Understanding User Needs for Serious Games for Teaching Children with Autism Spectrum Disorders Emotions

Bretagne Abirached, Yan Zhang, and Ji Hyun Park
School of Information
The University of Texas at Austin
USA
abirached@utexas.edu, yanz@ischool.utexas.edu, jhpark@ischool.utexas.edu

Abstract: Computer technologies, particularly games, are considered promising in assisting children with autism in learning social interactions and developing language skills, but few existing tools target a critical factor in communication, emotions. This study is an effort to analyze user needs for a serious game for teaching children with autism spectrum disorders emotions. Semi-structured interviews with parents and user observations were used in combination to investigate user needs. The results suggest that while parents recognized the importance of teaching children emotions, they do not have effective tools. We recommend that effective intervention tools need to be customizable, adaptive, and contextualized.

Introduction

Autism Spectrum disorder (ASD) encompasses a range of developmental disabilities including autism, Asperger syndrome, and pervasive developmental disorders. Individuals with ASDs often struggle with significant communication, social, and behavioral challenges. Although each individual with an ASD has a unique set of characteristics and severity of symptoms related to the disorder, a common difficulty experienced is the reduced ability to understand and make correct inferences about the mental states of others (Baron-Cohen 1997). Individuals with ASDs also often experience difficulties recognizing and comprehending non-verbal cues such as facial expressions (Baron-Cohen, Golan, Ashwin 2009, Baron-Cohen 1997, Begeer et al. 2008, Kuusikko et al. 2009) and maintaining eye contact. These difficulties often result in a reduced ability to easily and effectively engage in social and communication interactions. Also, a lack of attention to the facial region may account for a decreased ability to recognize emotions (Grossman and Tager-Flusberg 2008, Kuusikko et al. 2009). However, Faja et al. (2008) show that face processing abilities can be improved though effective training.

Significant efforts have been made to design interactive technologies to assist people suffering from cognitive impairments, particularly people with ASDs (see Densmore 2007, Konstantinidis et al. 2009, Moore and Taylor 2000). While many assistive devices are on the market, a surprisingly high percentage of them (> 35%) are not successfully adopted (Dawe 2006). The low adoption rate could be attributed to the lack of understanding of the needs, motivations, use context, and requirements of this specific user group (Burke, Kraut, and Williams 2010, Suchman 2007). Successful deployment of a technology for users with ASDs can only be assured by a clear understanding of end users’ needs (Piper et al. 2006).

This study presents an effort to understand users’ needs and requirements to inform the design of a computer-based game to help children with ASDs recognize, understand, and generalize emotions from facial expressions. The framework for the game design considers the strong systemizing skills in children with ASDs (Baron-Cohen 2009) and the six primary and cross-cultural emotions: happiness, sadness, fear, disgust, surprise, and anger described by Eckman and Friesen (1971). Particularly, these authors argued that these emotions can be evaluated systematically. Therefore, by providing a system that allows users to learn via a structured process and recognition of patterns, children with ASDs may develop an understanding of rules and regularities related to emotion recognition through a systemized method.

Related Literature

Previous research indicates that children with ASDs are at ease with emergent technologies and enjoy playing on computers (Bosseler and Massaro 2003, Hopkins et al. 2011, Madsen et al. 2008). Many of these studies
have focused on and shown positive results related to the use of novel technologies to assist children with ASDs in developing social skills (Foster et al. 2010, Hopkins et al. 2011, Hourcade, Bullock-Rest, and Hansen 2011); improving communications skills (Heinmann et al. 1995), including vocabulary building (Bosseler and Massaro 2003, Moore and Calvert 2000), vocalization (Hailpern, Karahalios, and Halle 2009); as well as enhancing assistive technologies like classroom visual support systems (Cramer et al. 2011, Hirano, 2010). While, other studies have examined various tools specifically designed to assist in recognizing emotions, these tools have not taken a computer-based game approach. These studies examine various approaches, including an animated DVD series (Golan et al. 2010) and personal videotaped segments of emotions and Social Stories (Bernad-Ripoll 2007).

