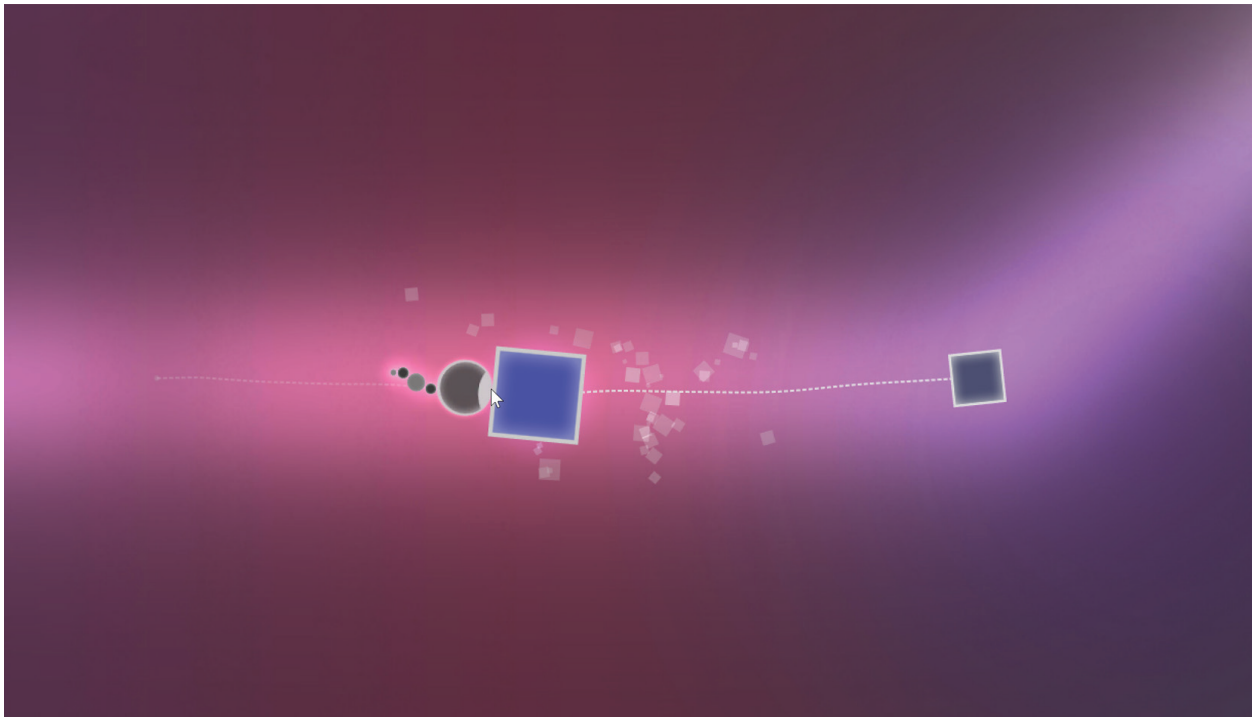


The Creative Design of Physical Rehabilitation Games

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Example URL: <http://www.workingexamples.org/example/show/638>

This working example describes a research project on digital games which assist stroke survivors in learning once more the physical abilities they lost during a stroke (e.g. drinking from a glass). Specifically, we aim to create a more engaging learning experience adapted to the needs and disabilities of stroke patients. Our focus lies on the creative design of these games.

Seed

Tell us about your idea or project. What's your vision?

In the current project the learning needs of stroke survivors are used as inspiration for designing new forms of gameplay in physical rehabilitation games. Learning procedures (e.g. goals, exercises or trajectories) and learner disabilities (e.g. bad sight or reduced dexterity) define the borders within which the instructional game designer operates, and can therefore be considered as creative design elements. As such we believe that the characteristics of the learning process should influence the look and feel of rehabilitation games. We explore new ideas, techniques, and methods for creating rehabilitation games, inspired by learning procedures and learner disabilities.

What problem are you trying to solve and why does it matter?

The project revolves around stroke rehabilitation, whereby patients are required to relearn daily, physical activities such as drinking from a glass or driving a car. After having suffered a stroke many people become disabled and lose their independent lifestyle. The fact that they consequently have to rely on caretakers severely impacts their quality of life (Choi-Kwon et al., 2006). However, they can regain a full or partially independent lifestyle by relearning these activities through stroke rehabilitation (Langhorne, Coupar, & Pollock, 2009).

