

# **Designing Therapeutic Games for Seniors: Case Study of “Le Village aux Oiseaux”**

\*S. Mader, \*J. Dupire, \*S. Natkin, \*E. Guardiola

\*Centre d'Étude et de Recherche en Informatique et Communications  
Conservatoire national des Arts et Métiers

Paris, France ({stephanie.mader, dupire, natkin, emmanuel.guardiola}@cnam.fr)

## **Abstract**

In this paper, we describe the method we used to design the therapeutic game called *Le Village aux Oiseaux*, a first person shooter aiming to stimulate the attention network of seniors suffering from the Alzheimer's disease. One of the main issues we had to deal with was how to adapt games designed for adolescents and young adults, to seniors. A lack of studies and game design guidelines, as well as a lack of data on what seniors enjoy while playing made this design more complicated and, thus, interesting to analyse.

## **Keywords**

Therapeutic game, games design, usability, evaluation, methods, serious game, elderly

## **1. Introduction**

In this paper, we describe the methods used to design *Le Village aux Oiseaux*, a therapeutic game targeting seniors suffering from the Alzheimer's disease. Our purpose was to design a game entertaining and motivating seniors while stimulating at the same time their attention network – creating a two-fold objective to the design of *Le Village aux Oiseaux*. Thus, the usual purpose of a video game (i.e. entertaining the player) had to be adapted to take into account these therapeutic objectives. However, the lack of data on what seniors enjoy in video games complicated the design process. We had to build the game according to several hypotheses relying on our insights and experience – and this naturally puts the validity of our hypotheses into questions. More generally speaking, every therapeutic game designer may be concerned by this issue, and hopefully our analysis of the methods we used to design *Le Village aux Oiseaux* will contribute to the research in this field.

After a short background, we study how the game designers propose their design hypothesis to create a gameplay being motivating and accessible to seniors while being stimulating for their attentional network. Then, we present the result of a study we conducted on 18 healthy seniors to validate these hypothesis. Eventually, we discuss these results and the transferability of our method.

## 2. Background

Rehabilitation games, or therapeutic games, belong to Games4Health. They are called “serious games” and target the health market (Sawyer and Smith, 2008, and Alvarez and Djaouti, 2008). There are several definitions of serious games, but most of them agree that a serious game is a game with a purpose beyond entertainment (Sawyer and Smith, 2008, Alvarez and Djaouti, 2008, Zyda, 2005, and Djaouti *et al*, 2007). The two aspects of serious games (i.e. games and serious purpose) must be balanced to maximise their efficiency.

The game mechanics of therapeutic games are crucial because they create and maintain the patient's motivation (Benveniste 2010, Kato *et al*, 2008, Burke *et al*, 2010, Howell, 2004, Shultheis and Rizzo, 2001, and Gamberini *et al*, 2008). Indeed, the most important issue in therapy is the patient's adherence to the treatment - some patients do not follow it regularly while others completely drop it (Benveniste 2010, Kato *et al*, 2008, and Burke *et al*, 2009). In chemical treatment (i.e. taking drugs), the issue mainly comes from unpleasant adverse effects of the main treatment. On the contrary, non-chemical therapies ask patients to do efficient, but boring and repetitive tasks, causing the patient's motivation to quickly diminish (Burke *et al*, 2010). Therapeutic games, by fostering the patient's motivation through game mechanisms, are seen as a promising solution.

According to different studies on play demographic statistics, many seniors are game players (e.g. 20% of the 18 millions players of social games in the US) (International Solutions Group, 2011, and ESA, 2011). Despite being identified as a potential gaming audience, seniors' interests and expectations about video games are not well-studied, leading to a lack of objective data and guidelines to design games specifically for them. As stated by Ijsselsteinjn *et al*, this is mainly due to the fact that the video game industry does not target seniors, and so does not collect precise data on them (Ijsselsteinjn *et al*, 2007). For instance, most analyses of gameplay data propose numerous age categories for young people while seniors are all in the 50+ category. Ijsselsteinjn *et al* state that the existing usability recommendations for this audience are not in sufficient numbers to design a game. Whitcomb, in his review of studies made on video games

for seniors, found out as well that most of the authors had to develop specific games to conduct their studies, because existing games were too fast or complex for seniors (Whitcomb, 1990).

### 3. Designing *Le Village aux Oiseaux*

*Le Village aux Oiseaux* is a cognitive rehabilitation game for patients suffering from the Alzheimer's disease. The therapeutic hypothesis on which the project was founded is that stimulating the attentional network of the patient may slow down the cognitive decline due to the disease's progression. In *le Village aux Oiseaux*, the player takes the role of a photographer on assignment arriving in a little Provencal town about to be destroyed by a real estate project. The player will take pictures of birds to prepare a report proving that the village is a nature reserve and should be protected, leading to the interruption of the real estate project.



