PsychNology Journal, 2013
Volume 11, Number 3, 191 – 211

LIFEisGAME Prototype: A Serious Game about Emotions for Children with Autism Spectrum Disorders

Samanta Alves[1], António Marques[2], Cristina Queirós*[1] and Verónica Orvalho[3]

[1] Psychosocial Rehabilitation Laboratory, Faculty of Psychology and Educational Sciences, Porto University (Portugal)

[2] Psychosocial Rehabilitation Laboratory, School of Allied Health Sciences, Porto Polytechnic Institute (Portugal)

[3] Porto Interactive Center, Faculty of Sciences, Porto University (Portugal)

ABSTRACT

This paper presents the LIFEisGAME prototype-Ipad version – a serious game that proposes to enhance facial and emotional recognition skills in children with Autism Spectrum Disorders (ASD). We assess the prototype game regarding motivation to play and game usability, and also participants' emotional recognition abilities and technology usage. People with autism are less likely to gaze at faces and are also impaired in face discrimination tasks. Recently, technology plays an active role in helping these individuals to understand emotions and recognise facial expressions. LIFEisGAME prototype was played during a 15 minute game session by 11 children with ASD, with ages varying from 5-15 years old (M=9.27, SD=2.97), 91% were male and 9% were female, 82% were verbal ASD and 18% were non-verbal ASD. We video recorded each child and the footage was analysed according to game usability and motivation to play. Parents (n=11) filled out a parental consent form and a questionnaire about their child´s technology usage and their emotional understanding. Therapists' opinions (n=8) about the game were given during an unstructured interview. The game was presented on an Ipad 4 (9.7 inches, 2048x1536). Participants enjoyed the prototype but it still needs to be simplified. All participants had experience with computer games. Fear, disgust and surprise were the most challenging emotions to recognise. Parents suggested adding musical stimuli to promote motivation and therapists recommended to include visual game instructions. Technology is a useful resource for autism and LIFEisGAME utilises technology to promote emotional understanding, bringing positive outcomes to quality of life for children with autism.

Keywords: *autism, emotions, prototype-game, children, Ipad*

Paper Received 26/06/2013; received in revised form 29/11/2013; accepted 20/12/2013.

Cite as:

Alves, S., Marques, A., Queirós, C. & Orvalho, V. (2013). LIFEisGAME Prototype: A Serious Game about Emotions for Children with Autism Spectrum Disorders. *PsychNology Journal, 11*(3), 191 – 211. Retrieved [month] [day], [year], from www.psychnology.org.

*Corresponding Author:
Cristina Queirós
Faculty of Psychology and Educational Sciences, Porto University
Psychosocial Rehabilitation Laboratory. Rua Alfredo Allen, 4200-135 Porto, Portugal
E-mail: cqueiros@fpce.up.pt

1. Introduction

The face is the key element for conveying emotions and plays an important role in both verbal and non-verbal communication. Many efforts have been made to teach people with Autism Spectrum Disorder (ASD) to recognise facial expressions, with varying results (Golan et al., 2008). However, they suggested that individuals with ASD are less likely to attend to faces (Tanaka et al., 2010) and are impaired in face discrimination tasks when compared with typically developing children (Wallace, Coleman, & Bailey, 2008). People with ASD are also characterised by the presence of a markedly abnormal or impaired development in social interaction and communication, and a marked restricted repertoire of activities and interests (APA, 2000).

The manifestations of ASD vary greatly and the term ASD is used to reflect the heterogeneity of impairments. Recent studies suggest the number of people suffering from ASD to be at-least 6 per 1000 in developed countries (Newschaffer et al., 2007).

According to the Theory of Mind, some difficulties that people with ASD exhibit in identifying emotions are due to the lack of understanding about other people's points of views, or even about the fact that another person has a different point of view. Thus, they have an empathy lack and empathy gaps (Baron-Cohen, Leslie, & Frith, 1985). On the other hand, neurocognitive theories of autism suggest that impaired face processing might lie at the root of the social dysfunction of the disorder (Schultz, 2005). Furthermore, neuroimaging studies of emotion recognition from faces reveal that people with ASD show less activation in brain regions central to face processing, such as the fusiform gyrus (Critchley et al., 2000; Schultz et al., 2003). Studies using eye-tracking technology found that when people with ASD are deciphering facial expressions, they spend less time looking at the eye area than the normative population (Klin, Jones, Schultz, Volkmar, & Baron-Cohen, 2002).

To overcome these difficulties, technology recently plays a more active role in promoting facial recognition and helps individuals with ASD to understand emotions. Some studies found that computer-based face training impacts face processing, and eight hours of training resulted in higher sensitivity to holistic processing. However, face recognition did not improve, which suggests that this may be due to the two-dimensional training (Faja, Aylward, Bernier, & Dawson, 2008). Other studies evaluated the efficacy of computer or DVD video based interventions to enhance the social skills abilities of children with ASD with positive results (Bernard-Opitz, Sriram, &

Nakhoda-Sapuan, 2001; LaCava, Golan, Baron-Cohen, & Myles, 2007). Skalski and Whitbred (2010) reinforce the importance of innovative features of technology, such as high definition (HD) visuals and surround sound-impact for game enjoyment, showing that surround-sound had an effect on player enjoyment. Other examples come from games such as “Mind Reading” (Golan & Baron-Cohen, 2006) or “Let´s Face It!” (Tanaka et al., 2010) and the animation series “Transporters” (Golan et al., 2009), later analysed in this paper.

