human-Robot Interaction. 2021, Association for Computing Machinery: Boulder, CO, USA. p. 412–416.

Tran, N., T. Grant, T. Phung, **L. Hirshfield**, C. Wickens, and T. Williams. *Robot-Generated Mixed Reality Gestures Improve Human-Robot Interaction*. in Social Robotics. ICSR 2021. Lecture Notes in Computer Science. 2021. Springer.

Williams, T., **L. Hirshfield**, N. Tran, T. Grant and N. Woodward (2020). *Using Augmented Reality to Better Study Human-Robot Interaction*. *Virtual, Augmented and Mixed Reality*. Design and Interaction, International Conference on Human-Computer Interaction, Springer International Publishing.

Grant, T., K. Dhruv, L. Eloy, L. Hayne, K. Durkee and **L. Hirshfield** (2020). A *Neurophysiological Sensor Suite for Real-Time Prediction of Pilot Workload in Operational Settings*. HCI International 2020 – Late Breaking Papers: Cognition, Learning and Games, Cham, Springer International Publishing.

Costa, M., Bergen-Cico, D., **Hirshfield, L.**, Razza, R., Wang, Q. *Perceived Restorativeness and Meditation Depth for Virtual Reality supported Mindfulness Interventions*. in Proc. of the International Conference of Human Computer Interaction, Copenhagen, Denmark (accepted, 2020).

Neupane, A., Saxena, N., **Hirshfield, L.**, Bratt, S. The Crux of Voice (In)Security: A Brain Study of Speaker Legitimacy Detection. The Network and Distributed System Security Symposium (NDSS). 2019.

Hirshfield, L.M., Williams, T., Sommer, N., Grant, T., Velipisalar, S., Workload-Driven Modulation of Mixed-Reality Robot-Human Communication. Workshop Paper, in Proceedings of the International Conference on Multimodal Interaction (ICMI). Boulder, CO. 2018.

S.W. Hincks, S. Bratt, S. Poudel, V. Phoha, R.J.K. Jacob, D.C. Dennett, and **L.M. Hirshfield**, “*Entropic Brain-computer Interfaces - Using fNIRS and EEG to Measure Attentional States in a Bayesian Framework*,” Proc. PhyCS 2017 International Conference on Physiological Computing Systems. 2017.

Neupane, A., Saxena, N., **Hirshfield, L.**, *Neural Underpinnings of Website Legitimacy and Familiarity Detection: An fNIRS Study*. In Security and Privacy Track, the World-Wide Web Conference (WWW), 2017.

Neupane, A., Rahman, L., Saxena, N., **Hirshfield, L.M.** *A Multi-Modal Neuro-Physiological Study of Phishing Detection and Malware Warnings*. In ACM Conference on Computer and Communications Security (CCS), October 2015

Serwadda, A., Poudel, S., Phoha, V., **Hirshfield, L.**, Bratt, M., Bandara, D., Costa, M., *Biometric Authentication using Functional Near-Infrared Spectroscopy*. the IEEE Biometrics, Theory, Applications, and Systems (BTAS) conference (2015).

Hirshfield, L., Costa, M., Bratt, S., Bandara, D. *Measuring Situational Awareness Aptitude Using Functional Near-Infrared Spectroscopy*. in Proc. of the International Conference of Human Computer Interaction, Los Angeles, CA (2015).

Solinger, C. **Hirshfield, L.** Hirshfield, S., Friedman, R., Lepre, C. *Beyond Facebook Personality Prediction: A Multidisciplinary Approach in Predicting Social Media Users' Personality*. Proc. of the International Conference of Human Computer Interaction, Crete, Greece. (2014).

Bandara, D., **Hirshfield, L.**, Velipasalar, S., *Insights into User Personality and Learning Styles through Cross Subject fNIRS Classification*. Proceedings of the International Conference of Human Computer Interaction, Crete, Greece. (HCII 2014).

Sommer, N., **Hirshfield, L.**, Velipasalar, S., *Our Emotions as Seen Through a Webcam*. Proc. of the International Conference of Human Computer Interaction, Crete, Greece. (HCII 2014).

