

HERL

Quarterly

VOLUME 23, NO. 4
OCTOBER - DECEMBER 2024



NEW TRAIL AHEAD



END OF THE YEAR

M I L E S T O N E S

This year, **Dr. Alicia Koontz** and her team worked alongside small business owner Peg Graham of QUA, Inc. to further her design of PPAL, a motorized height adjustable bedside commode with integrated transfer boards that enables persons who are at risk for toileting-related falls to safely transfer with less physical assistance from a caregiver. Her team further worked on advancing the design of a new arm ergometer that is capable of interfacing with fitness apps that provide wheelchair users with an immersive, virtual riding exercise experience. In addition, Dr. Koontz and team tested her new Caregiver Assisted Transfer Technique tool with 16 informal caregivers and Veterans at the National Veterans Wheelchair Games, providing them with education and training on how to make the transfer process easier and safer.

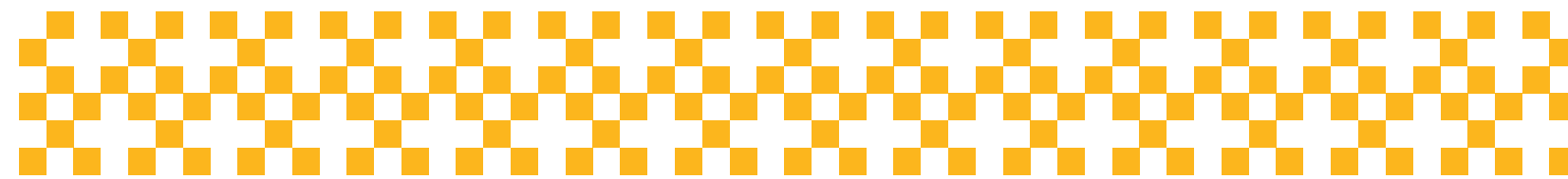


Dr. Jon Duvall's team completed the prototype of the Group 3 powered personal transfer system, a robotic bed and wheelchair system for people to get into and out of bed independently. We've secured funding to make improvements and conduct user testing. We've also designed the battery management system for a powered mobility device to use Nickel-Zinc batteries. These batteries are safer, more eco-friendly, and can be charged much faster than current batteries.

Dr. Jorge Candiotti attended different Veterans Sports Events (e.g. NVWG, WSC, Buckeye Games) for volunteering activities, participant recruitment, and research testing. He was invited to participate at the 23rd Annual National Association of Veterans' Research and Education Foundations (NVREF) in Washington, DC. He received a Paralyzed Veterans of America education grant, and a Medical Education and Patient Safety award to develop an educational board game about transportation barriers and strategies encountered by people with mobility disabilities.

Dr. Brandon Daveler's research milestones include the development of a conceptual prototype for a docking system for power wheelchairs on aircraft, the drafting of clinical limits of use tools for two types of off-road hand cycles, and preliminary conceptual development of a lightweight, power wheelchair able to be transported in a non-modified minivan.

Dr. Sangmi Park asserts HERL-Town is recognized as a promising educational tool, incorporating engaging and accessible game elements. This recognition is attributed to the ongoing efforts of the research team over the years in developing scenarios that capture transportation barriers for mobility device users. The aesthetics of the game elements were significantly enhanced through contributions from Jordan Cooper and feedback from test players.



Dr. Breelyn Styler says: "Paraphrasing my biggest milestones is difficult, as I feel that much of what I do does not directly translate into a feather in the research hat. This past year, I published some work from last year's Veteran Wheelchair Games and was fortunate to attend this year's games as well. I am most proud of getting to work alongside users—cue the cheese—but also seeing positive achievements from the undergraduate and PhD students I mentor, such as their abstracts being accepted and their papers receiving positive reviews! I also helped move things around and tidy up the biolab to make it shiny."

ACCOLADES & HIGHLIGHTS

Celebrating our best moments and achievements from the past three months.

