# Applying the Participatory Design Workshop Method to Explore how Socially Assistive Robots Could Assist Stroke Survivors

Theodoros Georgiou†
School of Mathematical and Computer Sciences
Heriot-Watt University
Edinburgh, UK
T.Georgiou@hw.ac.uk

Lynne Baillie
School of Mathematical and Computer Sciences
Heriot-Watt University
Edinburgh, UK
L.Baillie@hw.ac.uk

Martin Ross
School of Mathematical and Computer Sciences
Heriot-Watt University
Edinburgh, UK
MKR30@hw.ac.uk

Frank Broz
School of Mathematical and Computer Sciences
Heriot-Watt University
Edinburgh, UK
F.Broz@hw.ac.uk

## Abstract

The field of human robot interaction (HRI) is still relatively new and often borrows methods and principles from the more established field of HCI. HRI researchers are adopting HCI methods, however, these methodologies may need slight modifications and adaptations in order to better investigate the unique challenges of working in HRI. In this paper, we present our findings which utilised one such method: Participatory Design (PD) workshop. We held the workshop in our assistive living lab with ten stroke survivors. This workshop aimed to explore the design of new socially assistive robotic technologies that could be used to support stroke survivors in the home environment. Some of our findings were unanticipated, which suggested that some adaptations to the existing framework for PD workshops need to be revised in order to be useful to HRI research.

## Keywords

HRI; HCI; Stroke; Participatory Design; Socially Assistive Robots;

## CCS CONCEPTS

• Human-centered computing • Human-centered computing ~Participatory design

## 1 Introduction

Human-Robot interaction (HRI) research often uses principles and methodologies from the more established field of HCI. However, this poses an interesting question: are HCI methods directly compatible with HRI investigations, or do certain adaptations needed to be considered before they can be used to their full effect? For this paper, we selected a Participatory Design (PD) Workshop (similar to [1] and [8]) to:

(a) Investigate whether any methodological adaptations need to be made when investigating social interactions with robotic agents aiming to support stroke survivors and others with similar conditions in the home environment.


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(b) Generate new ideas from stroke survivors on ways to imagine and re-imagine interactions with technology in stroke rehabilitation and independent living.

In order to tackle these objectives, we held a multi-phase PD workshop with stroke survivors (our targeted end users), with each phase tackling a different aspect of the aforementioned objective through discussions, demonstrations and design.

## 2 Background

Participatory Design (PD) is an established methodology for running collaborative user studies in which end users are seen as full collaborators in the design process [3]. PD has been used successfully when designing in areas such as healthcare, for new technologies (e.g. [1][8]), and social robots (e.g. [6]). PD methodologies are often used in both HCI and HRI research as they have the advantage of being primarily user driven rather than designer driven. This allows the methodology to go beyond just designing for a given user group in theory, enabling the direct involvement of the user group to the design.

The use of robotic devices in rehabilitation for stroke survivors can provide high-intensity, repetitive, task-specific and interactive treatment [7]. Lab tests indicate that a socially assistive robot (SAR) has the potential to act as a rehabilitation coach and lead a stroke patient through rehabilitation exercises [10]. Given the potential of robotics in this field, studies such as the one presented here can be used for fleshing out the strengths and weaknesses of an established HCI methodology (such as PD workshops) when applied in the relatively newly defined field of HRI. This has the potential of not only helping future researchers in choosing the right methods for studies relating to socially collaborative robotics in home, public and community settings, but also in supporting researchers in the selection, adaptation, and integration of methods from HCI and HRI that allow for future repeatability.

## 3 Methodology

As mentioned previously, this was a multi-phase design workshop with stroke survivors. Table 1 below summarises the main phases and rationale for each phase. Participants in this workshop were randomly divided into small groups to allow and enable everyone to contribute to the discussions in the various phases. At least two facilitators were assigned in each group, with one asking the

questions associated with each of the phases, while a second facilitator noted the participants' responses.

*Participants:* The recruitment of participants was managed by Chest Heart Stroke Scotland (CHSS), an independent charity. Ten stroke survivors chose to participate in the study (7 males and 3 females). Participant age ranged from 49 to 85 years of age - mean 58 (±12.4), med=57.5. All ten participants reported cognitive and speech difficulties however, this did not have an observable effect on the progress of the workshop.