A limited number of studies have focused on the development of computer-based intervention technologies for assisting children with ASDs in recognizing and understanding facial expressions of emotions. However, none of the approaches presents a comprehensive dynamic computer game based approach. Elzouki, Fabri, and Moore (2007), Tseng and Do (2010), and Masden et al. (2008) all examine computer-based approaches. Elzouki et al.’s (2007) study was based only on recognizing facial expressions of four emotions using a computer-based technology, but the system does not use game approach and the images presented were static photographs. Tseng and Do’s (2010) system, FEW, takes a game-based approach but again uses static images of cartoon characters, and the study presents no user testing results. Masden et al. (2008) use a portable mini-computer to support a system that assists users in recognizing and understanding a facial expression by capturing and interpreting the expression on another individual in real-time. This system was not designed within a game framework, but user-testing results discuss the importance of increasing the desire to recognize and understand facial expressions of emotions. In another study of the same system, Masden et al. (2009) further discuss improving user experience based on user research, including supporting participants’ enjoyment of games.

Although previous research recognizes children with ASDs deficits related to recognizing facial expressions of emotions (Grossman and Tager-Flusberg 2008, Joseph and Tanaka 2003; Kuusikko et al. 2009, Rosset et al. 2008), the fundamental need for a system to assist children with ASDs in recognizing, understanding, and generalizing facial expressions of emotions using an interactive computer-game approach has not been sufficiently addressed. Furthermore, most of the current systems focus solely on the recognition of facial expressions of emotions, present inconclusive or no user-testing results, and lack extensive user needs and requirements assessments. The absence of a comprehensive computer-based game approach can be attributed to a lack of understanding user needs and requirements; given this, we present a mixed-method approach for examining user needs and requirements for enhancing emotion recognition skills in children with ASDs using computer-based game system.

Research Methods

Participants

Ten participants, seven boys and three girls, ranging from four to eleven years old, with ASDs participated in the study. The participants were recruited by posting flyers at a private therapy clinic, on a local autism email group, and on an online local Autism meetup group. The participants’ ASD diagnoses varied. Six were identified as having high-functioning autism or Asperger syndrome and exhibited intelligible verbal communication. Two were diagnosed with autism and one with pervasive developmental disorder; these participants exhibited more severe symptoms of ASDs and struggled with verbal communication.

Data Collection

Two methods, semi-structured interviews and observations of game playing sessions, were employed to acquire user needs and requirements.

Semi-structured Interviews

The semi-structured interviews consisted of two sections. The first section asked for demographic information, including the child(ren)’s age, diagnoses, as well as, general social, communication and interaction behaviors. We also asked about participants’ preferences related to computers, specifically whether the children like to use computers, what kind of computer programs they like to use, and typical behaviors displayed when interacting with the computer.

The second section asked a set of questions concerning participants’ learning of emotions and facial expressions. The questions were related to the current materials or tools used to help in the recognition and understanding of facial expressions, the expected outcomes of those tools and materials, and the likes and dislikes of
the materials and tools. The researchers also asked about intervention tools and materials used in the past and the effectiveness of those strategies. Each interview lasted from 20 minutes to 46 minutes.

Observations of Game Playing Sessions

It is often difficult for users to articulate what they need or what they want when there are no actual artifacts presented (Sharp, Rogers, and Preece 2007). Recognizing this limit, we presented a simple and basic prototype game to the children and their parents to observe their reactions to the idea of a serious game for teaching emotions and elicit their feedback. The game was developed by a group of researchers at the University of Porto, Portugal (Orvalho, Miranda, and Sousa 2010) and was used in this study as a platform to examine and understand the unique needs and requirements of this population.

The game begins by asking players to select an avatar; there are three avatars: a boy, a girl, and an alien. Players may click on all of the avatars, but the only playable selection is the boy. Players then must choose one of six basic emotions and one of three levels of difficulty. The available emotions are based on Ekman and Friesen’s (1971) six primary and cross-cultural emotions: happiness, sadness, fear, disgust, surprise, and anger. Three levels of difficulties were provided. The three levels differed in the speed at which the avatar changes its expression and the number of correct selections that must be made to win. The basic rule of the game is that the player must recognize and correctly identify the emotion on the avatar, by clicking the space bar, as the avatar randomly cycles through facial expressions representing all six emotions. The player can also choose to play with the boy avatar with selected facial features, such as his eyes or mouth, being obscured with a black bar as the avatar cycles through the emotions.