Director **Dr. Rory Cooper** inaugurated his exhibit at the newly remodeled Heinz Center's Sports Museum in October. He was awarded a Quilt of Valor at the Association of the US Army (AUSA) annual meeting in November and attended his first meeting for the Council on Inclusive Innovation (IC2) at the White House, accompanied by Drs. Jorge Candiotti and Jon Duvall. In December, Dr. Cooper began his term of service as a member of the Executive Committee of the US Olympians and Paralympians Association (USOPA).

HERL hosted an Assistive Technology "Moonshot" retreat in October as part of the university's *Plan for Pitt 2028* initiative, followed by two visits from Chatham OT students participating in our TRANSPORTATION BOARD GAME study in November. December visitors to our lab included teams from local and international organizations like BioForge and Wandercraft.

This quarter saw our team branch out beyond the labs' walls to participate in a variety of Veterans events around the city. **Peter Hoegel**, HERL Assistant Director for Administration and Operations, spoke at Pittsburgh's Duquesne Club during an event commemorating Veterans Day. Another team attended Pitt's *Hail to Heroes* football game alongside local servicemembers, former and current, that same month. As always, HERL's presence was seen and felt at Pittsburgh's annual Veterans Day parade. Volunteer participation for industry events, Thanksgiving food drives, and the holidays was equally as high, with HERL Research Participant Advocate **William Schoy** spearheading our efforts around town, and Post-Doc researcher **Dr. Sivashankar Sivakanthan** representing HERL at REHACARE 2024 in Germany.

Changes were ongoing throughout the quarter as our labs transitioned from Pitt's **School of Health and Rehabilitation Sciences** (SHRS) to the **School of Medicine** (SoM), and work began on the leasing of new workspaces at Bakery Square for our growing team. In November, HERL was the proud recipient of the **2024 Inglis Pioneer Award** for leading innovators.

Our interests are working to allow people to live at home, to rely on caregivers less, to empower people to be able to control aspects of their own care and live the way they want to live.

Nothing about us without us.

DEVELOPING TECHNOLOGIES FOR PEOPLE WITH DISABILITIES IN
THE AREA OF MOBILITY AND FUNCTION

DR. BRAD DICIANNO

4 PHOTOS *from* Q4



PHOTO GALLERY (TOP TO BOTTOM, LEFT TO RIGHT):

1. HERL Assistant Director for Administration and Operations, Peter Hoegel, speaks at a Veterans event held by the Duquesne Club.
2. (Left to right) Drs. Rob Rutenbar, Pamela Toto, Shyam Visweswaran & Brad Dicianno at HERL's *Plan for Pitt 2028 Moonshot* Event.
3. Dr. Cooper and Roc at Pitt's *Hail to Heroes* football game.
4. Members of HERL at the Heinz Center's Sports Museum unveiling of Dr. Cooper's exhibit.





Article

Pilot Testing and Validation of an Educational Game on Transportation Challenges for Mobility Device Users

Jorge L. Candiotti ^{1,2,3,4,*}, Sangmi Park ^{1,3,5}, Chang Dae Lee ^{1,4,6}, Evan J. Rafferty ⁷, Rosemarie Cooper ^{1,3} and Rory A. Cooper ^{1,2,3,6,*}

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Abstract: Despite the increasing use of assistive mobility devices, practical education to navigate real-world ground transportation barriers is lacking. The educational board game called HERL-Town, was developed to teach safe and effective navigation for mobility device users (MDUs) in the community. The study examined the initial validity, reliability, and overall quality of HERL-Town as an educational tool for overcoming transportation barriers in real-world environments. HERL-Town featured fifty scenarios focused on transportation barriers and strategies, which were assessed for content validity, while the game quality was evaluated using the Model for the Evaluation of Educational Games (MEEGA+) tool. Twenty-three experienced MDUs and four caregivers participated in the study. The results indicated a good quality score of 40/53 and forty-five scenarios met the content validity standards. The overall reliability of the scenarios was moderate (ICC = 0.729). Early psychometric findings suggest HERL-Town as a promising effective educational game for helping new MDUs and their travel companions navigate safe and effective ground transportation barriers, hence enhancing their confidence, independence, and participation in the community.