The specific problem we intend to address is the gap in creative design knowledge on developing games that incorporate rehabilitation therapy. Digital games have been put forward as valuable additions to existing rehabilitation programs that can increase the motivation of patients (Garcia Marin, Navarro, & Lawrence, 2011). However, little design knowledge is available on how to create such games because most research has thus far addressed other issues such as technology and effectiveness (Quinten & Malliet, 2011). Consequently, we want to explore the creative design possibilities and limitations of digital games and rehabilitation, in order to create a more engaging learning experience for stroke patients.

What are your goals and how will you know if you've achieved them?

There are two overall goals in the current project:

- 1 We want to expand the practical vocabulary of the rehabilitation game designer, enabling her to combine game design and rehabilitation issues more effectively and create a more engaging learning experience for stroke patients.
- 2 We want to highlight the role of creative design in the development of rehabilitation games.

We will know if we have achieved these goals if:

- 1 We have created design guidelines, best practices or practical examples which adequately assist the game designer in creating rehabilitation games.
- 2 We can provide examples where creative design solutions improve the design quality of rehabilitation games.

Who will your work impact? What do you know about them?

Our target audience consists of people who have suffered from a stroke and need upper-limb rehabilitation. They can have physical, cognitive and/or emotional impairments due to brain damage. Physical impairments include loss of dexterity, muscle weakness, spasticity (Ada & Canning, 2005), and balancing problems (Tyson et al., 2006). Cognitive impairments can include visual difficulties (Rowe et al., 2009), reduced memory and slower processing speed (Zinn, et al., 2007), as well as language and attention problems (Tatemichi et al., 1994). Finally, stroke patients may experience emotional problems such as a lack of confidence and social isolation (Salter et al., 2008).

Because the target audience is defined solely on the basis of their disease, a wide range of demographic characteristics are represented. Stroke can occur at any age but the prevalence increases with age (e.g. 75% aged 65+)(Stroke Association, 2013). Also, both women and men, and people from different ethnicities are affected (Stroke Association, 2013). However, there are several elements that increase the risk of a stroke, including smoking/Tabaco use, physical inactivity, high blood pressure, and diabetes mellitus (The American Heart Association, 2011).

What challenges might pop up?

Several challenges might present themselves in this project. First, the cognitive and physical disabilities of the patients influence their ability to play traditional games (Rand, Kizony & Weiss, 2004). For example, a person with a reduced dexterity of the hand might not be able to operate a traditional computer mouse. Therefore, alternative types of input and output should be addressed. Second, as most of the patients are of older age, their technological literacy might be low. Consequently, our end result should be easy to use and to understand. Finally, the demographic diversity of the target audience makes it difficult to create a themed game experience. For instance, one patient might like golf while another might dislike sports altogether. Certainly, more challenges will arise as the project progresses.

How does this work relate to what others are doing in the field?

Current research on physical rehabilitation games mainly addresses issues of technology and effectiveness (Quinten & Malliet, 2011). We want to complement this by adopting a creative design perspective. As such we hope to create more motivating forms of game play which integrate knowledge of physical rehabilitation and game play. Related examples include the works of Burke et al. (2009), Annema et al. (2010) and Alankus et al. (2010), we believe we can extend this research by exploring more in-depth the creative design aspects and process of rehabilitation games.

How can our community support you? (expertise, resources, etc.)

There are more games which teach traditional cognitive skills than physical skills. We believe that some of the knowledge of cognitive skill based games could also apply to physical skill based games. For example, the way in which to motivate a player to participate in multiple learning sessions might be similar in both types of games. Other Working Example members which explore cognitive learning games are invited to comment on our project. Perhaps, an interesting discussion may arise on the similarities and differences between cognitive and physical learning games.

Sprout

Tell us about your process and how your idea is evolving throughout the project.

Our initial intention was to simply combine stroke rehabilitation and digital game play. However, while designing an early prototype, it became clear that the term 'combine' is too vague: it does not define a clear design approach or a concrete goal. For example, it is not self-evident to combine the time-schedule of a rehabilitation therapy with a game's mechanics, and afterwards validate this as successful or not. Yet, such ambiguity is common in creative design research where problems are usually ill-defined and where there often exists no uniform method to find solutions (Cross, 1982; Buchanan, 1992). As a result, we adjusted our initial research goal in aiming to create an underlying understanding (Dorst & Cross, 2001; Cross, 2004; Stolterman, 2008) of how stroke rehabilitation and game play relate to one another.