However, these tools do not explore the maximum potential of interactive applications as none focused on using real time facial synthesis. Most traditional methodologies use Paul Ekman’s approach based on photographs of facial expressions and FACS (Facial Action Coding System), which are static approaches to emotional recognition and do not explore the dynamic dimension of facial expressions. For Ambadar, Schooler and Cohn (2005 as cited in Rump, Giovannelli, Minshew, & Strauss, 2009) dynamic emotion displays facilitate recognition, particularly for more subtle facial expressions. Recently, Gutiérrez-Maldonado, Rus-Calafell and González-Conde (2013) suggested the creation of virtual agents with feasible expressed emotions because photographs are unable to capture the dynamic aspects of human expressions. Using the Facial Action Coding System, they verified that anger was better recognised in the virtual reality images, but disgust was better recognised in photographs.

Ryan and Charragáin (2010) argue that the majority of strategies to teach emotion recognition appeal to non-standardised materials without empirical validation. Thus, there is a significant need for developing technology based methods for effective intervention, and to include motivation factors and usability tests on game design (Butler, 2013; Isbister & Schaffer, 2008; Olsen, Procci, & Bowers, 2011). Regarding motivation, according to Clark (2007, p.13), “games, by definition and design, rely on intrinsic, not extrinsic motivation. Psychologically it places the learner at the centre of the action and progress depends on intrinsic drivers. Avatars are proxies for the player/learner but they are, in motivational terms YOU the player. Game environments are there to be explored, probed and investigated. It’s you who gets hooked, interested, curious and driven. A game psychologically excludes extrinsic factors by locking you into its intrinsic world. You and the game become one”. Thus, motivation plays an important role in players’ performance and learning, especially within serious games (Derbali & Frasson, 2012), engaging the player within the game and eliciting psychological states such as competition, challenge, success, fantasy and excitement

(Przybylski, Rigby, & Ryan, 2010). Usability refers to computer program's efficiency (depending also on players' characteristics) and it can be evaluated empirically using performance tests (measuring effectiveness, accuracy, errors), surveys, interviews or observation of behaviours while playing games, evaluating users' satisfaction, enjoyment, engagement and motivation to play (Isbister & Schaffer, 2008). However, technological tools are an innovative approach and much work is yet to be done, including a theoretical framework that allows for making predictions and organising data. In fact, it is necessary to conduct research programmes with accurate and strict methodological and ethical controls (Botella, Garcia-Palacios, Barros, & Quero, 2009).

In this paper we evaluate the LIFEisGAME prototype, IPad version, with a sample of children with ASD. We propose an interactive game design which uses modern computer vision and computer graphic techniques. We aim to assess the prototype game regarding the motivation to play and game usability, and also to analyse participants' emotional recognition abilities and technology usage through a parents' questionnaire. Therapists' suggestions for game improvements were also collected. We did not intend to analyse pre- and post-improvement of recognition abilities, because validation of the game will come at a later stage when we have the final version of the game.

2. Technology Methods in Emotional Recognition

There is evidence that children with ASD learn better through interactive visual methods (Shukla-Mehta, Miller, & Callahan, 2010). Recently, a significant effort was made to use modern technology aimed to develop computer-based systems which can be used to teach children with ASD various social and communication skills. The computer game Let´s Face It (Tanaka et al., 2010) is an example of this new approach. It is organised into a theoretical hierarchy of face processing domains that reinforce the child's ability to attend to faces (Domain I), recognise facial identity and expressions (Domain II) and interpret facial cues within a social context (Domain III) (Tanaka, Lincoln, & Hegg, 2003). Another game, Mind Reading (Baron-Cohen, Golan, Wheelwright, & Hill, 2004), is defined by the authors as an interactive guide to emotions and mental states. It is based on a taxonomic system of 412 emotions and mental states, clustered into 24 emotion groups, and six developmental levels from four years old to adulthood. Results showed that following 10–20 hours of using the software over a period of 10–15 weeks, users significantly improved their ability to recognise complex emotions and mental states from both faces and voices, when compared to their performance before the intervention and compared with a control group (Golan & Baron-Cohen, 2006). Finally, the television series “Transporters” (Golan et al., 2009) is based on eight characters that are vehicles that move according to rule-based motion. This animation consists of fifteen 5-minute episodes, each focused on a key emotion or mental state.

Our prototype, LIFEisGAME, attempts to apply a serious game approach to teach children with ASD to recognise facial emotions using real-time automatic facial expression analysis and virtual character synthesis. Most of the current means of teaching children´s emotions are non-interactive, and the effectiveness of these existing games is questionable regarding their pedagogical method.

3. The LIFEisGAME Approach

Conventional computer games involve a simple feedback loop: input is obtained from a mouse and a keyboard, whereas the output (feedback) is provided through a monitor and audio speakers. Despite the existence of a large spectrum of computer games regarding complexity, from games that merely have basic interfaces to games with advanced 3D graphics, the input/output of the media rarely changes. LIFEisGAME is innovative, introducing a second feedback loop, which provides additional competences to the game. In this second loop, visual input from the player is continuously and automatically obtained by the use of a typical webcam. This additional input brings the human-computer interaction to a new level which conventional games cannot achieve, and allows the design of sophisticated game modes (Orvalho, Jain, Tamersoy, Zhang, & Aggarwal, 2012).