Procedure

Both the interviews and observations were one-on-one. Each session took place at a child’s home or cafes designated by the parent(s). Every child was accompanied by at least one parent, mostly mothers. At the beginning of the study, the researchers allowed the parent(s) to initiate the initial introduction to the children in order to make them feel at ease. Then, the semi-structured interviews were conducted with the parent(s).

After the interview, the child was prompted to sit in front of the laptop computer (ThinkPad T510 equipped with Windows 7, a mouse was provided) with the prototype games installed. In the test session, the child was asked to play as long as s/he wanted. After ending the play, the child was interviewed about what s/he liked and disliked about the game and how we could make the game more enjoyable. The parent(s) was also interviewed with similar questions. In situations where the child did not wish to talk, we only interviewed the parent(s). All gameplay sessions were video recorded, and the interviews were audio recorded.

Data Analysis

Each interview, including the parent interviews before the gameplay sessions and the interviews of both the children and parents after the gameplay sessions, was transcribed and analyzed using a qualitative content analysis method. The transcripts were independently examined by two researchers and open-coded for emergent data themes. These themes were then contextualized into the larger picture of the current game mode features in order to understand the needs, motivations, use context, and requirements of this specific user group, especially when related to the design of future game modes.

Video recording of the gameplay sessions were also analyzed. Specific features of the gameplay videos were examined, including total gameplay time, specific user selections, and common difficulties or errors made by the player. Specific user selections included the choice of avatar, emotion, and difficulty. These selections were analyzed in order to observe commonalities and differences between players and their gameplay activities.

Results

Participants

Table 1 describes the age, gender, and characteristics, either observed or described by the parent, of each participant.

Overall the participants reflected the varied nature of children on the autism spectrum. The participants’ communication skills ranged from non-verbal to being very expressive through verbal communication.

In terms of emotions, all of the parents indicated that the ability to recognize and understand emotions was a skill that was either currently difficult for their child or had been an issue in the past. Across the participants, this skill varied from having difficulties in recognizing even basic emotions, such as anger and surprise, to being able to mimic emotions but not understanding the meaning. For example, Participant 2’s mother described her son’s difficulties
in recognizing emotions: “he’s able to relay and communicate his feelings...but is] not always able to read people completely.” Participant 7’s mother described her son as being particularly good at memorizing and imitating but often unable to understand the context of people’s actions and emotions.

**Experience with Computer Games**

According to the parents, computer-based games have been used for both learning and entertaining purposes at home and school. During the interviews, most interviewees indicated that video games, including computer games, strongly attract children with ASDs in a positive way. Although, parents also noted that their child(ren) become immersed in the gameplay. Several children were identified as being so focused when playing video and computer games that parents described having to intervene or redirect, especially when a child would play the same thing repeatedly.

Particular games that parents indicated as games the children like to play are listed in Tab. 1. Parents noted many age-appropriate online games that center around virtual worlds, such as Disney’s Club Penguin and Poptropica, as well as educational tools.

Children were also described as being skilled in playing games, both computer-based and console-based games, especially *Nintendo Wii games*. Children were described as quickly understanding appropriate game interactions and actions as well as how to use input devices, including keyboard, mouse, and controller inputs. Two parents discussed how their children had a strong desire to win and at times become angry or distressed when they get something wrong within a game or lose, while another discussed her son’s desire to master games.

**The Status Quo of Teaching Emotions**

*Emotion Related Skills Not the Focus*

While the importance of recognizing, understanding, and responding appropriately to different emotions, especially in social situations, was discussed by many of the parents during the interviews, several noted that this skill was not the focus of any current intervention efforts. Four of the seven parents interviewed specifically stated that the concentration of their intervention strategies was on skills that seemed to be more fundamental than emotion recognition skills. Participant 7’s mother noted that her child’s behavior problems were a more pressing issue. She stated: “His problem behaviors were much more of a big deal. We weren’t necessarily so concerned with how can we catch him up, but how can we make him more livable”. Other parents similarly noted that there were behavior problems that had to be addressed before emotion recognition skills. The mother of Participant 1 noted that interventions did not focus on recognizing facial expressions of emotions until her son was four years old. This was

