Guess the Emotion: A Tablet Game to Support Emotion Regulation Skills for Children with Autism

Developing Educational Games for Teaching Children with Autism

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ABSTRACT

This research concerns the design and creation of an educational tablet game for children with autistic spectrum conditions (ASC) to help support and promote emotion regulation skills. A major atypical behaviour resulting from ASC imposes a deficit vis-à-vis a person's social communication and interactions. Therefore, children with ASC find emotion regulation challenging due to difficulties in recognizing, understanding and responding to emotions, such as interpreting facial expressions or gestures, and this ultimately has a detrimental effect on social relationships.

Through means of participatory design with young typically developing children used as proxies for this research; design, development and evaluation of the tablet game were successfully obtained. Alongside this, experts were also asked to provide suggestions and improvements on both the low-fidelity prototype and high-fidelity prototype of the narrative-based quiz game. The narrative of the game explores emotion regulation by presenting the player with emotional situations which are intended to evoke certain emotions. Overall, the results were promising and suggest that this educational tablet game could have the potential to be used as a tool to support emotion regulation for children with autism.

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Last but definitely not least, I would like to thank my wonderful family and friends for their continuous support, encouragement and laughter shared throughout the past four years.

DECLARATION

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

Brogan Kate Miller s1643299

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Chapter One

1 INTRODUCTION

1.1 EMOTION REGULATION IN CHILDREN WITH ASC

We as human beings experience a vast range of emotions and feelings which are sometimes sudden and unexpected; when encountered with such types of emotions it is important to be able to control them and act accordingly as emotions serve as important social functions (Gross, 1999) with the possibility of misinterpretation. Emotion regulation is described by Gross (2008) as being a procedure that involves influencing which emotions we endure, when we endure them, and how we actually experience and communicate these emotions to the world and those around us.

Being able to recognize the emotions of other people and regulate emotions as a means of reciprocation is a crucial skill needed for effective social communication and this skill is exploited every day by humans in a multitude of social settings. Individuals with Autistic Spectrum Conditions (ASC) can find this very challenging due to impaired social functioning affecting their communication abilities and resulting in poor emotion recognition of others (Mazefsky, Pelphrey and Dahl, 2012). Laurent and Rubin (2004) detail that developmental milestones in emotional regulation have a substantial effect on a child's aptness when it comes to engaging in mutually satisfying relationships, engaging in extended interactions, coping with new and changing situations, and participating in group social activities. Alongside this, maladaptive emotion management can be the onset of displays of aggression, tantrums, self-injury and anxiety (Sofronoff et al., 2007; Mazefsky et al., 2013).

This dissertation builds upon previous research and investigates whether the use of a tablet game could potentially provide further support for developing emotion regulation skills in children with ASC using a story-based narrative approach which explores a myriad of social situations. These situations have been selected with the intent of evoking certain emotions - whether this be positive emotions (e.g. happy, excited) or negative emotions (e.g. sad, angry, frightened). For the negative emotions, coping techniques and strategies will be provided as a means of helping to relieve any stress or anxiety. Moreover, this

research was conducted with the sole intention and hope that children with autism will be the predominant beneficiaries from the findings, however this research can also be viewed as a cornerstone for further research and to help provide insight for parents, guardians and carers. It is also important to note that the findings of this research are not fully constricted to the autistic population and can benefit young children of the same age as a whole. If a child with autism can perform certain tasks it is likely that typically developing children will also be able to do so, therefore giving insight into how young children may go about performing certain tasks and/or typical responses of children of a certain age. This research will involve workshops with typically developing children as this is only a proof of concept and taking the time and effort of children with autism at this early design and planning stage would not be ethical. Alongside this, access to such children is very limited.

The following core tasks were executed and enabled successful completion of this dissertation:

1. Reviewing the existing literature to build knowledge on what efforts have already been made in this field and any suggestions for future research.
2. Designing and running workshops to inform the design of the game and to include thoughts, ideas and suggestions from the primary end users: children.
3. The creation of low-fidelity and high-fidelity prototypes.
4. The development of a serious story-based tablet quiz game, made in Unity, to support and promote emotion regulation in children with ASC.
5. Vigorous testing of the game design and obtaining feedback through evaluations with experts and children.

1.2 RESEARCH OBJECTIVES

This research concerns the design and development of a story-based tablet quiz game to enhance emotion regulation skills in children with ASC. The main aims of the study are portrayed by the following research questions:

1. What are the emotion regulation difficulties children with autistic spectrum conditions (ASC) experience?
2. What approaches are currently in place to deal with emotion regulation difficulties in children with ASC and why might a technological based approach enhance these?

3. Would a story-based quiz game that explores emotion regulation and incorporates different strategies of emotion regulation potentially be effective in regulating emotion? (Effectiveness measured in terms of how many correct responses to the questions posed in the game)
4. Will this type of game approach be appropriate and usable for the intended target group?

1.3 STRUCTURE OF DISSERTATION

This dissertation is split into a total of 6 chapters. This concludes Chapter One and the rest of the dissertation is structured as follows:

Chapter Two: This chapter includes a literature review of ASC, emotion regulation, digital play, current technological interventions and other related work, intrinsic motivation and participatory design. This chapter focuses on research objectives one and two as stated above.

Chapter Three: This chapter details remarks and observations of children from the game design workshop activities and covers the pre-design aspect of the game through interviews with experts.

Chapter Four: This chapter explores the design of the game including design requirements, justifications, scene creation, game question structure and the implementation of the game itself.

Chapter Five: This chapter discusses the evaluation of the tablet game and presents the gathered feedback from interviews with experts and evaluation workshops with typically developing children. This chapter will focus on research objectives three and four.

Chapter Six: This chapter concludes the dissertation by analysing the findings from the research and evaluation and puts forth any potential further work to be carried out in the future.

Chapter Two

2 LITERATURE REVIEW

2.1 AUTISTIC SPECTRUM CONDITIONS (ASC)

Autism is a lifelong pervasive developmental disorder that has a major impact on how people communicate with others and perceive the world. People with ASC tend to have atypical behaviours relating to social communication and interaction; such as responding inappropriately in conversations, misreading nonverbal interactions (e.g. gestures and facial expressions), or having trouble bonding and establishing friendships with people close to their age. In addition to this, people with ASC are more inclined to have restricted, repetitive patterns of behaviour, interests or activities and are hypersensitive in response to changes in their environment and typical daily routines (American Psychiatric Association, 2013). Furthermore, additional prominent patterns of behaviour present in those with ASC include "extraordinarily strong fixations on objects or certain topics and unusual responses to sensory input, including the apparent absence of usual responses or hyperresponsiveness to things such as loud noises, textures, smells and lights" (American Psychiatric Association, 2013; Barlow, 2014 p.566).

The National Autistic Society estimate that there are around 700,000 autistic adults and children in the UK (National Autistic Society, 2019). Loomes, Hull and Mandy (2017) conclude that males are more prevalent to an autism diagnosis with their research unveiling that of children meeting the threshold for an ASC diagnosis, the true male-to-female ratio is 3:1. Baron-Cohen (2002) argues that this is due to two fundamental dimensions for understanding human sex distinctions – 'empathising' and 'systemising'. Empathising concerns the ability to easily identify an individual's emotions, feelings and thoughts and to respond with a suitable emotion. Emphasising, Baron-Cohen (2002) asserts, enables you to predict a person's behaviour and ultimately empathise with them. Systemising, on the other hand, harnesses the skill of analysing variables in a system and acquiring the rules that control the system. He argues that males are more likely to systemise (and are substantially better at it), whereas females are more likely to empathise. It is this crucial difference that resulted in his conclusion of the autistic brain being an extreme example of the male brain, per se. Furthermore, a recent study by Dean, Harwood and Kasari (2017) responds to the proneness of autistic males by suggesting females are better at

‘camouflaging’. This details a female’s ability to mask her social challenges markedly more than males and suggests a female’s ‘social landscape’ easily accommodates this phenomenon.

For those with autism, the right support and help at the right time could help initiate a positive change in their life. Only sixteen percent of autistic people and their families think the public understand autism in a meaningful way (National Autistic Society, 2019) – this is an incredibly small percentage and stresses the importance of research like this to help facilitate a deeper understanding of autism in a sincere way. In this study, ‘autistic children’, ‘children with autism’ and ‘on the autism spectrum’ will be used interchangeably to refer to children with ASC as these terms are preferred and highly endorsed by the UK’s autistic community (Kenny et al., 2016).

2.2 EMOTION REGULATION

Thompson (1994) defines emotion regulation as: “… the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals” (p. 27-28). Emotion regulation involves maintaining emotional arousal as well as suppressing it, when necessary (i.e. anger management). Thompson further states that the process of emotion regulation includes both strategies of emotion self-management as well as numerous external influences which give rise to emotions needing to be regulated, as emotion regulation typically occurs - in large part - through interacting with others.

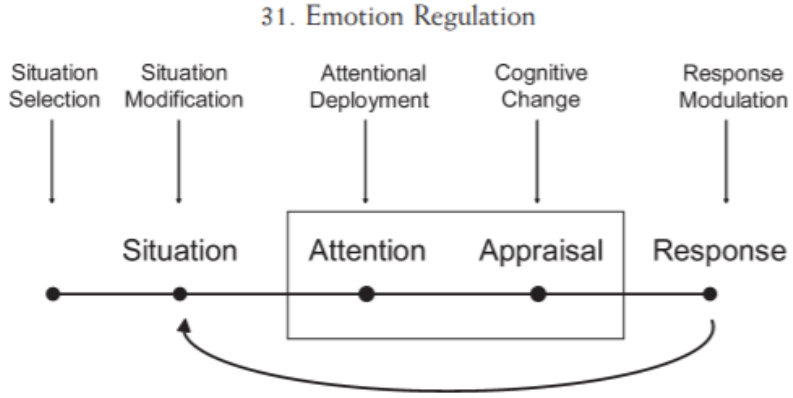


Figure 1: A process model of emotion regulation that highlights five families of emotion regulation. From Gross and Thomson (2007) and based on the “modal model” of emotion (Barrett, Ochsner & Gross, 2007; Gross, 1998; Gross, 2008)

Figure 1 above shows Gross' (2008) depiction of five families (steps) of emotion regulation and he states that when emotion regulation occurs in a person's daily life, they generally will utilize various regulatory processes not just one. Situation selection is first and foremost as this is pivotal in determining what emotions will be experienced by selecting what situation we immerse ourselves in – naturally one which will deter undesired emotions. Situation modification comes next; this regulatory process involves modifying the situation we are in to adjust the emotional ramifications encountered from the situation. Thirdly, attentional deployment deals with redirecting our attention within the situation we are exposed to and is deployed from childhood through to adulthood, especially when it is not possible to change or modify one's situation (Rothbart, Ziaie, & O'Boyle, 1992). Cognitive change conveys that even after encountering a situation whereby you would expect negative emotions to be aroused, it is not always the case that this particular emotion will be present. This is due to reappraisal – this requires a change in the situation's meaning and as a result, this will change the person's emotional response to the situation (Gross, 2002). Lastly, response modulation has a direct impact on the physiological, experiential, or behavioural responses of an individual, and these responses loop back to have an influence on the situation once more. From this diagram, it is evident that emotion regulation is a multifaceted process and not as straightforward as one would imagine, making this even more difficult for a person on the autism spectrum.

Edgar Schneider (2003), a man with high-functioning autism, details in his book 'Living the Good Life with Autism' that there are certain nuances in people's facial expressions, mannerisms and tone of voice – to name a few - that he describes as essentially being 'codes'. He furthers this point by suggesting that these codes need to be decoded in order to recognize and understand these non-verbal communications. However, autistic people struggle with this decoding process. Furthermore, he proclaims "I have an important component of the human psyche missing: the ability to connect emotionally with other human beings" (Schneider, 1999 p.25). This portrays that he is aware of the emotional deficit his condition has imposed upon him and he goes on suggest that people with autism are not totally devoid of all emotions, but instead have difficulty with the emotions that help them to connect with other human beings effectively. Chamak et al. (2008) stress the importance of personal accounts from those with autism, such as Edgar Schneider, as these can help to gain a deeper understanding into their behaviours and needs as well as impacting treatment interventions.

In a study by Losh and Capps (2006) looking at emotional experiences of children with high-functioning autism, the results confirmed that children with autism found it harder to articulate their emotional experiences in a logical and rational way. In contrast to the typically developing comparison children in the study, the autistic group were less likely to report personalized narrative accounts, assess the source of their emotional experiences, were less inclined to associate meaning to these experiences and regularly needed reminders to relate their memories to the task at hand. The lack of reporting self-narrative implies a difficulty in understanding the causes of certain emotional experiences. From this finding, the game design for this dissertation will be looking specifically at scenarios in which characters are faced with emotionally evocative encounters to ensure knowledge will be gained and strengthened when it comes to determining the origins of certain emotions experienced.

