‘Choose a Game’: A Prototype Tool to Support Therapists Use Games in Brain Injury Rehabilitation

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Abstract
Brain injury (BI) is recognized as a major health issue. It is common for therapists to include commercial-off-the-shelf (COTS) games in therapy sessions to help motivate patients who have had a BI to engage in rehabilitation activities. However, we have found that therapists are often frustrated with finding pertinent information about COTS games and systems, which are proliferating at a rapid rate. In this interactive demonstration, we present a web-based prototype ‘Choose a Game’ tool that is aimed at helping therapists select appropriate games for their patients with BIs that match their therapeutic goals and individual patient attributes. This demonstration is intended for researchers and practitioners interested in areas where technologies are rapidly proliferating for a user group who has wide-ranging attributes.

Author Keywords
Games; brain injury; rehabilitation; case-based reasoning.

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 [5]. Clinical experience and cases cited in the literature have identified that it is often challenging to motivate people who have had a BI to engage in the repetitive activities needed for BI rehabilitation [2]. As a result, some therapists use video games in their therapy sessions to help motivate patients. Because commercially available products are reasonably affordable and readily available, many therapists and clinicians choose to use commercial-off-the-shelf (COTS) games/systems such as the Nintendo Wii [3]. However, in exploratory research, we found that therapists had difficulty to find pertinent information about COTS games and systems, which are proliferating at a rapid rate [7].

In this interactive demonstration, we present a web-based prototype 'Choose a Game' tool, which is aimed at helping therapists select appropriate games for their patients who have had a BI that match their therapeutic goals and individual patient attributes; this demonstration is based on our previous work [6] and [8]. The 'Choose a Game' prototype leveraged a Web-centric knowledge-base that we designed and optimized in a larger project to support the use and creation of games for BI rehabilitation.

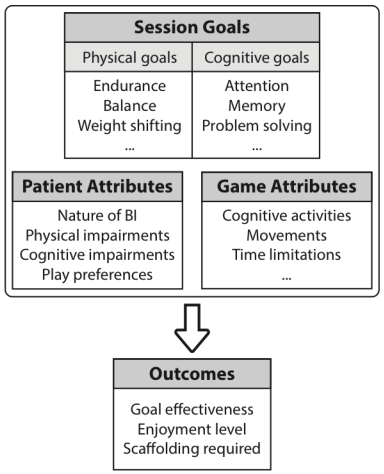

Figure 1: Summary attributes of a game therapy case.

Background: Prototype Creation Process

We created and evaluated the prototype using a user-centered and user-driven approach with 29 therapists who work with inpatients with BIs at two rehabilitation hospitals in Illinois: (1) Schwab Rehabilitation Hospital and (2) Marianjoy Rehabilitation Hospital. In this section, we briefly describe our approach; for more details, see [6] and [8].

We laid the foundation for the system through (1) interviews with the therapists and (2) onsite observations of therapy sessions of COTS game use. In this preliminary work, we identified that the problem and the solution spaces for this domain are both quite complex. (For more see [1,7].) To address this complexity, we adopted a case-based reasoning (CBR) methodology. CBR systems solve problems by referencing previous solutions or 'cases' [4]. In our study, a game therapy case describes a particular situation in which a game is used with a patient to address certain therapy goals; see Figure 1 for the summary attributes of a case.

We conducted paper-based diary studies to collect 'seed cases' for the knowledge-base. In the same timeframe, we designed and iterated interfaces for the 'Choose a Game' tool through multiple phases of usability studies. (For more see [8].) Based on the 'seed cases' and the initial interface, we created a working prototype of the 'Choose a Game' tool using an experimental CBR algorithm. We then conducted three evaluation study periods (four weeks + four weeks + 16 weeks) for the system. Each study period was followed by a short interview or survey to explore user interface issues and usefulness of the system.

Throughout the user study periods, we modified the system according to the user feedback. We found that the therapists were generally satisfied with the recommendations provided by the prototype tool (the average satisfaction rating was 4.2 on a scale of 1 to 5). In addition, the therapists' overall satisfaction of the matches increased for each study period (difference is significant using a Kruskal Wallis test: $H(2) = 10.64$, $p = .005$). For more see [6].

Experimental CBR Algorithm for the 'Choose a Game' Tool

1. For each case c_i in the case base C, calculate the **similarity** s_i between c_0 (the new case) and c_i ($0 \leq s_i \leq 1$, where $s_i = 1$ means c_0 and c_i are identical) based on the goals selection and the patient attributes.
2. If $s_i \geq s_{threshold}$ (where $s_{threshold}$ is a predetermined similarity threshold) put c_i into the candidate list.
3. For each case c_j in the candidate list, calculate its **outcome value** o_j ($0 \leq o_j \leq 1$) based on the goals effectiveness, the enjoyment ratings, and the help needed ratings from the diary data.
4. For each game g_k mentioned in the candidate list, find all cases that used g_k and put them into a set C_k. Calculate the average outcome value $\overline{o_k}$ and the average similarity $\overline{s_k}$ of all cases in C_k
5. Let the **overall score** for a candidate game g_k be: $r_k = \overline{o_k} \times \overline{s_k}$.
6. In descending order, sort the candidate games according to their overall scores. Output this sorted list.

