Bradley Hayes

Assistant Professor
University of Colorado Boulder
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Education

Yale University September 2009 – May 2016
Doctor of Philosophy, Computer Science
Committee: Brian Scassellati*, Dan Spielman, Julie Dorsey, Rod Grupen
Dissertation: *Supportive Behaviors for Human-Robot Teaming*
Master of Philosophy, Computer Science
Master of Science, Computer Science

Boston College September 2004 - May 2008
Bachelor of Science with Honors, Computer Science
Bachelor of Arts, Mathematics
Concentration, Scientific Computation

Professional Experience

Circadence Corporation; Boulder, CO October 2018 – Present
Chief Technology Officer

University of Colorado Boulder; Boulder, CO August 2017 – Present
Assistant Professor, Department of Computer Science, College of Engineering and Applied Science
Director, Collaborative AI and Robotics Lab (http://www.cairo-lab.com/)

Massachusetts Institute of Technology; Cambridge, MA October 2015 – August 2017
Postdoctoral Associate, Interactive Robotics Group, CSAIL

Yale University; New Haven, CT August 2009 – October 2015
Research Assistant / PhD Candidate, Social Robotics Lab, Computer Science Department

BAE Systems, Inc. Advanced Information Technology; Burlington, MA June 2008 – August 2009
Research Engineer, Multi-Sensor Exploitation Directorate

Microsoft; Redmond, WA June 2007 – August 2007
Software Development Engineer Intern - Anti-Malware Lower Engine Team

IBM Extreme Blue Labs; Austin, TX June 2006 – August 2006
Extreme Blue Technical Intern

IBM; Cambridge, MA June 2005 – August 2005
Software Development Engineer Intern

Honors and Awards

- **Best Paper Finalist**, Technical Advances, ACM/IEEE International Conference on Human-Robot Interaction, 2019.
- GRAKN.AI Top 5 Breakthroughs in Deep Learning in 2016.
- ACM Dissertation Award Nominee for Yale University, 2015.
- Yale University Kempner Fellowship. September 2014 – August 2015.
- **Best Paper Finalist**, RSJ/KROS Distinguished Interdisciplinary Research Award, RO-MAN 2014.

- 1st Place, Yale Entrepreneurial Society Elevator Pitch Competition, 2012.
- 2nd Place, Boston College Venture Challenge, 2009.
- US Patent # 7877700 -- "Adding accessibility to drag-and-drop web content", 2009.
- The Accenture Award for outstanding performance in Computer Science, Boston College, 2008.

Invited Panels and Talks

- **Workshop on Humans, Machines, and Experimental Social Science (HUMANESS), hosted by NYUAD. September 2020.**
- **Plenary Speaker at the South American Business Forum, hosted in Buenos Aires, Argentina. July 31, 2020.**
- **"AI & Trust" at the Applied Machine Learning Days Conference hosted at EPFL. January 28, 2020.**
- **University of Colorado Boulder, Institute of Cognitive Science Colloquium Series. Dec. 6, 2019.**
- **University of Washington, "Explainable AI for Establishing Shared Expectations During Human-Robot Collaboration", Nov. 8, 2019.**
- **Panelist, AI Los Angeles event on AI, Cybersecurity, and Privacy at the Cedars-Sinai Accelerator. November 21, 2019.**
- **ANIMATAS Project Winter School Keynote Speaker, Paris, France. November 20, 2019.**
- **TEDxMileHigh Humankind, "Can we trust artificial intelligence to make decisions for us?", June 22, 2019.**
- **Panelist, Silicon Flatirons Panel on Explainable Artificial Intelligence in Boulder, CO. May 3, 2019.**
- **Panelist, AFCEA Homeland Security Conference panel on "Technology Solutions to Enhance Critical Infrastructure Protection and Incident Response around the Nation" in Washington, DC. April 23, 2019.**
- **IEEE-RAS Spring School on Social and Artificial Intelligence for User-Friendly Robots, March 20, 2019.**
- **United Technologies Research Center, "Explainable AI for Human-Robot Collaboration", December 3, 2018.**
- **TEDxMileHigh Adventure, "Intelligent Robotics: Building Our Future Autonomous Teammates", October 11, 2018.**
- **Global Conference on Educational Robotics, Keynote, July 28, 2018.**
- **Boulder Startup Week, "State of Robotics in Colorado" Panel. May 17, 2018.**
- **Conference on World Affairs, "Dreams of a Digitized Humanity: AI" Panel and Demonstration. April 13, 2018.**
- **Boulder is for Robots Seminar. Mar 15th, 2018.**
- **HRI 2018 Workshop on "Explainable Robot Behaviors". Mar 5th, 2018.**
- **British Machine Vision Association meeting on "Cognitively inspired explainable perception-based AI"**. Feb 7th, 2018.
- **Brown University Humanity Centered Robotics Initiative Seminar Series.** November 8th, 2017.
- **Yale University Computer Science Seminar Series.** November 2nd, 2017.
- **IROS Workshop on Human-Robot Interaction in Collaborative Manufacturing Environments.** September 24th, 2017.
- **3rd Summer School on Social Human-Robot Interaction.** September 7, 2017.
- **University of Oxford.** April 28, 2017.
- **University of New Hampshire.** April 21, 2017.
- **Boston University.** April 3, 2017.
- **Stanford University.** March 16, 2017.
- **University of California Berkeley.** March 15, 2017.
- **Oregon State University.** March 13, 2017.
- **Cornell University.** March 3, 2017.
- **Northeastern University.** March 1, 2017.
- **Tufts University.** February 27, 2017.
- **University of Colorado Boulder.** February 23, 2017.
- **UC Berkeley / INRIA Paris: "Algorithms for Human-Robot Interaction" Workshop.** July 21, 2016.
- **University of Massachusetts, Amherst.** April 14, 2016.
- **Vicarious.** March 22, 2016.
- **Oregon State University.** November 17, 2015.
- **Joint Strike Fighter Joint Program Office.** November 13, 2015.
- **Cornell University.** April 3, 2015.
- **Worcester Polytechnic Institute.** November 21, 2014.
- **University of Edinburgh.** August 27, 2014.

