

# Rachael Bevill Burns

Stuttgart, Germany • Email: rburns@is.mpg.de • Citizenship: USA

## Education

### 2018 – 2023 **International Max Planck Research School for Intelligent Systems (IMPRS-IS)**

*Max Planck Institute for Intelligent Systems and University of Tuebingen Joint Ph.D Program*

*Ph.D. in Computer Science with a focus on Human-Robot Interaction (expected Spring 2023)*

Thesis: A Haptic Empathetic Robot Animal for Children with Autism

Advisor: Dr. Katherine J. Kuchenbecker

### 2015 – 2017 **The George Washington University (GW)**

*Master of Science in Biomedical Engineering, Washington, DC, USA*

Thesis: Robotic Motion Learning Framework to Promote Social Engagement

Advisor: Dr. Chung Hyuk Park

### 2011 – 2015 **The George Washington University (GW)**

*Bachelor of Science in Biomedical Engineering, Washington, DC, USA*

Senior Design Project: Assistive Communication Device for Mentally or Physically Impaired Patients

## Additional Educational Training

Sep. 2021 *Summer School on Wearable Robotics* in Madrid, Spain

Hosted by the COST Action on Wearable Robots (CA16116)

Week-long group project: Utilizing the Myo EEG armband to control gameplay in Unity

Sep. 2022 *Summer School on Haptics and Cognitive Robotics* in Dresden, Germany

Hosted by TU Dresden and the Centre for Tactile Internet with Human-in-the-Loop (CeTI)

## Selected Honors and Awards

2021 First place, HRI 2021 Student Elevator Pitch Competition

2021 **HRI Pioneer** – The Human-Robot Interaction (HRI) Pioneers Workshop brings together the world's top student HRI researchers to present and discuss their work with distinguished senior HRI scholars. One of 18 students chosen worldwide.

2021 IMPRS-IS Summer Bootcamp Award – 2nd place (3-way tie) for Best Research Lightning Talk

2019 IMPRS-IS Summer Bootcamp Award – 2nd place for Best Research Lightning Talk

2017 **Whitaker International Fellow** – Fellowship for emerging U.S. leaders in biomedical engineering to build collaborative ties with individuals and institutions overseas. One of 30 national recipients.

2017 Pi Alpha Kappa Professional Development Grant for Cherry Blossom Princess Alumnae

2015 GW Pelton Award for Outstanding Senior Design Project – 3rd place out of graduating class

2015 Outstanding Student Member Award, GW Theta Tau Professional Engineering Fraternity

2011–2015 GW School of Engineering and Applied Sciences Academic Scholarship

2011–2015 GW University and Alumni Academic Scholarship

2011 New Hampshire Red Sox Service Scholarship

## Publications

### Unpublished

- [U1] Rachael Bevill Burns, Fayo Ojo, and Katherine J. Kuchenbecker. **Title anonymized for double-blind submission.** Submitted to the *ACM/IEEE International Conference on Human-Robot Interaction (HRI)*.

### Journal Articles

- [J1] Rachael Bevill Burns, Hyosang Lee, Hasti Seifi, Robert Faulkner, and Katherine J. Kuchenbecker. **Endowing a NAO robot with practical social-touch perception.** *Frontiers in Robotics and AI*, 9(840335):1-17, April 2022. Includes video and database supplementary materials. DOI: [10.3389/frobt.2022.840335](https://doi.org/10.3389/frobt.2022.840335)
- [J2] Rachael Bevill Burns, Hasti Seifi, Hyosang Lee, and Katherine J. Kuchenbecker. **Getting in touch with children with autism: Specialist guidelines for a touch-perceiving robot.** *Paladyn. Journal of Behavioral Robotics*, 12(1):115-135, January 2021. DOI: [10.1515/pjbr-2021-0010](https://doi.org/10.1515/pjbr-2021-0010)
- [J3] Hifza Javed, Rachael Burns, Myounghoon Jeon, Ayanna M. Howard, and Chung Hyuk Park. **A robotic framework to facilitate sensory experiences for children with autism spectrum disorder: A preliminary study.** *ACM Transactions on Human-Robot Interaction (THRI)*, 9(1):1-26, January 2019. DOI: [10.1145/3359613](https://doi.org/10.1145/3359613)
- [J4] Rachael Burns, Myounghoon Jeon, and Chung Hyuk Park. **Robotic motion learning framework to promote social engagement.** *Applied Sciences, Special Issue on Social Robotics*, 8(2):241-258, January 2018. DOI: [10.3390/app8020241](https://doi.org/10.3390/app8020241)

### Peer-Reviewed Conference Papers

- [C1] Rachael Bevill, Srineil Nimbazad, Chung Hyuk Park, Myounghoon Jeon, and Ayanna M. Howard. **Multisensory robotic therapy through motion capture and imitation for children with ASD.** In *Proc. American Society of Engineering Education Conference (ASEE), Mid-Atlantic Section*, pages 1-8, Washington, DC, USA, April 2016.