LIFEisGAME uses state of the art technology (Leite & Orvalho, 2013; Miranda, Fernandes, Sousa, & Orvalho, 2011; Miranda, Alvarez, Soleno, Sousa, Fernández, & Orvalho, 2012; Orvalho, Bastos, Oliveira, & Alvarez, 2012) and is also based on preliminary studies that aimed to increase game motivation and game validation. Some studies focused on children’s character preferences (Fernandes, Alves, Miranda, Queirós, & Orvalho, 2011) and others in validation of the Radboud Faces Database (RaFD, from Langner et al., 2010) for the Portuguese population (Dores et al., 2013) and validation of facial expressions of some game characters (Queirós, Alves, Marques, Oliveira, & Orvalho, 2013).

After the development of a touch-screen prototype version (Alves, Marques, Queirós, & Orvalho, 2013), LIFEisGAME Ipad version includes five games modes (cf. figures 1 to 5, (c)Copyright Porto Interactive Centre, 2012): “Recon Mee-Free” (the player associates a thought, for example, seeing a ghost, to a facial expression presented by the characters, figure 1); ”Recon Mee-Match” (the player needs to match characters’ facial expressions to other models’ facial expressions, figure 2); “Sketch Mee” (the player can use the facial expressions drawn and make a dynamic video to watch the character´s face changing, figure 3); “Memory Game“ (the objective is to pair up facial expressions of models, figure 4) and “Build the Face” (the player draws facial expressions on the avatar´s face according to a target expression presented in a card; figure 5). The main character in the game is a boy with attractive features assessed by preliminary studies (e.g. baby face features like round face and big eyes). Game feedback is both visual and auditory. The game focuses on positive feedback and mistakes made by the player are not valued.

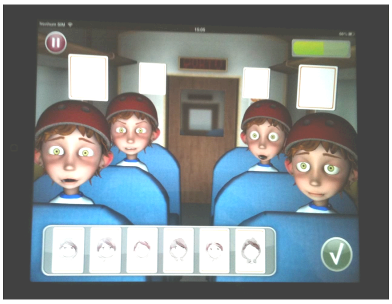

Figure 1. Game Mode “Recon Mee Match”

Figure 2. Game Mode “Recon Mee Free”

Figure 3. Game Mode “Sketch Mee”

Figure 4. Game Mode “Memory Game”

Figure 5. Game Mode “Build the Face”

4. Method

The data collection took place between March and June 2013. Participants belong to an Autistic Association based in Portugal. Parental consent forms were collected and formal authorisation from the institution was given. Children´s names were replaced by codes and any identifying information was removed. The data was only used by the Research and Developmental Team of the Game prototype LIFEisGAME.

4.1 Participants

We gathered a sample of 11 children diagnosed with ASD to play the prototype game. The ages varied from 5-15 years old (M=9.27 SD=2.97), 10 children (91%) were male and one (9%) was female. Regarding communication, 9 (82%) were verbal and 2 (18%) were non-verbal ASD individuals. Only one participant (9%) had fine motor skill problems. Parents (n=11) and therapists (n=8, being one special education teacher, 2 psychomotor therapists, 2 occupational therapists and 3 speech and language therapists) that work closely with children with ASD were also involved.

4.2 Procedure

The prototype game was presented on an Ipad 4 (9.7 inches, 2.048x1.536 resolution) in a quiet setting, with controlled noise and light. We video recorded each child during an open 15 minute game session. Footages were qualitatively analysed by two independent researchers regarding motivation to play and game usability.

There were no specific instructions to start the game, and a child-centred approach was utilised to reduce stress and promote friendly play time. There was a time limit of 15 minutes but it was explained that the child could play for longer. All children were previously informed about the game session by their parents and therapists to decrease anxiety levels caused by novelty. Additionally, the researcher who led the game sessions was also familiar to the children.

For game motivation analysis, the following points were considered: if the child played 15 minutes or more (time of play); if the child explored all game modes (game exploration); if the child smiled, laughed or expressed any kind of content, stayed in the room or showed motor mannerisms (behaviour). After playing, the child was asked to offer his/her opinion about the game, about what s/he liked and disliked about the game and about their favourite game mode. If the child was not able to speak, qualitative analysis of video footage was considered by the two researchers until final agreement was reached.

Regarding game usability, the following points were considered by trying to identify if the child was able: to start and finish the game (start/finish game); to start and finish the game mode (star/finish game modes); to navigate the game (change game modes, choose game level, restart the game, stop the game); to follow visual instructions to understand how to play each game mode (instruction understanding); to correctly use option buttons given in each game to achieve game objective (button options usability); and to require help at any point to continue play (assistance needed). After each individual analysis, researchers discussed their results until they agreed on a common interpretation of the footages.

A parents' questionnaire was also used to collect information about child´s facial expression abilities, facial emotional recognition and also about technology usage, because the literature cites that children with autism have different levels of functioning (Golan et al., 2008). Thus, we needed to be sure that our sample showed difficulties in facial expression and facial recognition. If children were capable in these domains, they would not benefit from the prototype game and would bias our results. Parents are a reliable source to gather this information, because typically they interact with their child every day and recognise better than anyone their difficulties. In the same way, parents are aware of the child´s technology usage, this is, if they use, for example, a computer, smartphone or tablet or other devices. All these data are important because children that frequently use technology can show high performance skills when playing LIFEISGAME prototype as a result of their experience and mask the true game usability.