Overall, our research process (based on the principles of research-through-design [Frayling, 1993]) is not evolving in a linear fashion from point A to point B, but is rather iteratively going forward and backward again (Kruger & Cross, 2006). We cyclically discover the requirements, opportunities and limitations (Ho, 2001) of rehabilitation and games and apply these in the creative process. For example, in a first stage we developed a prototype that did not meet the requirement of engaging game play. Although the main concept was abandoned during later iterations, nevertheless we extracted valuable knowledge from the design, which was used as inspiration later on. This allowed us to practically explore the design of rehabilitation games from the start without being restricted to earlier concepts. In the development of a second prototype we gradually destroyed the player experience by leaving out and transforming game elements. Although this left us with a highly minimalistic player experience, this proved valuable because it enabled us to discern unimportant game elements. This was useful as not all patients can adequately process a game containing many game elements. In conclusion, this project can be described as messy on a short term basis, but steadily progressive a the long term.

What interesting patterns or insights have you discovered?

An interesting insight we have gained is that the use of general game conventions is not essential to the development of rehabilitation games. We can create custom conventions that are more strongly attuned to the needs of the rehabilitation therapy. Popular contemporary games such as Call of Duty: Modern Warfare 2 (Infinity Ward, 2009) or BioShock Infinite (Irrational Games, 2013) have helped establish the impression that a good game needs to be big, visually realistic, have a traditional game narrative, etc. The current project aligns to the indie game movement (cf. Independent Games Festival and the Independent Games Summit) which attempts to break established conventions. Many indie game designers create their own conventions through experimentation. By taking inspiration from this approach, we too experimented with the conventions of games and were flexible in integrating physical learning demands into the design of our game. For instance, by creating an abstract game world we could easily modify the direction and paths of a physical exercise, because there exists no up or down, left or right in the abstract world. Of course, creating new conventions is hard work and has no guaranteed results. However, as the field of rehabilitation games is relatively new, experimentation may provide appropriate alternatives to pure entertainment game conventions.

What are some of your initial concepts or designs? We'd love to see them.

A short clip of the current game play can be found on the following link (<http://www.nickgeboers.com/AbstractGameplayTrailerShort.mp4>) (the quality isn't great, but right-click and "save as" will give the best quality). The game is played with a HapticMaster input device as is seen in the picture below. This device lets the player move the screen cursor by moving her arm in three dimensions (x, y, z) within a range of approximately 40cm (1.3ft). The dashed lines in the game world

indicate the movement path the player has to follow in real life. By adjusting the sensitivity of the input device, the real life movements can be made smaller or bigger while the game world stays the same. As such, the patient is encouraged to perform physical movements, which is the basis of the rehabilitation therapy.