Fig. 1: *Le Village aux Oiseaux*

The first design decisions were based on a study of Green and Bavelier, who found out that players of first person shooter games were better at different visual attentional tasks because the game trained their attention network (Green and Bavelier, 2003). In a later study, Dye, Green, and Bavelier discovered that players of action games, to which first person shooter games belong, had improved their attention network, making them faster and more efficient than non-players (Dye et al, 2009).

Therefore, the gameplay chosen for *Le Village aux Oiseaux* is the gameplay of first person shooter game. This implies (i) that the main mechanics of the game is to aim at target on the

screen and validating it by pressing on a button at the right time (i.e. while the crosshair is aligned with the target), and (ii) that the game world is a 3-dimensionals (3D) environment seen through the eyes of the avatar (i.e. first person perspective). However, first person shooter games are generally conceived for young male adults or adolescents, which is why this gameplay must be adapted to be accessible to and engaging for seniors (Ijsselsteinjn *et al*, 2007).



Fig. 2: Doom: a first person shooter game

We formulated different proposals, according to our insights, experience and an analysis of our purpose. First, we had to simplify the gameplay and the game controls. Indeed, moving and orienting the avatar in a 3D environment is a difficult task that requires some training. Thus, we decided to automatize this part of the gameplay, the avatar following a predefined rail, making the player's experience similar to the one of a roller coaster. It means that the level designer prepares a rail for the avatar to follow. The rail defines the path of the avatar in the 3D game world and where it looks. It also defines at which speed the avatar moves, when it stops and for how long. Therefore, *Le Village aux Oiseaux* belongs to a sub-category of first person shooter games called rail shooter.

Our main argument for this adaptation is that moving and orienting the avatar in a 3D environment is a complex task. It requires strong abilities in spatial orientation and representation, as well as learning complex control schemes. For example, in most games, the orientation is made with the left analog stick of a game controller, while the right one is used to move the character. As seniors are not used to such interaction, their first hours of play would be a tedious learning of this task. Such situation has to be avoided as it increases the probability of the player rejecting the game. By having a gameplay focused on the aim mechanic, the game is accessible to seniors while keeping a 3D environment. Indeed, aiming is mainly a 2D task, the player's challenge is to position his cursor upon the target's x and y positions (relative to the screen).

Moreover, rail shooters are primarily played with game controllers like Light Gun, Sony PSMove, or Nintendo WiiMote, simplifying the control scheme and make the aim more efficient and intuitive, so quickly enjoyable for the player (Johnson, 2002).



Fig. 3: Ghost Squad

Finally, having a camera on rail gives us a stronger control on the player experience. Having a complete control over where the player's character is and looks in the game world gives the possibility of regulating the rhythm of the game to help the player keep his attention focused on it. It is then possible to prepare more or less difficult game situations, and to include a more supervised storytelling within the game level. Finally, game parameters such as the character's speed or the duration of game situations can be changed by an adaptive difficulty system taking into account the player's profile (i.e. how well the player is performing).

To sum up, these design decisions have been based on four hypotheses:

- Seniors like games in which they have to aim a target and validate it.
- Seniors are able to use a game controller similar to a Nintendo Wiimote, because it is similar to a TV controller (buttons, shaping, action of pointing in the direction of the screen)
- Seniors adapt themselves to the use of such controller to point to targets on the screen
- Seniors have difficulties to move and orient a character in a 3D environment.

The objective of the experimentation described in the next section is to study the validity of these four hypotheses.

## 4. Experimentation

This experimentation is inspired by methods used in the video game industry. Indeed, while Game Design is not a standard process of defined steps, playtest is a widely used method (Djaouti *et al*, 2010). A playtests is a controlled play session of a video game under development, whose objectives are (i) to obtain data on how players perceive and enjoy the current game

version, (ii) to decide whether or not modifications are necessary, and if so (iii) which modifications have to be done and in which order of priority. Data are gathered through questionnaires, interviews, and observations of the player while he is playing. Such a playtest was realized before we started developing a playable prototype of *Le Village aux Oiseaux*. Therefore, we used games having strong similarities to the game we intended to develop (i.e. corresponding to the design we described above), and conducting this experimentation allowed us to confront our hypotheses to our targeted audience as soon as possible.