The parent´s questionnaire was divided into different sections: the first section contained questions regarding participants´ socio-demographic information (e.g. gender, age and school year), diagnosis and if the child was verbal or non-verbal. The second section analysed child´s favourite technological tool (e.g. computer, tablet, smartphone…), frequency of use (daily, weekly, monthly…) and use objective(s) (for play, search, video watching…). Closed questions and Likert type scales were used. In this section, parents were also questioned about their child´s favourite type of game and behaviour during play, using open-ended questions. The third section of the questionnaire was about facial expression recognition abilities and emotional facial recognition. Parents were asked which emotions the child was able to recognise (the options given were the six basic emotions of Ekman & Friesen, 1975) and how often the child recognised them (always, sometimes, rarely or never). Closed questions and Likert type scales were offered. Furthermore, facial expression abilities were also analysed, and parents were asked if their child was able to express all six basic emotions. If not, we asked which ones were more difficult to express. Finally, in the last section of the questionnaire parents were questioned if their child had fine motor skill problems. After the game sessions, the parents received feedback about the overall performance of the child.

To improve our prototype game, ASD therapists' opinions and suggestions were collected through one-to-one unstructured interviews. Before interviews, therapists had the opportunity to freely explore the prototype game. The overall aspects analysed were: a) Game Attractiveness - game interface, character, button designs and colours; b) Game tasks – type of tasks, visual instructions and option buttons; c) Game Usability and Personal Opinion – game navigation, game feedback, suggestions and opinions about the game. Interviews were audio-recorded and analysed by two researchers, using content analysis to extract data related to opinions and suggestions about the game.

5. Results

Since we used qualitative analysis to evaluate LIFEisGAME prototype with a sample of only 11 children, data are described using major information related to the evaluation of the game. The results are presented using the following data categories, according to game design literature (Butler, 2013; Clark, 2007; Derbali & Frasson, 2012; Isbister & Schaffer, 2008; Olsen et al., 2011; Przybylski et al., 2010): game motivation (behavioural information and therapists' interview data including game attractiveness), game usability (participants' performance during game session and therapists' opinions about game tasks), parents' questionnaires (characterisation of participants' facial recognition abilities, expression skills, and technology usage), game session performance for each of the game modes, and therapists´ suggestions.

5.1 Game Motivation

All participants seemed to enjoy the prototype game and used the 15 minutes of play time. Game modes were explored by all participants but the favourite game mode was the "Memory Game" being the most chosen and played for the longest amount of time. The game mode with the most enjoyment, promoting smiles and laughter, was the game “Sketch Mee”. Some excitement and stereotyped behaviours were observed, but all participants stayed in the room and none were involved in aggressive behaviour.

Regarding game attractiveness, therapists stated that the prototype game was fun and attractive, especially the main character (a boy with cartoonish features and a “baby face”-big eyes, small nose and round face). They also enjoyed the button designs and the choice of bright colours for game interfaces. Suggestions to increase motivation included adding sounds effects (immediately after action), for example, when winning or losing points. The rewards should be mainly visual (e.g. stars, toys) and less numeric (e.g. score), and feedback also needs to be positive, because the contrary can lead the child to frustration.

5.2 Game Usability

It was very intuitive starting and navigating the game, even for children that have never used an Ipad before, but some instructions need to be simplified. Previous experience with computer games facilitated game-play, and children were familiar with the design of the “start button, home pause, delete, re-start and close”. All children were able to start/re-start and finish the prototype game and game modes, choose different difficulty levels and change game mode. Regarding assistance, all participants at some point needed help to continue play. This was particularly true for the game mode “Recon Mee Free”. This game mode was the most demanding of all because the child had to put himself/herself in the place of others, that is, they had to think what others were thinking in a given situation. According to the literature, children with ASD struggle with this task, as shown in the studies of Theory of Mind (Baron-Cohen et al., 1985). In the game modes “Build the face” and “Recon Mee Match”, participants also needed assistance to better understand game instructions. We believe that these difficulties were not due to lack of information for playing the game, but a result of recognition and expression deficits typical of people diagnosed with ASD. As described by the literature, we observed difficulties in recognising and expressing emotions, with fear and surprise being the most challenging emotions for participants.

Therapists greatly agreed that game tasks were fun and innovative, and mentioned that touch technology is very intuitive and easily understood by children. Most of the game tasks involved interactivity and dynamics with characters, which increases game motivation and interest. Another positive aspect is that few words are used and the visual channel is privileged. Additionally, therapists believed that game instructions for each game mode need to be improved by adding videos for players to better understand game objectives. Button options design also needs to be rethought by trying to ensure that the image used is more clearly related with its function.

5.3 Parents' Questionnaires

Regarding parents' questionnaire (including participants' technology usage, emotion expression abilities and emotion recognition abilities), results are presented in Table 1. We collected 11 questionnaires and parents were keen on participating in the research study as they recognise the attractiveness of technology to their child and hope this interest can be used in a productive way. Most of the children (73%) prefer to use a computer instead of other technologies such as smartphones, and 45% use it almost every day. According to parents, computers were mainly used by the participants at home to watch music videos and to play computer games rich in music, bright colours and action. Regarding facial expression, about 73% of participants express emotions sometimes; of this, 82% can express happiness, 73% sadness and 54% anger. Only 45% can express fear, 27% disgust and 18% surprise. We also found the same difficulties in emotional recognition, where less than half of participants (45%) always recognise emotions. Results show that 82% can recognise sadness, 64% happiness and 54% anger. Only 36% recognise surprise, 9% disgust and 9% fear. We concluded that these children are familiar with technology usage but they have some difficulties expressing and recognising emotions.

