

Post Stroke Social Gaming

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Post stroke social gaming

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1. Introduction

One of the most challenging aspects for post stroke rehabilitation is to include other people in the rehabilitation process. We can identify at least three levels of inclusion in social rehabilitation:

1. Patient to Patient (Quite-symmetric collaboration or competition)

This first level presents challenges related to the patients' physical abilities.

In fact, the specific abilities that will be affected by stroke depend on the location, type and size of the lesion. Each patient is then characterized by a specific combination of deficits (National Stroke Association, 2010). Therefore, stroke rehabilitation programs are strongly personalized: they are adapted to a particular patient, to regain as much function as possible. Because each stroke is different from another it is possible to treat patients in independently but it's very difficult to treat them together. For example, two patients who have different recovery degrees would not be able to collaborate on the same exercise exactly because of their specific impairments.

2. Patient to Therapist (collaboration or competition)

This second level presents challenges related to the different physical abilities (as in the first case) but it's typically used during rehabilitation in care centers. In fact, therapists and patients could complete tasks together as a complement to personal rehabilitation.

3. Patient to Family (Asymmetric collaboration or competition)

This last level presents challenges linked to the different physical abilities (as in the first case) and it's not very diffused in real life (i.e. the family does not do rehabilitation exercises with the patient's at least in care centers).

2. Proposition

The above described scenario could be complicated when the post stroke therapy used is a 'virtual' therapy such as with serious games (Di Loreto et al. 2011). In fact besides described challenges, the acceptance of virtual therapy has to be taken into account. For example, while therapists physically interact with patients during the rehabilitation process (e.g., they correct the patient's position) they could feel that playing with the patient 'is not part of their job' (and then susceptible to degrade the therapy value).
On the other hand, we believe in the importance to add the social aspect to elders' therapy – the average age of post stroke patients is 65 years old – even if technology mediated. In this assumption we are supported for example by Gajadhar et al. (2010). Gajadhar et al.

underlined the importance of social interaction in technology mediated exergames. They found that online co-play was deemed less rewarding than physical co-playing or when elders thought they were playing against a computer.

For these reasons we have decided to exploit social gaming for post stroke rehabilitation. The concept we propose is to insert rehabilitation serious games inside a more complex virtual world with a virtual economy to overcome the problem of heterogeneity on abilities. In fact, most on-line rpg-like games present a virtual economy based on items (virtual resources) that could be crafted by a player or an NPC (non player character). The following characteristics may be found in virtual resources in mimicry of tangible property (see Castronova,2001).

1. **Rivalry**: Possession of a resource is limited to one person or a small number of persons within the virtual world's game mechanics.
2. **Persistence**: Virtual resources persist across user sessions. In some cases, the resource exists for public view even when its owner is not logged into the virtual world.
3. **Interconnectivity**: Resources may affect or be affected by other people and other objects. The value of a resource varies according to a person's ability to use it for creating or experiencing some effect.
4. **Secondary markets**: Virtual resources may be created, traded, bought, and sold. Real-world assets (typically money) may be at stake.
5. **Value added by users**: Users may enhance the value of virtual resources by customizing and improving upon the resource.

These conditions create an economical system with properties similar to those seen in contemporary economies. Our idea is to exploit this already existing economy to assign to the patient a role typically taken by an NPC (non playing character) in RPG games: the crafter. In this way we can 1) use motion based games (the main task in post stroke rehabilitation is to reach an object) while creating the sense of social presence, 2) insert the rehabilitation game in a more structured world consisting of different games, each one appealing to a different age range, and not only to elder people.

2.1 Games general interaction

Each crafting games for post stroke is then coupled with another (RPG) game, involving crafting. The full game consist then of two (or more) different games (A+B). Game A is a movement based game, conceived to be played by a stroke affected person, and based on stroke rehabilitation principles. Obviously different instances of movement based games could be played by different patients. Game B is thought to be played by a younger generation, used to RPG games and to their dynamic.