<table>
<thead>
<tr>
<th>No.</th>
<th>Sex</th>
<th>Age</th>
<th>Enjoys playing computer games (Y/N) and current games played</th>
<th>Described and Observed Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Male</td>
<td>11</td>
<td>Yes. Poptropica, Wii games like Raving Rabbits and Epic Mickey.</td>
<td>Delayed verbal communication skills. Intelligent. Sensory issues. Difficulties in making eye contact.</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>8</td>
<td>Yes. Likes PC games, like City of Heroes, and iPad games.</td>
<td>PDD-NOS diagnosis. Minimal verbal communication skills.</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>10</td>
<td>Yes. PBS Kids, Funbrain.com, Webkinz</td>
<td>Moderate to severe autism. Limited verbal communication but needs prompting. Emotional. Difficulties in making eye contact.</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>9</td>
<td>Yes. PBS Kids, Webkinz</td>
<td>Moderate to severe autism. Minimal verbal communication skills. Underactive. Difficulties in making eye contact. 5 &amp; 6 are brothers.</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>10</td>
<td>Yes, but prefers to watch TV or DVDs especially cartoons.</td>
<td>Clear verbal communication, but communication is limited and reserved.</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>10</td>
<td>Yes. Multiplication.com. Also likes iPad and Wii.</td>
<td>Clear verbal communication. Outgoing. 8 &amp; 9 are sisters.</td>
</tr>
<tr>
<td>10</td>
<td>Female</td>
<td>11</td>
<td>No. Regularly uses an iPad, but primarily for communication.</td>
<td>Moderate to severe autism. Non-verbal. Academically on grade level.</td>
</tr>
</tbody>
</table>

Table 1: Participant demographics, experience with games, and characteristics.
because of her son’s delayed language development, which was the primary concern during the early childhood interventions. The mother of Participant 4 discussed her concerns for her son’s anxiety and how addressing that issue was a priority. She said: “We are dealing with something pretty fundamental right now, with the anxiety issues. So, learning expressions and emotions has not been a priority. Once [her son] is more stable we can attack that”. The theme throughout many of the parent interviews was “just getting though the day”.

**Levels of Need**

Several levels of need related to emotion recognition skills were revealed through the analysis of parent interview data. The different levels identified were the need for 1) Recognition of basic emotions, 2) Recognition of more complex emotions, and 3) Understanding the reasons behind emotional responses.

When discussing the recognition of basic emotions, many of the parents identified that although this was not a current need, it had been difficult for their child at an earlier developmental stage. The mother of Participant 1 said that her son was unable to recognized most basic emotions until he was about 4 years old. Participant 7’s mother said that “when [her son] was younger he would not even have tried to recognize facial expressions”. While, the mother of Participant 4 explained that in order for her son to recognize even basic emotions the emotional response and expression needed to be exaggerated. She explained that “he recognizes more dramatic emotions”; he can recognize sad, but “he doesn’t know when you are sad, unless you are crying”.

Many of the parents described their child’s current ability to recognize basic facial expressions of emotions but said that the ability to recognize more complex emotions and moreover understand the context for those emotions was very difficult. The mother of Participant 4 explained, “sometimes the more subtle things are difficult. I wish [son’s name] would know more of the subtle expressions”. While Participants 5 and 6 were described as being able to recognize basic emotions such as happy and scared, their mother explained that they would not understand a more complex emotion like embarrassed.

Many of the children were described as being visual learners who are able to quickly learn game rules and objectives as well as memorizing processes or tasks; however, the participants were also described as having difficulties understanding the more complex issues of why particular actions or emotions are appropriate within a given context. With regard to emotion expressions or responses, one parent discussed how her son is skilled in learning or imitating an appropriate response to a specific situation but does not understand the underlying meaning or need for that action. Participant 1’s mother said that although her son’s ability to recognize emotions improved over time, he still unable to express the reason for his emotional state. The parents of Participants 8 and 9 expressed a similar sentiment. They described the girls as both being able to understand basic emotions and recognize those emotions on others but would not associate those emotions to a specific event. They described the girls’ abilities related to emotion recognition:

Their ability to recognize emotions is very basic, but we have never quizzed them on more subtle non-verbal gestures. But it would probably go right past them. Their ability to recognize emotions through facial expressions is pretty basic...they might not understand the context.