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| **Phase 1. Living with stroke discussion**: To attain a better understanding of the issues that arise in current treatment as well as participants' experiences with their current routines and course of rehabilitation. |
| **Phase 2. Demos with SARs in the assistive living lab**: To expose participants to a range of socially assistive robots and some of the possibilities they offer within a smart/assistive environment (Figure 1). |
| **Phase 3. Feedback and views on demos**: To acquire participant opinions, current views, and future visions linked to their needs from technology within the context of independent living and self-managed rehabilitation. |
| **Phase 4. User design sketches**: To encourage the participants to design and discuss new technologies and interactions with existing and/or these new technologies to assist them with rehabilitation and DLA. |

**Table 1 Design procedure with main phases and rationale.**

**Figure 1 Social robots demonstrated during Phase 2. Left: Pepper robot demonstrating upper limb rehabilitation exercises; Centre: Cozmo lifting and carrying its cubes; Right: MiRo acting as a social pet.**

## 4 Results and Discussion

Participant responses were encoded into categories and themes using an adapted version of the Constant Comparative Method (CCM) [5] (p.105) as defined by [2] (p.175). The advantage of using this approach over a thematic analysis [4] is that it maintains a strong connection between the findings and the data, that would otherwise be lost. Retaining this connection between data and findings is an important feature during the early stages of design.

Findings from Phase 1 of this workshop identified that stroke survivors in this group of participants struggle both with verbal and written communication. Even though participants showed high levels of motivation to recover, with some undertaking self-rehabilitation activities, the use of technology is still not a big part of their life. Not being able to communicate with the device due to speech impairments, was often expressed as being the primary reason for not adopting technology for rehabilitation or assistance with daily living activities (DLAs). Therefore, existing assistive agent designs often cannot just be re-used for stroke survivors. This highlights the need for including stroke survivors (or, in a more general sense, any specific population) in the design process of new technologies aimed to assist them.

Phase 4 was designed for addressing the second objective, where participants generated new ideas on ways to interact with technology in stroke rehabilitation and independent living. Intriguingly, even though all designs proposed by participants had a practical approach on using the capabilities of a robot assisting them in either rehabilitation or DLA tasks, there was a true mix of human robot interactions. Robot designs from the workshop participants included utilitarian robots (Figure 2 Left), to robots with agency, where the robot actively makes queries, following them around and reminding them until they have given confirmation that the task is complete (Figure 2 Right). This sense of agency and querying on behalf of the robot transforms it from being a mere machine to an assistant in the home.

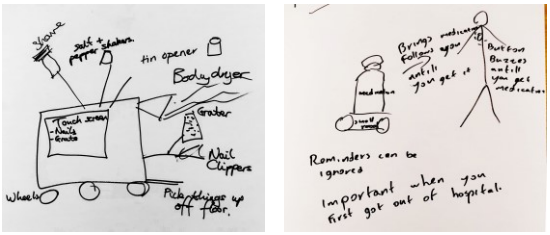


**Figure 2 Designs from participants drawn during Phase 4. Left: Utilitarian robot carrying a range of tools. Right: Robot with agency following the user around until its task is complete.**

Interestingly, in this workshop, we did not observe any designs considering stronger social interactions with the robots (such as interactions observed in [9]). The fact that none of the participants reported to be living alone may have been a reason for not looking for deeper social interactions from a robot at this stage, however, we can only hypothesise that the novelty and unfamiliarity with SARs may be another possible reason for this observation. HCI research so far has been focusing primarily on how machines can be used as a medium for promoting social interactions between individuals, whereas viewing the machine as a social entity by itself (e.g. [11]) remains a new and relatively underexplored domain.

Considering the first objective of this study, we believe that this is where current HCI methodologies need to be adapted for the unique challenges of working with HRI; demanding the exploration of strong social connections between the user and the machine. Exposing participants to the possibility of social interactions has the potential of allowing them to imagine a different, more social, kind of assistive robot, with ideas carrying over to the design phase.

## 5 Conclusion

Considering the unique challenges of working with HRI, such as further exploring strong social connections between the user and the machine (as opposed in using the machine as a social catalyst), mean that revisions to the methodology may be necessary.

In the future, we plan to investigate this further by adapting the methodology to extend the demo phase to include more social interactions with robots, hence exposing participants to the possibility of that type of an interaction, with the aim of allowing them to imagine a more socially assistive robot.

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