Co-Designing the Future of Aging: Human-Centered Robotics and AI for Rehabilitation and Independence D. Beckwée (Convener). *Gerontechnology* 25(s*)*

Participants W.A. Rogers (USA), D. Beckwée (Belgium), A. Mihailidis (Canada), E. Swinnen (Belgium). **ISSUE** Technological innovation in aging and rehabilitation increasingly relies on human-centered design to ensure robots and AI systems align with the real needs, abilities, and preferences of older adults and their caregivers. Despite rapid progress in assistive technologies, many solutions remain poorly integrated into daily life or clinical routines. This symposium brings together interdisciplinary research exploring how participatory design, human-centered AI, and person-focused robotics can enhance independence, engagement, and wellbeing in older adults and vulnerable populations. **CONTENT** Rogers will introduce a comprehensive framework for human–robot interaction (HRI) grounded in universal design, illustrating how user-centered principles can guide the development of robots that support diverse older adults with different abilities and preferences. Beckwée will discuss a co-design study exploring how older adults and physiotherapists envision next-generation assistive lower-limb exoskeletons, emphasizing usability, comfort, and fatigue management for home-based mobility support. Mihailidis will present a human-centered AI approach to transforming digital reminder systems into adaptive, caregiver-support tools that enhance safety and autonomy for people living with dementia while preserving caregiver oversight. Swinnen will describe the iterative, user-centered development of Ghostly, an electromyography-driven exergame combining clinical and motivational design principles to promote safe strength training in frail or hospitalized older adults. **CONCLUSIONS / ANTICIPATED OUTCOMES** The symposium will highlight that technology for aging well must be human-centered, participatory, and ethically grounded. Presentations will collectively demonstrate how integrating user insights throughout design and implementation leads to more acceptable, effective, and sustainable assistive technologies. Outcomes include design frameworks, practical evaluation tools, and interdisciplinary strategies for translating AI and robotics into meaningful, real-world support systems for aging and rehabilitation.

KEYWORDS: Human-centered design; robotics; AI in aging; rehabilitation technology; assistive innovation
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Innovation through robotics: Person-centered design to enhance human-robot interactions W. A. Rogers & T. L. Mitzner. *Gerontechnology* 25(s*)*

Purpose Older adults are open to the idea of interacting with robots, although they have preferences for the nature of the tasks that they want the robot to do as well as what they want the robot to look like. Given the heterogeneity of older adults, there is a wide range of tasks for which a robot could support their everyday activities. Their preferences, needs, abilities, and limitations must be considered in the process of design and deployment of robots. Moreover, it is crucial to involve older adults throughout the design process from formative to summative evaluation and beyond to the integration of the robot into their everyday activities. We have developed a framework that can be used to guide design of robots that will be useful to and usable by older adults [1]. **Method** Human-robot interaction (HRI), by definition, encompasses the human, the robot, and their interaction. The interaction has the goal of performing a task together, and it occurs within a broader context. We developed the HRI framework illustrated in Figure 1 to specify these different components. We developed the framework based on a combination of our own empirical case studies and evidence-based research findings in the literature, as well as on user-centered and universal design principles. The framework encompasses the four primary dimensions of HRI: the human, the robot, the interaction, and the environmental context. These dimensions represent the breadth of variables that should be considered in the design of a robot and the many factors that impact HRI. The framework can be used by robot developers to guide design priorities and specifications, as well as by researchers to delineate factors that may influence HRI. **Results and Discussion** To illustrate the application of the framework to robot design, we will present three use cases: (1) a robot to support on older adult who is mute with quadriplegia and his primary caregiver who is also his wife; (2) a robotic shower to support older adults with mobility disabilities; and (3) a wayfinding robot to support older adults with vision impairments. These examples illustrate both the complexity of designing robots to support older adults as well as the application value of the HRI framework.