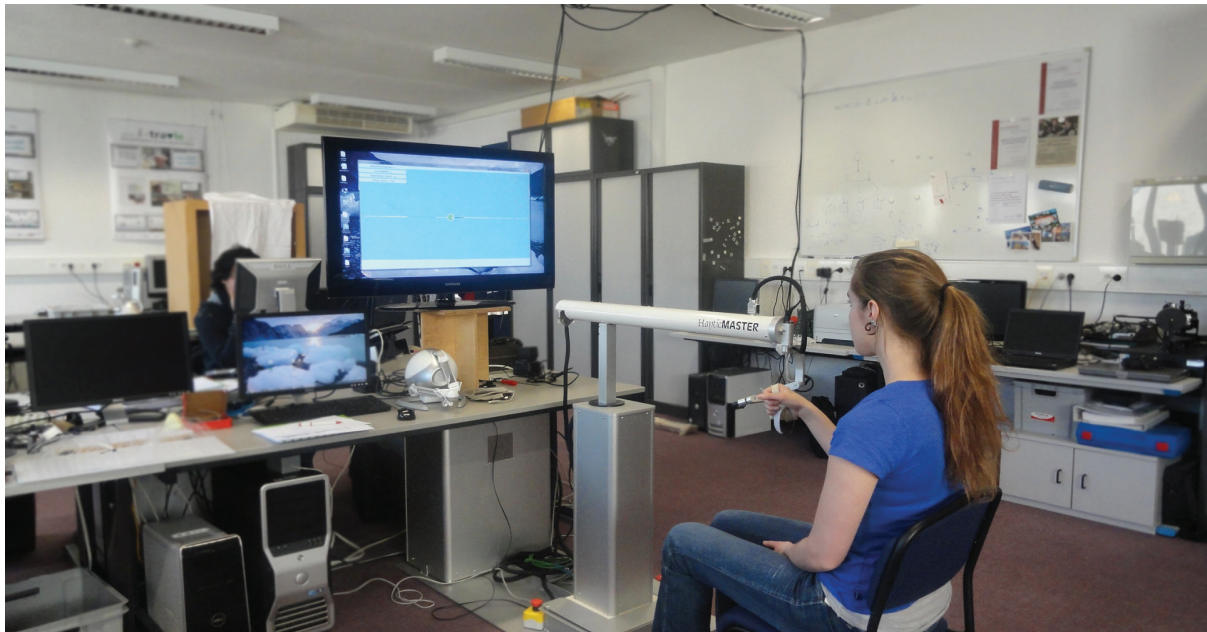


Figure 1: An example of how a player operates the game with the HapticMaster input device.
(<http://www.workingexamples.org/uploads/Image/712>)

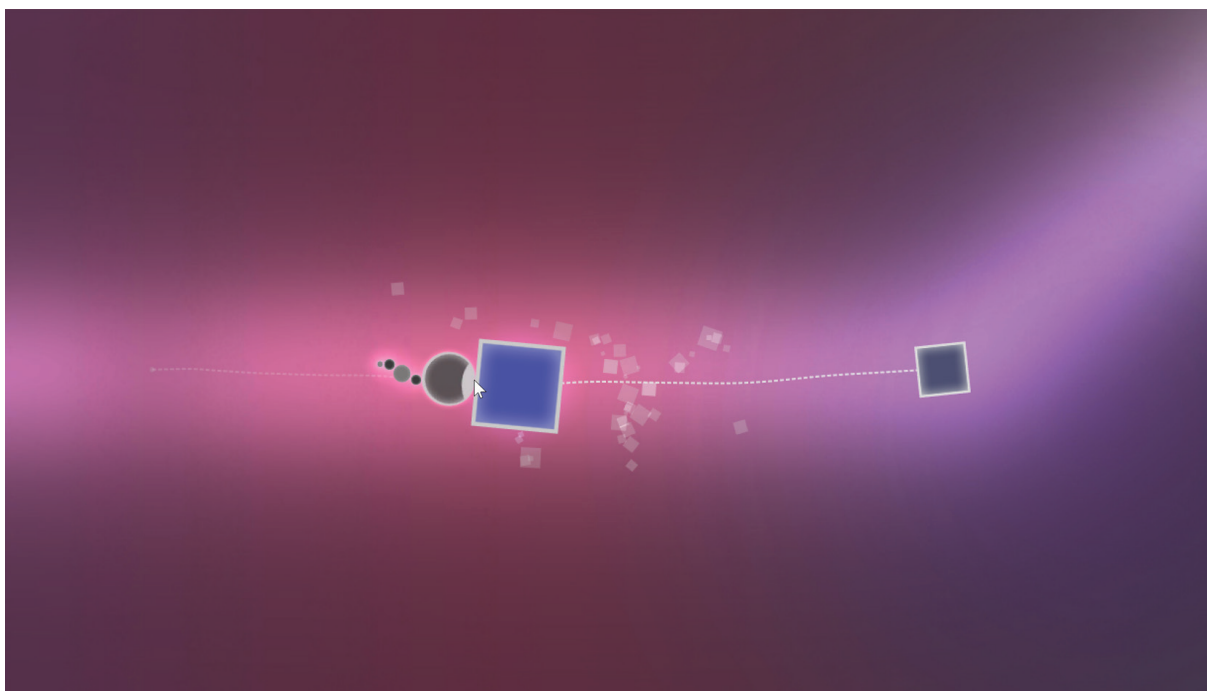


Figure 2: A screenshot of the current game play.
(<http://www.workingexamples.org/uploads/Image/594>)