Parent´s Questionnaires	***Results***
Technology Usage	- 8 children (73%) prefer to use a computer instead of other technologies. - 5 children (45%) use the computer *almost every day*. - computers were mainly used by the participants at home to watch music videos and to play computer games rich in music, bright colours and action.
Emotion Expression	- 8 children (73%) express emotions sometimes. - 9 children (82%) can express happiness, 8 (73%) sadness and 6 (54%) anger - 5 children (45%) are able to express fear, 3 (27%) disgust and 2 (18%) surprise.
Emotion Recognition	- 5 children (45%) *always* recognise emotions. - Parent's reports show that 9 children (82%) can recognise sadness, 7 (64%) happiness and 6 (54%) anger. - Only 4 children (36%) recognise surprise, 1 (9%) disgust and 1 (9%) fear.

Table 1. Results from Parent´s Questionnaire

5.4 Game Session Performance

After footage analysis, the overall performance of the participants was described for each game mode and is presented in Table 2, where we can observe how children perceived game objectives, their behavioural response and the amount of support offered. As we can see, during "Build the Face" mode, children enjoy using touch technology, despite difficulties when drawing some emotions (e.g. anger, disgust). "Recon Mee" was the most difficult during both modes (Match or Free), with all children needing help to understand the game mode objective. The Memory Game mode was played for longer and voted by 63% children as their favourite. Finally, "Sketch Mee" was the game mode that triggered more satisfaction.

Game Modes	***Results of children***
"Build the Face"	During this game mode, 10 of the eleven (90%) children were efficient sketching directly onto the character´s face. They enjoyed the "touch technology" and making "funny faces" with the character. Some difficulty was observed in drawing facial expressions in 6 children (54%) (e.g. anger, disgust). Happy and sad were the easiest emotions to draw (10 children, 90% of sample).
"Recon Mee Match"	All children needed some help to understand game objectives, but after some explanations they easily understood how to play.
"Recon Mee Free"	Only 3 (27%) children were able to play this game mode because this game requires the ability to put oneself in the place of others, to think what others are thinking. Children with ASD struggle with this, as shown in the studies of Theory of Mind (Baron-Cohen et al., 1985). This is a good way to practice these social deficits.
"Memory Game"	This was the game mode played for longer and voted by 7 (63%) children has their favourite. The game objective was quickly perceived by all children.
"Sketch Mee"	This game mode originated lots of laughter. All children enjoyed seeing the character's facial expressions changing. It is important to have this kind of dynamic input because facial expressions are not static.

Table 2. Game Session Performance of the children for each Game Mode

5.5 Therapists´ Suggestions

Qualitative analysis of therapist´s suggestions is presented in Table 3. Overall, to improve the prototype game, therapists suggest clarifying playing instructions through visual clues (e.g. short videos) and to increase feedback using sounds. For example, in game mode “Build the Face”, the player would hear a positive sound if the drawing of the facial expression was right and a negative sound if wrong. Additionally, some game modes, like “Recon Mee Free” need more customising options, like the possibility of choosing which thoughts to explore, and relating them to real life events of the player. Furthermore, customisation options would also include more difficulty levels in all game modes and the possibility to choose which emotions to play with. To promote motivation to play, musical stimuli is pointed out as a very important aspect in game play. Lastly, therapists’ suggest improving the design of some “option buttons” to be more explicit about their functions.

Game Modes	*Therapists´ Suggestions*
“Build the Face”	Add instructions on how to play the game mode and offer feedback about if the drawing of the facial expression was right or wrong.
“Recon Mee Match”	Increase visual clues in this game mode and sounds for right and wrong answers.
“Recon Mee Free”	Customise the game mode by choosing which thoughts to explore.
“Memory Game”	Add difficulty levels, remove name of emotions in cards and offer the possibility to choose which emotions to play with.
“Sketch Mee”	Add musical stimuli to the game to promote motivation and feedback perception. Review the design of some option buttons to be more explicit about their functions.

Table 3. Therapists´ Suggestions for Each Game Mode

6. Conclusions

New technologies, such as IPads and computers, are powerful teaching tools, especially for children with ASD. They are good visual learners (Shukla-Mehta et al., 2010) and are attracted by consistency and rules, as argued by Baron-Cohen (2006) in his Systemizing Theory. A computerised environment is also predictable, consistent, and free from social demands. Children can also work at their own place and define the level of understanding. Lessons can be repeated, interest and motivation can also be maintained through different and individual selected computerised rewards.

Furthermore, multisensory interactions, controlled and structured environments, use of multilevel interactive functions, and the ability to individualise instructions, are also other features that motivate children with ASD to work and learn with computers (Hopkins et al., 2011).

