Design for One: An Empathic Approach to Design for an Expert User

Abstract
We are a team consisting of member of Everyday Design Studio, from Simon Fraser University. This paper describes the process of designing a game controller and mouse with a quadriplegic teenager. We discuss how our design approach addresses issues that other approaches may neglect. We suggest that design for one can be adopted by OT and HCI practitioners in similar situations or where the traditional methods and techniques have failed to support patients’ requirements. Further design for one provides an empathic understanding of user’s circumstances and certain experiences through peer-to-peer interaction and collaboration among designer, user, and health care providers.

Author Keywords
Occupational therapy (OT); assistive technology (AT); empathy; participatory design (PD)

ACM Classification Keywords
Design, Experimentation, Human Factors, Performance

Introduction
Interaction design and HCI typically do not consider design for a single person. In contrast, within OT and AT, designing for a single person is common. Designing a new product or application is critical particularly in
the healthcare context and for vulnerable and impaired individuals. According to Scherer, a large percentage of assistive devices for quadriplegic patients end up unused [8]. Several factors may cause the device’s abandonment by users such as device performance, and change in the ability and preference of users [3]. This requires OT and AT professionals to be constantly designing and refining devices for a single person. The unique experience and needs of such users necessitates great empathy in developing solutions for them.

In HCI literature, empathy is rooted in ethnographic approaches, and the more recent approaches investigate the potential of involving an empathic approach in ergonomics [10], and interactive technologies [4], and concluded that these areas will benefit from empathy. Relatedly, Participatory Design (PD) approaches have gained much attention recently in healthcare [11] particularly to design an appropriate product for a patient. In PD end users are involved as co-designers and treated as experts. However, many PD techniques and tasks are not directly applicable while designing with vulnerable individuals, and required modification and appropriation to be used in other situations and contexts as practiced with seniors [7] or with younger patients [1].

In our particular case, the performance requirements in designing a game controller and mouse for our user (Nick) are critical and specific. Nick’s movements, agility, and dexterity cannot be generalized sufficiently for our needs. In addition, his embodied understanding of his performance abilities together with his deep reflection on his body and its relations to the world makes him an expert co-designer of our design process. Putting all these together, the uniqueness of the situation makes designing for Nick a challenge of gaining the knowledge necessary to empathize with the situation he faces.

**Design Orientation and Goals**

This research was conducted in cooperation with occupational therapists, assistive technology resource personnel, and our expert user Nick. Our original motivation in working with Nick was to help him interact with computational tools to allow him to communicate through online forums. In addition to this goal, Nick asked us to design a game controller for him to play computer games. As we consulted with his OT and AT specialist, we understood that existing devices on the market did not offer the flexibility to customize its design to suit Nick’s unique needs. Our design goals with this project were, on the practical level, to design and produce a high fidelity prototype game controller utilizing an open source electronic prototyping process [2] and digital fabrication for Nick. and on a research level, to investigate the design process issues in designing for one that could provide credible recommendations to HCI researchers, and how empathy in design plays a part in resolving them.

**Our Expert User**

Nick is a seventeen year-old high school student, who enjoys video games and especially first person-shooter (FPS) games like Halo™. He is a highly experienced mountain biker who injured himself in a mountain biking accident. In our project we involved Nick as an expert user due to his unique physical abilities and demands. Nick has some sensory input where he does not have motor skills and the particulars of his movements are unique to him. HCI literature qualifies a user as an expert according to the certain domain

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**Figure 1:** Initial Exploratory meetings.

**Figure 2:** Initial design meetings.

**Figure 3:** Designing with Nick in GF Strong Rehabilitation Centre.
knowledge the user has [7, 11] or length of time a user has utilized a technology [6]. We began working with Nick soon after his accident and continued for approximately six months that included his initial stay at the hospital’s spinal cord injury ward and his extended stay at its rehabilitation centre. All the ideation and design process was conducted with Nick in the rehabilitation centre.

Design Process
We employed a research-through-design approach, which is an iterative process in which a series of experimental prototypes are designed, built and tested in a real life setting. Throughout the design process, we consulted with Nick’s OT and AT specialists on therapeutic, medical and technological matters. The prototype was designed in incremental stages to test each parameter with Nick, and to allow for him to reflect on and co-direct the design. This allowed us to fine tune the prototype to match his functional capabilities as they emerged as a result of the iterations. After every other prototype, the OT or AT specialist offered their feedback. The baseline for the success of the game controller was based on Nick’s game performance and comfort level with the controller.

Initial Exploratory Meetings
Our design process was inspired by observing how Nick’s OT designed his hand splint, and discusses about the challenges of creating AT for a quadriplegic patient. For our first meetings with Nick we set ourselves the task of identifying specific needs of the project. We discussed ideas he had about what a possible game controller that suited him would be like. In addition, we explored Nick’s movement of his arms, wrists, hands, and fingers, as well as his positioning in relation to the computer. Further we collaboratively drew sketches, brainstormed ideas with Nick, and began to approximate a directional control pad with buttons and modifications of an existing mouse. These sketches led more or less directly to the initial prototyping of a controller. We took notes and video during these sessions for future references.

Prototyping Process
Our initial prototype of the game controller was quickly built out of foam to discover what changes to make, since early on mutual learning between designer and expert user was at its highest. The materials of the controller changed along with the design as the project progressed. The final game controller is comprised of a laser cut multi-element panel, sandwiched between conductive switches made out of copper tape. The final design allows Nick to access the most basic button for any FPS game, and all the buttons are reprogrammable. The size of the button was made to best suit his movements in order to maximize his performance in game.

Testing the Prototypes
The medium and high fidelity prototypes have gone through numerous iterations to respond to the limited-precision movement in Nick’s right hand. The final products (game controller and mouse) were tested by Nick, and he responded to them positively when he was able to play an FPS game on his computer.

Design for One Characteristics
Designing for one is design for commitments and implications. It is an experienced-centered process in which a series of experimental prototypes were
designed, built and tested in a real life setting. The uniqueness of the user's situation, the involvement of the user as design expert, and critical design decisions based on the user's reflections are three commitments that we considered throughout the process. Further, design for one promotes an empathic approach due to the iterative process of design for a unique individual according to his reflections. The extensive iterations we created with our participant allowed for the emergence of tacit knowledge and new skills that were initially unknown. The continual iteration of the prototype achieved a degree of fit with Nick that could not be achieved through any other approaches, or by measurements or requirements gathering alone.

Implications and conclusion
Design for one techniques (DIY and digital fabrication) can be an alternative for occupational therapists and HCI practitioners in situations where the most optimal fit and granularity of design details is a necessity. Since every single patient is unique, an occupational therapist can design custom apparatus, tailored to their requirements. Design for one is an empathic approach that involves a user as an expert in every single step of the design process, and can be adopted where other qualitative approaches are not able to address the critical and particular needs of a case. The uniqueness of the design situation and the benefit of this quality of fit make designing for one a necessary if not preferable approach in many instances.

References
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