Did They Really Like the Game? – Challenges in Evaluating Exergames with Older Adults

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Abstract

Exergames offer exciting perspectives not only for recreational, but also for therapeutic use. Increasing numbers of older adults in many industrialized countries raise the need for affordable and reliable solutions to help people to stay healthy and fit at advanced ages. While games user research is vital to increasing the quality of game designs and improving game design processes, many research tools are difficult to use with senior gamers, and the target group is especially vulnerable to mistakes both in game design and games user research.

We report and classify some of these challenges along with possible approaches, aiming to fuel intensified exchange about methodological experiences among researchers in the field.

Author Keywords

Evaluation, methodology, games, entertainment, game design, older adults, physical therapy.

ACM Classification Keywords

K.4.2 [Computers and Society]: Social Issues – *Assistive technologies for people with disabilities, Handicapped persons/special needs*; K.8.0 [Personal Computing]: General - *Games*.

Figure 1. Cinderella is a multi-player game for up to three players. The game encourages movements according to music rhythm. Movements are based on kinesiatric exercises. It is part of the Wuppdi! suite that contains five small games for the support of motion-based therapy for Parkinson's disease patients.

Figure 2. A virtual garden specifically designed for institutionalized older adults using Microsoft Kinect as input device. Gestures were designed in collaboration with a physical therapist. Additionally, the game features a calibration routine which adapts interaction paradigms to the range of motion of individual players.

Introduction

Industrialized societies are faced with a growing number of older adults, and many industries have started to embrace senior citizens as a new target audience. Even in video game development, which has traditionally focused on a younger audience, older adults are increasingly considered a valuable user group. Yet, little is known about their needs regarding interface and game design. This is particularly difficult when designing exergames, which aim to encourage players to remain physically active [8]. Since motion detection has become part of mainstream gaming hardware (Nintendo Wii controllers, Sony Playstation Move, Microsoft Kinect, etc.), games that motivate physical activities are available to a wide range of users. Although research suggests that such games are beneficial for older adults [7], age-related changes and impairments influence the interaction process [3], leading to a variety of problems related to the usability and accessibility of such games. In this context, an important step towards the development of senior-friendly games is the establishment of a user-centered design process, which introduces evaluations at an early point of the development process. However, applying established methods in games user research [6] can be difficult due to the impact of age-related changes and special needs of the target audience.

In this paper, we summarize results of our own case studies to identify core challenges of evaluating exergames with older adults, and we address the development of evaluation methods that allow researchers and practitioners to meet the needs of older adults. Thereby, we hope to foster the creation of accessible exergames and games for physical therapy for senior citizens.

Challenges: Evaluating Games with Elderly

The challenges that were noted in a range of studies involving exergames developed at the University of Bremen, Germany (Figure 1) and the University of Saskatchewan, Canada (Figure 2) can be categorized roughly as general challenges related to the evaluation of games with older adults, as well as challenges specific to the evaluation of exergames for the elderly.

General Challenges
Four general game-related challenges were observed during our studies, ranging from issues caused by the impact of age-related changes to a lack of gaming experience and a low level of computer literacy, which influences the perception of games among older adults.

Anxiety related to technology necessary for an evaluation: Pretests of the Wuppdi! prototype [2] showed that an experimentation room that displays too many cables and computers as parts of non-invasive research tools (cameras, microphones, etc.) can scare and confuse elderly participants to the point that they withdraw from an experiment. *Negative feelings related to personal performance:* Failure in games is often attributed to personal failure rather than poor game design [4]. Many participants are concerned that their performance is tested instead of the quality of the game. *Social factors* severely influence the research of exergames for older adults as many elderly try to be polite when experimenters are present. To this end, experimenter effects should be considered carefully as a potential bias, especially when conducting interviews or focus groups that include direct questioning of participants. *Overstraining participants:* Player performance and their ability of answering extensive questionnaires vary on a daily basis [3]. During the evaluation of Wuppdi! [2], therapists and caregivers pointed out that individu-

Figure 3. The Frog Prince (part of the Wuppdi! suite) is a single player game which requires wide circular arm movements, similar to breast-stroke swimming. Synchronous movement of both arms controls forward motion, movement of a single arm controls turns.

al physical fitness and cognitive awareness among older adults may vary strongly from one day to the next and also over the course of a day. The duration of play sessions and the length of asynchronous qualitative instruments have to be adjusted accordingly.

Challenges Specific to Exergames
Evaluating exergames with older adults is particularly challenging. In this section, we list different problems that we observed during our evaluation sessions.

First of all, encouraging physical activity among elderly users may increase certain *health risks* for frail participants. Cognitive load is increased when participants have to coordinate movements, interact with games and try to reflect on their experience. Such multi tasks are particularly challenging for older adults but also beneficial in physical therapy [5]. Additionally, participants were *extremely focused on in-game events* while playing the Wuppdi! prototypes, and sometimes came close to stumbling in the real world. For older adults, this may be a serious health hazard as falls can easily lead to bone fractures. Furthermore, we observed *tendencies in older adults to overexert* while engaging with exergames to complete all tasks within an evaluation [4]. Since they only informed the experimenter about their exhaustion after the gaming session, it was not possible to abort it. The *application of multiple tests* to measure physical stress and exertion requires extended ethics approval and the involvement of medical staff. In research about games for therapy, it is important to evaluate therapeutic effects – *long-term studies* and the involvement of therapists and physicians is necessary.

On the technical side, natural user interfaces, such as the Kinect, capture continuous and noisy image data and thus have problems with jitter not only in the vid-

eo-stream recordings, but also in the resulting approximated skeletal postures and movements. As a result, game prototypes we used had to be adjusted to be much more tolerant towards imprecise input. This can be challenging in combination with the differences in range of motion among elderly and tracking difficulties resulting from additional special needs, for example when participants are in wheelchairs [3].

Another important aspect of physical therapy game design is the involvement of therapists, family members and nursing staff, who have additional interests, such as being able to support a player with playing the game and tracking their performance (cf. [1]). While most therapists were interested in our research prototypes and the approach of games for physical therapy, many were cautious to point out that they would not want the games to get in the way of their work, or to 'replace' therapeutic intervention time. Still, these third party groups can be valuable to the game design process, assume roles in the game mechanics (cf. [7]) and in data analysis, since they are practically involved with the patients and often provide important insights into individual participants' capabilities and needs. The inclusion of methods allowing researchers to harness the potential benefits brought in by third parties could prove highly valuable.

Discussion
Evaluating exergames with older adults is associated with unique challenges that are related to the impact of age-related changes and a lack of gaming experience among today's elderly. To obtain reliable results, the games user research community needs to provide methods which reduce the cognitive load of participants instead of overwhelming them by presenting too many new challenges at the same time (e.g. new gaming

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technology, a variety of research methods and unfamiliar persons involved with the evaluation).

In our studies, we found that small adjustments to the evaluation environment (e.g. hiding technical components) helped participants adjust to the situation. Furthermore, providing simple, specifically designed questionnaires*, reading them out as structured interviews and keeping the session duration as short as possible helped reduce the cognitive load of participants experiencing age-related changes. Additionally, allowing enough time, buffer and explanations during the procedures is crucial when working with special populations such as institutionalized older adults.

Finally, an important aspect that has to be addressed by future work is achieving clinically valid measures of the effectiveness of games played by older adults: If exergames are to be applied in physical therapy, it is crucial to gain insights into long-term effects and detailed physical effects, which requires research methods that go far beyond those designed to examine game usability and accessibility.

Acknowledgements

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