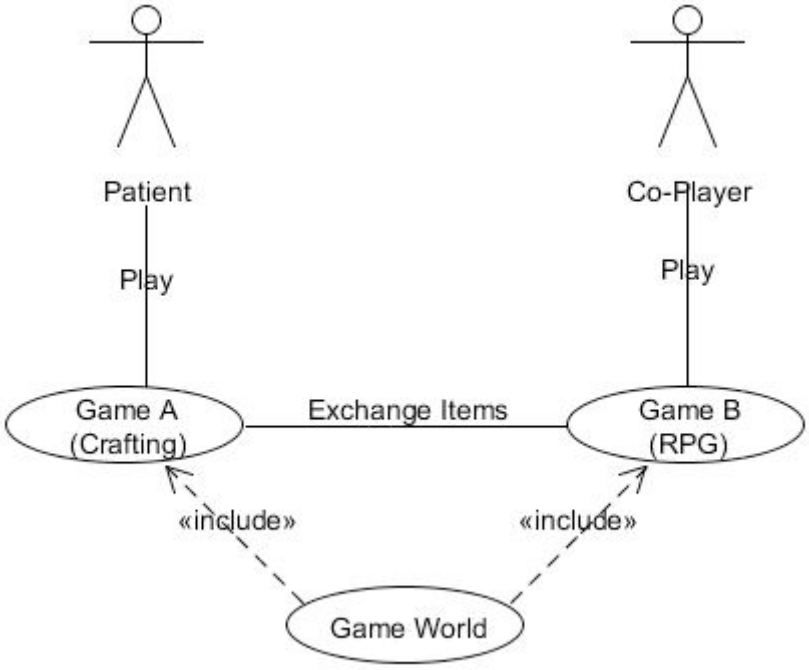


Figure 1-The relationship between players in our idea

3. A practical example

As an instantiation of the above described framework we developed the 'RehabCraft' game for post stroke rehabilitation, which is conceived to be played as a couple with the 'Legendary eagles' game.

The legendary eagles' game is an rpg game based on the following history. Sometime in the future mankind has managed to practically destroy the world via magnetic weapons. The world was knocked off its axis and continents have sunk into the ocean. Only small islets remain. Several decades later, the survivors have managed to remodel their lives. They have built homes on the islets, as well as shops and a school. The top, elite students of this school are recognized worldwide as the best people in the world: the Legendary Eagles. The game addresses a target of 20 years old people.

In this game is enclosed an arena where the players participate in tournaments. To participate to these tournaments they ask a forger to build for them swords and shields. Obviously the use of swords and shields is a gameplay choice linked to the kind of game described above. Whatever object could be crafted in the movement based game. In order to ask to the forger to create an item the player has to collect different materials in the main RPG game. Once the player has gathered the right amount of materials he can ask the forger to make him a new weapon.

On the other side the forger role is then taken by a patient playing a crafting game. The patient's movement quality is stocked during the game and influences the 'quality label' assigned to the crafted object. This quality label is an attribute that will stick to the object once retransmitted to the RPG game, in combination with the crafter nickname. In this way we are able to create a sort of classification list, giving feedbacks to the patient that can help to enhance his motivation (for example, how many fights were won with his crafted sword).