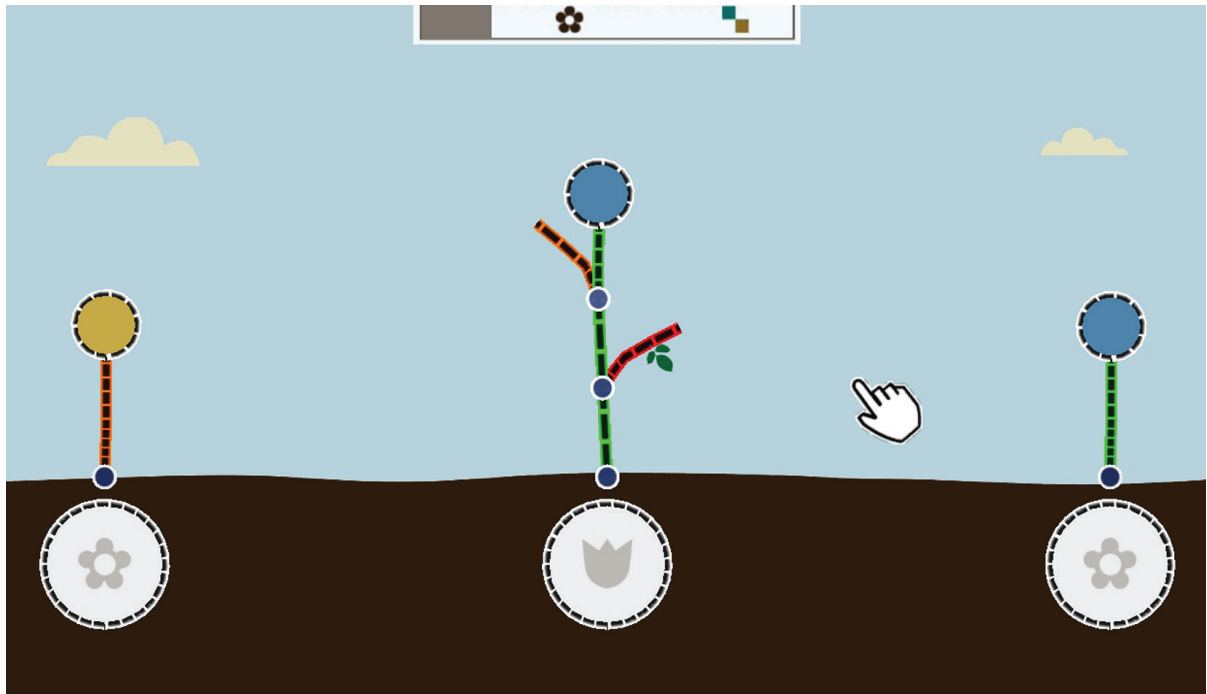


Figure 3: A screenshot of the first prototype.
(<http://www.workingexamples.org/uploads/Image/595>)