Escalante, J. Butcher, S. **Hirshfield, L.M.** *Using the EEG Error Potential to Identify User Interface Design Flaws*. the International Conference of Human Computer Interaction (HCII 2013).

Hirshfield, L.M., Gulotta, B., Hincks, S., Hirshfield, S., Russel, M., Ward, R., Williams, T., Jacob, R. "This is Your Brain on Interfaces: Enhancing Usability Testing with Functional-Near Infrared Spectroscopy". In the Proceedings of ACM CHI 2011 Human Factors in Computing Systems Conference, ACM Press.

Girouard, E. Solovey, **L. Hirshfield**, E. Peck, K. Chauncey, A. Sassaroli, S. Fantini, and R. Jacob, "From Brain Signals to Adaptive Interfaces: Using fNIRS in HCI," in *Brain-Computer Interfaces: Applying our Minds to Human-Computer Interaction*, ed. A. Nijholt, pp. 221-237, Springer (2010).

Hirshfield, L.M. Solovey, E.T, Girouard, A. Kebinger, J. Jacob, R.J.K., Sassaroli, A. Fantini, S. *Brain Measurement for Usability Testing and Adaptive Interfaces: An Example of Uncovering Syntactic Workload in the Brain Using Functional Near Infrared Spectroscopy*. *Proc. ACM CHI 2009 Human Factors in Computing Systems Conference*, (2009), ACM Press.

Hirshfield, L.M., Chauncey, K. Solovey, E.T., Girouard, A. Gulotta, R., Jacob, R.J.K., Sassaroli, A., Fantini, S., *Combining Electroencephalograph and Functional Near Infrared Spectroscopy to Explore Users' Instantaneous and Continuous Mental Workload States*. International Conference on Human Computer Interaction, 2009.

Sassaroli, A., Tong, Y, Fantini, S. **Hirshfield, L.M**, Girouard, A., Solovey E.T., Jacob, R.J.K., *Discrimination of mental workload levels in human subjects with functional near-infrared spectroscopy*. in the Journal of Innovative Optical Health Sciences, 2009.

E.T. Solovey, A. Girouard, K. Chauncey, **L.M. Hirshfield**, A. Sassaroli, F. Zheng, S. Fantini, and R.J.K. Jacob, "Using fNIRS Brain Sensing in Realistic HCI Settings: Experiments and

Guidelines,” ACM UIST 2009 Symposium on User Interface Software and Technology, ACM Press (2009).

Journal Articles:

Eloy, L., E. Doherty, C. Spencer, P. Bobko, and L. Hirshfield, *Using fNIRS to Identify Transparency- and Reliability-Sensitive Markers of Trust across Multiple Timescales in Collaborative Human-Human-Agent Triads*. *Frontiers in Neuroergonomics*, 2022. **3**.

Bobko, P., L. Hirshfield, L. Eloy, C. Spencer, E. Doherty, J. Driscoll, and H. Obolsky, *Human-agent teaming and trust calibration: a theoretical framework, configurable testbed, empirical illustration, and implications for the development of adaptive systems*. *Theoretical Issues in Ergonomics Science*, 2022: p. 1-25.

Wang, J., T. Grant, S.V. Gursoy, B. Geng, and **L. Hirshfield**, *Taking a Deeper Look at the Brain: Predicting Visual Perceptual and Working Memory Load from High-Density fNIRS Data*. *IEEE Journal of Biomedical and Health Informatics*, 2021: p. 1-1.

Sommer, N.M., B. Kakillioglu, T. Grant, S. Velipasalar, and **L. Hirshfield**, *Classification of fNIRS Finger Tapping Data With Multi-Labeling and Deep Learning*. *IEEE Sensors Journal*, 2021. 21(21): p. 24558-24569.

Bergen-Cico, D., T. Grant, **L. Hirshfield**, R. Razza, M.R. Costa, and P. Kilaru, *Using fNIRS to Examine Neural Mechanisms of Change Associated with Mindfulness-Based Interventions for Stress and Trauma: Results of a Pilot Study for Women*. *Mindfulness*, 2021. 12(9): p. 2295-2310.