### ***Methods***

The playtests have been done during summer 2010 in two privately-held retirement homes with 18 autonomous and healthy seniors. All games used for the experimentation were video games developed for the Nintendo Wii and have been played using the Wiimote Controller. In every game, the main interaction was to aim a target on screen and to validate it by pressing a button. Depending on the game, the validation produce different results: firing, selecting or taking a picture. Initially, we had 19 participants, but one of them had to give up because he was one-eyed since his birth and the lack of contrast between the color of the cursor and the environment of the game made him unable to play. Thus, we excluded this participant from our data. Only one of the participants had already played on Wii and three had used a PC. Some participants were curious and came by themselves while the others have been encouraged to participate as they had no spontaneous desire to play. Each testers played one of the four selected games. Before playing, each player had time to navigate the menu of the Wii in order to get used to the Wiimote. The instructions on the game's objectives and controls were provided orally. In the next sections, we provide for each game a qualitative analysis based on observations of the player's movement and verbalization, as well as on the post-play interviews. At the end, we also provide a quantitative analysis based on the post-play interview's questionnaire.

### ***WiiPlay – Shooting Range***

*WiiPlay – Shooting Range* is one of the mini-games included in the game *Wii Play* (Nintendo, 2006). In this game, the screen is fixed and the player has to shoot as much targets as possible in a limited amount of time. The session is composed of five different challenges. First, the player has to shoot at balloons flying bottom-up, then at fixed targets of different values (see Fig. 4). In the third challenge, the targets are clay pigeons that are thrown like in hunt standard shooting exercises. For the fourth challenge, players have to shoot on cans, and in the last challenge on UFO to protect characters from being kidnapped by aliens. This game provides an

interesting scoring system. For instance, combo mechanisms (i.e. when the player shoots a target, a timer starts, giving him some time to shoot the next target for more points. If the player continues the streak, he is awarded more points for each targets) and bonus targets (i.e. ducks flying through the screen). *WiiPlay – Shooting Range* has been selected because it was simple while providing subtle scoring rules.



Fig. 4: Wii Play - Shooting Range

understood the more subtle scoring rules. They did not see the score displayed on screen, during or at the end of the session. Thus, they had no opportunity to understand how scoring was calculated. Finally, they all found the game was difficult because its pace was too high. However, they had the time to play a second session and everyone improved their scores. They all reported that they enjoyed playing this game.

### ***WiiPlay – Find Mii***

*WiiPlay – Find Mii* is another mini-game of the game *WiiPlay*. Players have to find one or more characters in a crowd in a limited amount of time. The screen is fixed and the objective is written before the challenge starts (but players can display it again by pressing a button). For instance, objectives can be to find the quicker character, or to find twins. When the player achieves the objective, he obtains more time and goes to the next level with a new objective and another game environment (e.g. streets, pool). We selected this game because we wanted to know if seniors enjoyed picking out a target from a crowd.





Fig. 5: Find Mii

We observed during the playtest that the written objectives were too quickly displayed, to be entirely read by the seniors. They were also too confusing. However, each participant stated that he had enjoyed playing this game. However, some of them warned us that, in their opinion, this game would quickly become boring. Also, one of our participants interrupted his session because the time pressure of the game along with the possibility to fail and to be judged by the game was overwhelming and made him too anxious.

### ***Rayman Raving Rabbids 2***

*Rayman Raving Rabbids 2* (Ubisoft, 2007) is a game composed of several mini-games, one of them being a rail-shooter game. Thus, the game character (i.e. Rayman) moves on a predefined path through a 3D environment while being attacked by Raving Rabbids (i.e. a kind of virtual rabbit that is very stupid). Rayman is armed with a plunger launcher. The player has to shoot on the targets before being hit by their plungers. Before shooting, rabbids have a visible behavior that announces they will shoot, thus the player can anticipate the attack and decide which rabbids has to be shot in priority. When the player fails to hit a rabbid before shooting, the rabbid's plunger gets stuck on the screen (as if it was stuck to the character's head), obstructing the player's view for a while. With this game, we wanted to observe how seniors react to the on-rail movement, i.e. if it disturbs them. We also wanted to see if seniors would quickly understand the interaction with the rabbids.





Fig. 6: Rayman Raving Rabbids 2

One of our participants pointed out that the movements were too fast, in particular because several elements appear and move during these sequences. The three others were not disturbed by this aspect. One of them even states it was better to have the character moving through the game environment. All participants understood the rabbids' behaviour when they hit them, but none of them noticed that the rabbids were attacking them. They also noticed that the rabbids were taunting them but did not understand why. Two of them noticed the presence of a score, but none understood how it was calculated. They also did not understand game subtleties such as how to deal with UFO providing a cover screen to the rabbids. Finally, the seniors were not able to understand why the rabbids became invulnerable to their shot and that they had to first destroy the UFO to reach the rabbid. All of them report they enjoyed playing this game.