2.2.1 ALEXITHMYIA VERSUS AUTISM

A relatively recent debate has been whether it is solely autism that causes an impairment in recognizing people's facial expressions or whether alexithymia (the reduced ability to recognize and understand one's own emotions or the emotions of others (Apfel and Sifneos, 1979)) instead could be contributing to this deficit – making this a salient point to take into consideration. Cook et al. (2013) insist that researchers intending to look at the connection between autism and face perception need also consider alexithymia. They also suggest that a higher incidence of alexithymia within the population of individuals with autism, rather than exclusively autism, may be accountable for the emotional deficits seen in people on the autism spectrum. However, further research needs to be conducted to develop a more profound understanding of the connection between the two. Furthermore, Griffin et al. (2016) delineate the lack of knowledge available concerning alexithymia in terms of younger autistic children and stress that enhancing our understanding of this area may help to single out important factors which have an influence on emotion processing early on.

2.3 DIGITAL PLAY AND DIGITAL LEARNING

In recent years there has been an intense and ongoing debate as to whether digital technology has been prosperous in promoting learning through play in young children. Alongside other scholars on determining the effects of play on a child's life, Erikson (1963, 1997) is of particular note as he stresses the importance play has on a child's ability to express emotions and to provide practice of controlling their emotions in a pragmatic way (Brooker et al,. 2014). To further this point Vygostky (1967), another prominent figure in child play theory, emphasized the importance of pretend play in the process of helping to organize a child's thoughts and enabling self-regulation to flourish (Brooker et al., 2014). In light of this knowledge, digital play poses as an opportunity to support these skills and learning through mediums such as computers, tablets, iPads and other interactive systems that are currently in vast use.

Yelland (1995) looked at children's attitudes towards using computers and computers in general. Her findings indicated that all the children who were part of the study, with a mean age of 7 years and 1 month, communicated that they believed computers helped them to learn and reported their liking for computers. They also identified as being proficient users. More recently, a study conducted by McKenney and Voogt (2010) focused on how 4-7-year olds perceive their own use of computers. The children in this study again generally reported positive attitudes towards computer use and highlighted playing games as being their most common computer activity. Children aged 4-years old reported to playing games in school more frequently than those children who were aged 7-years old and the second most common activity performed on computers in school, after playing games, was revealed to be practicing word and/or math games. Computer use was seen to increase as the grade level increased. This portrays that children are engaging in the use of technology with a positive attitude, both at home and at school, but the question still remains whether the content they are accessing is promoting learning.

Chmiliar (2017) focused on improving learning outcomes with an iPad for preschool children with disabilities. Eight preschool children with various disabilities were given an iPad to use in the classroom and at home for a duration of twenty-one weeks. The ages of the children ranged from three and a half to five years old. All eight children had speech and language impairments, five out of the eight children had difficulties with social interaction and three out of the eight children had problems with behaviour. All of the children exhibited learning gains at the end of the twenty-one weeks and showed increases in self-talk while they played, alongside improvements in

vocalizations and vocabulary which were observed at school and by the parents at home. The main challenges faced were fine motor skills (in terms of finger dragging and tapping for two children), difficulty maintaining attention, and parents finding it hard to limit their iPad use at home. Overall, this study confirms the use of an iPad in the classroom and at home has a positive influence on learning outcomes and that children were successfully able to engage with and explore the device relatively quickly, with some children needing more support than others.

Following on from this, Kagohara et al. (2013) also found positive results stemming from the use of iPods and iPads to enhance learning for individuals with developmental disabilities, mainly those with a diagnosis of autism and/or intellectual disability. They conducted a review of fifteen studies which looked at various domains including academic, communication, employment, leisure and transitioning across school settings. The overall conclusion reached from all fifteen studies was positive and deduced that the use of iPods and iPads for learning across the five domains listed previously can be successfully employed within educational settings and are serviceable as an aid for those who have a developmental disability.

Further support comes from Hourcade et al. (2013) who found a positive effect on autistic children's social interactions through the use of tablet apps. In their study, they reported that children with autism spoke more sentences, engaged in more verbal exchanges and were more physically engaged with activities when they were presented with the involvement of tablet apps, as opposed to activities which did not involve a tablet. This again encourages and supports the use of technology to promote social skills of children with autism.

There is substantial evidence for the argument that technology is beneficial for promoting play and teaching children, and more specifically children with autism, as seen above. In light of this, my next topic for consideration concerns the current technological interventions that have been implemented thus far - and shown evidence of success - for children with autism, with a focus on emotion regulation.

2.4 TECHNOLOGIAL INTERVENTIONS AND OTHER RELATED WORK

The following sections detail interventions in support of promoting emotion regulation in those on the autism spectrum. For clarification, the definition of technology in this report relates to tablets, desktop computers, mobile phones, laptops and generally any electronic device which supports software or tools with educational purposes. It is important to note that the focus of this section is not the device per se, but instead the software and tools that are presented on the various devices discussed. Related work will include non-technological interventions that support emotion regulation in individuals with autism.

2.4.1 EMOTION TRAINER

Emotion Trainer (Silver 2000; Silver and Oakes, 2001) is a CBI (Computer Based Intervention) program which helps young children with autism to better recognise and predict emotions in others. The program presents users with a photograph of a face, a scene or an object and then the user is faced with a short text question and either two or four response buttons. If the user gets an answer right they are rewarded with a 'well done', if they choose the wrong answer, they receive a 'try again' message and a hint towards the correct answer. If they further choose the wrong answer, they are then given a direct cue to the correct response.

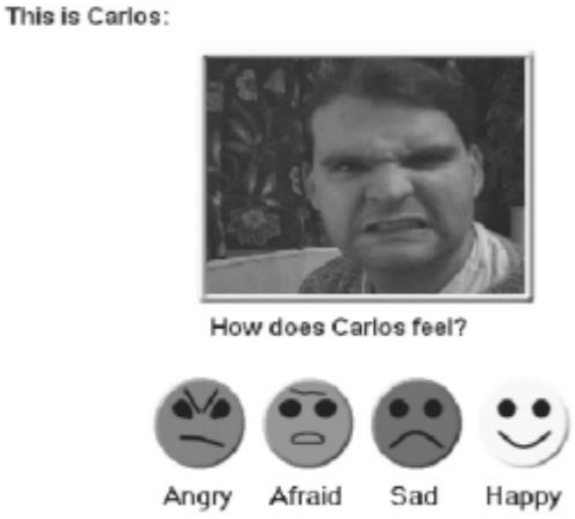


Figure 2: Screen from Emotion Trainer, section 1. (Silver and Oakes, 2001)

The program is split into five sections which allow the user to; become familiar with the facial expressions of the most common emotions, understand certain events trigger emotional responses, understand key principles of when you would be happy or sad, understand various mental states and finally to determine whether the character will be happy or sad in the presence of certain objects depending on context.

The results showed improvements in all sections of the program with particular focus on predicting emotions generated by external stimuli and by mental states. A further conclusion was that the more a child used the program, the larger the positive effect on their emotion understanding ability.

The implementation of the tablet quiz game for this dissertation will be very closely related to this Emotion Trainer program, incorporating and modifying the five main sections of the program, as well as the reward messages and helpful hints, to determine if the results are still as substantial in the present day. There will also be a more substantial focus on the context in each scene, due to this being a major component in the emotion regulation model stated previously (section 2.2).

2.4.2 JUST-IN-TIME IN-SITU LEARNING

This intervention comprises of hardware and software to help individuals with autism interact with other people in a live setting and develop a qualitative intuition of their own and other people's visible facial expressions (Madsen et al., 2008). The aim is to be able to allow those on the autism spectrum to gauge, in real time hence 'in-situ', whether the person they are conversing with is looking confused or disagreeing with what they are saying, or if somebody is interested in what they are saying.

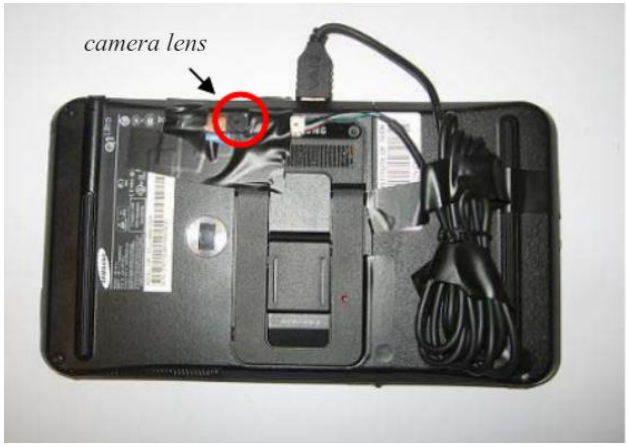


Figure 3: Back of Samsung minicomputer with attached camera for video processing

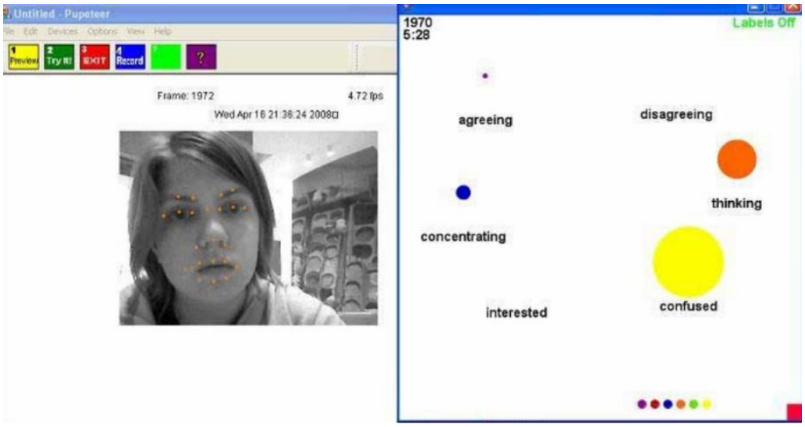


Figure 4: Facial Analysis System video input and Emotion Bubbles Interface

An Emotion Bubbles Interface was created for the Facial Analysis System which read the input from the camera. This interface was used to determine whether the person was agreeing, disagreeing, concentrating, thinking, confused or interested in what another person was saying through a colour scheme. Depending on how intense they were feeling and expressing a certain emotion, the bubble varied in size (e.g. Figure 4 shows elevated levels of confusion, a smaller detection of thinking and an even smaller detection of the person simply concentrating). This interface was successful in enabling autistic individuals to be able to modify their conversation in real-time to increase levels of interest and agreement, and to see how their expressions were perceived by their peers.

In relation to this research however, it could be difficult for children to monitor and interpret the facial analysis feedback and further presents the possibility of there being a lack of situation meaning due to children solely trying to decode the feedback on the screen without taking into account the context. Furthermore, this type of learning is unnatural for every day and may have a negative effect on an autistic child's perceptual load.

2.4.3 ASCme.IT

Digital Bubbles (2018), a group of researchers from Universities in the UK, developed an app called *ASCmeI.T.* which gives people with autism a platform to share their thoughts and ideas for new technology which could be developed to support those on the autism spectrum. It was developed to give children, adults, carers, parents, professionals and others in the autism community a chance to explain their ideas by uploading a short video of their suggestions. Although this is not an intervention where the outcomes can be easily observed and measured, it does provide and support the opportunity for new CBI and other forms of technological interventions to be developed in the near future for

those with autism. It is of considerable importance as all proposals are directly from those on the autism spectrum or those who want to help support them, giving researchers a deeper insight into which areas of autism could be investigated or investigated further.

This relates to this research in that both the design and evaluation workshops with children, and the expert interviews both pose as an opportunity to gain feedback on what has been done so far and any potential ideas, improvements and suggestions to revise the quiz game.

2.4.4 SCERTS MODEL

SCERTS is an innovative educational model that centres around working with children with autism and their families (Prizant et al., 2006). The acronym SCERTS stands for social communication (SC), emotion regulation (ER), and transactional support (TS). This model targets the main challenges encountered by children with autism and their families and is a lifetime-span model which can be implemented from initial diagnosis, throughout schooling and into later stages in life. The SCERTS Model directly tackles emotional regulation by focusing on goals for the development of self-regulatory and mutual-regulatory capacities (Prizant et al., 2005). The emotion regulation aspect of this model ties in with focus of this dissertation in that the aim is to develop a tablet game to support and encourage emotion regulation skills in children with autism.

2.4.5 COMIC STRIP CONVERSATIONS AND SOCIAL STORIES

Comic Strip Conversations were created by Carol Gray (1994). They portray a conversation between two or more people with the use of simple illustrations that aim to depict ongoing communication to help those who find it hard to comprehend and keep up with quick-fire conversation. They are potentially of useful help for children with autism as they depict what people say and do but also what people may be thinking – a hidden component that those on the autism spectrum find it hard to recognize and process. Colours can be incorporated into the pictures to represent emotional content of statements, such as thoughts and questions, as seen in Figure 6. Social stories were also created by Carol Gray (1998) and are short stories written again to help those with autism unambiguously narrate a specific situation. These situations can be daily routines such as the steps of brushing one's teeth and can be used in conjunction with Comic Strip Conversations. Gray (1994) states that through the use of Comic Strip Conversations, the thoughts and feelings of others are deemed to be just as salient as spoken words in interactions, and the addition of colours to

highlight the feelings and intentions implied by the spoken words makes it much more helpful. Scattone et al. (2002) provide promising evidence for the decrease in disruptive behaviours through the use of properly constructed social stories implemented in a school setting.

The tablet game developed as part of this research will incorporate social stories by depicting scenarios where certain emotions would be evoked through cartoon scenes with characters. These scenes will aim to show that different outcomes, events and objects can determine which emotions people may feel and experience.