N. M. Sommer, S. Velipasalar, **L. Hirshfield**, Y. Lu and B. Kakillioglu, "Simultaneous and Spatiotemporal Detection of Different Levels of Activity in Multidimensional Data," in *IEEE Access*, vol. 8, pp. 118205-118218, 2020, doi: 10.1109/ACCESS.2020.3005633.

Bandara, D., Grant, T., **Hirshfield, L.**, Velipasalar, S. *Identification of Potential Task Shedding Events Using Brain Activity Data*. *Journal of Augmented Human Research*. (2020).

Bandara, D., Velipasalar, S., and **Hirshfield, L.**, *Classification of Affect Using Deep Learning on Brain Blood Flow Data*. *Journal of Near Infrared Spectroscopy*, 2019.

Hirshfield, L.M. Bobko, P., Barelka, A., *Toward Interfaces that Help Users Identify Disinformation Online: Using fNIRS to Measure Suspicion*. *Journal of Augmented Human Research*. 4(1), 2019.

Bandara, D., **Hirshfield, L.**, Velipasalar, S. *Building Predictive Models of Emotion with Functional Near-Infrared Spectroscopy*. Vol 110. *International Journal of Human-Computer Studies* (2017).

Bobko, P., Barelka, A., **Hirshfield, L.**, Lyons, J. How the Study of the Construct of Suspicion Can Benefit Theories and Models in Organizational Science. *Journal of Business and Psychology*. 2014.

Bobko, P., Barelka, A., **Hirshfield, L.M.** A Review of the Construct of “Suspicion” with Applications to Automated and Information Technology (IT) Contexts: A Research Agenda. *the Human Factors and Engineering Society Journal (HFES)* 2014).

Hirshfield, L.M., Barelka, A. Bobko, P. Paverman, D., Hirshfield, S., Using Non-Invasive Brain Measurement to Explore the Psychological Effects of Computer Malfunctions On Users During Human-Computer Interactions. *Journal of Advances in Human-Computer Interaction* , 2014.

Hirshfield, L., Bobko, P., Barelka, A., Costa, M., Funke, G., Mancuso, V., Finomore, V., Knott, B. *The Role of Human Operators' Suspicion in the Detection of Cyber Attacks*. *Int. J. Cyber Warf. Terror.* 5, 3 (July 2015), 28-44.

Haas, M., **Hirshfield, L.**, Ponangi, P. , Kidambi,P., Rao, D., Edala, N., Armbrust, E., Fendley, F., Narayanan. S.. Decision-making and emotions in the contested information environment. *ICST Journal Transactions* (2013).

Book Chapters:

Hirshfield, L.M., Bergen-Cico, D., Costa, M., Jacob, R., Hincks, S., Russell, M. *Measuring the Neural Correlates of Mindfulness with Functional Near-Infrared Spectroscopy*. In *Empirical Studies of Contemplative Practices*. NOVA. 2018.

A. Girouard, E. Solovey, **L. Hirshfield**, E. Peck, K. Chauncey, A. Sassaroli, S. Fantini, and R. Jacob, “From Brain Signals to Adaptive Interfaces: Using fNIRS in HCI,” in *Brain-Computer Interfaces: Applying our Minds to Human-Computer Interaction*, ed. by D.S. Tan and A. Nijholt, pp. 221-237, Springer (2010).

Other Publications:

A. Sassaroli, F. Zheng, A. Girouard, E.T. Solovey, K. Chauncey, **L.M. Hirshfield**, E. Peck, R.J.K. Jacob, and S. Fantini, “Application of correlation analysis tools for the classification of mental workloads in functional near-infrared spectroscopy,” *BIOMED OSA Topical Meeting*, Poster presentation (2010).

E.T. Solovey, O. Shaer, A. Girouard, **L.M. Hirshfield**, M.S. Horn, J. Zigelbaum, and R.J.K. Jacob, “Programming Reality within the Reality-Based Interaction Framework,” *Proc. ACM CHI 2009 Workshop on Programming Reality: From Transitive Materials to Organic User Interfaces* (2009).