Keywords: gamification; education; transportation; accessibility; mobility devices



Citation: Candiotti, J.L.; Park, S.; Lee, C.D.; Rafferty, E.J.; Cooper, R.A. Pilot Testing and Validation of an Educational Game on Transportation Challenges for Mobility Device Users. *Disabilities* **2024**, *4*, 450–462. <https://doi.org/10.3390/dis4040450>

Academic Editors: Francisco Reuter and Norbert Henrich

Received: 22 August 2024
Revised: 5 October 2024
Accepted: 18 October 2024
Published: 19 October 2024



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Identifying Awareness and Knowledge Sources for Mobility Assistive Technology Among People with Disabilities in Saudi Arabia

The survey findings revealed some gaps in knowledge among Saudi MAT consumers with respect to wheelchair skills and emerging technologies, suggesting a more knowledge translation research is needed in this area.

Alqahtani, S.; Dicianno, B.; Goldberg, M.; Kim, J.; Joseph, J.; Cooper, RA. *Identifying Awareness and Knowledge Sources for Mobility Assistive Technology Among People with Disabilities in Saudi Arabia* . *International Journal of Physical Therapy Research Practice*. 2024.

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Candiotti, J; Park, S; Lee, C.D; Rafferty, E.J; Cooper, R; Cooper, R.A. *Pilot Testing and Validation of an Educational Game on Transportation Challenges for Mobility Device Users. Disabilities*. 2024.





Article

Time Efficiency and Ergonomic Assessment of a Robotic Wheelchair Transfer System

Shantanu A. Satpute ^{1,2,3,*}, Kaylee J. Uribe ^{1,2,3}, Oluwotofunmi O. Olaore ¹, Minori Iizuka ¹, Ian C. McCumber Gandara ^{1,3}, William J. Schoy IV ^{1,2}, Rituja A. Kulkarni ^{1,2}, Rosemarie Cooper ¹, Alicia M. Koontz ¹, Owen Flaugh ¹ and Rory A. Cooper ^{1,2,3,4,5,*}

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Abstract: Background: Caregivers experience high rates of occupational injuries, especially during wheelchair transfers, which often result in back pain and musculoskeletal disorders due to the physical demands of lifting and repositioning. While mechanical floor lifts, the current standard, reduce back strain, they are time-consuming and require handling techniques that subject caregivers to prolonged and repeated non-neutral trunk postures, increasing the risk of long-term back injuries. Aims: The aim was to assess the time efficiency and ergonomics of the powered personal transfer system (PPTS), a robotic transfer device designed for bed-to/from-wheelchair transfers. Methods: We evaluated transfers with the PPTS and mechanical lift with eight able-bodied participants who assisted with transfers between a bed and a wheelchair. Inertial measurement units (IMUs) were placed on participants to track their motion and assess trunk joint angles during transfers. Results: The PPTS significantly reduced the transfer time (14.51 s vs. 52.82 s, $p < 0.001$) and required significantly less range of motion for trunk flexion ($p < 0.001$), lateral bending ($p = 0.009$), and axial rotation ($p = 0.001$), all of which have been associated with back injuries. Additionally, the PPTS significantly reduced the time caregivers spent in non-neutral trunk postures, potentially lowering injury risks. Conclusions: These findings suggest that the PPTS improves transfer efficiency and caregiver safety, offering a promising alternative to the current standard of care for wheelchair-to/from-bed transfers.

Keywords: disability; motion capture; inertial measurement units; biomechanics; caregivers; musculoskeletal; musculoskeletal injuries; assistive technology



Citation: Satpute, S.A.; Uribe, K.J.; Olaore, O.O.; Iizuka, M.; McCumber Gandara, I.C.; Schoy, W.J.; Kulkarni, R.A.; Cooper, R.; Koontz, A.M.; Flaugh, O.; et al. Time Efficiency and Ergonomic Assessment of a Robotic Wheelchair Transfer System. *Sensors* **2024**, *24*, 7558. <https://doi.org/10.3390/s24077558>

Academic Editors: Norberto Cusidini and Paolo Capogrosso

Received: 4 October 2024
Revised: 21 November 2024
Accepted: 22 November 2024
Published: 27 November 2024



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Accessible Commercial Airline Travel for Mobility Device Users: A Focus Group Study with Veterans

This study aimed to identify the needs of mobility device users (MDUs) to pursue accessible airline travel at every stage of the journey, from trip planning to departure to arrival at the destination airport.