### Short Peer-Reviewed Conference and Workshop Papers

- [S1] Rachael Bevill Burns, Ruby Rosenthal, Keshav Garg, and Katherine J. Kuchenbecker. **Do-it-yourself whole-body social-touch perception for a NAO robot.** Workshop paper (1 page) accepted to the *IROS Workshop on Large-scale Robotic Skin: Perception, Interaction, and Control*. Kyoto, Japan, October 2022.
- [S2] Rachael Bevill Burns. **Teaching safe social touch interactions using a robot koala.** Workshop paper (1 page) presented at the *IROS Workshop on Proximity Perception in Robotics: Increasing Safety for Human-Robot Interaction Using Tactile and Proximity Perception*. Prague, Czech Republic (virtual), September 2021.

- [S3] [Rachael Bevill Burns](#), Hasti Seifi, and Katherine J. Kuchenbecker. **Evaluation of a touch-perceiving, responsive robot koala for children with autism.** Workshop paper (4 pages) presented at the *HRI Workshop on Workshop YOUR study design! Participatory Critique and Refinement of Participants' Studies*, Boulder, USA (virtual), March 2021.
- [S4] [Rachael Bevill Burns](#), Hasti Seifi, Hyosang Lee, and Katherine J. Kuchenbecker. **A haptic empathetic robot animal for children with autism.** *Companion of the ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, pages 583–585, Boulder, USA, March 2021. [DOI: 10.1145/3434074.3446352](https://doi.org/10.1145/3434074.3446352)
- [S5] [Rachael Bevill Burns](#), Hasti Seifi, Hyosang Lee, and Katherine J. Kuchenbecker. **Utilizing interviews and thematic analysis to uncover specifications for a companion robot.** Workshop paper (2 pages) presented at the *ICSR Workshop on Enriching HRI Research with Qualitative Methods*, Golden, USA (virtual), November 2020.
- [S6] [Rachael Bevill Burns](#), Hyosang Lee, Hasti Seifi, and Katherine J. Kuchenbecker. **A fabric-based sensing system for recognizing social touch.** Work-in-progress paper (3 pages) presented at the *IEEE Haptics Symposium*, Washington, D.C., USA (virtual), March 2020.
- [S7] [Rachael Burns](#) and Katherine J. Kuchenbecker. **Designing a haptic empathetic robot animal for children with autism.** Workshop paper (4 pages) presented at the *Robotics: Science and Systems Workshop on Robot-Mediated Autism Intervention: Hardware, Software and Curriculum*, Pittsburgh, USA, June 2018.
- [S8] [Rachael Bevill](#), Mahsa Alborz, Zac Chalup, Scott Downen, Kelsey Genuino, Chelsea Nayback, Noelle Nesbitt, and Chung Hyuk Park. **Robot therapist for assisting in at-home rehabilitation of shoulder surgery patients.** Poster presentation at the *GW Research Days*, Washington D.C., USA, April 2017. Recipient of Innovation & Entrepreneurship Prize.
- [S9] [Rachael Bevill](#) and Sam Cowin. **Motion learning for emotional interaction and imitation of children with autism spectrum disorder.** Poster presentation at the *GW Research Days*, Washington D.C., USA, April 2017. Best poster (tie) in Biomedical Engineering, Graduate Research category.
- [S10] [Rachael Bevill](#), Srineil Nizambad, Chung Hyuk Park, Myoungsoon Jeon, and Ayanna M. Howard. **Behavioral learning and imitation for music-based robotic therapy for children with autism spectrum disorder.** Workshop paper (5 pages) at the *RO-MAN Workshop on Behavior Adaptation, Interaction and Learning for Assistive Robotics (BAILAR)*, New York City, USA, August 2016.
- [S11] [Rachael Bevill](#), Paul Azzi, Matthew Spadafora, Chung Hyuk Park, Hyung Jung Kim, Jong Won Lee, et al. **Multisensory robotic therapy to promote natural emotional interaction for children with ASD.** In *Proc. ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, pages 571-571, Christchurch, New Zealand, March 2016. Video submission. [DOI: 10.1109/HRI.2016.7451861](https://doi.org/10.1109/HRI.2016.7451861)
- [S12] [Rachael Bevill](#), Chung Hyuk Park, Hyung Jung Kim, Jong Won Lee, Ariana Rennie, Myoungsoon Jeon, and Ayanna M. Howard. **Interactive robotic framework for multi-sensory therapy for children with autism spectrum disorder.** In *Proc. ACM/IEEE International*

*Conference on Human-Robot Interaction (HRI)*, pages 421-422, Christchurch, New Zealand, March 2016. [DOI: 10.1109/HRI.2016.7451786](https://doi.org/10.1109/HRI.2016.7451786)

## Hands-on Demonstrations

[H1] [Rachael Bevill Burns](#)\*, Neha Thomas\*, Hyosang Lee\*, Robert Faulkner, and Katherine J. Kuchenbecker. **Tactile textiles: An assortment of fabric-based tactile sensors for contact force and contact location**. Hands-on demonstration presented at *EuroHaptics*, Leiden, The Netherlands, September 2020. \*These authors contributed equally to this publication.