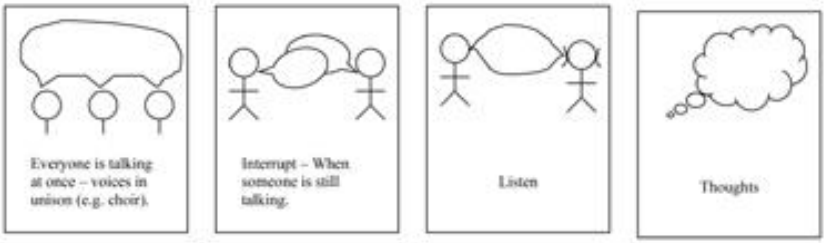


Figure 5: Example of Comic Strip Conversation (Gray, 1994; National Autistic Society, 2018)

Figure 6: Example of Emotion Colouring (Gray, 1994; National Autistic Society, 2018)

2.4.6 AUTISM 5-POINT SCALE

The Autism 5-Point Scale, created by Kari Dunn Buron and Mitzi Curtis (2003), can be viewed as an emotional 'thermometer' of sorts. It is a visual tool and assists individuals with autism to communicate and regulate in emergency situations. The idea behind the 5-Point Scale is to help provide steps on how to act, react, and interact effectively and quickly in difficult social situations and be able to assess the consequences of certain actions. Individuals with autism can benefit from having repetitive problems dissected into smaller concrete steps and thus providing a framework for how to act in social situations. The 5-

Point Scale can be adapted to many social situations children with autism struggle with such as having an obsessional scale (1 being 'It is a great day! My obsessional personality is a neurological work of art!', and 5 being 'I can't control it, I will need lots of support.'), a touching and talking scale (1 representing 'Thinking in a friendly way' and 5 being 'Punching and kicking') and also a voice scale helping to monitor how loud a child should be speaking depending on the situation (1 being 'No talking at all' and 5 being 'Screaming! Emergency only!').

Furthermore, the authors produced an app to represent the 5-Point Scale specifically for emotion regulation. It provides appropriate customizable steps that can be taken when individuals are feeling a certain level of anxiety and want to return to a safe relaxed state - without the need to be verbal. The customization function enables individuals to tailor the levels based on their needs such as changing the pictures to relate to who a first responder would be for that level of anxiety, and also adding the voice of a parent or carer. These changes can provide instant recognition for the individual to do something safe. This app further adds to the range of technology available for autistic individuals to help improve their emotion skills. There has been no vigorous testing done to provide evidence for major success of the use of this app however, this is can be viewed as a more subjective intervention which has calming and reassuring effects for children with autism.

Figure 7: Screenshots of the Autism 5-Point Scale EP. From the Apple App Store. (Buron and Curtis, 2003)

The tablet game developed for this dissertation will encompass certain coping strategies for heightened levels of emotions such as anxious, angry or sad. It will also provide strategies for positive emotions too and hopefully will be able

to provide a customization function, like that shown in Figure 7, for children to draw their own ways of coping.

2.5 INTRINSIC VERSUS EXTRINSIC MOVTIVATION

Intrinsic motivation describes the inherent desire to seek out novelty and challenge, to explore and investigate, and to stretch and extend our capacities (Ryan and Deci, 2017). It facilitates personal growth and it is associated with a genuine interest and enjoyment in whatever one is doing. Whereas extrinsic motivation involves a desire to do something so that one may either obtain something pleasant or avoid something aversive. This type of motivation arises from external incentives and consequences and is associated with both positive and negative outcomes, as well having some unintended and unwanted "side effects". Intrinsic motivation produces higher quality learning and creativity and is therefore the type of motivation focused on in this section of the dissertation report (Ryan and Deci, 2000).

Considering intrinsic motivation is crucial for designing a successful game to teach children with autism as this directly relates to their interest in the game and may help increase their performance. Golan et al. (2010) suggest that young autistic children must be intrinsically motivated in order for them to respond to the socio-emotional stimuli presented. In their study, they found heightened levels of intrinsic motivation through the use of an educational DVD which incorporated systemizing to teach the children emotion recognition skills. Systemizing, as discussed earlier in this chapter, relates to rules and control of a system and the ability to predict the behaviour of it. The authors conclude that this method of systemizing, alongside the use of an entertaining DVD, is intrinsically motivating when used to learn about emotions and presents educational information in an intelligible and appealing format for the autistic mind.

Moreover, Whyte et al. (2015) assert that the main goal of serious games is to assure that what the child learns in the game will generalize to improve real life outcomes. Additionally, serious games with reward systems that foster intrinsic motivation for more sustainable learning are a vital component of serious game design. There is evidence to suggest that when learning opportunities are incorporated within the story content of a serious game, they enhance intrinsic motivation for learning (Baranowski et al., 2008; Garris et al., 2002; Gee, 2003; Reiber, 1996) and also storylines that develop specific characters serve as

potential tools for enhancing social skills, such as empathy, and also foster intrinsic motivation (Dickey, 2006).

In relation to the serious tablet game developed in this dissertation, it is clear to see that the use of a 'serious' learning approach using a storyline which integrates characters - or a fixed main character - will be favourable in enhancing levels of intrinsic motivation in children. Not only is this important in terms of motivation, but also the use of a character can help the child distance themselves from any negative emotions i.e. instead of the use of personal pronouns such as 'I' and 'me' opting to use 'they', 'he/she' or simply a made up character name. From these findings it is also clear to see that having simple rules in the game and the implementation of a reward system could be beneficial in increasing intrinsic motivation. These aspects of the game design will be discussed further in Chapters 3 and 4.

2.6 METHODOLOGY

2.6.1 REFORMING THE RESEARCH QUESTIONS

From the reviewed literature the following conclusions can be drawn with regards to research questions one and two posed in Chapter One:

1. Emotion regulation difficulties experienced by children with autism include the inability to recognise and understand the emotions and feelings of others in terms of facial expressions, spoken interaction and non-verbal communication. It is also difficult for autistic individuals to infer thoughts and meaning, alongside the emotional aspect, behind people's spoken words. They also find it challenging to regulate and control their own emotions in emotional social situations.
2. There are various technological and non-technological interventions in place to deal with emotion regulation difficulties experienced in children with autism. They are substantiated with promising evidence of improvement in these skills as a result of these approaches and in particular the CBI (computer-based interventions). This could be due to the influx of technology available to children and the increased use of such tools and technology within schools as a different mechanism for teaching and learning. Advances in software and technology support a plethora of digital and interactive help to improve and strengthen the difficulties mentioned above.

These findings feed into question three from the previous chapter which queried whether a story-based quiz game that explores emotion regulation, by incorporating various strategies of emotion regulation, would be effective in terms of regulating emotion. Again, in light of the knowledge gathered from the literature review, it would seem that a story-based approach would be instrumental in relation to teaching emotion regulation skills as serious story-based games – with characters and rewards systems - have shown to increase intrinsic motivation in children with autism and this is crucial to their learning experience. However, effectiveness cannot be measured until the game has been implemented and tested with children and experts, and it is important to note that a full measure of effectiveness cannot be truly determined due to the inability of testing with autistic children.

Therefore, the remaining research questions are proposed below, and these questions cover **five core areas of Human Computer Interaction (HCI)** and are prominent **aspects of design**:

1. Will this serious story-based quiz game be effective in promoting and regulating emotion? (**utility and functionality**)
2. Will this type of game approach be appropriate and usable for the intended target group? (**usability and satisfaction**)
3. What game design requirements are needed to ensure productive game play will be attained? (**learnability**)

Game design and relevant justifications and considerations will be discussed in depth in Chapter Four.

2.6.2 PARTICIPATORY DESIGN

Participatory design (PD) is a design process that involves different non-designers in various co-design activities throughout the design process. Essentially, it is a process of designing ‘with’ users and implies collaboration with users throughout the entire design and development process (Martin and Hannington, 2012). This is the chosen design process utilized for this project as it will help to gain insight from children directly - the end users - and presents an opportunity for them to share their ideas and opinions regarding the game design, story structure, functionality and characters.

Children are immensely honest in their comments on technology and have idiosyncrasies and opinions different to those of their parents and teachers (Druin, 2002). Therefore, it is logical that if they are to be the end users, they

should have some say in the development process. Figure 8 below depicts the numerous ways in which children can be involved in the design of new technology.

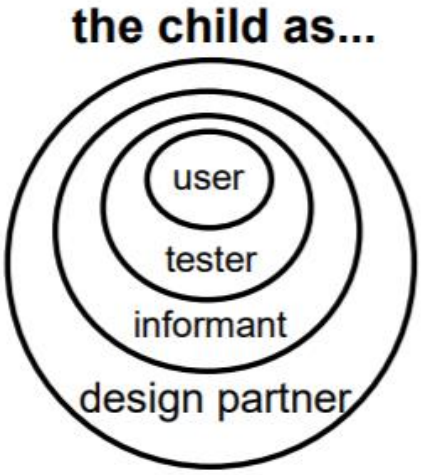


Figure 8: Four roles of children in the development of new technology. (Druin, 2002)

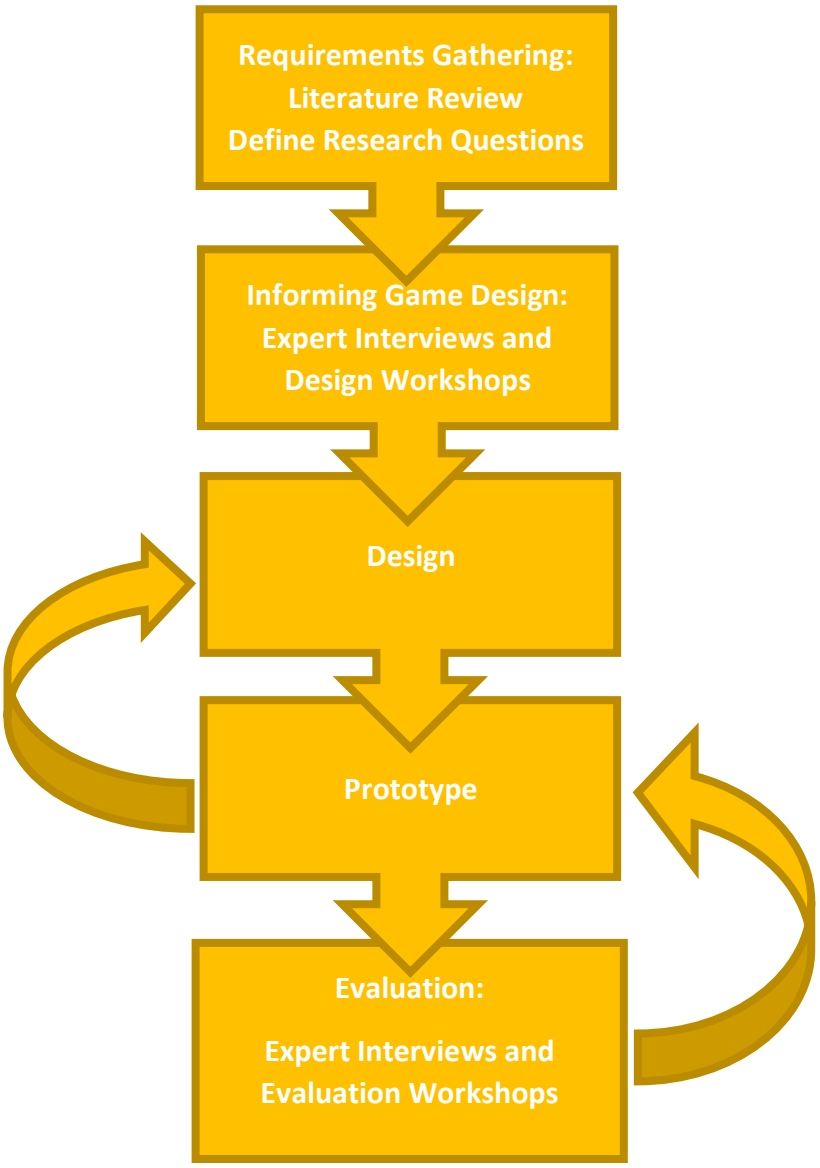
Cooperative Inquiry is a method used in this design process with supports the ongoing inclusion of children throughout the process (Guha et al., 2013). Cooperative Inquiry comprises of a range of techniques, that involve adults and children, which help the design process flow. These techniques include brainstorming, coding, building, iterating, and testing. Typical materials used in sessions are large sheets of paper for brainstorming and prototyping, sticky notes to report any criticisms and role play can be used to problem solve - making this a fun, engaging and productive design process for both children and adults.

Given the time constraint imposed upon this project, the design and evaluation process will be conducted with typically developing (TD) children as a proxy. These children will be the same age as those of the target group and will be able to give a rough insight into the likes and dislikes of that age group, in terms of game design. Working with autistic children would require a longer time period to enable them to familiarise themselves with the researcher and adapt to novel situations such as being involved in a design workshop with other children and using and interacting with prototypes. These situations could induce high anxiety levels. Additionally, as mentioned before, access to autistic children is also very limited and requires a much more vigorous ethics procedure. Therefore, experts from fields covering autism, HCI, mental health and education will be interviewed to give feedback on the design and implementation of the tablet game. These carefully selected experts are intended to represent the target population with the hope that they will give advice and

suggestions in relation to the appropriateness of the game, and how autistic children would typically react to the software. To reiterate, as this is only a proof of concept, experts will also be asked to give insight on any further aspects which could be modified – in the near future - to support emotion regulation in children with autism, enabling this game to contribute towards the range of educational tools available.