Our results show that LIFEisGAME prototype is attractive and enjoyable. All participants enjoyed the prototype game and used the 15 minutes of play time. Some excitement and stereotyped behaviours were observed, but all participants stayed in the room and none were involved in aggressive behaviour. The game mode that triggered more satisfaction was the game “Sketch Mee”, mainly because players could create their own facial expressions, modifying eyes, eyebrows, mouth, nose… and then see the avatar´s animation video. This level of interactivity was greatly appreciated and there is evidence that children with ASD learn better through interactive visual methods (Shukla-Mehta et al., 2010), suggesting that dynamic aspects of human expressions are important and one solution can be virtual agents with feasible expressed emotions such as Gutiérrez-Maldonado et al. (2013) created. The attractiveness of the main character (as valued by the therapists) also made this game mode fun to play. The “Memory Game” was the game mode played for the longest and can be easily understood because the game tasks involved were simple, predictable and repetitive, characteristics appreciated by children with ASD. “Recon Mee” was the most challenging game mode, where only a few participants understood the game mode objective. This happened because this game explores the ability of the player to think about what others are thinking in a given situation. Children with ASD struggle with these tasks, as argued by Theory of Mind (Baron-Cohen et al., 1985).

To achieve greater motivation, most of the game tasks involved interactivity and dynamics with characters. In fact, Sato and Yoshikawa (2007), and also Gutiérrez-Maldonado et al. (2013) reported that a dynamic presentation of facial expression induces a more intense emotional experience than does a static presentation. Additionally, during the parents’ testimonies we observed that computers are children´s favourite technological tool and that they are mainly used to watch music videos and to play computer games rich in music, bright colours and action. Again, we can find the importance of attractive graphics and characters together with dynamic interfaces. Other motivational aspects are that few words are used and the visual channel is privileged. Thus, the prototype game tries to address different levels of functioning in the ASD spectrum and values the visual learning capacities of this population.

The prototype game also showed high usability. All children were able to start/re-start and finish the prototype game and game modes, choose different difficulty levels and change game mode, maybe because they frequently use technologies according to parents' testimonies. However, for children that never used an Ipad before, it was also very intuitive to start and navigate the game.

Like we expected, parents pointed out their children's difficulties in recognising and expressing emotions. While playing the prototype game, players revealed these difficulties. Happiness and sadness were the easiest emotions to play with, in opposition to anger and disgust. As stated in the literature review, individuals with ASD are impaired in face discrimination (Wallace et al., 2008) and are less likely to attend to faces (Tanaka et al., 2010). These results confirm the importance of effective intervention methods to overcome these difficulties.

Despite the advantages in the use of technology, this study has some limitations. Most of our participants had previous experience with computers, and, when assessing the game usability we can be misled by former knowledge. Also, the game was not played at the same time of day by all participants, and children that played later in the day (after school) could be less motivated than others. Children who are more alert can play more and achieve greater gains. The game itself needs to be improved, sound effects need to be reviewed, instructions simplified and all characters' facial expressions validated. The non-validation of facial expressions is crucial because we must be sure that the character is expressing the target-emotion.

When talking about the use of technologies in clinical interventions, we can find a lack of ethical guidelines for technological interventions. It is necessary to conduct research programmes with accurate and strict methodological and ethical control, where the need for protecting private data is crucial. An increasing amount of personal information is becoming available by the use of the internet, social networks (e.g. Facebook and Twitter), which brings up privacy issues (Botella et al., 2009). To overcome this, some associations of online professionals and health care organisations have developed codes of conduct for online services in recent years (American Psychological Association, 1997) including services by Telephone, Teleconferencing, and Internet. Additionally, other issues include in the creation of new entities, such as Avatars, and the creation of these entities leads to ethical and philosophical issues about their degree of individuality or identity (Botella et al., 2009).

However, recently avatars have become important to autism interventions because of the possibility to use controlled environments, both for physical exercises aiming to motivate children with ASD (Finkelstein, Barnes, Wartell & Suma, 2013) or to test avatar's usability as dynamic aspects of human expressions (Gutiérrez-Maldonado et al., 2013).

Lastly, most of these technological interventions implicate high costs. Although costs have recently decreased, it remains expensive to develop technological tools and equipment required for programme implementation. It is very important to decrease these costs so that they can be accessible to everyone. Another challenge is that psychologists and patients unfamiliar with technology interventions may resist their use in therapy if they lack the confidence and skills required to use them (Botella et al., 2009).

Although sometimes expensive, technologies allow children with special needs, as those with ASD, to access tasks that would be otherwise unreachable (Pensosi, 2010). LIFEisGAME hopes to use the motivational aspects of computer software to enhance learning emotions and facial recognition. Moreover, this game does not involve high costs, and the player only needs a computer and a regular camera. This game also has the advantage for being used by people that, although are not diagnosed with ASD, also have deficits in expressing and recognising emotions, such as people with Schizophrenia. Indeed, abnormalities of the fusiform gyrus and amygdala are both implicated in the deficits of emotional perception processing in both schizophrenia and autism (Abdi & Sharma, 2004).

Regarding future research, we hope to apply the suggestions collected from this study and develop a new and improved version of LIFEisGAME. The next step will be to validate this serious game as a teaching tool, hoping to bring a positive effect to the social lives of children with ASD.

7. Acknowledgments

This work is partially supported by Instituto de Telecomunicações and the UT Austin/Portugal Program CoLab grant (FCT) UTA-Est/MAI/0009/2009 (2009) supported by the Portuguese government.

8. References

Abdi, Z., & Sharma, T. (2004). Social cognition and its neural correlates in Schizophrenia and Autism. *CNS Spectrums*, *9*, 335-343.

Alves, S., Marques, A., Queirós, C., & Orvalho, V. (2013-June). *Exploring the LIFEisGAME Prototype: Touchscreen Version*. Poster presented at LifeisGame session Presentation Project, Faculty of Sciences of University of Porto, Portugal.