## Databases

[D1] [Rachael Bevill Burns](#), Hyosang Lee, Hasti Seifi, Robert Faulkner, and Katherine J. Kuchenbecker. **Sensor patterns dataset for endowing a NAO robot with practical social-touch perception**. *Edmond*, Dataset, V1. 2022. [DOI: 10.17617/3.6x](https://doi.org/10.17617/3.6x)

[D2] [Rachael Bevill Burns](#), Hyosang Lee, Hasti Seifi, Robert Faulkner, and Katherine J. Kuchenbecker. **User study dataset for endowing a NAO robot with practical social-touch perception**. *Edmond*, Dataset, V1. 2022. [DOI: 10.17617/3.6w](https://doi.org/10.17617/3.6w)

## Research and Project Experience

Haptic Intelligence Department, Max Planck Institute for Intelligent Systems (MPI-IS)

### Doctoral Researcher

Aug. 2018 – Apr. 2023 (expected)

- Designed and conducted structured video-conferencing interviews with 11 autism specialists to establish qualitative requirements and quantitative specifications for a touch-perceiving social robot for children with autism.
- Built custom fabric-based piezoresistive tactile sensors that retain sensitivity while externally mounted to robots of various curvatures. Implementing a classification algorithm to recognize social touch gestures and force intensity based on sensor resistance values.
- Programming a dynamic robot emotion response system that reacts to affective touch communication gestures.

### Whitaker International Fellow

Nov. 2017 – Aug. 2018

- Designed an independent project combining previous research experience in socially assistive robotics for children with autism and new research direction incorporating haptics. Reviewed literature on animal-assisted intervention, human-robot interaction, and haptics.
- Developed an external piezoresistive sensor for a robotic platform, superior to the robot's onboard tactile-sensing capabilities. Tested multiple iterations, including comparisons between capacitive and resistive sensing methods.

GW Assistive Robotics and Telemedicine (ART-Med) Laboratory, Biomedical Eng. Dept.

### Graduate Researcher and Lab Manager

Sep. 2015 – Oct. 2017

- Studied the effect of personalized robotic imitation on participants' mood, engagement, and perception of the robot's agency, using a Robotis OP-2 robot and a Microsoft Kinect.
- Engaged children with autism with an educational emotion-guessing game using a robot that showcased twelve emotional states through verbal prompts and physical gestures.
- Taught children with autism about sensory exploration and how to safely navigate sensory overload using the robots Darwin Mini (Robotis) and a customized Romotive.

### GW School of Engineering and Applied Sciences (SEAS)

#### Graduate Administrative Assistant for Academic Success

May 2015 – July 2016

- Managed the SEAS Tutoring initiative, which provided free tutoring for underclassmen engineering courses. Renovated the application process, trained and oversaw 14 tutors, proposed fiscal year budget, and ran the overnight finals study event "Tompkins Takeover".
- Met weekly and worked closely with 28 freshmen whom were struggling with the transition to college-level coursework. Supported academically at-risk freshmen by developing and teaching an online summer calculus refresher course.

### GW Bioengineering Laboratory for Nanomedicine and Tissue Engineering, Mechanical Eng. Dept.

#### Undergraduate Researcher

Jan. 2014 – May 2015

- Used stereolithography (laser-curing additive manufacturing approach) to test the adhesion properties of hydrogels for biodegradable tissue scaffolds. Studied the differences in stem cell growth under natural, LED, and laser light.
- Synthesized biomaterials for lab studies, including cell culture media, resin hydrogels, and nano-hydroxyapatite.

### Educational Presentations

Invited speaker at the FIRST Robotics Championship Conferences, Houston, USA. Two lectures:

"My friend, the robot: An introduction to human-robot interaction", April 18, 2019.

"Baymax in real life: An introduction to socially assistive robotics", April 19, 2019.

Presenter (in English and German), Girls' Day, Max Planck Institute for Intelligent Systems. April 25, 2018 and March 28, 2019

Presenter (in English and German), Open House Day, Max Planck Institute for Intelligent Systems. September 15, 2018

### Media Highlights

Jan. 2022 The magazine MaxPlanckResearch published an article focusing on the ongoing human-robot interaction in the Haptic Intelligence lab. Rachael's work on HERA is featured alongside two other robots. The Detektor.fm podcast also summarized the article.