2.6.3 RESEARCH STRUCTURE

The diagram below shows the design process for the tablet game app and the rest of this section expands on each step in the process.



1. **Requirements Gathering**

The goal of this stage was to understand the target population of the tablet game app and their needs. It included reviewing extensive existing literature relating to the main difficulties of autism and emotion regulation and what interventions and approaches are currently in use, along with their success rate.

2. **Informing Game Design**

This stage involved design workshops with typically developing children and interviews with experts to inform the game design. The main aims of the workshops were to get children's input on the following:

- Design of narrative/scenarios for the game which elicit certain emotions by having them draw a time they were feeling happy, sad, excited or worried. Worried was chosen as it is less negative than "angry".

- Coping strategies and methods on how to act when they are feeling either happy, sad, excited or worried.

- Possible characters for the game by having them design their own emoji, conveying any emotion they wish.

- Ways to reward the correct identification of emotions through a task which involves the children acting out various emotions/ emotional scenarios.

Observations were carried out with young children who completed worksheets (see next chapter) and from these observations a game framework was outlined.

3. **Game Design**

This stage encompasses the initial tablet game app development producing a low-fidelity prototype based on design ideas and requirements gathered from stages one and two.

4. **Prototype**

Following on from the low-fidelity prototype, this stage involves the completion of a higher-fidelity prototype that is ready to be tested by experts and typically developing children. Improvements will be made iteratively in accordance with feedback received from both experts and children.

5. **Evaluation**

The final tablet game application will be put to the test in this stage with an evaluation and testing workshop involving typically developing children to test

the effectiveness and usability of the game. Also, feedback will be obtained from experts in determining the appropriateness of the game for the target user group.

Chapter Three

3 PRE-DESIGN

This chapter details the methods that were used to inform the design of the game and the results and impact these had on the overall design of the game, which is elaborated in full in the next chapter.

Two methods are explored in this chapter: a design workshop with typically developing children and semi-structured interviews with experts from the fields of HCI, autism, mental health and education.

3.1 OBSERVATIONS OF TYPICALLY DEVELOPING CHILDREN

3.1.1 AIMS

The aims of this study were to get children to inform the game design by inventing characters, recalling times they felt particular emotions to understand the kind of scenarios and emotional situations children are faced with and to act out and recognise the emotions of others. These tasks helped structure the design to support a game which helps children with autism foster emotion regulation skills such as recognising and understanding emotions, and when certain emotions would be experienced.

3.1.2 METHOD

Participants

The participants of this study were seven typically developing children with ages ranging from 6-12 years old. This varied age range was beneficial in viewing how attitudes and self-reporting changed with age. There were three female participants and four male participants. The exact demographics can be viewed in Table 1 below. Participants were recruited through an email sent to staff members of the School of Informatics. The email gave a brief overview of the research project and workshop and explained what their child(ren) would be asked to do. It also included the time and location and relevant phone numbers. As this research project has ran in previous years and been very successful, many of the participants reported to having taken part in previous similar workshops over the years. Ethics approval was sought and granted for this workshop, and the following methods requiring user participation, in

accordance with the School of Informatics Ethics Committee. Participant Information Sheets, Parent Information Sheets and Consent Forms were also drafted for this study (please see Appendix).

Table 1: Participant Demographics Design Workshop

Participant Number	Age	Sex	Siblings
P1	6	Male	**Yes**
P2	8	Female	
P3	10	Male	
P4	10	Male	
P5	12	Male	
P6	12	Female	
P7	12	Female	

Setting

The workshops were held in a reserved room in the University of Edinburgh's Informatics Forum. Only the necessary researchers stated on the Information Sheets were present for the duration of the study.

Materials

The materials used in this workshop were as follows:

- A4 paper worksheets
- A variety of coloured pencils and crayons
- Small paper cards
- An iPhone 7 used as a recording device (disconnected from Wi-Fi and used in accordance with Ethics guidelines)

Procedure

When the children arrived, they were guided through the Child Information Sheet detailing what activities they would be partaking in by the researcher and asked to fill out the Consent Form. The parents were similarly given the Parent Information Sheet and had an opportunity to ask the researcher any questions before leaving. Participants were reminded that their participation was voluntary and that they could choose to leave the study at any time, without having to give an explanation. They were also encouraged to ask any questions they had about any of the tasks.

1. Task One

The children were presented with the sheets, shown below in Figure 10, and asked to draw or write about what they do when they are feeling happy, sad, excited and worried. The terms ‘emotions’ and ‘feelings’ were used interchangeably to accommodate the younger participants. The goal of this task was to get the children to write about what they like to do when they are feeling certain emotions. The drawing aspect of the activity was intended to be helpful in informing the story design of the game and it also tied in with getting the children to identify coping mechanisms and strategies for when they are feeling certain negative emotions e.g. breathing exercises or listening to happy music. Children were given the option to draw or write, whatever they felt most comfortable with, about someone they know if they did not want to write about themselves directly. The emotions presented in Task One are a variation of Ekman’s (1999) basic emotions with the omission of anger, surprise, disgust and fear (these are dealt with in a subsequent task). Worried was picked instead of fear as it was felt this was less negative and also only four emotions were picked due to the time limit of each activity.

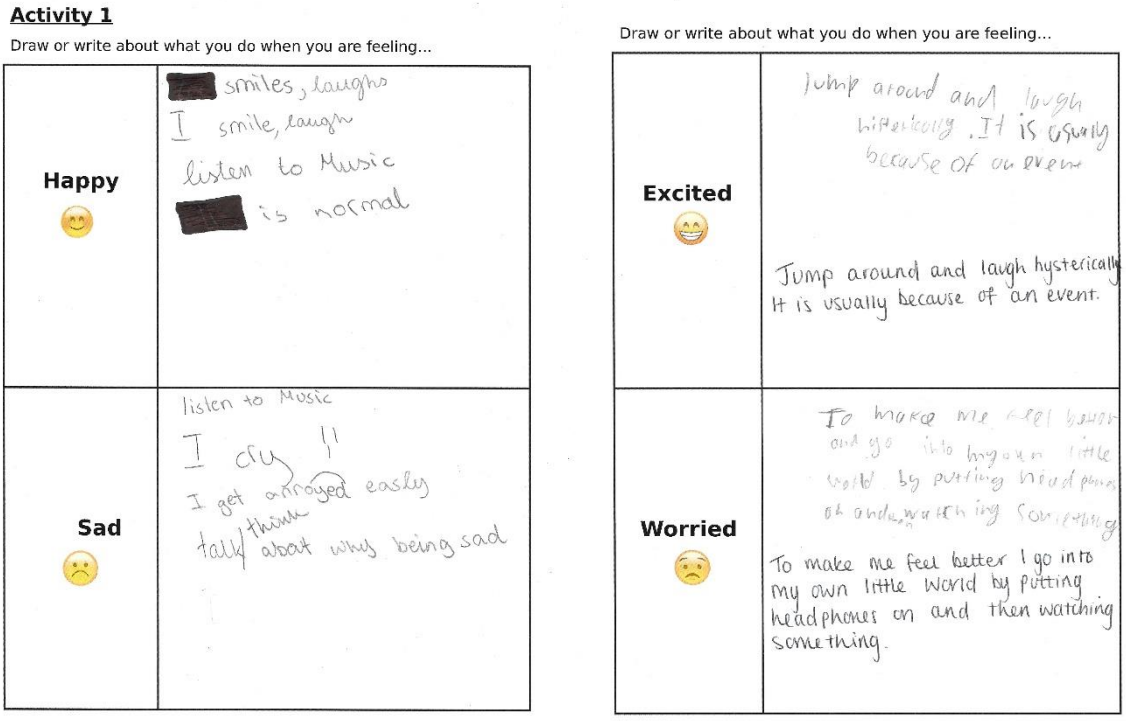


Figure 10: Worksheets for Task One with example answers

2. Task Two

The goal of Task Two consisted of getting the children to create their own emoji character that expresses an emotion. The children were given a sheet of paper with a box drawn on it and some emojis at the bottom for inspiration/help, which can be viewed in Figure 11. They were instructed to draw their own emoji design in the box. This activity was to get a feel for what emotions are predominant and favoured amongst the children and serve as an aid to inform character design for the story-based quiz game. The children were free to design any character they liked and showing any emotion they wished and were also encouraged to design their own emotions. Figure 11 below shows an example worksheet.

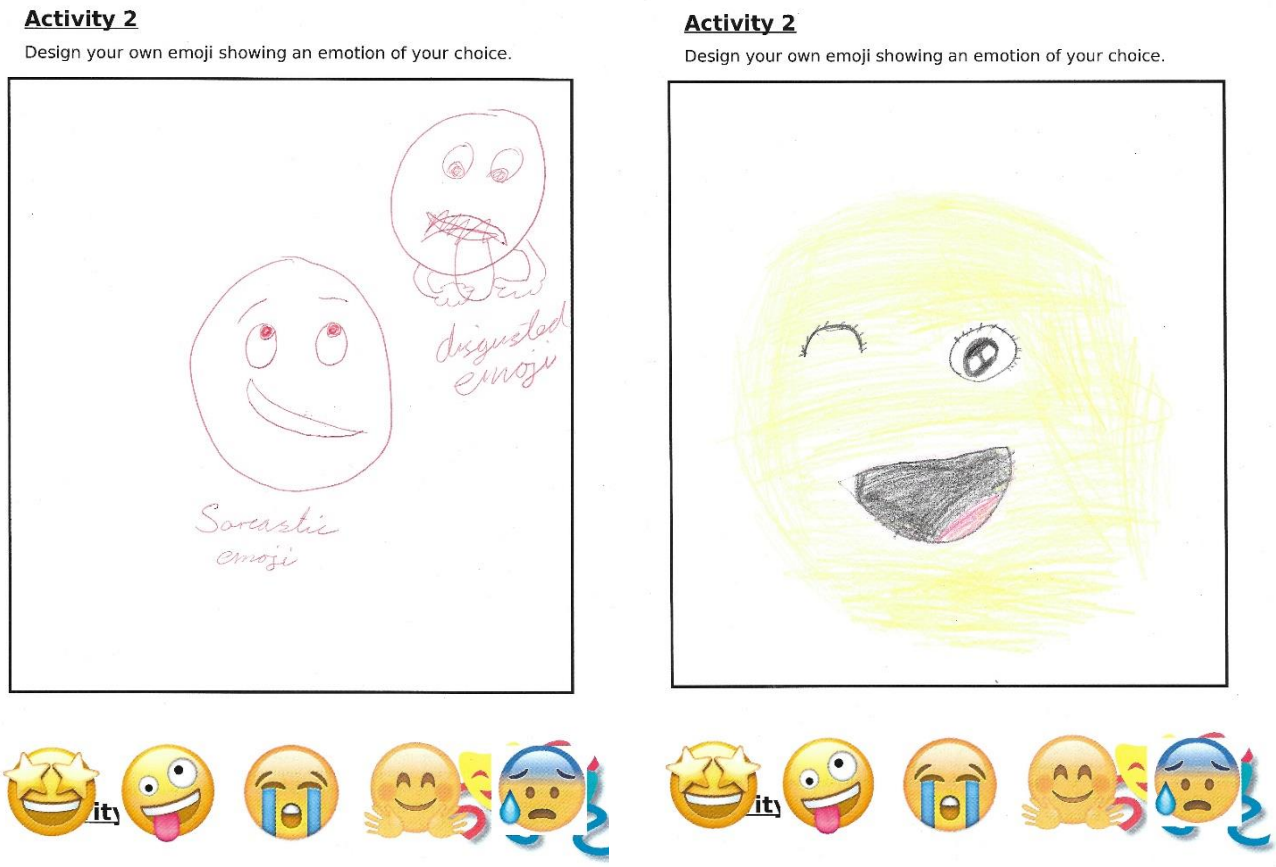


Figure 11: Worksheets for Task Two with example answers, and example emojis at the bottom of the pages.

3. Task Three

This activity focused on engaging children in acting out emotions and understanding the specific events/experiences when certain emotions will be evoked, in a fun interactive way. In this activity the children each got to choose two cards from a pile in the middle of the floor. On the cards there was either an emotion word i.e. HAPPY or a description of something that would make you feel a certain emotion such as happy i.e. opening the birthday present you always wanted. The child's job in this activity was to act out to the rest of the group what is on their card. This activity required the child to not only understand the emotion but to understand the contexts in which certain emotions are evoked. It aimed to target emotion recognition as well as emotional self-regulation. This task incorporates Ekman's (1999) basic emotions with the inclusion of all six emotions: happiness, sadness, anger, disgust, fear and surprise. Again, 'fear' was switched for 'worried' and 'scared'. It was thought that acting out would take marginally less time than writing out, so this was the reasoning behind using all six. It is important to note that if a child did not identify the emotion he/she was acting out correctly, or if another child failed to label which emotion they were acting out correctly, that no comments were made on whether the children guessed the right emotions or not. The only comments made were whether all the children agreed on one emotion or not. This activity gave each child a shot of role playing by acting out a direct emotion and acting out the description of an emotional situation and proved to be a fun activity for all.