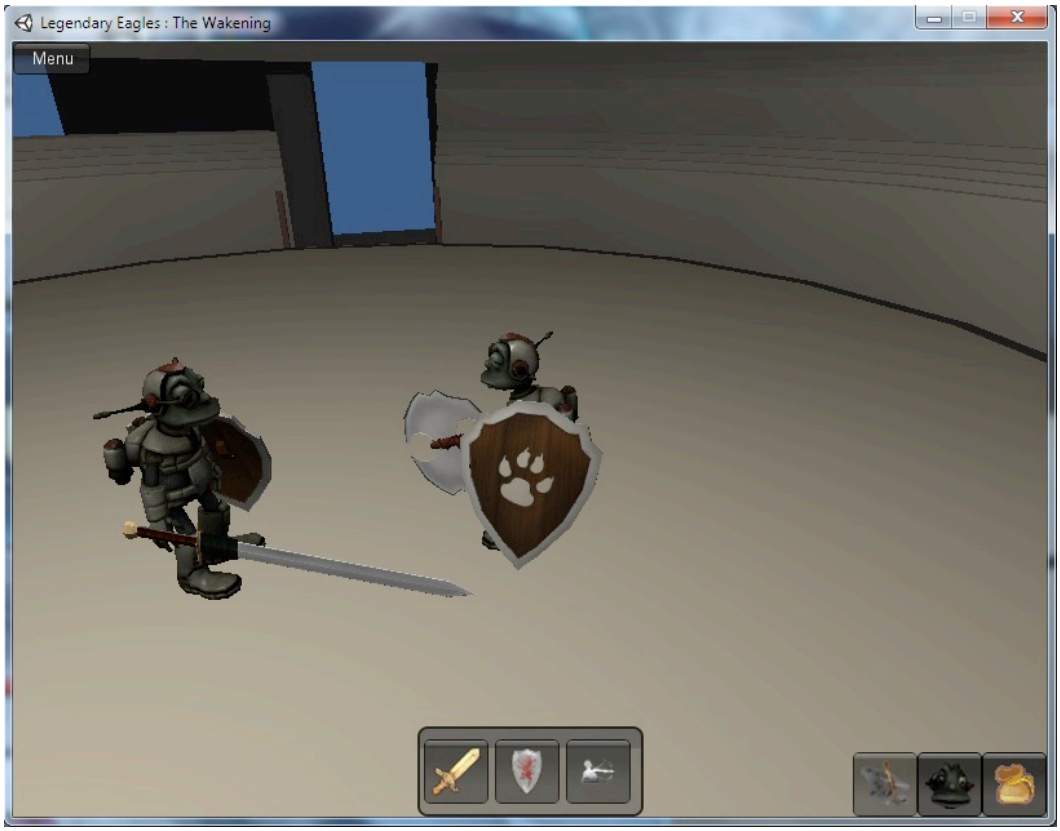


Figure 2- A scene from the Legendary Eagles prototype

The crafting games were conceived after most than a year of study and participatory design with therapists. This participatory work allowed us to extract from the therapists' expertise general rules to apply in movement based post stroke rehabilitation games (see for example the level design section description.

Hereafter the detail of the construction of a rocking horse (a fun element added to the game) and its relationship with the RPG game.

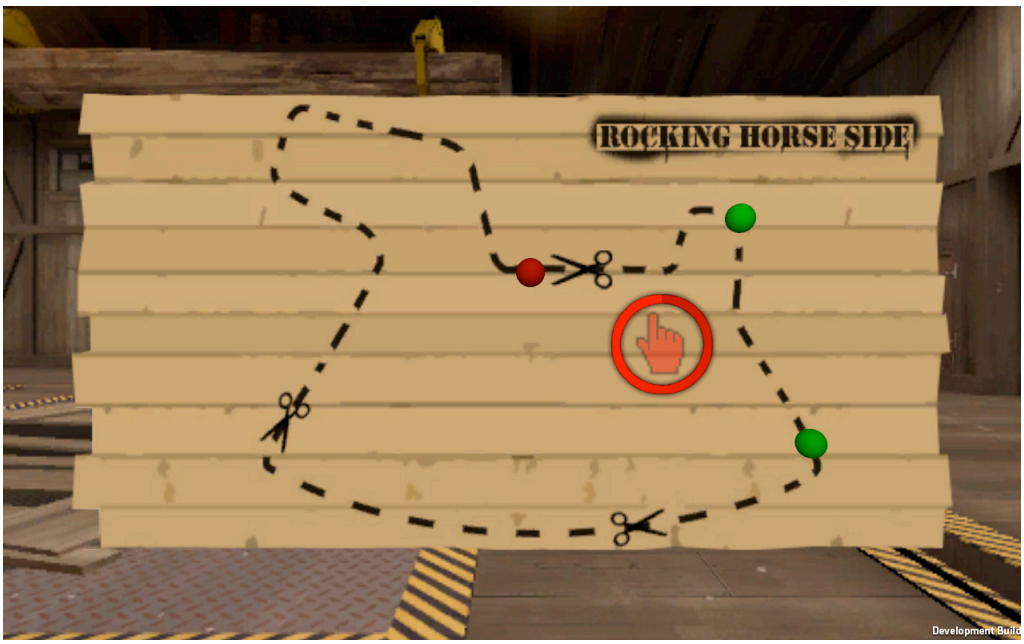


Figure 3 - A level from the RehabCraft prototype

3.1 Assets:

Tools are used for the Crafting Game (i.e., the patient game). Materials are used for both, the Crafting Game and the RPG Game.