Teaching Experience

University of Colorado Boulder --- **CSCI 7000 "Algorithmic Human-Robot Interaction"** Spring 2018-2020

University of Colorado Boulder --- **CSCI 3302 "Introduction to Robotics"** Fall 2017 - 2019

Guest Lecturer

University of Colorado Boulder, CSCI 5622 – Machine Learning(2018)
University of Colorado Boulder, CSCI 3002 – Human-Computer Interaction (2018)
Massachusetts Institute of Technology, 16.422J -- Human Supervisory Control of Automated Systems (2015)
Worcester Polytechnic Institute, RBE526 – Human Robot Interaction (2014)

Grants and Funding

"Life-long Learning for Motion Planning in Human Populated Environments" $749,094
National Science Foundation: National Robotics Initiative (NSF NRI) Sept 2018 – Aug 2021

"Opportunistic Planning for Emergent Capability in Dynamic Human-Robot Teams" $99,938
Army Research Laboratory: Strengthening Teamwork for Robust Operations in Novel Groups May 2020 – May 2021

Academic Service, Memberships, and Public Outreach

- Grant Review:
  - National Science Foundation (RI, NRI, CRII, S&AS)
  - AI Singapore Research Programme (2019)
  - Vrije Universiteit Brussel Interdisciplinary Research Programmes (2019)
  - NRF South Africa (Thuthuka 2018)
  - Ontario Research Fund (2017)
- Journal, Conference, and Workshop Leadership:
  - Associate Editor, ACM Transactions on Human-Robot Interaction, 2018-Present
  - Organizing Committee, "Solutions for socially intelligent HRI in real-world scenarios", RO-MAN 2020.
  - Editor, ACM Transactions on Human-Robot Interaction Special Issue on AI-HRI, 2018.
  - Organizing Committee, AAAI Fall Symposium on "Interactive Learning for AI-HRI", 2018.
  - Organizing Committee, HRI Workshop on Longitudinal Human-Robot Teaming, 2018.
  - Area Chair, 32nd AAAI Conference on Artificial Intelligence, 2018.
  - Organizing Committee, AAAI Fall Symposium on "Human-Agent Groups", 2017.
  - Senior Program Committee, International Joint Conference on Artificial Intelligence, 2017.
  - Program Committee, International Joint Conference on Artificial Intelligence, 2017.
  - Program Committee, 31st AAAI Conference on Artificial Intelligence, 2017.
  - Program Committee, ACM/IEEE International Conference on Human-Robot Interaction, 2017.
  - Organizing Committee, AAAI Fall Symposium on "AI for Human-Robot Interaction", 2016.
  - Associate Editor, IEEE International Conference on Intelligent Robots and Systems, 2016.
  - Associate Editor, IEEE International Symposium on Robot and Human Interactive Communication, 2016.
  - Program Committee, IJCAI Workshop on Interactive Machine Learning, 2016.
  - Program Committee, International Joint Conference on Artificial Intelligence, 2016.
  - Program Committee, AAAI Robotics Fellowship Program, 2016.
  - Program Committee, Human-Robot Interaction Pioneers Workshop, 2016.
  - Program Committee, ACM/IEEE International Conference on Human-Robot Interaction, 2016.
  - **General Chair, AAAI Fall Symposium on "AI for Human-Robot Interaction", 2015.**
  - **General Chair, Human Robot Teaming Workshop at HRI 2015.**
  - Program Committee Chair, Human-Robot Interaction Pioneers Workshop, 2014.
- Conference and Journal Review:
  - Frontiers Robotics and AI
  - Mechatronics
  - Journal of Autonomous Agents and Multi-Agent Systems.
  - Robotics and Automation Letters.