Table 2: Example Cards from Activity 3

Act out:  **HAPPY**
Act out:  **MISSING THE BUS TO SCHOOL**

Table 3: Table showing the rest of the emotion words used on cards for Activity 3

Emotion Word
Sad
Excited
Scared
Worried
Surprised
Angry
Disgusted

Table 4: Table showing the rest of the emotion descriptions used on cards for Activity 3

Emotion Descriptions/Context
Opening the birthday present you always wanted.
Seeing your best friend in the morning at school.
Watching a scary film.
Losing your favourite toy or gadget.
Being on a rollercoaster.
Smelling a horrible smell.
Someone ate your lunch.
Getting caught in the rain.

3.1.3 RESULTS

Task One

All seven participants attempted task one and a full list of their responses can be seen in Table 5 below. A few participants struggled initially with drawing emotions for 'sad', namely P1, and all participants aged eight and above opted to write instead of draw – or use a mixture of both methods. Once the suggestion was made that the participants could write about their friends or family members, the majority of participants chose to do so for at least one or more emotion. The responses from the children were typical answers you would expect from children in that age bracket and no answers stood out with particular importance. P5, however, made a notable association between the

feelings of ‘excited’ and ‘worried’ pointing out that each impacts the other as the emotions “build up and comes out in one go”.

Table 5: Responses Recorded from Task One

Participant	Happy	Sad	Excited	Worried
P1	“I’m happy because I get free snacks.”	“I’m sad when me and (name) fight.”	“I’m excited because I’m going to football.”	“I’m worried because when we go on the plane it might fall down”.
P2	“We had to dress in red at school.”	“My brother pushed me in the swimming pool”	“When my mum made a costume party at our house and there was a m&m chocolate machine.”	“My brother was worried when he thought he wasn’t going to football club, but we did go.”
P3	“I have a mild smile on my face nothing much. It might have been because I am excited.”	“Pout and cry.”	“Jump around and laugh hysterically. It is usually because of an event.”	“To make me feel better I go into my own little world by putting headphones in and watching something.”
P4	“Listen to music – pop, rock, jazz, classical.”	“See above.” Implying also listening to music.	“Sing and dance to the Beatles, Queen, David Bowie and much more.”	“Tell a parent.”
P5	“Listening to music.”	“Do things that typically make you happier.”	“Builds up and comes out in one go.” →	“Builds up and comes out in one go.” ←
P6	“P7 smiles, laughs. I smile, laugh,	“Listen to music. I cry. I get annoyed	“I talk a lot about it. I am very happy. I	“Talk about it. Cry. P7 is

	listen to music. P3 is normal."	easily and talk or think about why I am being sad."	just talk A LOT."	very easily provoked."
P7	"P6 smiles a lot more frequently. She also laughs a lot. So do I."	"P6 pouts a lot when she's annoyed or sad. I'm quite bitter when I'm sad. P3 pouts when he is sad too."	"P3 laughs hysterically when he's excited. I have more of a spring in my step. Same with P6, she also talks a lot A LOT."	"P6 is very talkative when she's worried, she rants. I am easily provoked."

Task Two

All participants engaged in Task Two fully and four participants (P1, P3, P4 and P5) managed to create multiple emojis/characters showing emotions. P1 opted for superhero and supervillain characters. P2 drew a yellow emoji with a tongue. P3 chose to draw a shocked and confused emoji, incorporating an exclamation mark '!' and question mark '?' into his design. P4 chose to create two new emojis – a sarcastic emoji, making use of higher eyebrow placement and eye rolling, and a disgusted emoji. P5 based his emoji designs around classical composers with as he stated, "high powered wigs", which covered happy, worried and awkward facial expressions. Participants 6 and 7 both opted for a variation on the classic yellow emoji design with one eye winking and the other also drew a tongue insisting it was "playful".

Task Three

This task proved to be immense fun for the children and each child successfully acted out what was on their cards. It rightly served as a break from writing and drawing and incorporated a playful aspect to the design workshop. Nearly all cards were guessed right, a few overlaps of emotions were seen with items such as "missing the bus to school" and "someone ate your lunch" in terms of relaying variations sadness/hunger/confusion to the audience. However, overall the participants were accurate in their guessing and successfully reasoned between them the correct answers when there were various answers to choose

from, and thus displayed high levels of emotion recognition and emotion understanding – two vital components of emotion regulation.

3.1.4 DISCUSSION AND CONCLUSIONS

The design workshops proved to be fun and engaging for the children giving them the chance to draw, write and act as well as verbalize any thoughts they had towards the design of the game. Most of the emotion scenario descriptions used in Task Three (seen in Table 4 above) were correctly acted out and guessed by the other group members, suggesting that these types of short story scenarios give rise to particular emotions which are easily identified and recognised by children and could be implemented into the game design. Task Two was also thoroughly enjoyed by the children as they were able to create their own emojis. The successful completion of this task showed that all the children knew what emojis were and they were able to accurately express emotions by creating a small cartoon face. The results of this task can be transferred to the game design in that, although the game scenes will have full bodied characters (justifications discussed in the next chapter), the expressions from the emojis created in this task can be relayed to the characters faces in the game as most of the children's designs tended to be exaggerated facial expressions to show an emotion. The results of Task One exhibits a divide in responses between P1 and P2 versus the rest of the participants. P1 and P2 both chose to recall situations which made them happy, sad, etc., whereas the rest of the participants chose to detail what they would do or how they would act when they feel the emotions listed on Task One's sheet. Both interpretations of the activity are beneficial in terms of the game design as P1 and P2's responses help shape the creation of scenarios, and the rest of the participants help to create the scenarios to a lesser extent (e.g. describe how the character should perhaps look in the scene from the provided answers instead of the scene context) and instead predominantly give suggestions for coping strategies. If this project permitted a longer time frame and more resources it may have been possible to run workshops with more children, and with the inclusion of autistic children to better understand the needs and wants of the target population. However, the outcomes of this design workshop helped to shape the game scenario design and pinpoint various coping strategies which are exercised by the children.

3.2 INTERVIEWS WITH EXPERTS

3.2.1 AIMS

The aims of these interviews were to gain feedback on the initial game design concept from a low-fidelity prototype (Figure 12 and 12.1 shown below) and suggestions for improvement from those with a background in HCI and ASC through semi-structured interviews. Each expert was asked to detail any specific game requirements needed for the target population they deemed to be essential with regards to their own individual background relating to either ASC, education or HCI. Expert interviews at this stage of the design process were crucial in identifying any flaws with the initial game concept so they could be rectified early on in the development process and provided further justification for exploring this area of ASC through means of technological interventions.

3.2.2 METHOD

Participants

Three experts were interviewed to inform the initial game design, all with varying backgrounds and experience. Each interviewee gave input on the game design as well as ideas and areas of improvement based on their own experience.

Table 6: Experts Interviewed to Inform Game Design

Expert	Background
Expert 1 (E1)	Lecturer in Human Computer Interaction as well as having experience with Assistive Technologies, Educational Technology and Technology for Autism.
Expert 2 (E2)	Research postgraduate student with experience in HCI, ASC and working with young children. Has also previously done a similar project for their MSc.
Expert 3 (E3)	Lecturer in Applied Psychology and has personal experience through

	having family members with ASC. Research interests centred around socio-cognitive functioning in ASC and has done previous work looking at face perception and social processing in ASC.

Materials

Materials used in each expert interview comprised of:

- An iPhone 7 to audio record the interview
- Sheets of paper to show a low-fidelity prototype to discuss with experts

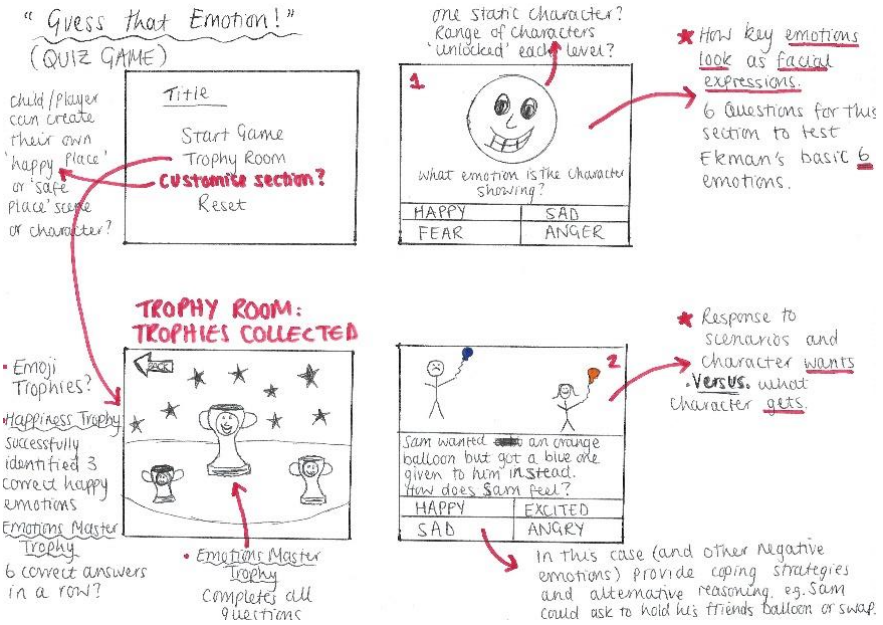


Figure 12: Low-fidelity prototype showing initial game design with questions and comments to discuss with experts.

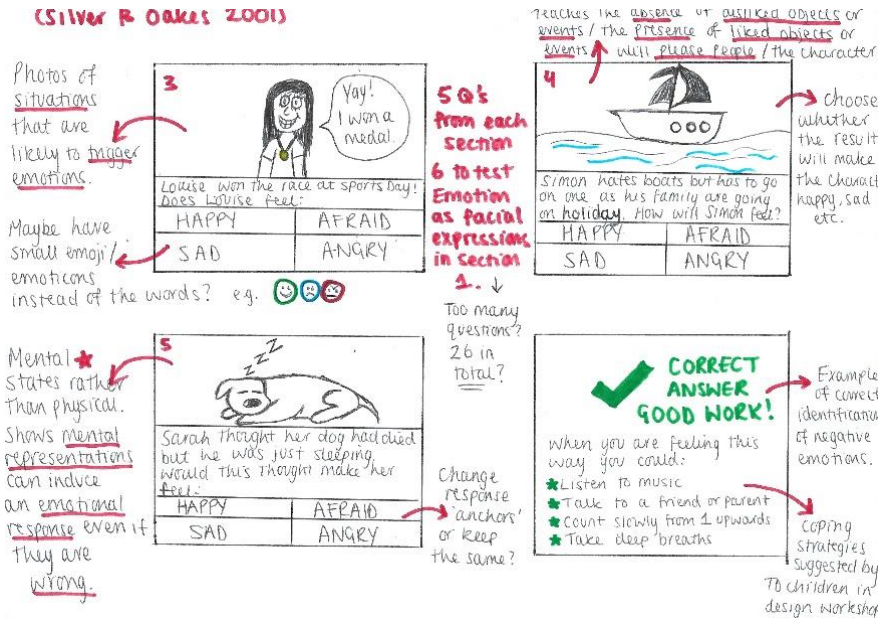


Figure 12.1: Low-fidelity prototype showing initial game design with questions and comments to discuss with experts.

Setting and Procedure

All interviews took place within various University of Edinburgh buildings located within the main campus. Each interviewee was contacted by email in which the main aims and background of the project were detailed. Following on from this, during the interviews the main aims were further discussed face-to-face with the participants and they were invited to ask any questions they had relating to the project to make sure they fully understood the project goals and

could give relevant and efficacious suggestions. All participants were asked to sign a consent form - mainly due to the use of audio recording as a further aid to any note taking, enabling the researcher to give their full attention to what was being said by the participant.

All experts were shown the sheets provided in Figure 12 and 12.1 which exhibit comments and questions to be discussed with the experts and these were displayed next to various scenes of the low-fidelity game prototype. This type of visual aid was found to be very beneficial as it gave structure to the interviews in that each participant could work their way through the provided scenes drawn in a coherent and logical manner and could answer the questions catered to that particular scene. This enabled experts to provide in-depth comments and suggestions refined to one scene of the game, as there are many different aspects incorporated into different scenes of the game. In consideration of E3's background, some additional questions were asked in this interview relating to facial perception in autism - such as: "In terms of facial perception, as this is a tablet game for younger children using cartoon characters, do you think it is important to also incorporate human faces into the game design too as cartoon characters' emotions are often exaggerated?". These questions, and the responses from E3, proved to be advantageous in the development of characters and scenarios for the game whereas E1 and E2 provided valuable suggestions relating to the functionality and HCI aspects of the game.

To conclude the interviews, participants were asked if they had any further questions or comments relating to the development of the game, and then were thanked by the researcher for their participation.