**Current Approaches for Teaching Emotions**

Teaching emotions did not seem to be a focus for many parents and most reported no specific strategies targeted at emotion comprehension skills. Yet, parents did indicate that teaching emotions was an integral part of their interventions. Based on the interviews, two main approaches were identified: using existing tools and using improvising strategies. Existing tools are the materials and intervention systems designed by professionals for special populations with a particular learning outcome in mind. Whereas, the improvising strategies refer to methods parents adopted to suit the specific learning needs and goals of their child in a particular situation or context.

The most commonly adopted existing tool identified by parents was visual-based communication systems (e.g., PECS). Other tools identified included Superflex and the Transporters DVD. Examples of improvising strategies included reading books and discussing the attitudes and emotions of the characters in the book. The most common improvised strategy discussed was to engage in step-by-step discussions of social situations. Parents described using a system of storytelling to explain particular social interactions their child(ren) encountered and explain appropriate emotional responses. For example, parents recounted stories involving an inappropriate outburst or response from the child, a situation of the child struggling to interact with peers, or a scenario where the child was being bullied. For example, Participant 2’s mother described a situation where her son was nervous about the school bus being late and that his reactions angered some of the other students waiting for the bus. The mother described how it is important to talk to her son about situations like this, including what happened and his feelings in a very concrete “step-by-step” manner. Other parents also explained that this was one of the most effective tools in facilitating their child’s understanding of complex social situations and the related emotional responses.
Game Testing Results

Game Play Sessions

Ten children participated in the study, only eight of them wanted to play the game. Participants 4 and 10 refused to play the game, even after parental intervention and encouragement. Approximate total gameplay time for participants averaged 15 minutes ($SD = 7$).

During the analysis of the gameplay sessions, all of the participants were able to successful complete numerous rounds of gameplay. When analyzing wrong answer selections the most commonly confused emotions were fear and surprise. While playing the game, Participant 1 stated “fear is the hardest for me.” Participant 3 explained to his mother that “his [the avatar’s] eyes go wide” when the expression is surprise, but this is also the case for fear, which Participant 3 selected several times when the correct selection was surprise. This illustrates how using only one facial feature to match an expression can lead to incorrect selections.

Children’s Overall Reaction to the Prototype Games

Generally, the reactions to the games were positive. However, children’s ability to provide feedback varied. Participant 1 was the most vocal during the gameplay and frequently asked questions related to his desire to play the other avatars in the game, especially the alien avatar. Participants 3 and 9 were both observed describing how to play the game and the expression on the avatar. Participants 2, 5, 6, 8, and 7 provided minimal verbal feedback. Researchers did observe several children exhibiting excitement or laughing during the gameplay.

While many of the children were initially uncertain about how to play the game, after a quick explanation they were all able to effectively use the game controllers and understand the rules and goal of the game. Additionally, several children were observed patiently watching the screen to select the correct emotion. For example, one participant was observed waiting through 12 avatar expression cycles before the correct emotion was displayed.

Characteristics of Game Play Behaviors

During the gameplay several characteristics of the children’s behaviors and gameplay strategies were observed.

- Repetition
  Some of the parents noted that their children exhibited repetitive behaviors while playing games or watching videos. In the study, we considered a behavior repetitive as the player selected the same emotion three or more times to play. Such repetition was observed three times during the gameplay sessions. All three repetitive play instances occurred in the game mode where the avatar’s whole face is visible. The shortest series of repetitive play involved the same emotion being played three times in a row, while the longest repeated series involved the same emotion being played six times consecutively. In two of the three repeated series the emotion selected was sad, while in the third instance happy was selected.

- Matching
  In the current game setup, once an emotion is selected a static image of an avatar expressing the selected emotion is available to the player in the upper-right corner of all subsequent screens. Participants were observed numerous times matching the emotion to the static image provided on the screen with the avatar’s expressions rather than learning the features of the facial expressions.

- Lack of Holistic Face Processing
  Some participants limited their attention to particular facial features, such as the mouth and eyes. This phenomenon was observed when four of the participants selected exercises where a section of the face was masked. Two participants were able to successfully complete a masking exercise: Participant 2 successfully completed the exercise with the mouth covered, and Participant 9 completed the exercise with the eyes covered. When asked why he selected this mode of exercise by his mother, Participant 2 answered that he does not look at people’s eyes.

