
Therapeutic Gaming in Context: Observing Game Use for Brain Injury Rehabilitation

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Abstract

Video games are often used in brain injury (BI) therapy sessions to help motivate patients to engage in rehabilitation activities. However, very little is known about contexts of game use in real-world rehabilitation settings. In this paper, we explore contexts of commercial game use in BI therapy through observation of inpatient therapy sessions. Based on a systematic analysis of the observation recordings, we found that (1) only 30% of session time was used for gameplay; (2) therapists needed to provide various kinds of cognitive and physical patient support during the play sessions; and (3) therapists adopted multiple strategies to reinforce the therapeutic values of the games. This study is helping us create decision and information sharing tools to support the design of games for BI rehabilitation.

Author Keywords

Brain injury; gaming therapy; observation; therapists

ACM Classification Keywords

K.4.2. Computers and Society: Social Issues
(Handicapped persons/special needs); K.8.0. Personal
Computing: Games

Introduction

Brain injury (BI) is a leading cause of long-term disability in many societies [10]. People who have had a BI exhibit a wide range of physical and cognitive disabilities and have varied recovery paths. It can be challenging to motivate patients to engage in repetitive activities needed for BI rehabilitation [4]. As a result, some therapists use video games in their therapy sessions to help motivate patients. Based on budget and availability in their institutions, therapists use varied combinations of commercially available games designed for the general public and games that are specifically designed for BI therapy [2].

Previous research have identified that many commercial off-the-shelf (COTS) games designed for the general public (including motion-based games that combine entertainment with physical exercise) are effective at not only motivating patients to engage in rehabilitation activities but also at addressing therapeutic goals such as balance and gait (e.g. [6]). However, research has indicated that COTS games are often too fast-paced and too challenging for low functioning patients [8]. As a result, therapists usually use COTS games only with a small portion of their patients who demonstrate higher physical and cognitive abilities [7].

To mitigate the limitation of COTS games, researchers and practitioners have created games that are designed specifically for BI rehabilitation [3]. Much of this work has focused on games run on specialized platforms (e.g. virtual reality systems, see [9] for a review) that usually bear a high cost and thus suffer from limited scalability to general therapeutic practices. Along with the development of motion capture technologies and

the availability of motion-based game consoles (e.g. Nintendo Wii and Xbox Kinect), research in this area has recently shifted towards methods that create customized games leveraging commercially available hardware [3]. Many of the practices in this area focused on games with adjustable parameters to address the wide-ranging causes, effects and recovery arcs associated with BIs (e.g. [1]).

In summation, there has been a great deal of interest in the use and creation of video games for BI rehabilitation. However, most of the previous work in this area focused on investigating the effects of games on the patient's health improvement and general wellbeing. There is very little discussion about context of game use; i.e. how games are used in BI therapy in real-world rehabilitation settings. For example, little is known as to how therapists and patients interact when using games and what kind of assistance therapists need to provide to support patients in gameplay. We argue that understanding contexts of use is crucial for supporting both the continued use and creation of games aimed at supporting BI rehabilitation.

As a part of a larger project, this exploratory work aimed at understanding contexts of commercial game use through observation of therapy sessions. We were interested in understanding: (1) the general settings and timing issues of game use in BI therapy, (2) the kind of support therapists needed to provide to patients, and (3) factors that contributed to and diminished enjoyment in therapeutic gaming. This knowledge will help us in the larger project in which we focused on decision and information tools to support the use and creation of gameful approaches for BI rehabilitation.



Figure 1. AV cart loaded with three gaming console and games

Related work

This study builds on research that investigates therapists' perspectives in game use for rehabilitation. For example, Glegg et al. (2013) conducted a survey-based study with 47 therapists to understand their attitudes towards adopting a virtual reality (VR) gaming system the authors developed for BI therapy [5]. They found that while therapists generally had positive attitudes to use the system, they were not very confident in their ability to use the system independently. More closely related to this work, Annema et al. (2010) conducted master-apprentice style contextual inquiry studies on therapeutic game use (including both commercial games and customized therapeutic games) with 20 therapists in four rehabilitation institutions that covered a diverse patient population including patients who have had a BI [2]. They suggested that the design of therapeutic games needed to consider the commonly limited session time and the therapist's support during gameplay. We extend this work by focusing on non-interrupted observations.