3.2.3 RESULTS

Expert 1

E1 stressed two main components of the game: complexity and customisation. E1 suggested complexity could be implemented by having multiple levels in the game, with the first level having only four basic emotions - instead of Ekman's 6 basic emotions - shown using simple emoticons instead of an actual cartoon character. From this basic level complexity, E1 suggested each subsequent level should get harder and incorporate more emotions and transition from emoticons into characters. This feeds into the suggestion of customisation also as E1 proposed the idea of having player settings where it is possible to pick which starting level the player is best suited to, based on their age and abilities. E1 was in favour of the customise section, shown in Figure 12, where the child can

draw their own happy place and also encouraged the use of an authoring tool throughout the scenes whereby an adult who knows the child would be able to introduce the image and give the context in the scenes. E1 advised that they had done previous work concerning computer-based rewards for children with autism and indicated they liked the trophy reward. E1 expressed that the trophy, paired with animation and sound, is a fun and engaging reward and gave the suggestion that the more trophies the player accumulates, the bigger the reward. In terms of the coping strategies, E1 recommended that they should be kept separate from the game play as they thought that it was too confusing for children having it appear in the game the way it currently was (seen in Figure 12.1) as the child has just correctly identified the emotion and is now presented with further text. Simply put, E1 suggested that this was a problem of 'theory of mind' as the child might be confused if they are dealing with their own emotions or trying to understand/advise other peoples.

Expert 2

E2 expressed that they were not sure how useful emotions with no context would be (Figure 12, scene 1) and what this would actually be teaching children, especially if they are cartoon characters, and suggested changing the basic emotion sections to include some simple context. Furthermore, E2 made the point that cartoon faces do not predict human facial expressions so what would it mean to be able to correctly identify an exaggerated cartoon face. In terms of rewards, E2 suggested that there should be a way to track the player's progress (the number of trophies they already have) and to make sure that when the player is given a trophy that it is exaggerated i.e. with sound and animation. E2 stated that if any sound is used in the game there should be an option to also turn it off as children could become overwhelmed by this. In addition to this, E2 indicated that they liked the 'Trophy Room' idea and stated that trophies are universal and easily identified by all children. E2 further advised to keep scenes and scenarios simple and aimed at one emotion or it could become too confusing for children. An example of this being Scene 4 in Figure 12.1 above, this harnesses some ambiguity as it could represent multiple emotions depending on the individual. E2 made the suggestion to refine the context sentence to make it more obvious which emotion is correct in this game setting. To further aid any ambiguity, E2 suggested the use of hints in the game whereby buttons could be removed giving the player a 50/50 choice or having some form of text hints. E2 agreed with E1 in that the coping strategies should be kept separate from the game play scenes or to incorporate them into different questions of the game. For complexity, E2 suggested changing the anchor

answer button positions so that the game is not repetitive and adds an element of difficulty to the game, albeit small.

Expert 3

E3 suggested that cartoons can actually improve eye gaze behaviour and furthered this point by stating that, depending on the child's level of functioning, it would not make a difference having cartoon faces as opposed to human faces as cartoons are something children with autism engage better with – especially younger children. E3 further explained that not much work has been done on performance of cartoon faces versus human faces, but their postgraduate student found no effects when looking at this particular area of autism and facial perception. E3 advised that the use of a character's whole body would also be beneficial in the scenes as this will make it more video game like and something autistic children are used to from the games they currently play. When asked about particular negative emotions (see Figure 12.1, scene 5 above) and if these would be too stressful for a child with autism, E3 suggested that scenarios concerning death and negative outcomes should be fine as there is the use of a character to distance themselves and mitigate any distress they may feel. E3 also went on to suggest that if there is the use of voice overs in the game it should be someone the child is familiar with as many children with autism identify with familiar 'favourite people'. In E3's personal experience with autistic children, their favourite person tends to be the chef as the chef in schools means lunch time. Therefore, having an element of familiarity, E3 advises, means the child will usually engage well, listen and pay attention. E3 commended the use of scenarios within the scenes and agreed with E2 in that clear context is needed to understand ambiguity and links better with other learning needs such as social stories. Finally, E3 praised the layout of the game and found there to be a nice level of complexity by affirming that being bombarded with too many things can be too much to process and cause stress. They also agreed that the things the researcher is aiming for links well with social cognitive aspects that underlie the problematic area in focus, this being emotion regulation and recognition.

3.3 DISCUSSION

Following on from the pre-design workshops and expert interviews outlined in this section, the subsequent design requirements are detailed below:

1. The intended target user group is younger children with autism, aged 5-10 years old.
2. The language used in the game should be kept minimal, unambiguous and accompanied with a picture for those who find it difficult to read.
3. It will be a single-player game with anchor response buttons displaying the emotion word and an emoji, again to cater to those in the younger age bracket of the target user group.
4. There should be animations and sound for correct answers, and for incorrect answers there should be a non-invasive sound and possible hints. All sounds should have the option to be muted.
5. Trophy rewards should be received after so many correct answers are given, and the rewarding of a trophy should be exaggerated.
6. Coping strategies should be present within the game, but not disrupting the main game play.
7. The game should use simple scenes, with context, conveying a cartoon character and using their whole body, not just their face.
8. Players should be able to track their progress in the game by seeing how many trophies they have received.
9. There should be an element of customisation for the player within the game.
10. Quiz questions will be based on the character in the scene and not the individual playing the game in order to distance the player from any negative emotions arising in the game.
11. The game should be fun and engaging whilst serving as an educational tool.
12. The scenarios should be relevant to the target age group in that they are able to be understood by the children and situations they may have personally experienced.

The twelve game requirements outlined above are directly related to findings from the literature covering systemising, motivation, rewards, sounds and animations. They are also a result of suggestions from experts who advised including the character's full body, making scenarios relatable to children and keeping coping strategies in a separate section of the game.

Chapter Four

4 DESIGN AND DEVELOPMENT

This chapter details the design and development of the tablet quiz game in accordance with the findings from the literature review (Chapter Two) and the outcomes of design workshops with children and interviews with experts (Chapter Three). In this chapter, the relevant game justifications and requirements will be explained in detail and will be substantiated by principles of good design. To conclude this chapter, there will be an overall discussion of the implementation of the educational tablet game involving the necessary hardware and software components before it is presented to typically developing children and experts for evaluation – which is discussed in the next chapter, Chapter Five.

4.1 DESIGN PRINCIPLES AND REQUIREMENTS

The intended end users of this tablet game, as a product of this research and building upon previous computer-based interventions, are autistic children who have emotion regulation difficulties. This game is designed to help children **recognise**, **identify** and **understand emotions** and in which **context** these emotions would take place, as well as the expected **responses** to such emotional scenarios. Alongside serving as an educational tool, this tablet game should be **fun**, **engaging** and **motivating** for a child and this can be achieved by employing a quiz game structure. With these aims in mind, two sets of goals can be established: usability goals and user experience goals. The field of Human-Computer Interaction (HCI) sets forth a guideline for making design decisions and evaluating user-centred systems, and in particular the creation and fulfilment of goals relating to both usability and user experience.

The following principles were considered throughout the design and development of this tablet quiz game (Ritter et al., 2014):

1. **Functionality:** This concerns what the system will actually do and what will be achieved by deploying the system. In terms of this research, the functionality of the game is to help promote and strengthen emotion regulation skills in children with autism. This will hopefully be achieved through the use of a simple quiz game which depicts a cartoon character in various scenarios which are intended to elicit certain emotions. This design principle is directly related to the revised research objective one

(stated in Chapter Two): Will this quiz game be effective in promoting and regulating emotion?

2. **Utility:** The utility of a system scrutinizes whether the system is useful for the users and how long will it be useful for. Again, this relates to research objective one by measuring how many correct responses are obtained in the quiz game and whether the learning from this game can be generalized to everyday scenarios. As this game is only a proof of concept there is the possibility of further work in the future to create a fully built version of the game, and from here a more precise measure of utility and 'shelf life' of the game could be measured. However, for now, correct responses will be measured in terms of utility of the game alongside any comments from the children (during evaluation workshops) expressing how well scenarios relate to them and are useful.
3. **Usability:** This is harder to define as this comprises of users' attitudes towards the system and performance. The International Standards Organisation (ISO) 9241 state the definition of usability of a product as: "…the degree to which specific users can achieve specific goals within a particular environment; effectively, efficiently, comfortably, and in an acceptable manner". Relating to this research, usability is defined as: the user being able to complete the quiz game with no major errors, the user being able to learn the user interface so they can apply it to further parts of the game and are able to navigate the game easily, and to be able to relate some scenarios in the game to personal experience.
4. **Satisfaction:** This relates to positive attitudes reported by the user when using the product. For this dissertation, satisfaction can be measured by users reporting the tablet game highly and any positive comments made about any aspect of the game style or user interface layout and design. Both usability and satisfaction relate to research objective two: Will this type of game approach be appropriate and usable for the target group?
5. **Learnability:** This concerns how easy it is for users to learn the system and what the users may need to know before interacting with the system. The tablet game created for this project will be a fairly basic version of a quiz game due to the target user age and should be considerably learnable due to the consistency implemented throughout all the questions. In terms of what users should know beforehand, they should be able to read simple sentences and/or be able to look at cartoon scenes in order to provide a rough interpretation of what is happening in the scene to understand the questions posed. Learnability ties in with research objective four: What game design requirements are needed to ensure productive game play will be attained? Game design requirements were listed previously, at the end

of Chapter Three, and will also be provided further below for reference in this chapter.

Secondly, after taking into account HCI usability goals that govern a well-designed system, it is also vital to acknowledge user experience goals which make the game fun, engaging and motivating for children with autism:

1. **Fun:** This can be achieved as the game concept is a quiz game - although it is not a majorly competitive quiz there is still elements of fun and competition due to the connotations of the word 'quiz'. Incorporating animation, sound and a simple element of humour into some of the scenes and/or question response options will also hopefully be fun and enjoyable for the children.
2. **Engaging:** As this is to be an educational game it is important to engage the children in educational content to learn new skills or strengthen existing skills whilst maintaining a typical fun, game-like structure. Children can be immersed in the game through colourful scenes conveying emotional scenarios and context.
3. **Motivating:** As mentioned previously in Chapter Two, the incorporation of systemising and rewards - together with story context - into a serious style of game play is found to be highly motivating for children with autism. Since this quiz game has simple rules and structure (i.e. multiple choice questions, the more correct answers the player gets means the more trophies they get) it should harness a motivational aspect for the children in that they will want to receive all the trophies possible and complete the game - therefore fostering intrinsic motivation.

Following on from these usability and user experience goals, the game design requirements gathered from the pre-design activities in Chapter Three are stated again below for reference and to facilitate the design justifications explained further in this chapter:

1. The intended target user group is younger children with autism, aged 5-10 years old.
2. The language used in the game should be kept minimal, unambiguous and accompanied with a picture for those who find it difficult to read.
3. It will be a single-player game with anchor response buttons displaying the emotion word and an emoji, again to cater to those in the younger age bracket of the target user group.
4. There should be animations and sound for correct answers, and for incorrect answers there should be a non-invasive sound and possible hints. All sounds should have the option to be muted.

5. Trophy rewards should be received after so many correct answers are given, and the rewarding of a trophy should be exaggerated.
6. Coping strategies should be present within the game, but not disrupting the main game play.
7. The game should use simple scenes, with context, conveying a cartoon character and using their whole body, not just their face.
8. Players should be able to track their progress in the game by seeing how many trophies they have received.
9. There should be an element of customisation for the player within the game.
10. Quiz questions will be based on the character in the scene and not the individual playing the game in order to distance the player from any negative emotions arising in the game.
11. The game should be fun and engaging whilst serving as an educational tool.
12. The scenarios should be relevant to the target age group in that they are able to be understood by the children and situations they may have personally experienced.

4.2 ISO REQUIREMENTS FOR HUMAN-CENTERED DESIGN

The International Standards Organisation (ISO) 9241-210 detail the following requirements for any human-centred system design process:

1. Understand and specify the context of use
2. Provide a detailed user requirement specification
3. **Produce solutions that meet the requirements gathered**
4. User-centred evaluation and modification

From the game design requirements stated above, the rest of this chapter focuses on producing a solution to meet the requirements gathered as step one and step two have been covered in the previous chapters. This solution takes the form of an educational tablet game to support and promote emotion regulation in children with autism, with relevant justifications and game creation described in full in the upcoming sections.

4.3 GAME STRUCTURE

The idea for this educational quiz game is based upon the positive findings from an Emotion Trainer Program created by Silver and Oakes (2001). The game

constitutes various questions targeting emotions and emotional understanding using cartoon characters. The aim of the game is to answer the questions posed by choosing from the multiple-choice options presented. Trophies are rewarded after so many correct responses, and the trophies are displayed in the players' 'Trophy Room'. Coping strategies have also been implemented into the game but are kept in a separate section of the game as advised by various experts. The aim of the game, in terms of physical play of the game on a tablet, is to complete all the questions and collect all the trophies and display them in the Trophy Room. The educational aim of the game is to help promote and strengthen emotion regulation skills, such as recognising and identifying emotions, and in particular, stimulating an emotional understanding in children with autism in terms of scenarios where specific emotional responses would be expected due to the context.

4.3.1 MAIN MENU

The main menu, shown in Figure 13 below, encompasses a simple set of buttons which either start the game play, visit the trophy room, takes the player to the coping strategies section of the game, enables settings to be changed, or lastly, resets any saved player data enabling a new player to start the game or for the player to start over. The reset button clears any player preferences i.e. it clears all trophies collected and reverts back to question one instead of the saved question scene in memory if the player has not yet completed the game. The text for the button which reads 'What can I do when I feel…" was chosen instead of 'Coping Strategies' as it was thought that this is less technical and may give children a better clue of where they will be taken to in the game once the button has been pressed.