L.M. Hirshfield, E.T. Solovey, A. Girouard, J. Kebinger, M.S. Horn, O. Shaer, J. Zigelbaum, and R.J.K. Jacob, “Using Brain Measurement to Evaluate Reality Based Interactions,” *Proc.*

ACM CHI 2009 Workshop on Challenges in Evaluating Usability and User Experience of Reality-Based Interaction (2009).

A. Sassaroli, Y. Tong, **L.M. Hirshfield**, A. Girouard, E.T. Solovey, R.J.K. Jacob, and S. Fantini, “Real-time assessment of mental workload with near infrared spectroscopy: potential for human-computer interaction,” *BIOMED OSA Topical Meeting*, Poster presentation (2008).

A. Girouard, **L.M. Hirshfield**, E. Solovey, and R.J.K. Jacob, “Using functional Near-Infrared Spectroscopy in HCI: Toward evaluation methods and adaptive interfaces,” *Proc. ACM CHI 2008 Workshop on Brain-Computer Interfaces for HCI and Games* (2008).

R.J.K. Jacob, A. Girouard, **L.M. Hirshfield**, M. Horn, O. Shaer, E.T. Solovey, and J. Zigelbaum, “What Is the Next Generation of Human-Computer Interaction?,” *interactions*, vol. 14, no. 3, pp. 53-58 (2007).

M.S. Horn, O. Shaer, A. Girouard, **L.M. Hirshfield**, E.T. Solovey, J. Zigelbaum, and R.J.K. Jacob, “Putting Tangible User Interfaces in Context: A Unifying Framework for Next Generation HCI,” *Proc. ACM CHI 2007 Workshop on Tangible User Interfaces in Context and Theory* (2007).

L.M. Hirshfield, A. Girouard, E.T. Solovey, R.J.K. Jacob, A. Sassaroli, Y. Tong, and S. Fantini, “Human-Computer Interaction and Brain Measurement Using Functional Near-Infrared Spectroscopy,” *Proc. ACM UIST 2007 Symposium on User Interface Software and Technology*, ACM Press, Poster paper (2007).

Research Grants

Hirshfield, L.M., COSMO I: Human-Guided Machine Learning for Cognitive State Modeling”, SBIR with Aptima, Army Research Lab. 1/20/23-7/4/23.

Hirshfield, L.M., D’Mello, S., Ceko, M., Neuro-Inspired Collaborative Problem Solving in Human-Agent Teams. Army Research Lab, STRONG Cycle 4 Seedling. \$100,000 May 2022-May 2023.

Hirshfield, L.M., D’Mello, S., Boothe, B., Meta Review of Calibrated Trust in Human-Agent Teams. Toyota Research in North America, \$68k. Nov 2022- March 2023.

Hirshfield, L.M. Tools for Objective Measurement and Evaluation (TOME). STTR with Aptima. NAVAIR. Phase 3 (\$102,000). July 2021-April 2022. Option Period.

D’Mello, S., Sumner, T., Penuel, B., Puntebekar, S., Palmer, M., Beveridge, R. NSF Institute on Student AI Teaming. University of Colorado. \$19,993,294 Sep2020-Sep2025.

Hirshfield, L., D’Mello, S., Bobko, P. Development of a Theoretical Framework and Intelligent Trust Modulation System for Enhancing Trust and Performance Outcomes of Human-Agent Teams. Army Research Lab. (\$814,000). July 2019-Dec 2024.

Williams, T., **Hirshfield, L.** APERTURE: Augmented Reality and Physio-Enhanced Robotic Gesture. National Science Foundation. (\$490,800), Sep 2019-Sep 2022.

Hirshfield, L.M., D’Mello, S., Wearable Cognitive, Physiological, and Behavioral Sensor Suite for Human Machine Teaming Research. AFOSR Defense University Instrumentation Program (DURIP). (\$508,000). March, 2019.

D’Mello, S., **Hirshfield, L.,** Modeling Brain and Behavior to Uncover the Eye-Brain-Mind Link during Complex Learning. National Science Foundation. (\$605,124), Sep 2019-Sep 2022.