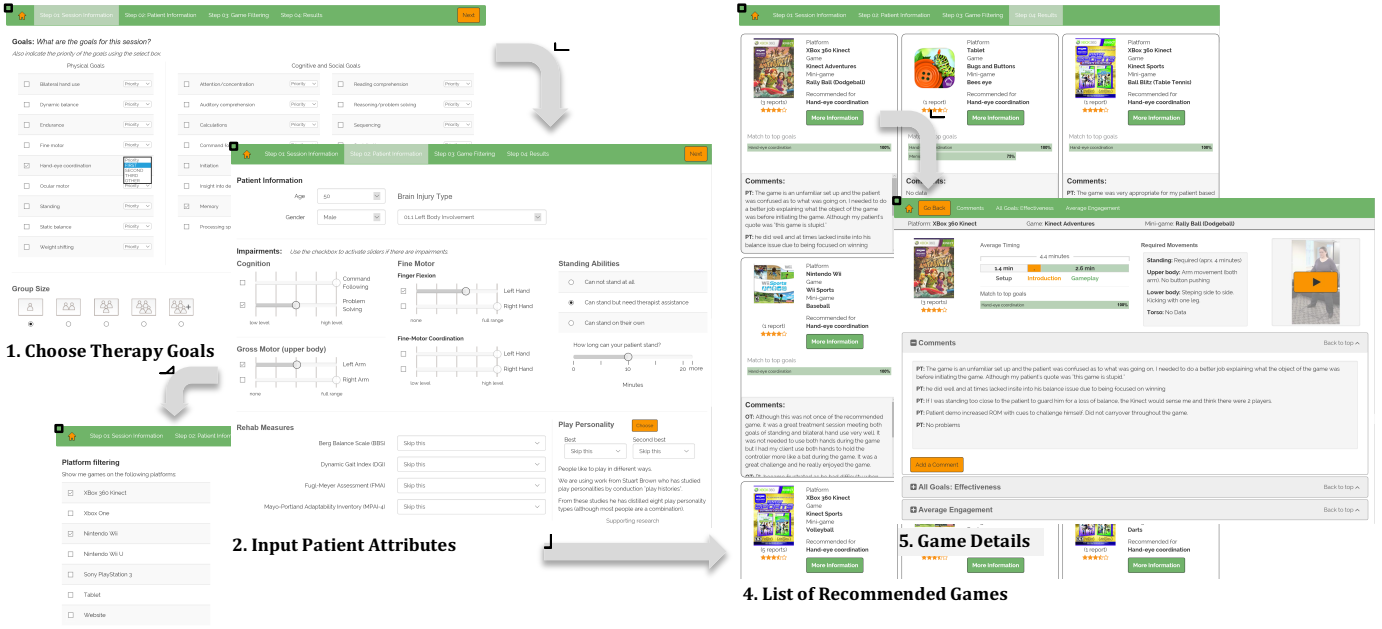

Figure 2: User Interaction of the 'Choose a Game' Tool

System Description

We coded the back end algorithm in Java and built a responsive interface using the Bootstrap framework. See Figure 2 for the input and output screens; for more, see [6]. The prototype can be accessed at: http://gametherapy.cstcis.cti.depaul.edu:8080/TherapyGameRecommender/index.html

The current interaction design followed three steps. Once logged in with an email address, therapists (1) chose goals for the session (from a list identified in our previous work) and specified the priority of the goals, (2) entered information about their patient by clicking checkboxes that activated sliders for severity of possible patent impairments, and (3) filtered for game platforms. To help save time, the system only asked for patient attributes that were important for game decisions. The system was also capable of providing recommendations without any patient information, i.e., to only goal matches. However, the recommendations were more precise *with* patient information.

After inputting session information, therapists were presented with a list of recommended games. Information about games included: (1) game console and name, (2) information about how well the game

matches to the input case, and (3) comments about the games from therapists. Therapists were also able to navigate to a detail page that provided additional game information, including information about the game's required movements, the game's rated effectiveness at all goals, and a gameplay demo video.

The system also automatically logs therapists' inquiries (information about Session Goals and Patient Attributes) and after each therapist inquiry, sends out a questionnaire asking them to identify the games they eventually used (associated with Game Attributes) and evaluate the Session Outcomes. As a result, the inquiry and the corresponding questionnaire served as a digital diary form that resulted in new cases added to the knowledge-base.

Conclusion

In this demonstration, we explore how domain experts' knowledge can be (1) collected and structuralized in a user-centered and user-driven approach and then (2) synthesized into a tool that helps the domain's larger community. We aimed this demonstration towards researchers and practitioners interested in areas where technologies are rapidly proliferating for a user group who has wide-ranging attributes, as the domain of therapeutic gaming for BI rehabilitation.

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