Figure 13: Screenshot of Main Menu Scene

4.3.2 SCENARIO AND CHARACTER CREATION

Again, keeping in line with Silver and Oakes' Emotion Trainer Program, the scenes in the quiz game depict scenarios which target five main components of various emotional onsets and emotional understanding. These sections consist of:

- How key emotions look as facial expressions
- Character wants versus what the character gets
- Scenarios which trigger an emotional response
- Mental representations which induce an emotional response, even if they are not true
- Emotions evoked by the presence/absence of liked/disliked objects

Each of the sections above proved beneficial in the Emotion Trainer program and therefore will be implemented into scenarios for the scenes of this game. Each section is marginally different from the others; however, they all have the common purpose of targeting different emotions and causes of emotional onsets.

Figure 14 below shows an example scenario picture used in the game questions. The scenarios are intended to be relatable to children of the intended age group (5 to 10-years-old) and are depicted in a colourful simple manner to take into account the abilities of the age cohort and to incorporate a fun and pleasing visual aid for those whose reading abilities are not yet fully developed. As previously discussed, the design of each scenario in the game has come directly from input from experts and ideas and discussions in the design workshops with children.

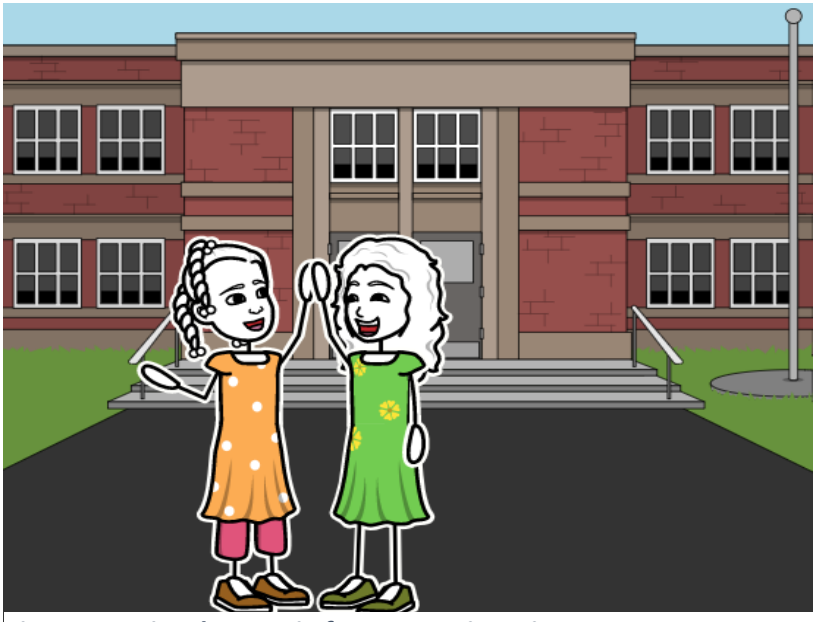


Figure 14: Visual Scenario from Scene in Quiz Game

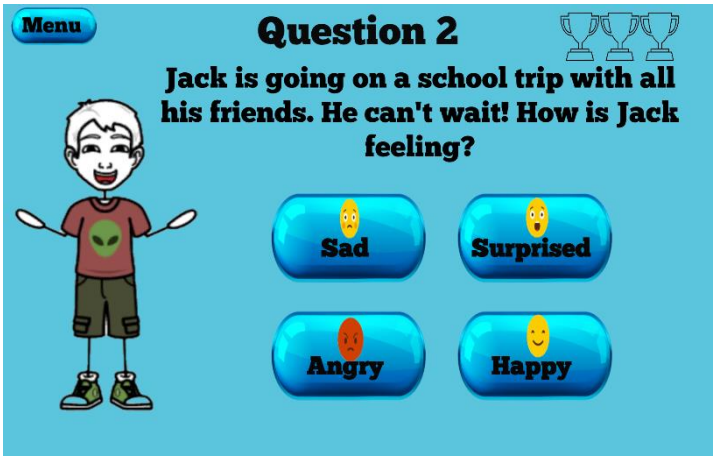
Following E3's advice, the choice to use the character's full body and a simple background scene has been implemented. Findings from Riby and Hancock (2009) looking at eye-tracking evidence for autism using both human actor movies and cartoons provide further justification for this choice. Their research found that atypical eye gaze behaviour extended across human actor and cartoon images or movies however, the children with autism in the study spent less time looking at the faces of characters and preferred to look at the background of the scene or the characters' body. This suggests that children perhaps merely rely on the characters' body or the background to infer meaning from a scene. A further point this study reveals is that children with autism may be less engaged by moving and complex scenes that include sound and language, in comparison to static images. This finding supports the choice of only having static images presented in this game, and only minimal sound and animation when answers are selected, and trophies are given.

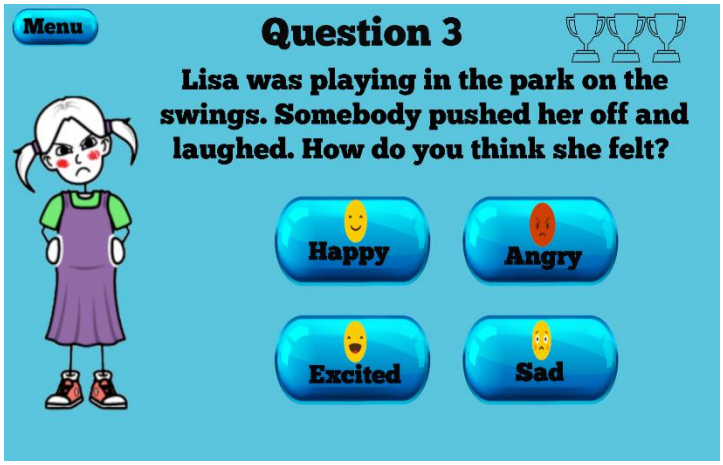
To further substantiate this choice, Remington et al. (2012) present evidence that suggests those on the spectrum have a higher perceptual load than typically developing adults and children, and their results exhibit an association between ASC and enhanced perceptual capacity in a visual detection task. This could also suggest that providing more context in the scene, such as a simple background and the character's full body, will be easily absorbed by a child with autism and can help them to understand and engage better with the scene.

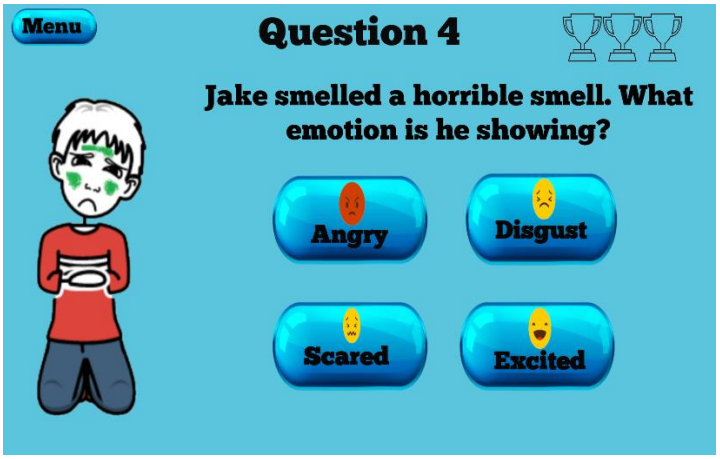
Furthermore, incorporating various characters has been chosen to clearly show that emotions are experienced by everyone, not just one particular individual or group. With this in mind, the use of various characters is also helpful in showing that all human beings are subjected to certain situations which can have negative outcomes and cause the onset of negative emotions. Lastly, the use of characters is also crucial in ensuring the distancing of negative emotions in the scenarios from the child who is playing the game so that they do not experience any stress or discomfort throughout their gameplay.

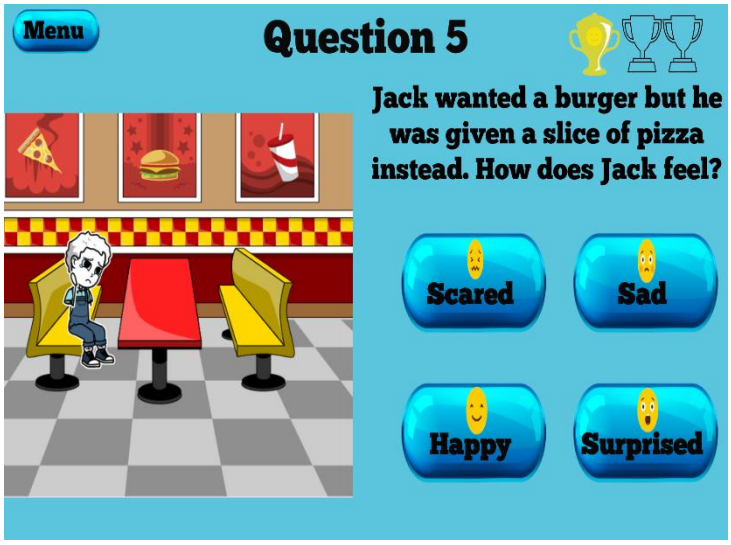
4.3.3 QUESTION STRUCTURE AND VISUAL STYLE

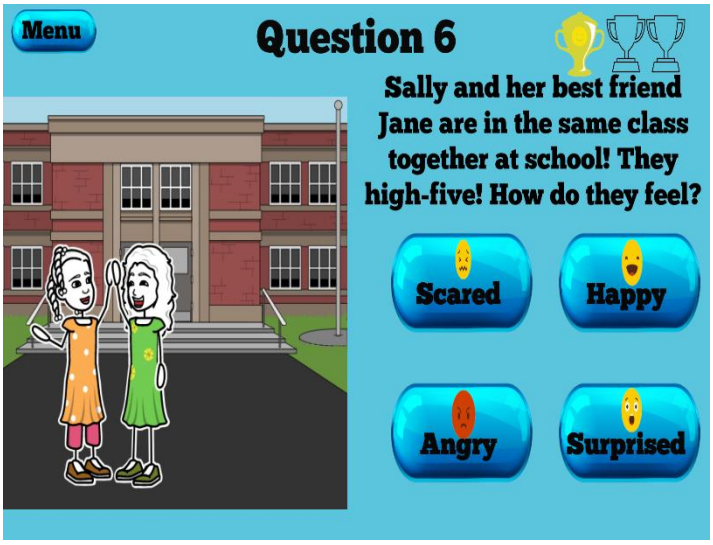
Table 7: Screenshots of Questions from Quiz Game











Menu

Question 7

Alice was excited to visit the fairground but then she seen a clown. She hates clowns. How does she feel?

Scared | Sad | Happy | Excited

Menu

Question 8

Sam has missed the bus to school. He is now going to be late and may get a row. How does he feel?

Scared | Sad | Happy | Surprised

Menu

Question 9

The boys did not let Sarah join in the basketball game. How is she feeling?

Scared | Happy | Sad | Surprised

Menu

Question 10

David had never been camping before. His dad decided to take him. How is David feeling?

Scared | Sad | Happy | Surprised

Menu

Question 11

Tom thought the castle was haunted. He could hear strange sounds. Aimee told him it was an owl. How does Tom feel?