(Article links in [English](#) and in [German](#). Podcast [link](#): German only)

Mar. 2017 Rachael and her colleagues at the GW ART-Med lab are one of several research teams featured in a documentary by Arirang TV entitled, "Smart with Heart: The Human Face of

- the Fourth Industrial Revolution". This documentary highlights the work being done by researchers across the globe to improve quality of life using assistive technology. [\(Link\)](#)
- Aug. 2016 Heise Online published an article (in German) which highlighted talks given at the Workshop on Behavior Adaptation, Interaction and Learning for Assistive Robotics (BAILAR) at the RO-MAN conference in New York City. Rachael's research on the impacts of music, imitative play, and robots for children with autism is described. [\(Link\)](#)
- Apr. 2015 During a U.S. House general session, Congressman Frank Guinta commended Rachael for representing New Hampshire in the Cherry Blossom Princess Program, a week-long program that offers cultural, educational, and professional development opportunities for young women leaders during the National Cherry Blossom Festival in DC. [\(Link\)](#)

## Student Supervision and Mentoring

- Ruby Rosenthal, Undergraduate Researcher: Summer 2022 – present
- Keshav Garg, Master's Student Intern: Summer 2021 – Fall 2021
- Fayo Ojo, Post-Bachelor's Researcher: Fall 2020 – present
- Sophia Haass, Undergraduate Researcher: Summer 2019
- Nora Krumwiede, Berufsorientierung an Gymnasien (BOGY) Intern: One week, Fall 2018
- Julia Waibel, Berufsorientierung an Gymnasien (BOGY) Intern: One week, Summer 2019
- Luka Jeremic, High School Intern: Summer 2016
- Alex Kimiavi, High School Intern: Summer 2016

## Instruction and Course Development

**MathBoost (Pre-Calculus):** I developed this course for incoming engineering freshmen who scored below the recommended level needed on their initial math placement test to enroll in Calculus I. The course was conducted online and focused on pre-calculus concepts. Upon completion of the eight-week curriculum, quizzes, and a practice test, students could take a second placement test. A strong performance on this second test enabled them to enroll in Calculus I for the Fall 2015 semester. *46 students enrolled.*

**Weekly Math Review – MATH 1220 and MATH 1221 (Pre-Calculus):** This was a mandatory review session I hosted for academically at-risk engineering freshmen who did not pass the MathBoost course, and/or who received a C or lower for MATH 1220. The review matched the topics covered that week in the course, and it was also open for all engineering freshmen to attend as part of the SEAS Tutoring initiative. *15 students enrolled.*

**Weekly Math Review – MATH 1231 and MATH 1232 (Calculus I):** This was a mandatory review session I hosted for academically at-risk engineering freshmen who scored low on their initial math placement test but passed the MathBoost course, and/or for those who received a C or lower for MATH 1231. The review matched the topics covered that week in the course, and it was also open for all engineering freshmen to attend as part of the SEAS Tutoring initiative. *24 students enrolled.*

## Professional Service

### Reviewer for:

IEEE Robotics and Automation Letters (RA-L)

Paladyn. Journal of Behavioral Robotics (PJBR)

ACM Conference on Human Factors in Computing Systems (CHI)

The Robotics: Science and Systems (RSS) Conference – RSS Pioneers

ACM/IEEE International Conference on Human-Robot Interaction – HRI Pioneers

IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)

IEEE RAS/EMBS International Conference on Biomedical Robotics & Biomechanics (BioRob)

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

Eurohaptics (EH)

### Leadership

IMPRS-IS Interview Symposium, Session Chair 2022

GW Women in Engineering Mentor, 2020 – present

MPI-IS Ph.D. Student Representative, 2018 – 2019

IMPRS-IS Soft Skills Seminar Series (S4) Event Coordinator, 2018 – 2019

GW Theta Tau, Professional Engineering Fraternity: Vice President 2014 – 2015,

Community Service Director 2012 – 2013

## Professional Skills

Languages: English (native), German (B1 – intermediate proficiency)

Software and Computer Languages: MATLAB, SPSS, Python, Arduino IDE, Processing, Choregraphe (for the NAO robot), SolidWorks, C, C++, Java, HTML, LaTeX, Microsoft Office, OBS Studio, Adobe Premiere Pro, MaxQDA, Limesurvey and Qualtrics

Research Skills: User study design and implementation, human subjects ethical protocol, 10+ years experience with children with autism, medical device design, FDA regulatory law, universal design and accessibility, fabric-based tactile sensor design and fabrication, mechanical prototyping including laser cutting and 3D printing, electronics prototyping, cell culturing