American Psychological Association (1997). *APA Statement on Services by Telephone, Teleconferencing, and Internet*. Retrieved from: http://www.apa.org/ethics/education/telephone-statement.aspx

American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders, 4th edition, text revision*. Washington, DC: APA.

Baron-Cohen, S., Leslie, M., & Frith, U. (1985). Does the Autistic child have a theory of mind? *Cognition, 21*, 37-45.

Baron-Cohen, S., Golan, O., Wheelwright, S., & Hill, J. (2004). *Mindreading: The interactive guide to emotions*. London: Jessica Kingsley.

Baron-Cohen, S. (2006). The hyper-systemizing, assortive mating theory of Autism. Progress Neuro *Psychopharmacol Biological Psychiatry 30*, 865-872

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with Autism and normal children through computer assisted instruction. *Journal of Autism and Developmental Disorders, 31*, 377-398.

Botella, C., Garcia-Palacios, A., Barros, R., & Quero, S. (2009). Cybertherapy: Advantages, limitations, and ethical issues. *PsychNology Journal, 7(*1), 77-100.

Butler, C. (2013). Motivation-Based game design: A framework for evaluating engagement potential. In J. C. Anacleto, E.W. G. Clua, F. S. Correa da Silva, S. Fels, H. S. Yang (Eds), *Entertainment Computing – ICEC 2013, Lecture Notes in Computer Science*, 8215 (pp. 176-179). Berlin: Springer.

Clark, D. (2007). *Games, motivation and learning*. Sunderland, UK: Caspian Learning Ltd.

Critchley, H. D., Daly, E. M., Bullmore, E. T., Williams, S. C., Van Amelsvoort, T., Robertson, D. M., … Murphy, D. G. (2000). The functional neuroanatomy of social behaviour: Changes in cerebral blood flow when people with Autistic Disorder process facial expressions. *Brain, 123*, 2203–2212.

Derbali, L., & Frasson, C. (2012). Assessment of learners' motivation during interactions with serious games: A Study of some motivational strategies in Food-

Force. *Advances in Human-Computer Interaction*, Article ID 624538. doi:10.1155/2012/624538

Dores, A.R., Barbosa, F., Marques, A., Queirós, C., Oliveira, M. Q., Pedroso, J. P., … Carvalho, I. P. (2013). A Radboud Faces Database como ferramenta para o estudo do reconhecimento emocional: uma investigação em Portugal [The Radboud Faces Database as a tool for the study of emotion recognition: a Portuguese research]. In A. Pereira, M. Calheiros, M. Vagos, I. Direito, S. Monteiro, C. Fernandes da Silva & A. Allen Gomes (Eds.). *Livro de Actas VIII Simpósio nacional de investigação em Psicologia* (pp. 37-43). Lisboa: Associação Nacional de Psicologia.

Ekman, P., & Friesen, W. (1975). *Unmasking the face: A guide to recognizing emotions from facial clues*. Prentice-Hall, Inc.: Englewood Cliffs, New Jersey.

Faja, S., Aylward, E., Bernier, R., & Dawson, G. (2008). Becoming a face expert: A computerize face-training program for high functioning individuals with Autism Spectrum Disorders. *Developmental Neuropsychology, 33*, 1-24.

Fernandes, T., Alves, S., Miranda, J., Queirós, C., & Orvalho, V. (2011). LIFEisGAME: A facial character animation system to help recognize facial expressions. In M. M. Cruz Cunha, J. Varejão, P. Powell & R. Martinho (Eds). *ENTERprise Information Systems, proceedings CENTERIS (pp.423-432)*. New York: Springer.

Finkelstein, S., Barnes, T., Wartell, Z., & Suma, E. (2013 - March). Evaluation of the exertion and motivation factors of a virtual reality exercise game for children with Autism. *Virtual and Augmented Assistive Technology - VAAT Workshop 2013,* Orlando, Florida. Retrieved from: http://ict.usc.edu/bibtexbrowser.php?key=finklestein_evaluation_2013&bib=ICT.bib

Golan, O., & Baron-Cohen, S. (2006). Systemizing empathy: Teaching adults with Asperger Syndrome and High Functioning Autism to recognize complex emotions using interactive multimedia. *Journal Developmental and Psychopathology, 18*(2), 591-617.

Golan, O., Baron-Cohen, S., Ashwin, E., Day, K., McLintock, S., & Leggett, V. (2008 - April). Facilitating emotional understanding and face-processing in young children with Autism Spectrum conditions using animations of vehicles with faces. *British Psychological Society Annual Conference,* Dublin, Ireland.

Golan, O., Ashwin, E., Granader, Y., McClintock, S., Day, K., Legget, V., & Baron-Cohen, S. (2009). Enhancing emotion recognition in children with Autism Spectrum conditions: An intervention using animated vehicles with real emotion faces. *Journal of Autism and Developmental Disorders, 40*(3), 269-279.

Gutiérrez-Maldonado, J., Rus-Calafell, M., & González-Conde, J. (in press). Creation of a new set of dynamic virtual reality faces for the assessment and training of facial emotion recognition ability. *Virtual Reality*. Retrieved from: DOI: 10.1007/s10055-013-0236-7

Hopkins, I., Gower, M., Perez, T., Smith, D., Amthor, F., Wimsatt, F., & Biasini (2011). Avatar assistant: Improving social skills in students with an ASD through a computer-based intervention. *Journal of Autism Developmental Disorder, 41*(11), 1543-1555.