Methods

In this study, we worked with therapists from Marianjoy Rehabilitation Hospital (MRH) in Wheaton, Illinois. After initial interviews with the therapists (interview findings were reported in [7]), we assembled two AV carts with three commercial game consoles (Wii, Xbox Kinect, and Sony Move) and multiple games requested by the therapists (see Figure 1). We then were on-site three days a week for four weeks to observe therapists using games during inpatient therapy sessions. Ethical approval of this study was acquired from the Institutional Review Boards at DePaul University and Marianjoy Rehabilitation Hospital.

Participants. We observed therapy sessions with six the therapists (5 male, 1 female), including four physical therapists (PT) and two occupational therapists (OT). Therapists used games with eight different patients (5 male, 3 female). Patients ranged in age from 34 to 69 years; all had experienced their most recent BI within 30 days of our observations. Causes of BIs included stroke ($N = 6$), car accident ($N = 1$), and multiple sclerosis surgeries ($N = 1$). Two of the patients had previously played video games.

Observations. We were on-site three days a week during the four-week observation period from October to November 2013. On our on-site days, we asked participating therapists to inform us whenever they had a therapy session in which they would use games. Observations required therapists to complete a 'documentation of capacity' in which they assessed that the patient had the capacity to understand our consent forms; informed written consent was obtained prior to the observations. Observations were video recorded from the front and back. While we were physically present, we avoided contact with the therapists and patients during the session. After each session, we debriefed the therapists and patients.

Data analysis. We conducted two rounds of video coding using ATLAS.ti to analyze the observations. The first round focused on time spent on different activities during the therapy session. Specifically, we coded for time spent on gaming (coded from disc insert to the end of game result showing) and time spent for actual gameplay (coded when the patient was actively interacting with the game). In the second round, we inductively coded for: (1) supports therapists provided to patients, (2) methods therapists used to reinforce therapeutic values of the games, and (3) factors that were associated with enjoyment in gameplay.

Results

At MRH, patients were scheduled for at least four hours of therapy in 30 or 60-minute sessions. When gaming was considered appropriate, the therapists would reserve the gaming room (approximately 150 sq. ft.) where the AV carts were stored and used. We observed seven 30-minute sessions and one 60-minute session.

Games used

One to four games/mini-games were played in each therapy session. In total, we collected data about 23 game/mini-game plays with our observations. Therapists used a mix of Wii games (11 plays) and Kinect games (12 plays); no Sony Move game was used. The most popular game used was Wii Fit with the balance board ($N = 9$, 39%) and Minute to Win It mini-games on the Kinect ($N = 4$, 17%). Other games used included Kinect Adventures ($N = 3$), Body and Brain Connection on Kinect ($N = 3$), Kinect Sports mini-games ($N = 2$), Mensa Academy ($N = 1$) and Cooking Mama ($N = 1$) on the Wii.

Timing in play sessions

Although the therapy sessions were scheduled for 30 or 60 minutes, only about half of the time was used for gaming ($Mean = 55.3\%$). The rest of the time was spent transferring the patient before and after the session and taking breaks during the session. Further, patients actively played games for only about half of the already limited gaming time ($Mean = 55.4\%$). As a result, only a small portion of the session time was used for gameplay ($Mean = 30.0\%$, $SD = 6\%$). Game setup, loading, and the display of game results took the rest of gaming time. There was no significant difference between the setup time of Wii games and that of the Kinect games ($U_{(21)} = 82$, $p = .35$).

Support provided

We identified several kinds of patient support that therapists needed to provide to streamline the gameplay (see Figure 2).

Physical Support	Wii Games	Kinect Games	Total
Protection	██████████	██████████	70%
Scaffolding	███	███	22%
Cognitive Support	Wii Games	Kinect Games	Total
Rules	██████████	██████████	78%
Strategy/tactics	██████████	██████████	74%
Movement	██████████	██████████	65%
Non-play UI	██████████	██████████	56%
Demo	███	███	8%

Figure 2. Types of support therapists provided to the patients

PHYSICAL SUPPORT

In most game plays we observed (70%), therapists protected patients from falling by putting hands on the patient's body or holding a support belt around the patient's waist. Therapists sometimes (22%) also provided additional physical scaffolding, including (a) hand-over-hand assist with remotes, (b) help with moving a body part (e.g. arm), and/or (c) bearing some of the patient's weight.