- Deliberate Incorrect Selections
  At times, participants were observed deliberately selecting wrong answers because they enjoyed a particular form of game feedback. Participants 5 and 7 were observed deliberately selecting wrong answers to receive the auditory feedback, a jarring beeping sound. Participant 7’s mother noted this was a common behavior, as her son often preferred the wrong answer feedback within a game to the correct answer feedback. The desire to deliberately make incorrect selections was also noted by the parent of Participant 5 in the course of the interviews. However, more often participants were observed patiently waiting for the correct emotion to select. This supports descriptions of some of the parents that their child(ren) enjoys winning.

- Active Parent Involvement
During several of the game sessions, the participants were prompted by their parents to continue playing the game even as they exhibited signs of diminished attention toward the game. Participants 1 and 3 were encouraged by their mothers to return to the game after walking away, both returned and continued to play.

Parents not only intervened when encouraging their child to return to the game, but also often assisted their child in playing and understanding the game. At times the child wanted the parent to share in the experience and at other times the parent would add to the child’s learning by asking them questions about the game. Parents asked their children to read aloud the game instructions and choices, asked them what emotion they were looking for, and encouraged them to find and select the appropriate emotion.

Preferences to Game Interfaces

- Characters in the Game
  
  Children were asked the types of avatars they would like to play with in a game during or after the game play sessions, responses varied but the most common response was for an alien avatar. This preference is supported by the game play observations. When given the choice of three avatars, a human-like boy, a human-like girl, and an alien, all of the male participants attempted to play with the alien avatar at some point during the game play session. None of the children were able to play with the alien avatar, as it was not available in the tested prototype. Another observation from the gameplay sessions was when selecting avatars the male participants selected the young-boy avatar, while the female participants selected the young-girl avatar.

- Game Feedback
  
  One observation during the gameplay sessions was the importance of feedback within the game. In the tested game modes, a player’s progress is represented by a series of symbols within a vertical bar. Several players used this bar to determine how many selections they still needed in order to finish the current round of gameplay. The game also includes both visual and auditory feedback mechanisms. When selecting the correct emotion, feedback includes a green flash on the screen as well as a dingy style auditory response. When an incorrect selection is made, feedback includes a red flash on the screen as well as a jarring auditory response. During the gameplay observations, the auditory feedback, for both correct and incorrect selections, elicited the most excitement from the participants, but two participants indicated that they preferred the game without the sound.

Discussion and Implications

The primary goal of this study is to understand user needs from the perspectives of both parents of children with ASDs and the children themselves, with regard to learning facial expressions of emotions. Two methods were employed: semi-structured interviews and observations of gameplay sessions. The results suggest that the two methods complement each other. The interviews reveal parents’ perceptions and views toward teaching emotions, and the existing means to achieve this purpose; while the game play observations allowed us to observe children’s’ behaviors of interacting with the games and their preferences. The game play sessions also provide a platform for parents and children to further discuss about features and functions to include in future game designs.

It was found that little attention has been given to the aspect of emotion in current interventions. Although every parent interviewed acknowledged the importance of recognizing and understanding facial expressions of emotions no computer-based tools specifically designed to aid in the development of this skill were identified. Additionally, many of the tools developed for teaching children with ASDs to recognize and understand facial expression of emotions are static and lack an interaction level that will retain the child’s attention. Many parents had therefore developed their own strategies for helping their children learn this skill.

Previous research indicates that children with autism are at ease with and enjoy playing on computers (Bosseler and Massaro 2003, Hopkins et al. 2011, Moore and Taylor 2000). In this study, we also found that the majority of our participants like to play computer games and had little difficulty in figuring out how to play a new game. Additionally, parents expressed their child(ren)’s enjoyment and contentment while interacting with computer and video games. Thus, a serious game approach, when appropriately designed, could be an effective tool to teach children emotions.

Four implications for future game design emerged from the results of both the interviews and the observations: 1) allow customization, 2) incorporate context, 3) enable adaptability, and 4) build games on multiple platforms.

Allow Customization

Morris et al. (2010) suggest that the customization of software is best way to increase the accessibility of
computer-based interventions to a wide range of users. Additionally, Hailpern et al. (2009) conclude that individual customization for children with ASDs is necessary to effectively enabling preferred feedback styles of end-users (e.g., parent, clinician, or child). The results of this study support these claims. The wide varieties in children’s characteristics, ways of processing information, and preferences to different visual and acoustic feedback that we observed in this study suggest that future games should also allow children, parents, or therapists to customize 1) agents that the children interact with (e.g., Avatars, real human faces, game guide, etc.), 2) feedback and rewards, 3) the combination of text, audio, and video options, 4) visual elements of the game (e.g., photos, illustrations, videos, lighting etc.), and 5) context of the game environment (e.g., home, school, bus stop, or real environment etc.).