    - International Journal of Robotics Research.
    - International Journal of Robotics Research: Special Issue on HRI.
    - ACM Transactions on Interactive Intelligent Systems.
    - Journal of Human-Robot Interaction.
    - Autonomous Robots.
    - Robotics and Computer-Integrated Manufacturing.
    - Conference on Robot Learning (CoRL)
    - Robotics: Science and Systems (RSS)
    - IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
    - IEEE International Conference on Robotics and Automation (ICRA)
    - ACM/IEEE International Conference on Human-Robot Interaction (HRI)
    - IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN).
    - AAAI Conference on Artificial Intelligence (AAAI)
    - International Joint Conference on Artificial Intelligence (IJCAI).
    - IEEE-RAS International Conference on Humanoid Robots (Humanoids).
    - IEEE International Conference on Development and Learning and Epigenetic Robotics (ICDL-EPIROB)
- Membership in Professional Societies:
    - Association for the Advancement of Artificial Intelligence.
    - IEEE
    - ACM
- Outreach:
    - Conference on World Affairs Panelist (2018) and Moderator (2020).
    - TEDxMileHigh Speaker and Adventure Host. 2019.
    - Invited Public Science Q&A for Reddit.com on Human-Robot Collaboration and AI (front page, 45k views). 2016.
    - Led international charity drive benefiting GirlsWhoCode. 2016.
    - HackCU Hackathon Mentor, Boulder, CO, 2018.
    - HackMIT International Hackathon Mentor, Cambridge, MA 2016.
    - Boston Museum of Science Podcast. 2016.
    - MIT Centennial Open House Organizer and Exhibitor, Cambridge, MA 2016.
    - World Science Festival Exhibitor, New York City, NY, 2014.

Publications

Journal Papers

J1. A. Tabrez, R. Leonard, B. Hayes. (2020). One-shot Policy Elicitation via Semantic Reward Manipulation. Robotics and Automation Letters (RA-L). (**Under Review**)

J2. M. Gombolay, J. Yang, B. Hayes, N. Seo, S. Wadhwania, Z. Liu, T. Yu, N. Shah, T. Golen, J. Shah. (2017). Robotic Assistance in Coordination of Patient Care. International Journal of Robotics Research (IJRR).

Highly Refereed Conference Papers

C1. A. Pasricha, B. Hayes, A. Roncone. (2020). PokeRRT: Leveraging analytical models for non-prehensile manipulation in multimodal motion planning. **Under Review at to IROS 2020.**

C2. J. Kawell, A. Tabrez, B. Hayes. (2020). Hierarchical Query-based Interactive Plan Augmentation and Repair through Semantic Constraints for Robust Skill Planning and Execution. **Under Review at to IROS 2020.**

C3. B. Hayes and M. Moniz. (2020). Trustworthy Human-Centered Automation through Explainable AI and High-Fidelity Simulation. 11th International Conference on Applied Human Factors and Ergonomics (AHFE 2020).

C4. Tariq Iqbal, Shen Li, Christopher Fourie, Bradley Hayes, and Julie A. Shah. (2019). Fast Online Segmentation of Activities from Partial Trajectories. Proceedings of the IEEE International Conference on Robotics and Automation (ICRA 2019).

C5. Aaquib Tabrez, Shivendra Agrawal, and Bradley Hayes. (2019). Explanation-based Reward Coaching to Improve Human Performance via Reinforcement Learning. Proceedings of the 2019 ACM/IEEE International Conference on Human Robot Interaction (HRI 2019).

C6. C. Mueller, J. Venicx, and B. Hayes. (2018). Robust Robot Learning from Demonstration and Skill Repair Using Conceptual Constraints. 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018).

C7. B. Hayes and J. Shah. (2017). Interpretable Models for Fast Activity Recognition and Anomaly Explanation During Collaborative Robotics Tasks. 2017 IEEE International Conference on Robotics and Automation (ICRA 2017).