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Keywords: robot, disability, activity support

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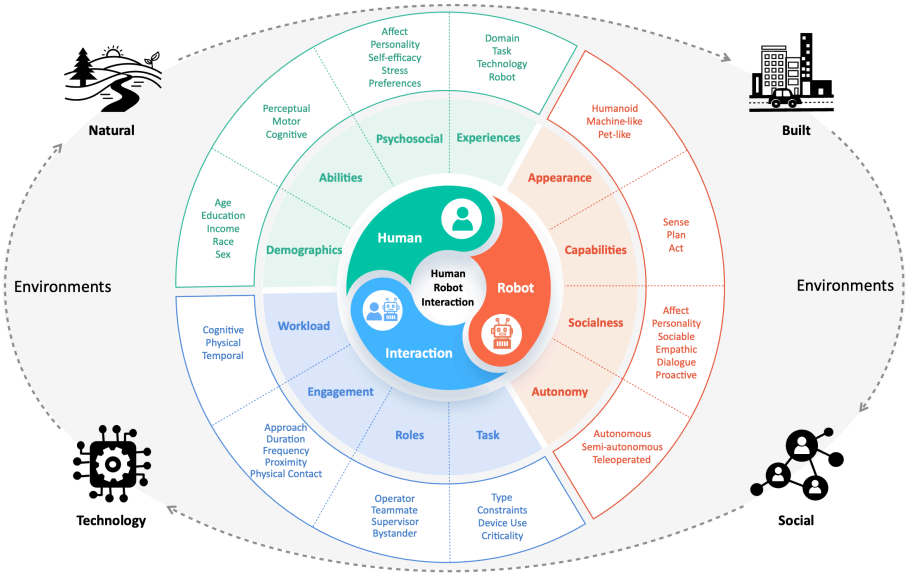

Figure 1. Human robot interaction framework (Rogers & Mitzner, 2026)

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Integrating Older Adults' and Physiotherapists' Perspectives and Fatigue Assessment for Next-Generation Assistive Exoskeletons D. Beckwée. *Gerontechnology* 25(s*)*

Purpose Older adults often experience a decline in functional abilities, affecting their independence and mobility at home. Wearable lower-limb exoskeletons (LLEs) have the potential to serve as both assistive devices to support mobility and training tools to enhance physical capabilities. However, active end-user involvement is crucial to ensure LLEs align with users' needs and preferences. This study employed a co-design methodology to explore home-based LLE requirements from the perspectives of older adults with mobility impairments and physiotherapists. **Method** Four older adults with self-reported mobility limitations participated by creating personas to represent different user needs and experiences (i.e., PERCEPT methodology, alongside four experienced physiotherapists who contributed their professional insights [1]. **Results and Discussion** As assistive devices, LLEs were seen as valuable for promoting independence, supporting mobility, and facilitating social participation, with essential activities including shopping, toileting, and outdoor walking. Physiotherapists expressed enthusiasm for integrating LLEs into remote rehabilitation programs, particularly to improve strength, balance, coordination, and walking speed. Key design considerations included a lightweight, discreet device that is easy to don and doff and comfortable for extended wear. Physiotherapists highlighted the potential of digital monitoring to assess physical parameters and personalize therapy. Fatigue emerged as a significant challenge for older adults, reinforcing the need for assistive LLEs to alleviate exhaustion and enhance functional independence. A shortlist of LLE features was drafted and scored, covering activity and design applications, revealing key design trade-offs between functionality and usability, notably the need to balance sufficient assistive support and digital monitoring capabilities with low weight, discretion, and ease of donning and doffing. Additionally, while physiotherapists valued rich sensor-based feedback for personalization and remote monitoring, older adults prioritized fatigue reduction, comfort, and seamless integration into daily activities, underscoring the importance of adaptive support levels in home-based LLEs. These findings provide valuable insights into the design and usability of home-based LLEs, offering a foundation for developing devices that improve acceptance, usability, and long-term impact on healthy aging.