Lee, C. D; Rafferty, E; Oliver, C; Cooper, RA; Candiotti, J; Deepak, N; Cooper, R. *Accessible Commercial Airline Travel for Mobility Device Users: A Focus Group Study with Veterans. Transportation Research Record*. 2024.

UJPRP | Accessible Commercial Airline Travel for Mobility Device Users: A Focus Group Study with Veterans, 353

Time-Efficiency and Ergonomic Assessment of a Robotic Wheelchair Transfer System

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Satpute, S; Uribe, K; Olaore, O; Iizuka, M; McCumber, IC; Schoy WJ IV; Kulkarni, R; Cooper, RA; Koontz, AM, Flaugh, O, et al. *Time Efficiency and Ergonomic Assessment of a Robotic Wheelchair Transfer System. Sensors*. 2024.





Research Article

Accessible Commercial Airline Travel for Mobility Device Users: A Focus Group Study with Veterans

Chang Dae Lee ^{1,2,3,*}, Evan Rafferty ⁴, Chloe Oliver ⁴, Rosemarie Cooper ^{2,5}, Jorge Candiotti ^{2,3,4,6}, Nikitha Deepak ^{2,5}, and Rory A. Cooper ^{2,3,6,7}

Abstract: This study aimed to identify the needs of mobility device users (MDUs) to pursue accessible airline travel at every stage of the journey, from trip planning to departure to arrival at the destination airport. Semi-structured focus groups were conducted with MDUs (n = 13) and their caregivers (n = 7). Descriptive statistics were used for demographic information, and a qualitative content analysis was used to analyze the transcribed interviews and extract themes. Three overarching themes were identified: service, accessibility, and safety. Sub-themes related to service encompassed booking concerns, disconnected services, untrained airport staff, and damaged mobility devices. Accessibility sub-themes included the in-cabin aisle, in-cabin toilet, and airport infrastructure. Safety sub-themes encompassed aisle chairs and passenger seats. This study has uncovered challenges, particularly in relation to booking concerns, disconnected services, untrained airport staff, and airport infrastructure. To address these challenges, potential solutions are suggested, including staff education, installation of in-cabin accessible toilets and versatile seats, modification of wheelchairs and aisle chairs, and improvements to accessible airport infrastructure. We anticipate that the findings will provide insights into the redesign of aircraft, airports, wheelchairs, and aisle chairs as well as inform the development of legislation and guidelines.

Keywords: disability; equity; journey planning; qualitative research; user need

In 2022, U.S. airlines, as reported by the Bureau of Transportation Statistics, transported over 850 million passengers globally (1). While airline travel is often considered a public right for all individuals, it poses challenges and, at times, becomes impractical or impossible for people with disabilities, especially for people using mobility devices, including manual and powered wheelchairs as well as scooters (2). Globally, approximately 1.3 billion people, or one in six individuals, experience disabilities (3) affecting one or more daily activities. In the United States alone, just over 6.8 million individuals rely on mobility devices, including 1.7 million who are wheelchair or scooter users (4). For mobility device users (MDUs), accessing airline services is often constrained by structural limitations, such as tight aisles, the absence of seating areas with docking stations for powered wheelchairs, and inaccessible lavatories within the cabin (5–9). While MDUs may be permitted to occupy an airplane seat, the process involves transferring from their mobility device to a

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HERL SPOT LIGHT

WHO IS **SHANTANU SATPUTE?**

Shantanu successfully defended his PhD in November. He has been at HERL for four years and this is what he had to say about it:

I feel very privileged

to work at HERL, contributing to advancements in assistive technology and moving a step closer to improving mobility and independence for individuals with disabilities. Thanks to our incredible team at HERL and everyone that participated in our study—this work wouldn't have been possible without you.