C8. B. Hayes and J. Shah. (2017). Improving Robot Controller Transparency Through Autonomous Policy Explanation. 12th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2017).

C9. M. Gombolay, J. Yang, B. Hayes, N. Seo, S. Wadhwania, Z. Liu, T. Yu, N. Shah, T. Golen, J. Shah. (2016). Robotic Assistance in Coordination of Patient Care. Proceedings of Robotics: Science and Systems (RSS 2016).

C10. B. Hayes and B. Scassellati. (2016). Autonomously Constructing Hierarchical Task Networks for Planning and Human-Robot Collaboration. Proceedings of 2016 IEEE International Conference on Robotics and Automation (ICRA 2016).

C11. H. Admoni, T. Weng, B. Hayes, and B. Scassellati. (2016). Robot Nonverbal Behavior Improves Task Performance in Difficult Collaborations. Proceedings of the 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2016)

C12. B. Hayes and B. Scassellati. Effective Robot Teammate Behaviors for Supporting Sequential Manipulation Tasks. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2015).

C13. B. Rosman, B. Hayes, and B. Scassellati. Enhancing Agent Safety through Autonomous Environment Adaptation. IEEE International Conference on Development and Learning and Epigenetic Robotics (ICDL 2015).

C14. B. Hayes, E.C. Grigore, A. Litoiu, A. Ramachandran, B. Scassellati. A Developmentally Inspired Transfer Learning Approach for Predicting Skill Durations. In *Proceedings of the 4th joint IEEE International Conference on Development and Learning and Epigenetic Robotics*. (ICDL 2014).

C15. B. Hayes and B. Scassellati. Discovering Task Constraints through Observation and Active Learning. In *2014 IEEE/RSJ International Conference on Intelligent Robots and Systems*. Chicago, Illinois, USA, September 2014.

C16. B. Hayes, D. Ullman, E. Alexander, C. Bank, and B. Scassellati. People Help Robots Who Help Others, Not Robots Who Help Themselves. Proceedings of the 23rd IEEE International Symposium on Robot and Human Interactive Communication. Edinburgh, Scotland, August 2014.

C17. E. Alexander, C. Bank, J.J. Yang, B. Hayes, and B. Scassellati. Asking for Help from a Gendered Robot. In *Proceedings of the 36th Annual Conference of the Cognitive Science Society (CogSci 2014).* Quebec City, Canada, July 2014.

C18. B. Hayes and B. Scassellati. Improving Implicit Communication In Mixed Human-Robot Teams With Social Force Detection. In *Proceedings of the 3rd joint IEEE International Conference on Development and Learning and Epigenetic Robotics*. Osaka, Japan, August 2013.

C19. H. Admoni, B. Hayes, D. Feil-Seifer, D. Ullman, and B. Scassellati. Dancing With Myself: The effect of majority group size on perceptions of majority and minority robot group members. In: *M. Knauff, M. Pauen, N. Sebanz, & I. Wachsmuth (eds.), Proceedings of the 35th Annual Conference of the Cognitive Science Society (CogSci 2013). Austin, TX: Cognitive Science Society*. Berlin, Germany, July 2013.

C20. H. Admoni, B. Hayes, D. Feil-Seifer, D. Ullman, and B. Scassellati. Are You Looking At Me? Perception of Robot Attention is Mediated by Gaze Type and Group Size. In *Proceedings of the 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2013)*. Tokyo, Japan, March 2013.

Tutorials

T1. B. Hayes, E. Kamar, and M. Taylor. Interactive Machine Learning: From Classifiers to Robotics. At the 16th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2017).

T2. B. Hayes, E. Kamar, and M. Taylor. Interactive Machine Learning: From Classifiers to Robotics. At the International Joint Conference on Neural Networks (IJCNN 2017).

T3. B. Hayes, E. Kamar, and M. Taylor. Interactive Machine Learning: From Classifiers to Robotics. At the 31st AAAI Conference on Artificial Intelligence (AAAI 2017).

Lightly Refereed Conference, Workshop, Symposia, and Poster Papers

W1. A. Tabrez, M. Luebbers, B. Hayes. Automated Failure-Mode Clustering and Labeling for Informed Car-To-Driver Handover in Autonomous Vehicles. ACM/IEEE HRI Workshop on Assessing, Explaining, and Conveying Robot Proficiency for Human-Robot Teaming at HRI 2020. Cambridge, UK.

W2. C. Mueller and B. Hayes. Safe and Robust Robot Learning from Demonstration through Conceptual Constraints. HRI Pioneers Workshop at HRI 2020. Cambridge, UK.