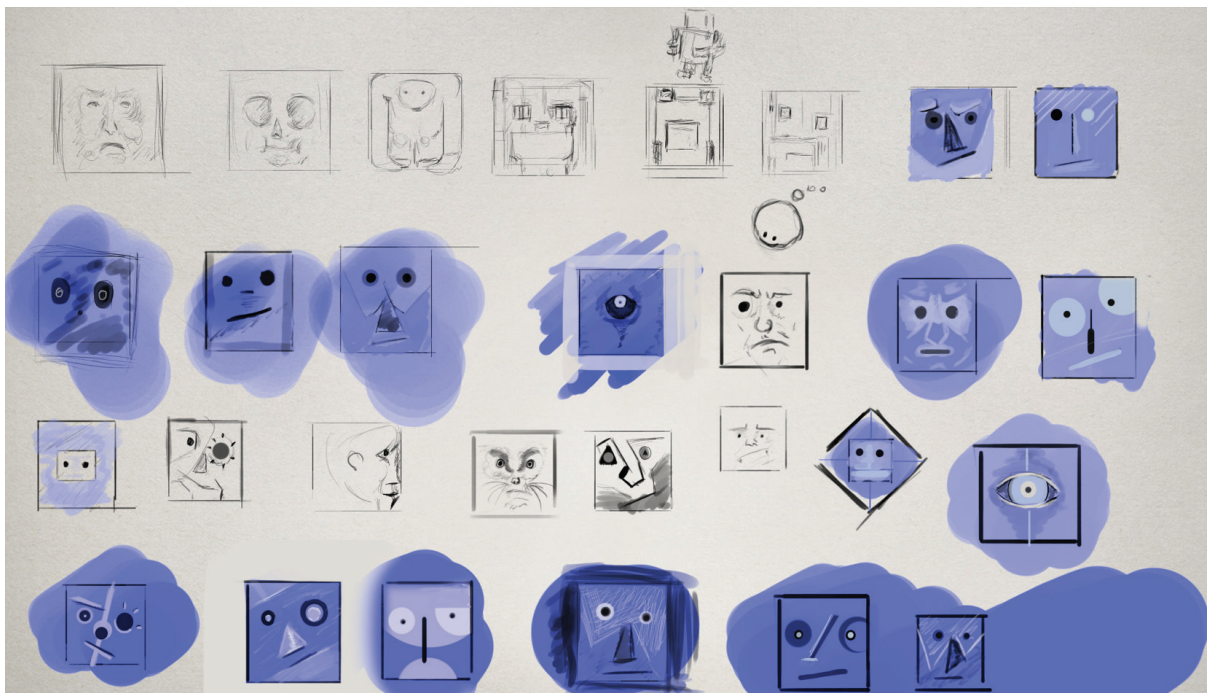


Figure 4: A series of character design experiments combining abstraction and figuration.
(<http://www.workingexamples.org/uploads/Image/596>)

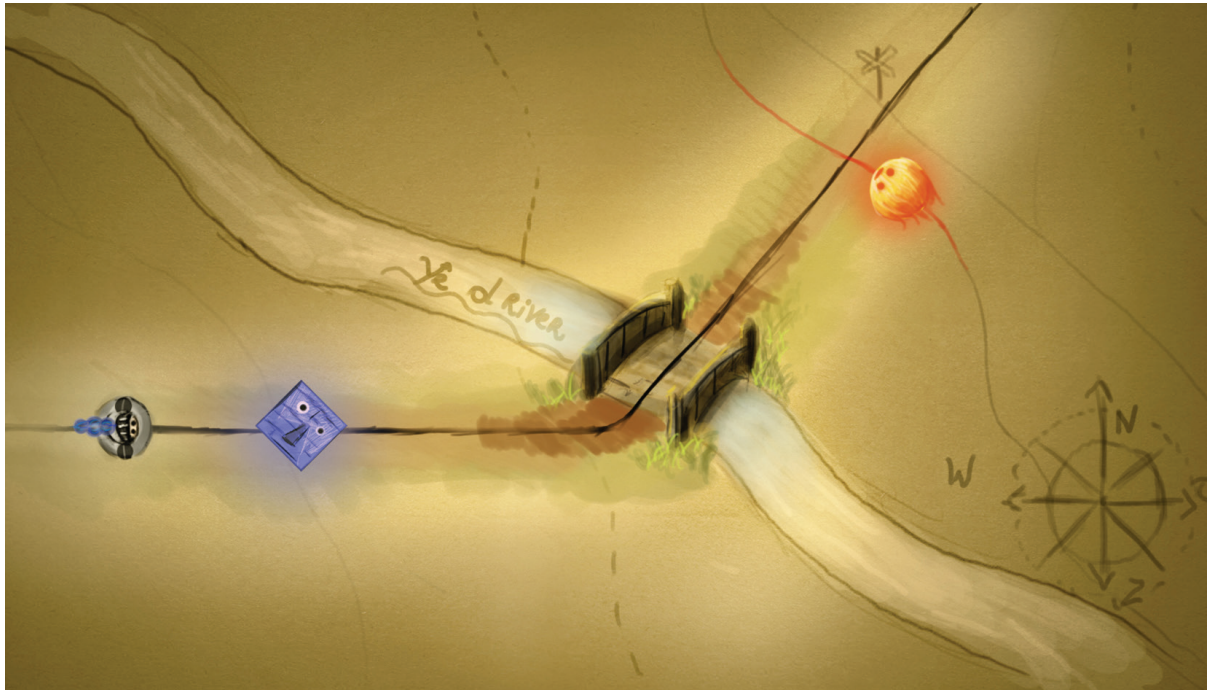


Figure 5: A visualization of the transformation between figuration and abstraction in the game's narrative.
 (<http://www.workingexamples.org/uploads/Image/597>)

How will you make sure that this thing you're creating will be adopted by your audience?

At two points during the development phase, rehabilitation therapists played the game and, afterwards, indicated where improvements could be made to facilitate a better rehabilitation for the patients. Furthermore, we have performed playtests with eight patients in a local rehabilitation center. In these tests, we included issues on how they handled the game both on a cognitive level (can they understand the concept) as well as on a physical level (can they operate the game). Furthermore, questionnaires on the level of interest of the patients were also included. When the results are analyzed, we hope to learn how the game can be better adjusted to the needs of the target audience.

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