Tools:

- Scissors
- Saw
- Sandpaper
- Paintbrushes
- Hammer

Materials :

- Wood
- *Cutted wood*
- *Scrubbed wood*
- Paint
- *Painted Wood*
- Paper
- Nails
- Leather strips and scraps

3.2 Level design

Level 0: animated intro to put the player in media res.

Co-Player Level 1– *A- Find the rocking horse schema:* The user playing GAME B has to help an NPC character. Once the quest is finished he receives the rocking horse schema
B- Collecting Woods: The user playing GAME B has to defeat a set of enemies in order to collect wood.

Patient Level 1 – Cutting the pieces: Using the schema retrieved by the Co-Player character, the patient has to cut each piece of wood in the right shape.
Game Mechanics based on therapists' expertise: Templates for the shapes are traced onto the wood and the patient player has to cut the pieces according to the outlines *(following a path)*. Shapes have to be proposed one by one and the shape to cut has not to be too complex.
Tool used: Saw
Material used: Wood

NB: When the GAME A is played independently, the rocking horse schema and the wood are given to the patient player from the start.

Co-Player Level 2–*Find the paint:* The user playing GAME B has to help an NPC character. Once the quest is finished he receives the paint for the rocking horse.

Patient Level 2 – Scrub the pieces:
Game Mechanics based on therapists' expertise: Use sandpaper the patient scrubs the wood to remove any unevenness in the wood *(free movement)*.
Tool used: Sandpaper
Material used: Cutted Wood

Co-Player Level 3– *Retrieve the nails:* The user playing GAME B has to help an NPC character. Once the quest is finished he receives the nails for assembling the rocking horse.

Patient Level 3 – Paint the pieces: Using the paint retrieved by the Co-Player character, the patient player has to paint each pieces of wood.
Game Mechanics based on therapists' expertise: Step 1: the patient has to blend the colours with a circular movement *(following a path)*. Step 2: Once colours are blended he can paint

the wood pieces using whichever movement he wants *(free movement)*.Woods pieces have to be proposed one by one.
Tool used: Paintbrushes
Material used: Scrubbed Wood

NB: When the GAME A is played independently, the paint is given to the patient player from the start.

Co-Player Level 4–*Find paper and other materials (details):* The user playing GAME B has to help an NPC character. Once the quest is finished he receives the materials for decorating the rocking horse.

Patient Level 4 – Decorate the pieces: the patient creates decorative items for the rocking horse.
Decorative items are ears, reins, tail (all the elements that could be cut down).
Game Mechanics based on therapists' expertise: To make the ears, the patient cut two equal triangles in the same way he cut wood *(following a path)*. For reins and tail he has to cut leather strips *(free movement)*.
Tool used: Scissors
Material used: paper and leather strips

Patient Level 5 – Assemble the pieces: the patient assembles the pieces of the rocking horse according to a plan.
Game Mechanics based on therapists' expertise: A template for the shapes is show to the player. Step 1: The patient player has to slide the proposed shape in the right spot *(free movement)*. Step 2: Then, using the hammer the patient player has to fix nails on the template shape *(free movement)* Shapes have to be proposed one by one.
Tool used: Hammer
Material used: Nail, Painted Wood