By the Numbers

OUR WORK THIS YEAR

- 14** prestigious personal and organization awards received.
- 20** manuscripts published in respected, peer-reviewed journals. 9 more accepted.
- 4** patents awarded by the USPTO.
- 23** lectures and visits from distinguished peers and organizations to our lab.
- 1** research web portal published: RERC - Move It.
- \$75M+** in grant proposals and funding submitted.
- 28** individual internships funded.

WE'VE PRESENTED LECTURES AND RESEARCH ACROSS

- 2** continents
- 5** countries
- 7** American states + the District of Columbia

RUMINATION OF THE QUARTER

"MY **FAVORITE** THING ABOUT HERL IS HOW IT **CHALLENGES** ME TO THINK ABOUT THINGS I HADN'T CONSIDERED BEFORE AS A KOREAN OT RESEARCHER. IT REALLY **HELPS** ME **APPRECIATE** THE **BEAUTY** OF INTERDISCIPLINARY RESEARCH AND GETS ME READY TO BE A **BETTER** TEAM MEMBER WITH MY **EXPERTISE**."

- Sangmi Park
Post-Doc Researcher

Fundraising for **ELeVATE**

THANK YOU!

With your help, we met our goal of

\$10,000

to cover the living stipends for Veterans during the 10-week, on-campus portion of the summer 2025 ELeVATE program here at HERL.

You can find out more about the campaign at engage.pitt.edu/Elevate-Vet-Success

Through participatory action design and engineering, individuals with disabilities are not passive recipients of technology but active participants in creating a more inclusive future. The work of pioneers in inclusive engineering and design demonstrates the power of participatory action in shaping a more accessible and inclusive world.

Creating inclusive communities.

**FORGING A NEW FUTURE THROUGH PARTICIPATORY ACTION
DESIGN AND ENGINEERING**

DR. RORY COOPER

Recruiting Participants.

SIGN UP TO OUR REGISTRY



A research registry is a collection of individuals interested in learning about research studies that may be of interest to them. We are inviting you to join in the Human Engineering Research Laboratories (HERL) Assistive Technology Registry because you might be interested in participating in our current or future research studies.

1

ACCESSIBLE AIRLINE TRANSPORTATION FOR MOBILITY DEVICE USERS: SURVEY



Purpose: To estimate pent-up demand among mobility device (MD) users to travel on commercial airlines and identify MD users’ needs and pain points.

Study Requirements: Complete a survey about your demographics and airline travel experiences. The survey is expected to take no more than 20 minutes to complete.

2

SOCIALLY CONNECTED EXERCISE SYSTEM FOR WHEELCHAIR USERS



Purpose: To identify the design needs and wants for an at-home, socially-connected fitness machine for use by persons with disabilities.

Study Requirements: Age between 18 and 70, use a wheelchair as their primary means of mobility, have only the use of their upper limbs for exercise, have adequate upper limb strength and function.

3



TRANSPORTATION AND NEIGHBORHOOD ACCESSIBILITY IN PITTSBURGH

Purpose: To assess community members’ knowledge of transportation and neighborhood accessibility in Pittsburgh.

Study Requirements: You will be asked to complete questionnaires regarding transportation and accessibility of Pittsburgh, as well as provide feedback on them. Completing all questionnaires will take approximately 20 minutes.

4



TRANSPORTATION OF EMERGING ADULT AGED MOBILITY DEVICE USERS

Purpose: To understand barriers young adults face while using various modes of transportation. This research will play a critical role in the development of an innovative game researchers at HERL are developing.

Study Requirements: You will be asked to participate in an interview to provide your experiences and perspectives accessing and utilizing transportation services in your community.

5



ASSESSING THE CAREGIVER ASSISTED TRANSFER TECHNIQUE (CATT) INSTRUMENT

Purpose: To validate the caregiver Assisted Transfer Technique Instrument, a new tool to assess the assisted transfer performance of individuals with disabilities and their caregivers.

Study Requirements: The study takes place over two visits in your home or our lab (your choice), each visit is no longer than two hours.

6



BONE HEALTH IN INDIVIDUALS WITH SPINAL CORD INJURY

Purpose: To learn about the connection between irisin (muscle-secreted bone mediating protein) and bone health in individuals with spinal cord injury (SCI). This study will explore whether exercise can increase irisin concentrations in circulation.

