Evaluating robot effectiveness for older adults and their care partners

Y. Tsai, S. A. Olatunji, H. P. Mahajan, R. A. Mudar, W. A. Rogers

Purpose Effectiveness generally refers to the attribute of a system, process, or product to support its users in completing actions accurately (adapted from ISO 9241-11 usability definition (ISO,1998)). The effectiveness of a robot to support an older adult therefore refers to the degree of accuracy and completeness with which older adults can accomplish their goals using the robot. The satisfaction of the older adults in this process is vital because it impacts their comfort, willingness to use, actual use, and eventual acceptance of the robot (Boot et al., 2020). Older adults and their care partners have been reported to be open to robots as a care tool (Shishehgar et al., 2019). However, a critical question emerges - are robots ready? Is the task completion process satisfying to the users? These are the questions motivating this research wherein we examined the effectiveness of robots to support older adults and their care partners. **Method** We examined literature in the past 5 years to identify relevant studies on assistive robots for the care of older adults and to support their care partners. We focused on four stakeholder groups: older adults with mobility impairments, older adults with cognitive impairments, professional caregivers, and family care partners. A total of 44 papers were identified. Robot effectiveness was evaluated using a Likert scale (1-poor to 5-excellent) based on measures reported in the articles related to overall effectiveness such as accuracy and/or completion of the task by the robot. User satisfaction was evaluated using a Likert scale (1-very dissatisfied to 5-very satisfied) based on measures in the articles related to the users' acceptance of the work completed by the robot and the way it completed the task. We identified emerging themes and gaps that could influence robot effectiveness and user satisfaction. **Results and Discussion** Our ratings of documented robot effectiveness (M=3.58, SD=0.77) and user satisfaction (M=3.53, SD=0.61) were both in the positive direction above the mid-point of the scale. A one sample t-test revealed that the mean ratings were significantly higher than the mid-point for robot effectiveness ($t_{(18)}=3.28$, $p<0.01$) and for user satisfaction ($t_{(18)}=3.75$, $p<0.01$). The themes and gaps observed centered around: *(i) utility* – robot interventions show potential to support older adults with mobility and cognitive impairments with various tasks of daily living; *(ii) learning support* – adequate training along with instructional support materials are needed to operate these robots; (iii) *ease of use and personalization* – ease of communication, control, behavior, appearance and ability to be tailored to their personal preferences is critical; and. (iv) *error recovery modalities* – recurring robot failures were mentioned in several studies without much discussion on recovery options for the users. Overall, our review revealed a positive trend in the effectiveness of the current state of assistive robots to support older adults and their care partners. It also highlighted areas of improvements that could bridge the gap between development and actual use of the robots by the care recipients and care partners to improve their quality of life.

References

Boot, W., Charness, N., Czaja, S. J., & Rogers, W. A. (2020). *Designing for older adults: Case studies, methods, and tools*. CRC Press.

ISO 9241-11:2018 (2018) Ergonomics of human-system interaction—Part 11: usability: definitions and concepts

Shishehgar, M., Kerr, D., & Blake, J. (2019). The effectiveness of various robotic technologies in assisting older adults. *Health Informatics Journal, 25(3)*, 892-918.