Hirshfield, L.M., Velipasalar, S., Improved Cross-Subject Cognitive and Emotional State Classification Using Functional Near-Infrared Spectroscopy Data for Deep Learning. National Science Foundation. (\$494,374), Sep 2018-Sep 2021.

Hirshfield, L.M., Kainerstorfer, J., Development of a Remote-fNIRS Device for use Under Naturalistic Working Conditions" Air Force Office of Scientific Research. (\$541,605). Jan 2018 – Jan 2021.

Hirshfield, L.M. Tools for Objective Measurement and Evaluation (TOME). STTR with Aptima. NAVAIR. Phase 2 Option Period (\$140,000). May 2019-July 2020. Option Period.

Hirshfield, L.M. Tools for Objective Measurement and Evaluation (TOME). STTR with Aptima. NAVAIR. Phase 2 Base Period (\$70,000). February 2018- November 2018 Base Period.

Hirshfield, L.M. Tools for Objective Measurement and Evaluation (TOME). STTR with Aptima. NAVAIR. Phase 1 Base + Option period (\$55,000). July 1, 2016 – September 7, 2017.

Hirshfield, L.M. Adaptable System for Measuring Performance of Teams of Operators in Targeted Environments (ASYMPTOTE), funded by Charles River Analytics Inc., Prime Contractor Air Force Research Labs. (\$94,490). October 2016-October 2017.

Bobko, P., **Hirshfield, L.M.,** Algorithm Transparency Trust in Autonomy for Human-Machine Teaming (TAHMT). SRA International. Prime Contractor: Air Force Research Lab. FA8650-16-D-6616. (\$40,000.) Feb 2016 – Sep 2017.

Hirshfield, L.M. The Human Side of the Fatigue Free Platform: Helicopter Pilots’ Interactions with Automation. Army Research Lab.. (\$99,669). Fall 2015-Fall 2016

Hirshfield, L.M. Understanding the Effects of Cyber Attacks on Human Operators. AFOSR Young Investigator Award. (\$357,478). Fall 2014 – Fall 2017.

Hirshfield, L.M. Cyber Trust and Suspicion. Air Force Office of Scientific Research (AFOSR). (\$306,000). Fall 2012 – Fall 2015.

Hirshfield, L.M. Measuring Trust and Suspicion in Human Computer Interactions. Air Force Office of Scientific Research (AFOSR). (\$292,300). Spring 2011 – Spring 2014

Hirshfield, S. and **Hirshfield, L.M.** Hamilton Usability Lab. Defense University Instrumentation Program. (\$458,900). Spring 2010.

Jacob, R.J.K. (PI), Using Brain Measurement to Evaluate the Effects of Interface Disruptions on Computer Users. Air Force Office of Scientific Research. (\$277,812). 2008 – 2011.

Synergistic, Outreach, and Community Activities

➤ Aptima, Inc. Scientific Advisory Board.

- Board President. The Clinton Early Learning Center. Clinton NY (9/17- 6/19).
- Graduate student co-creator of Tech Camp 101 in 2003. Tech Camp 101 was a free technology camp for underprivileged students from the Denver, CO area.
Miller, L., Shearer, S., Moskal, B. Technology Camp 101. Stimulating Middle School Students' Interests in Computing. Frontiers in Education Conference. 2005.
- Co-authored a computer science education paper about the use of Alice Programming as a way to attract and retain underrepresented students to computer science.

Powers, K., Ecott, S., and **Hirshfield, L.M.** 2007. Through the looking glass: teaching CS0 with Alice. SIGCSE Bull. 39, 1 (March 2007), 213-217.
- Chair of Special Paper Session at HCI International 2015 titled 'Using Machine Learning on Cognitive Data'. Toronto, Canada.
- Recipient of the Mohawk Valley Engineers Executive Council Young Technologist of the Year Award. April, 2012.
- Past and present reviewer for SIGCHI, ACM TOCHI, Journal of Social, Cognitive, and Affective Neuroscience, and the International Journal of Human-Computer Interaction.