### ***Wild Earth: African Safari***

*Wild Earth: African Safari* (Majesco, 2008) is a photo safari game. In this game, the player can freely move his character through the game environment and can orient the character's view. He has to explore the environment to complete assigned objectives such as taking a picture of a giraffe. For our experimentation, we chose a special level. The character is in a copter and the player can only orient the character's view. To do so, the player has to point the screen's edge, thus starting the view displacement in the indicated direction (i.e. if the player points the left border of the screen, the view is moved to the left). When the player points away from the border, the movement stops and the view stays fixed until the player points again an edge. We selected this game to validate that orienting the character's view is a difficult task for seniors. This game was also interesting because its theme was similar to *Le Village aux Oiseaux* and we wanted to see if seniors were interested.

As we thought, controlling the view was really tedious for seniors. However, they all enjoyed the game, and stated they wanted to play again to improve themselves.



Fig. 7: Wild Earth: African Safari

### ***Quantitative analyses***

Almost every participant (89%) reported they were entertained or very entertained by the game they played. None of them stated that they had not been entertained at all. Regarding the Wiimote controller, 78% of them have reported that they could do what they wanted (easily or perfectly), and 72% stated they got quickly used to the controller. On the score, 81% assured that beating their own score was important to very important. Finally, on their performance self-evaluation, one third had a feeling of failure, while two thirds had a feeling of success.

## **5. Discussion & Conclusion**

First, our study highlights that even if we based our design hypotheses mainly on our insights and experience, we were able to propose valid hypotheses despite the lack of data on our targeted audience. However, we insist on the fact that such design hypotheses should be challenged as soon as possible - for instance, and if possible, through a similar method than the one we described above. Indeed, it would allow us to continue the design and development of the project on more solid foundations.

In this case, our experimentation allowed us to validate our 4 hypotheses. First, seniors can enjoy video games in which they have to aim and validate a target since 89% of our participants have reported they were entertained by the game they played. Then, seniors can manipulate a Wiimote (78% of them made what they wanted with the controller), and they can quickly get used to it (72% reported that they were able to use it quickly or in a short amount of time). Finally, seniors stated they had difficulties to orient the character's view.

Otherwise, it is interesting to highlight that seniors were attracted by competition and wished to improve their score. Thus, proposing a score based on their performance at the end of the challenge, along with a score based on their effort may be an interesting combination to please competitive and non-competitive seniors. We also observed that the subtleties (e.g. combo mechanisms) that were not understood by seniors are part of the standard video game culture. Indeed, combo mechanisms, bonus targets, behavior to announce an imminent attack, or sequence that have to be completed in a specific order (i.e. the UFO-rabbit situation) are classical systems in video games. Players are used to them, they expect to be confronted to them and quickly detect them, because they understand the visual clues on screen and test different strategies until they find a winning one. Therefore, video games do not explain these mechanisms in details anymore. Video game culture is less present in seniors and they tend to get stuck to past winning strategies. Indeed, seniors do not try another strategy when they have found one that works, even if the strategy does not work anymore. In the manner of *WiiPlay- Shooting Range*, *Le Village aux Oiseaux* will propose a rich and deep gameplay. However, the game subtleties have to be understandable for a senior audience and have to be non-obtrusive to the player progression, thus being a bonus like in *WiiPlay – Shooting Range*. Lastly, while the theme we choose for *Le Village aux Oiseaux*, the little town and the shooting pictures of birds activity seems relevant to our audience, we think it requires more discussion. Indeed, there is a disagreement among game designers on the relevance of violent video games for serious or entertainment game. In our knowledge, there is still no study establishing if seniors enjoy violent video games or not. As a consequence, we intend to do such studies, because we believe that seniors may enjoy violent video games, and that we need such facts to build a deeper knowledge on seniors' interest in video games, to be able to design better games for them.

In conclusion, the design method we used for *Le Village aux Oiseaux*, consisting of letting game designers formulate their design hypotheses, and then studying the validity of their hypotheses through experimentation, was efficient. It helped us to overcome the issue due to the lack of data on our targeted audience and to gather some knowledge on their player profile. For instance, seniors enjoy video games in which they have to aim and validate a target. Finally, the Wiimote was a valid controller, seniors have been able to use it quickly and were efficient with it. Still, it is important to keep the control scheme simple to avoid too complex interactions.