3.3 Game Workflow

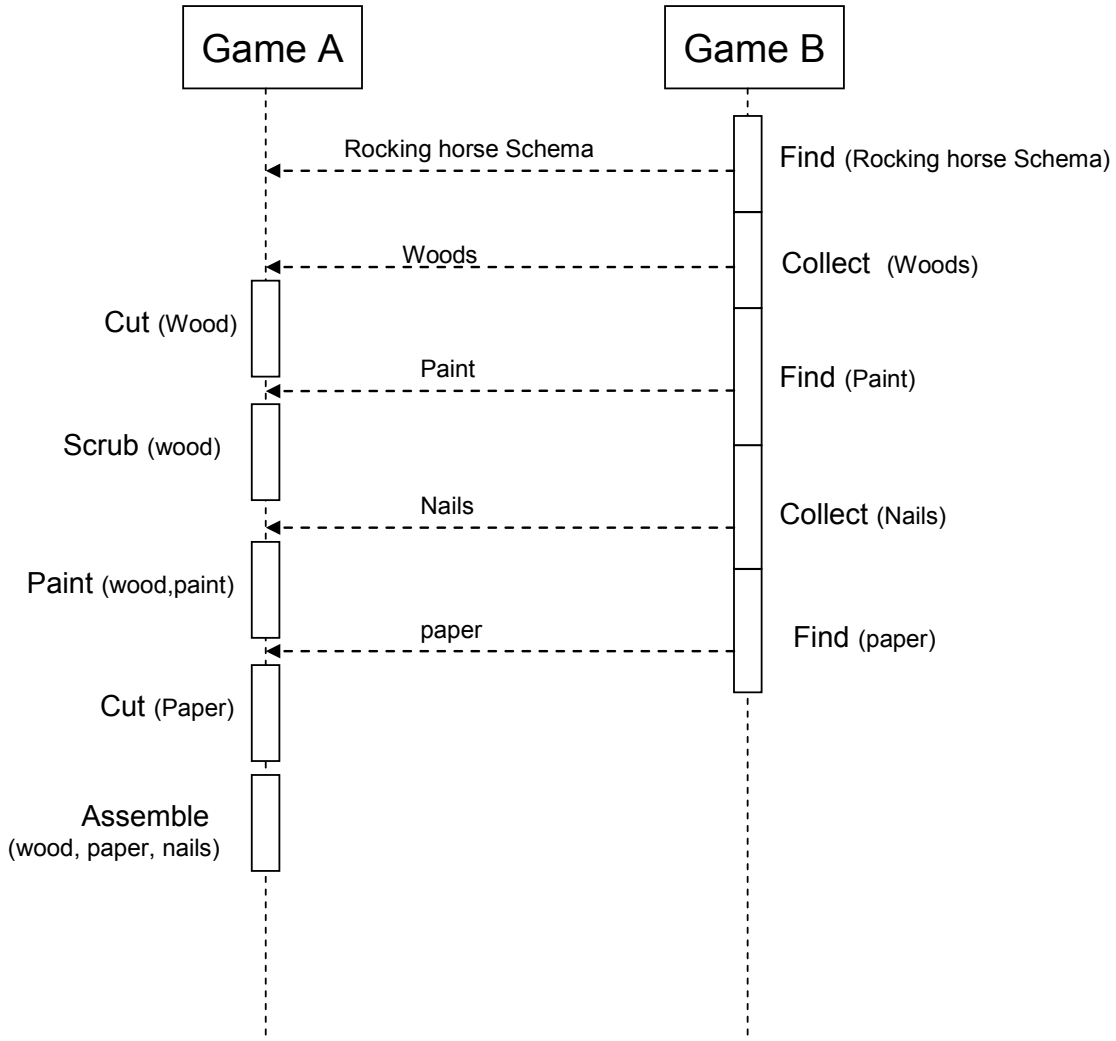


Figure 4-The workflow for the two games

4. Importance of this approach

The above described approach to social gaming for post stroke rehabilitation allow us to address all the inclusion levels described in the introduction:

1. Patient to patient

The different patients' physical abilities could be addressed inside the above described approach in two ways.

a) In a collaborative approach players can work on the same object (at the same time or not).
b) In a competitive approach players can compete on the crafting of the same object, because of the quality label described in section 3.

2. Patient to therapist

With the above described approach we can potentially cope with this aspect. On the other hand therapist's acceptance of the playing approach is strongly subjective.

3. Patient to family

This last level presented difficulties linked to the different physical abilities (an healthy person playing with a sick person). With the above described approach we can create social gaming, leaving the healthy person playing a more difficult game while the patient plays a game conceived for his rehabilitation. In fact it's the game play level which gives meaning to the relationship between the different games/players.

Experimentation:

A first experiment could be conducted assessing as:

Experimental hypothesis:

Motivation and duration of rehabilitation sessions are increased for group B when compared with group A.

Experimental scheme:

To experiment with the presented approach for social therapeutic games, the following experimental scheme is proposed:

- Two groups (A,B) of N patients are selected. For both groups, the therapeutic game is proposed in addition to classical therapy. Patient are free to stop each rehabilitation session whenever they want.
- Group A (control group) members are asked to play to only rehabCraft
- Group B members are asked to play with RehabCraft with a connection to another RPG game (to be defined) played by family member.

Independent variables:

- Motivation level assessed through a questionnaire.
- Time of rehabilitation (measured in seconds for each session)

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