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Keywords: exoskeletons; design; performance augmentation; rehabilitation robotics

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Human-Centered AI to Transform Digital Reminder Systems for Dementia Care A. Mihailidis.
Gerontechnology 25(s*)*

Purpose Digital reminder systems play a central role in supporting older adults living with dementia (PLwD), yet their design remains oriented toward prompting tasks rather than supporting the broader, ongoing decision-making responsibilities of caregivers. Caregivers use reminder systems not just to cue activities, but to interpret behaviors, track changes, coordinate care, and gauge wellbeing. This project advances a human-centered AI approach to reimagining reminder systems as intelligent caregiver-support tools - systems that integrate everyday interactions into meaningful insights, adapt to changing needs, and preserve caregiver oversight. The goal is to augment caregiver awareness, reduce burden, and enhance the safety and autonomy of PLwD through thoughtfully designed AI capabilities. **Method** We conducted qualitative interviews with informal caregivers and collaborated with EPLED lived-experience advisors to identify unmet needs, expectations for AI, and sources of value and risk in digitally mediated care. Guided by these insights, we explored several complementary AI techniques that could meaningfully extend reminder systems: (1) machine-learning methods to detect behavioral deviations from reminder-interaction logs; (2) models to identify conversational changes that often signal cognitive or emotional shifts; and (3) generative-AI approaches to producing supportive, cognitively appropriate follow-up questions and triaging responses. A speculative simulation probe allowed caregivers to react to AI-generated examples, shaping requirements for transparency, tone, personalization, and control. Across these studies, we adopted a caregiver-in-the-loop approach, ensuring that AI capabilities enhance rather than replace human judgment. **Results and Discussion** Caregivers envisioned reminder systems that help them notice emerging patterns, understand deviations in routines or communication, and coordinate responses across family or PSWs. They emphasized the need for AI that surfaces insights as hypotheses rather than certainties, provides adjustable sensitivity and phrasing, and clearly communicates why an alert or summary was generated. Across all findings, caregivers stressed the importance of maintaining interpretive authority while benefiting from AI-generated cues and summaries. This work demonstrates how human-centered AI—integrated into a familiar, everyday platform like a reminder system—can transform routine prompts into rich, context-aware supports that reduce caregiver burden, enhance safety, and enable more confident decision-making in dementia care. This work reflects an early-stage, formative evaluation grounded in qualitative caregiver interviews, lived-experience input, and feedback on AI-generated scenarios explored through a speculative simulation probe. These activities informed system requirements and design principles, with full implementation and clinical validation planned as future work.

Keywords: dementia care, human-centered AI, digital reminder systems, caregiver support, decision support, assistive technology, anomaly detection
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Ghostly: Development Pathway of a User-Centered, Electromyography-Driven Exergame for Strength Training in Vulnerable Populations E. Swinnen. *Gerontechnology* 25(s*)*

Purpose Prolonged bed rest leads to rapid muscle atrophy (up to 0.5% muscle mass loss per day), causing decreased independence and slower recovery in hospitalized older adults (e.g., after stroke or orthopedic injury). Traditional strength exercises are often unfeasible or unsafe in this group, highlighting the need for motivating, adaptive, and low-load rehabilitation tools. Ghostly was developed to address this gap: an electromyography (EMG)-driven exergame combining evidence-based isometric exercises with engaging gameplay and blood flow restriction (BFR) techniques to optimize muscle activation in weakened or bedridden patients. This work presents the broader development pathway of Ghostly, from proof-of-concept to clinical feasibility, illustrating how user-centered design principles guided iterative technical, clinical, and user experience refinements across multiple prototypes and populations. **Method** Since its inception, Ghostly evolved through different development phases, from concept validation in healthy users to testing clinical feasibility in hospitalized patients (n = 15). A mixed-methods approach was used to assess user experience and feasibility of both Ghostly alone and in combination with BFR. Feedback from end users informed iterative improvements [1]. **Results and Discussion** Across prototypes, users consistently reported high satisfaction, ease of use, and motivation. The feasibility trial confirmed safe implementation in hospital settings, with high adherence and positive engagement. Key implementation lessons from expert and user feedback highlighted usability and adoption challenges, including the need to optimize color contrast, adjust reaction time demands, and better tailor the exergame to the diverse capabilities and needs of different patient populations. Ghostly exemplifies a translational, user-driven innovation pipeline in rehabilitation technology, bridging lab-based engineering with bedside clinical practice. Building on the promising feasibility and user acceptance data, a hybrid multi-centre randomized controlled trial is now underway to assess its effectiveness in preventing deconditioning.

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Keywords: electromyography, exergame, rehabilitation, older adults, user-centered design

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