## Acknowledgement

Stéphanie Mader gratefully thanks the SNSF (Swiss National Found for Scientific Research) for their financial support. *Le Village aux Oiseaux* has been funded by the DGCIS from 2009-2011. The project is carried by a consortium of four industrials: Tekneo, Seaside Agency, SpirOps, Neofactory, and of two research laboratories: French National Institute of Health and Medical Research (INSERM) and the French National Conservatory of Arts and Crafts (CNAM). The authors also gratefully thank Maud Sacquet for her help.

## References

1. B. Sawyer, P. Smith (2008), “Serious game taxonomy”, *The Serious Games Summit @ GDC*.
2. J. Alvarez, D.Djaouti (2008), “Une taxonomie des serious games dédiée au secteur de la santé”, *Revue de l'Electricité et de l'Electronique, Société de l'Electricité, de l'Electronique et des Technologies de l'Information et de la Communication (SEE)*, vol. 11, pp. 91-102.
3. M. Zyda (2005), “From visual simulation to virtual realitygames”, *Computer*, vol. 38, no. 9, pp. 25-32.
4. D. Djaouti, J. Alvarez, R. Ghassempouri, J.-P. Jessel, G.Methel (2007), “Towards a classification of video games”, *Artificial and Ambient Intelligence convention, Artificial Societies for Ambient Intelligence*.
5. S. Benveniste (2010), “Incremental design of therapeutic music games: Theory and application to the treatment of behavioral disorders and alzheimer's disease”, *Ph.D. Dissertation, MINES ParisTech*.
6. P.M. Kato, S.W. Cole, A.S. Bradlyn, B.H. Pollock (2008), “A video game improves behavioral outcomes in adolescents and young adults with cancer: A randomized trial”, *Pediatrics*, vol. 122, no. 2, pp. e305-e317.
7. J.W. Burke, M.D.J. McNeill, D.K. Charles, P.J. Morrow, J.H. Crosbie, S.M. McDonough (2010), “Augmented reality games for upper-limb stroke rehabilitation”, *Proceedings of the 2010 Second International Conference on Games and Virtual Worlds for Serious Applications*, ser. VS-GAMES '10, 2010, Washington, DC, USA: IEEE Computer Society, pp. 75-78.
8. K. Howell (2004), “Games for health conference 2004: issues, trends, and needs unique to games for health”.

9. M.T. Shultheis, A.A. Rizzo (2001), "The application of virtual reality technology in rehabilitation", *Rehabilitation Psychology*, vol. 46, no. 3, pp. 296-311.
10. L. Gamberini, G. Barresi, A. Maier, F. Scarpetta (2008), "A game a day keeps the doctor away: A short review of computer games in mental healthcare", *Journal of CyberTherapy and Rehabilitation*, vol. 1, no. 2, pp. 127-145.
11. J.W. Burke, M.D.J. McNeill, D.K. Charles, P.J. Morrow, J.H. Crosbie, S.M. McDonough (2009), "Optimising engagement for stroke rehabilitation using serious games", *Vis. Comput.*, vol.25, pp. 1085-1099.
12. International Solutions Group (ISG) (2011), "Popcap Games Social Gaming Research".
13. ESA (2011), "Essential facts about the computer and video game industry; 2011 sales, demographics, and usage data".
14. W. Ijsselsteijn, H.H. Nap, Y. de Kort, K. Poels (2007), "Digital game design for elderly users", *Proceedings of the 2007 conference on Future Play*, ser. Future Play '07, New York, NY, USA: ACM, pp. 17-22.
15. G.R. Whitcomb (1990), "Computer games for the elderly", *SIGCAS Computer Society*, vol. 20, pp. 112-115.
16. C.S. Green, D. Bavelier (2003), "Action video games modifies visual selective attention", *Nature*, vol. 423, no. 6939, pp. 534-537.
17. M.W. Dye, C.S. Green, D. Bavelier (2009), "The development of attention skills in action video game players", *Neuropsychologia*, vol. 47, no 8-9, pp. 1780-1789.
18. D.M. Johnson, J. Wiles, P. Sweester, K.M. Hollingsworth, J.A. Gardner (2002), "The inherent appeal of physically controlled peripherals", *International Workshop on Entertainment Computing*, Makuhari, Japan, pp. 371-378.
19. D. Djaouti, J. Alvarez, J.-P. Jessel (2010), "Concevoir l'interactivité ludique: une vue d'ensemble des méthodologies de game design", *Actes du colloque Ludovia 2010*, Ax-les Thermes, France.