Study Requirements: For more info or to check eligibility, call 412-822-3685 and mention the Irisin SCI Study.

7



DESIGN IMPROVEMENTS AND EVALUATION OF A KNEE STRESS-RELIEF POWERED EXOSKELETON FOR VETERANS WITH KNEE OSTEOARTHRITIS

Purpose: To compare the study's performance to a passive knee brace in people with osteoarthritis (OA).

Study Requirements: Participants will answer questions and perform tasks during two visits.

QUESTIONS?

CONTACT

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In the News

Special Lecture on Engineering and Society

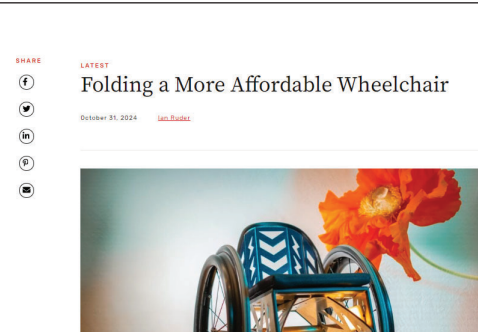
Forging a New Future through Participatory Action Design and Engineering
The livestream will resume shortly.

NATIONAL ACADEMY OF ENGINEERING

National Academy of Engineers

October

Forging a New Future through Participatory Action Design and Engineering



New Mobility

October

Folding a More Affordable Wheelchair



Gears of Progress

November

Rory Cooper: on rehabilitation engineering, evolution of wheelchair design, and Paralympic sports

NAE Perspectives

Rory A. Cooper is the founding director of the Human Engineering Research Laboratories, a joint center of the Department of Veterans Affairs (VA). He is a VA senior research career scientist and the FISA Foundation Distinguished Professor of Rehabilitation Engineering at Pitt.

Forging a New Future Through Participatory Action Design and Engineering

Perspectives | November 8, 2024

"The disability community knows better than any other how being involved in the planning from day one is critical to a successfully accessible product, regardless of how many years in the future it lies." - National Council on Disability

In 1990, the Americans with Disabilities Act (ADA) established a groundbreaking set of civil rights protections for individuals with disabilities. Its primary focus was on ensuring equal access to employment, public accommodations, and services. As a result, the ADA profoundly influenced sectors such as education, travel, entertainment, and communication, providing people with disabilities with

NAE Perspectives

November

Forging a New Future Through Participatory Action Design and Engineering

pg November

 November

dependence for

 November

Innovations

December

With the Army's AI center, a suite of defenses and the city's unique blend of industry and are continuing to serve their country





Emily & Pepper



Ali & Buttercup



Jorge (*left*) & Remy



Breelyn & Morty



Vicki, Stinger & SMAW



Josh's male cats



Charlie & Norton

UPCOMING EVENTS.

January 7: HERL's 31st anniversary

February 8: 2025 Invictus Games

February 21-22: First ever **KEYSTONE WHEELCHAIR GAMES** hosted at HERL

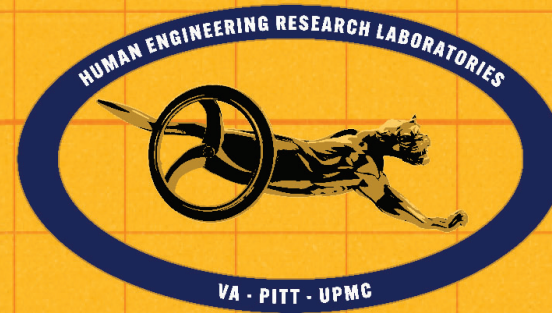
March 13: PA Technology Summit

March 20-22: 39th International Seating Symposium (ISS)

March 29 - April 5: National Disabled Veterans Winter Sports Clinic (NDVWSC)

Stay tuned for our next newsletter in March.

Happy holidays!



Scan this QR Code
to see all our relevant links,
including our website and
social media accounts!
linktr.ee/herlcomms

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OUR AFFILIATIONS