W3. Aastha Acharya, Shohei Wakayama, Bradley Hayes, and Nisar Ahmed. Iterative Reward Learning for Robotic Exploration. AIAA Scitech 2020 Forum. Orlando, FL.

W4. Carl Mueller and Bradley Hayes. Abstract Constraints for Safe and Robust Robot Learning from Demonstration. Doctoral Consortium at the 34th AAAI Conference on Artificial Intelligence (AAAI 2020). New York, NY.

W5. B. Hayes and K. Dores. (2019). Using Artificial Intelligence to Mitigate Cyber-Risks. International Airport Review.

W6. Aaquib Tabrez and Bradley Hayes. Improving Human-Robot Interaction through Explainable Reinforcement Learning. In Proceedings of the HRI Pioneers Workshop at the 2019 ACM/IEEE International Conference on Human Robot Interaction (HRI 2019). Daegu, South Korea.

W7. J. Perlow, B. Rosman, B. Hayes, P. Ranchod. Raw Material Selection for Object Construction. In *Proceedings of the 28th Annual Symposium of the Pattern Recognition Association of South Africa and the 10th Robotics and Mechatronics Conference of South Africa*.

W8. B. Hayes, M.C. Gombolay, M.F. Jung, K. Hindriks, J. de Greeff, C. Jonker, M. Neerincx, J.M. Bradshaw, M. Johnson, I. Kruijff-Korbayova, M. Sierhuis, J.A. Shah, B. Scassellati. HRI Workshop on Human-Robot Teaming. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction Extended Abstracts*. Portland, Oregon, March 2015.

W9. B. Hayes and B. Scassellati. Social Hierarchical Learning. In Proceedings of the AAAI 2015 Doctoral Consortium. Austin, Texas, January 2015.

W10. B. Scassellati and B. Hayes. Human-robot collaboration. AI Matters 1, 2 (December 2014), 22-23.

W11. B. Hayes and B. Scassellati. Developing Effective Robot Teammates for Human-Robot Collaboration. In Proceedings of the "Artificial Intelligence and Human-Robot Interaction" (AI-HRI) Fall Symposium. Arlington, Virginia, November 2014.

W12. B. Hayes and B. Scassellati. Social Hierarchical Learning: Enabling Human-Robot Teamwork. Poster and interactive demonstration in the "Robotics Exhibition" at CogSci/AAAI 2014. Quebec City, Canada, July 2014.

W13. B. Hayes and B. Scassellati. Online Development of Assistive Robot Behaviors for Collaborative Manipulation and Human-Robot Teamwork. *Proceedings of the "Machine Learning for Interactive Systems" (MLIS) Workshop at AAAI 2014*. Quebec City, Canada, July 2014.

W14. B. Hayes and B. Scassellati. Challenges in Shared-Environment Human-Robot Collaboration. In *Proceedings of the "Collaborative Manipulation" Workshop at HRI 2013*. Tokyo, Japan, March 2013.

W15. B. Hayes and B. Scassellati. Social Hierarchical Learning. In: *Proceedings of the "HRI Pioneers" Workshop at HRI 2013*. Tokyo, Japan, March 2013.

Advising and Student Mentoring

• **Shivendra Agrawal**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Summer 2019 - Present**
• **Christine Chang**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Summer 2019 - Present**
• **Aaquib Tabrez**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Fall 2018 – Present**
• **Jack Kawell**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Fall 2018 – Present**
• **Matthew Luebbers**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Fall 2018 – Present**
• **Carl Mueller**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Spring 2018 – Present**
• **Jeff Venicx**	**University of Colorado Boulder**	**(PhD Thesis Advisor)**	**Spring 2018 – Present**
• **Luke Burks**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **Mike Kasper**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **John Stechschulte**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **Brett Israelson**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **Radhen Patel**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **Steven McGuire**	**University of Colorado Boulder**	**(PhD Committee)**	**2019**
• **Sina Aghli**	**University of Colorado Boulder**	**(PhD Committee)**	**2018**
• **Fernando Noble**	**University of Colorado Boulder**	**(PhD Committee)**	**2018**
• **Yash Gandhi**	**University of Colorado Boulder**	**(MS Committee)**	**2020**
• **Jeremy Muesing**	**University of Colorado Boulder**	**(MS Committee)**	**2019**
• **Austin Whitesell**	**Oregon State University**	**(MS Committee)**	**2018**
• **Jason Perlow**	**University of the Witwatersrand**	**(MS Committee)**	**2018**