COGNITIVE SUPPORT

Therapists also provided various types of cognitive support before, during, and after game play, including:

- **Rules.** Teaching the rules (or elements of the rules) of the game and/or helping the patients read the rules on screen or go through the game tutorial.

- **Strategy/tactics.** Providing instructions, suggestions, or feedback to help patients make decisions in gameplay. For example, during gameplay of a Wii Fit mini-game 'Obstacle Course', the therapist asked the patient to "wait here until the obstacle is out of the way."
- **Movement.** Providing support so that patients understood the "correct" movements to play the game. For example between plays of the Soccer heading mini-game in Wii Fit, one OT explained to the patient: "What you are doing sometimes is that you kind of duck like that (only moving the head), but it's not taking that up (sic)... should be a straight weight shift."
- **Non-play UI.** Guiding the patient going through the setup or dealing with non-play UI issues during gameplay (e.g. "move back a little" in a Kinect game).
- **Demo.** Showing the patient how to play by providing a demonstration play.

Reinforcing therapeutic values

Therapists used games mostly to add fun and/or novelty to therapy [7]. However in some sessions we observed ($N = 13$), therapists also adopted strategies to reinforce therapeutic values of the games. We identified three ways therapists commonly use to make sure patients get the therapy out of gameplay:

- Emphasize certain postures or movements related to therapeutic goals. For example, one PT asked the patient to keep a "nice straight back" while standing.
- Modify the game by posing additional requirements on movement. For example, one PT asked the patient to play the Soccer Target Kick mini-game on Kinect several times with alternate legs.
- Modify the game by introducing additional equipment. For example focusing on balance, one PT

asked the patient to stand on a foam board while playing the Body and Brain Connection game on Kinect.

Enjoyment

A number of factors were identified as associated with the enjoyment in gameplay, including:

- **Challenge.** A right amount of challenge was associated with greater enjoyment. While in many game plays ($N = 10$, 43%) patients were frustrated and overwhelmed by the games, we also observed a few game plays ($N = 2$, 9%) where patients were bored for a lack of challenge. Pace and visual complexity of the game were common factors associated with an inappropriate amount of challenge.
- **A sense of being in control.** Understanding the rules of the game, being able to perform the basic mechanics, and a self-belief of being able to "beat the game" led to greater enjoyment.
- **A sense of progress.** Progress in the game (e.g. reaching a higher level), increased score from the last play, and improved skill in the game were associated with enjoyment.

Discussion and future work

Through a systematic analysis of the video recorded observations of game use in inpatient BI rehabilitation contexts, we were able to identify several issues that need to be considered in the use and creation of games for BI rehabilitation. Echoing findings by Annema et al. (2010), only a small portion of the session time was spent on gameplay (potentially effective therapy) in our observations (about 30%). We also identified (1) the kinds of physical and cognitive supports therapists provided when using the games, (2) strategies therapists adopted to make the play sessions more

therapeutically effective, and (3) several factors that were associated with enjoyment in gameplay.

Our findings have several implications on the design of games for BI rehabilitation. As identified in previous work, the game setup, loading, and result showing time need to be minimized in order to make full use of the therapy session. Second, game designers may want to consider ways to minimize therapists' support during gameplay. Ideally, some types of support can be incorporated into the gaming system so that patients may use the games more independently. Third, game designers may also consider supporting the methods therapists used to reinforce the therapeutic values of the games.

Limitations and future work

Our method was limited to only observing high-level patients who had the capacity to understand a consent form. In addition, our study was only conducted in one rehabilitation site. Other facilities may have different patient populations and/or different practices.

We plan to extend this study to other rehabilitation facilities. We are also leveraging this and other information we are collecting to create decision and information tools that support therapists and game designers; we are working with therapists and game designers through participatory design practices in the creation and evaluation of these tools.

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