Incorporate Context
The second implication is to integrate context into the game. Parents indicated that providing a storyline with real-life scenarios would help their children understand social interactions. Being able to understand how certain emotional responses result in a particular outcome should be a primary goal of an intervention tool, as put by one of the parents it is important to show how “when someone acts this way there is a negative outcome [and] when they act that way there is a positive outcome.” After observing the gameplay, many parents discussed the need for context in the game. The mother of Participant 7 explained: “Short stories are important to learning and understanding cause and effect. That is something he really needs help with – that actions make people happy or sad.” By providing context, children with ASDs may be better able to apply the skills learned within the game and generalize that knowledge to real-world situations. Both Bernad-Ripoll (2007) and Tseng and Do (2010) have suggested embedding narratives and social scenarios to provide context.

Enable Adaptability
The third design implication is to make the game adaptive. Adaptability means enabling the game to adapt to the behavior of each child. For example, the game could help the player make eye contact by modifying the level of eye contact made by the computer agent and slowly increasing eye contact in order to encourage this behavior without upsetting the player. Additionally, if a player demonstrates repetitive behaviors, the game could alter the player’s attention to the next stage by providing visual or sound effects. Adaptability could also be integrated into the game using speech recognition and interactive scenarios. Speech recognition could allow the game to react to the child’s simple conversation or simple verbal command, such as yes/no answers to a predefined question. Another example is interactive (reflective) scenarios that could provide children with ASDs a safe environment to explore different responses to their actions in social contexts. The inclusion of interactive environments to facilitate learning is supported by previous studies, including interactive computer-based educational approaches (Davis et al. 2006, Heinmann et al. 1995, Sehaba, Estraillier, and Lambert 2005).

Technology Platforms
Different technology platforms allow children to interact with computer-based games in a variety of ways. Recently, computer games have been adapted for different interfaces, such as multi-touch wall panels and movement-based game systems (e.g. Nintendo Wii and Xbox Kinect games). In this study, parents noted that their children show delight and enjoyment while playing Wii and Ipod. Future development on these platforms has a great potential to capture the inherent enjoyment and interactivity of these interfaces for teaching children with ASDs.

In addition to the four major implications, several parents also noted a need for a more integrated game flow. Currently, the game modes are played as very distinct exercises. In order to immerse the player into the game, the modes need to be incorporated into a larger more complex game. This game might include a virtual world in which the games are played and a include series of rewards for completing levels.

Limitations
This study has limitations. First, no specific instrument was used to determine the children’s ASD diagnoses. The researchers simply asked the parents to describe their child’s behaviors and characteristics. For some, this response included very detailed information about the child’s medical history and specific diagnosis, while other parents responded more broadly about their child. Therefore, it is difficult to directly compare children’s behavior and preference in terms of different verbal, speech, and cognitive comprehension levels. Second, this study does not have a control group, which prohibits us from concluding that the observed behaviors are unique to children with autism. Nevertheless, we asked the parents to provide comments about the children’s game play sessions. These comments, to a large degree, helped us understand the children’s behavior and improve the validity of our interpretations. In future studies, a controlled group should be provided. Third, the sample size is limited. Although the nature of the study is qualitative and a small sample size allows us to conduct detailed observation of
children’s behavior, a larger sample is needed to test the validity of the results put forward in the study.

Conclusions

Parents of children with ASDs recognize the importance of teaching children emotions, but lack effective means. An interactive game targeted at teaching children emotions by recognizing facial expressions can help fill this gap. Our research results suggest that in order to develop an effective game designed to be an intervention tool that aids children with ASDs in enhancing emotion recognition and comprehension skills needs to be not only interactive, but also adaptive to individual child’s characteristics and needs. At the same time, the game should incorporate meaningful social context to encourage generalization to other settings. The game should also be customizable in the sense that parents or children can choose characters, sounds, and context that suit their needs. Our results also suggest that it is desirable to make the game available on multi-touch platforms.

References


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