Isbister, K., & Schaffer, N. (2008). *Game usability: Advancing the player experience.* Burlington, MA: Morgan Kaufmann Publishers.

Klin, A., Jones, W., Shultz, W., Volkmar, F., & Baron-Cohen, D. (2002). Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry, 59*(9), 809-816.

LaCava, P., Golan, O., Baron-Cohen, S., & Myles, B. S. (2007). Using assistive technology to teach emotion recognition to students with Asperger Syndrome: A pilot study. *Remedial and Special Education, 28*, 174-181.

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H., Hawk, S. T., & Van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition and Emotion, 24*(8), 1377-1388.

Leite, L., & Orvalho, V. (2013). Inter-Acting: Understanding interaction with performance-driven puppets using low-cost optical motion capture device. Journal International *Journal of Advanced Computer Science, 3*(2), 65-69.

Miranda, J. C., Fernandes, T., Sousa, A. A., & Orvalho, V. (2011). Interactive technology: Teaching people with Autism to recognize facial emotions. In T. Williams (Ed.), *Autism Spectrum Disorders – From Genes to Environment* (pp. 299-312). Croatia: InTech. Retrieved from: http://www.intechopen.com/

Miranda, J. C., Alvarez, X., Soleno, J., Sousa, A. A., Fernández, I., & Orvalho, V. (2012, August). Perceiving interactive sketching through facial expressions. In *Proceedings of the ACM Symposium on Applied Perception- SAP* (p.127). Los Angeles, USA.

Newschaffer, C. J., Croen, L. A., Daniels, J., Giarelli, E., Grether, J. K., Levy, S. E., … Reaven, J. (2007).The epidemiology of Autism Spectrum Disorders. *Annual Review of Public Health, 28,* 235-258.

Olsen, T., Procci, K., & Bowers, C. (2011). Serious games usability testing: How to ensure proper usability, playability, and effectiveness. In A. Marcus (Ed.) *Design, User Experience, and Usability. Theory, Methods, Tools and Practice* (pp. 625-634). Berlin: Springer.

Orvalho, V., Bastos, P., Oliveira, B., & Alvarez, X. (2012 - May). A Facial Rigging Survey. *Presented at the 33rd Annual Conference of the European Association for Computer Graphics – EUROGRAPHICS.* Cagliari, Italy.

Orvalho, V., Jain, S., Tamersoy, B., Zhang, Y. &, Aggarwal, J. (2012 - May). An interactive game for teaching facial expressions to children with Autism Spectrum Disorder. IEEE International Symposium on Control, Communications and Signal Processing – ISCCSP. Rome, Italy.

Pensosi, V. (2010). Comunicación personalizada: Iniciativas de la Fundación Orange en comunicación aumentativa y tecnología, In M. I. Gomez & M. Gomez (Eds.). *Puentes para la comunicación interpersonal*. Murcia: Consejería de Educación, Formación y Empleo de la Región de Murcia.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology, 14*(2), 154-166.

Queirós, C., Alves, S., Marques, A., Oliveira, M., & Orvalho, V. (2013 - June). Project LIFEisGAME: Characters Preferences and Characters´ Empirical Validation. *Poster at LIFEisGAME closing session*. Porto: FCUP.

Ryan, C., & Charragáin, C. N. (2010). Teaching Emotion Recognition Skills to Children with Autism. *Journal of Autism and Developmental Disorders, 40* (12), 1505-1511.

Rump, K. M., Giovannelli, J. L., Minshew, R. N., & Strauss, M. S. (2009). The development of emotion recognition in individuals with Autism. *Child Development, 80*(5), 1434-1447.

Sato, W. & Yoshikawa, S. (2007). Enhanced experienced of emotional arousal in response to dynamic facial expressions. *Journal of Nonverbal Behaviour, 31*, 119-135.

Schultz, R. T., Grelotti, D. J., Klin, A., Kleinman, J., Van der Gaag, C., Marois, R., & Skudlarski, P. (2003). The role of the fusiform face area in social cognition: Implications for the pathobiology of Autism. *Philosophical Transactions of the Royal Society London B: Biological Sciences, 358*, 415-427.

Schultz, R. T. (2005). Developmental deficits in social perception in Autism: The role of the amygdala and fusiform face area. *International Journal of Developmental Neuroscience, 23*, 125-141.

Shukla-Mehta, S. Miller, T., & Callahan, K. J. (2010). Evaluating the effectiveness of video instruction on social and communication skills training for children with Autism Spectrum Disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities, 25*, 23-36.

Skalski, P. & Whitbred, R. (2010). Image versus sound: A comparison of formal feature effects on presence and video game enjoyment. *PsychNology Journal, 8*(1), 67-84.

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J., Herlihy, L., … Schultz, R. T. (2010). Using computerized games to teach face recognition skills to children with Autism Spectrum Disorder: The Let's Face It! program. *Journal of Child Psychology and Psychiatry, 51*, 994-952.

Tanaka, J., Lincoln, S., & Hegg, L. (2003). A framework for the study and treatment of face processing deficits in autism. In H. Leder & G. Swartzer (Eds.). *The development of face processing* (pp. 101-119). Berlin: Hogrefe Publishers.

Wallace, S., Coleman, M., & Bailey, A. (2008). Face and object processing in Autism Spectrum Disorders. *Autism Research, 1*, 43-51.