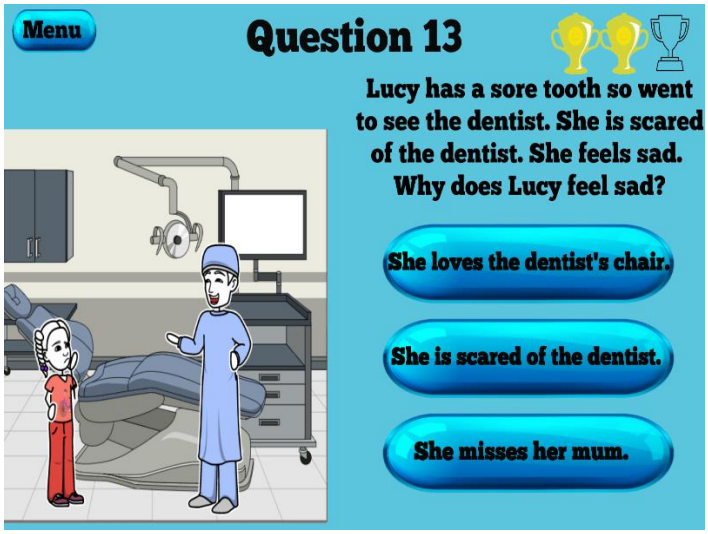
Scared | Sad | Happy | Surprised

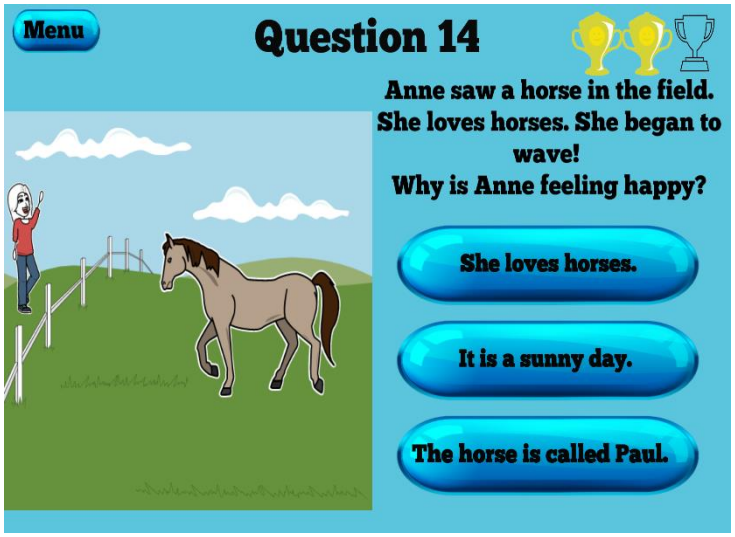
Menu

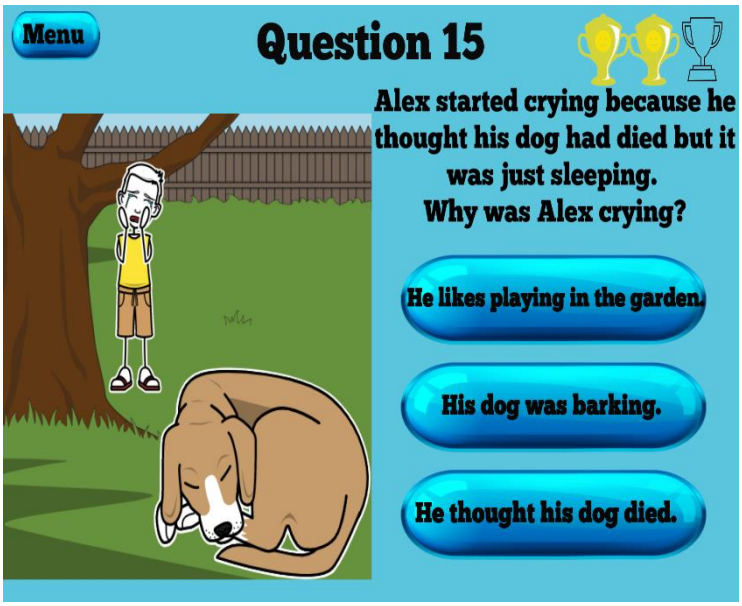
Question 12

It is Hannah's birthday. Her mum organised a secret surprise party for her and she did not know. How does Hannah feel?

Surprised | Sad | Happy | Scared







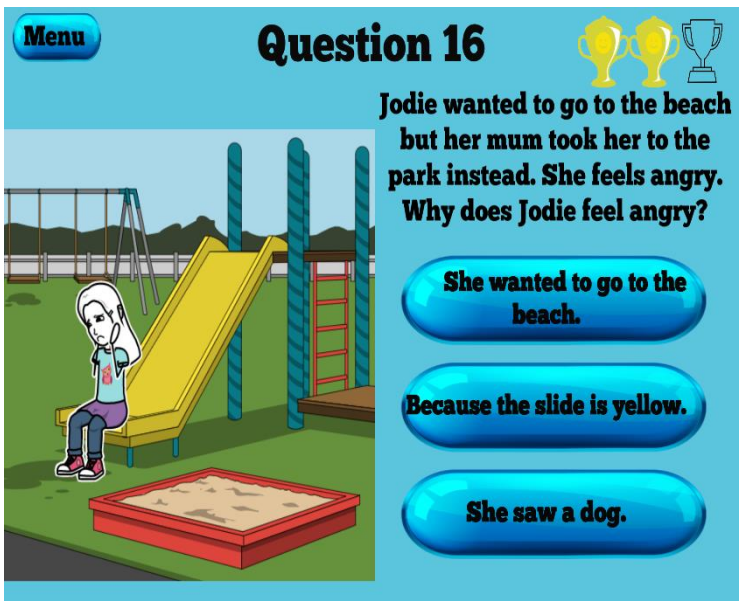


Table 7 above shows the questions included in the quiz game. The first four questions display four of Ekman's (1999) basic six emotions, as advised by E1, and are kept visibly simpler than the subsequent questions by only having an image of a solo character and some simple text; which was also suggested by E1. 'Disgust' has been chosen for Question Four as this is a harder emotion to guess in comparison to happiness, sadness etc., and signifies the end of the basic emotion questions, hinting the questions could be getting slightly harder. This is evident as continuing on with the game, Question Five poses a different style of question by now including a picture to show some simple context, and a more detailed question to further the context. The question style is kept uniform from Question Five through to Question Twelve, then Question Thirteen demonstrates a change in style once more. This is to further signify a change in

difficulty as now the questions posed are harder due to the responses targeting the child's comprehension of the context and image as the question gives the character's emotion, and the child now has to choose the option which best explains why the character feels the emotion. This question style was chosen for the end questions to keep the child engaged with the game so it is not repetitive through every scene, and to target those children in the older end of the age cohort who may have found the preceding questions very easy to answer. The anchor response buttons are switched in every scene, as advised by E2, to further add some complexity to the game questions so the child will still have to locate the button they wish to press. Furthermore, in the latter questions there is only three answer options to choose from instead of four. This is due to the complexity of the game getting harder as the child now must understand the comprehension. Therefore, reducing the answer options from four to three should hopefully heighten chances of success at 'first attempt' as there are now only two decoy answers.

In terms of the five sections targeting the onset of emotions listed previously – those implemented in the Silver and Oakes Emotion Trainer Program – the sections and corresponding questions numbers are listed below:

- **How key emotions look as facial expressions**: Although this can be viewed as applying to all questions in terms of the cartoon character viewed in the scenes, the main questions which focus primarily on the character's expression with minimal context given are questions one, two, three and four (basic emotions).
- **Character wants versus what the character gets**: Questions targeting this section are question five and question sixteen.
- **Scenarios which trigger an emotional response**: This section can be viewed as the predominant section the game targets as a main aim of the game is for the child to understand the derivations of scenarios/situations and why consequently emotions are experienced due to these scenarios. Therefore, questions six, eight, nine, ten and twelve encapsulate this section.
- **Mental representations which induce an emotional response, even if they are not true**: Questions eleven and fifteen focus on mental representations.
- **Emotions evoked by the presence/absence of liked/disliked objects**: This style of question is present in questions seven, thirteen and fourteen.

All questions and scenes have been kept very simple and try to avoid any ambiguity, keeping in mind the advice from E2. In addition to this, the context of questions should be easily relatable to the target age cohort e.g. missing the bus to school, going to the fairground, being scared of the dentist, losing a favourite toy and so on. These design decisions reflect design requirements two, three, ten and twelve listed above.

With regards to visual style and game design requirements seven and eleven, each question has adopted a colourful aesthetic which represents the current scenario in question and presents educational content in a fun and engaging manner.

In each scene of the game, the 'Menu' button present in the top left-hand corner takes the player back to the Main Menu of the game. A 'Back' button could have been implemented instead which would allow the user to backtrack to the previous question and change their answer. This could have been a useful and more desired button, however, the reasoning behind taking the user back to the Main Menu is to enable them to then be able to click on 'Trophy Room' and view their collected trophies as they are awarded in the game.

4.4 REWARDS

Rewards are a vital part of the game play and ensure children will be intrinsically motivated and gain satisfaction and enjoyment from playing the game. Figure 15 below shows the reward obtained by children after completing certain milestones in the game. Figure 15.1 conveys the trophy room where trophies are stored and both Figure 15.2 and 15.3 show the animations that appear for correct and incorrect answers, respectively. This section relates to requirements four and five of the game design.

Figure 15: Trophy Icon

Figure 15.1: Collection of Images showing the Trophy Room and placement of trophies once they are received in the game. The bottom image shows the completed trophy shelf.

4.4.1 TROPHY ICON STYLE

The trophy icon, shown in Figure 15, was chosen as this was deemed suitable and is universally recognised as a type of reward. E2 also favoured this style of trophy and agreed with the reasoning behind it. From comments made at the design workshop, each child had their own vision of what a pleasing reward would look like to them. As this is a subjective area of the game in that certain rewards will not appeal to all children due to individual differences (e.g. dinosaurs, power rangers to name a few), the trophy icon was chosen to represent the reward as again, this is a universal symbol and can apply to all. Taking into account E1's suggestions, enabling customisation into this section of the game could be implemented for future work (discussed in Chapter Six), so that each child can choose their own type of reward. However, the choice was made to use this icon for the time being and feedback on this choice can be received in the evaluation stage.

4.4.2 CORRECT AND INCORRECT ANSWERS

Figures 15.2 and 15.3 below show the screen that is presented when a correct response or incorrect response is clicked. These animations appear on the screen accompanied by a non-invasive tone to give the player feedback on their actions. For the incorrect answers, the feedback is kept minimal to avoid any negative feelings and these screens only appear for a few seconds before returning back to the question to give the player another chance to answer.

Figure 15.2: Animation for Correct Answer

Figure 15.3: Animation for an Incorrect Answer

Constantin et al. (2017) conducted a study looking at computer-based rewards for children with autism. They aimed to find out what kind of rewards children like and prefer, and the overall results revealed that children with autism showed a preference for silly cartoon faces with speech bubbles. These results indicate that this type of social reward can be effective for autistic children. In light of this knowledge, the use of silly cartoon faces and animations with some social text - as displayed in Figures 15.2 and 15.3 - could be viewed as positive and engaging feedback for children with autism. Furthermore, the addition of animation and sound when receiving a reward was preferred – but again there is an importance concerning the specific nature of the sound and animation used in that it must not be too overwhelming for autistic children.

4.4.3 RECEVING A TROPHY

Following on from above, when players receive a trophy there will again be a non-invasive sound heard – different to the correct response noise above - and some animation including confetti and a message of praise. The choice to include these features comes directly from expert advice which encouraged the exaggeration of receiving a trophy to ensure the children are congratulated on their correct answers and find the game fun and are motivated to continue with play. Figure 15.4, 15.5 and 15.6 below display the screen the player is presented with when they receive a trophy. The first trophy is received in the game when the player completes the basic emotions sections i.e. when the player has answered question four correctly, they will be awarded with a trophy. The second trophy is rewarded when the player reaches question eleven and has thus answered six correct questions ‘in a row’. Although ‘in a row’ should technically mean without answering any questions incorrectly along the way, this factor is ignored due to the age group of players and to enhance the players’ sense of achievement. Lastly, the final reward is obtained when the game has finished, and all questions have been answered (Figure 15.6). Having the trophies spaced out like this ensures players will strive to complete the game as they have something to work towards, therefore deepening their levels of motivation. Throughout the scenes, the player’s progress can be tracked in the top right-hand corner which shows how many trophies can be collected and how many the player currently has. Again, this design choice is in response to feedback from experts in the pre-design stage and satisfies game requirement number eight.

Figure 15.4: First Trophy Awarded

Figure 15.5: Second Trophy Awarded

Figure 15.6: Final Trophy Awarded

Figure 15.7: End Scene, all trophies collected visible in top right-hand corner

4.4.4 TROPHY ROOM

The Trophy Room shown in Figure 15.1 displays a room with a shelf on which the trophies are placed upon once received. The design of this room is intended to be directly relatable to a child's own room through the addition of a teddy bear and story books - common items you would expect to find on a child's shelf in their bedroom. This scene in particular could benefit from being customisable as many children store their trophies and awards in different places around the house and may want to change the 'room' and 'shelf' idea completely. Furthermore, the background of this particular scene may be too distracting for a child with autism, also providing an opportunity for customisation. This aspect of the game will be discussed further in the next chapter resulting from any observations and critiques made in the evaluation stage and this could potentially be an area for future work.

4.5 COPING STRATEGIES

Figure 16 shown below depicts the incorporation of coping strategies into the game. The coping strategies detailed in this scene are from suggestions made by the children in the design workshops and are therefore age appropriate and already widely recognised and utilized by children. Jahromi et al. (2012) found that children with autism, in their study, tended to opt for less constructive coping and emotion regulation strategies and used more avoidance and venting strategies in comparison to their typically developing peers. This can be viewed as justification for the inclusion of a wide range of positive coping strategies in the game to help children regulate and cope with any negative emotions, and

therefore making it easier for children with autism to identify and utilize effective regulation strategies.

Figure 16: Different Coping Strategies Suggested by Children in Design Workshops

4.6 USER INTERACTION

The user, children with autism in this case, should be able to interact with the tablet game effortlessly and be able to perform any desired task from an intuitive and well-designed user interface.

With this in mind, the game design has adopted various pivotal heuristics to ensure the game design meets the desired usability and user experience goals. With regards to Neilsen's (1995) 10 Heuristics, the principles detailed below have been closely followed:

1. **Visibility of System Status**

This principle has been implemented in that the player can clearly see which question they are on, or which scene they are in due to informative titles. The user is also notified when their response is correct or incorrect and when they have received a trophy. Furthermore, when the player has clicked on/hovered over a button, the button's gradient changes – indicating that it has been pressed and the system acknowledges this – before navigating the user to the location the button represents.

2. **Match between System and the Real World**

The game uses words, phrases, scenarios and concepts which are familiar to the user and the target age group, in line with requirement one.

3. **User Control and Freedom**

The game displays the menu option in every scene of the game enabling the user to exit the gameplay at any point and resume at a later time. There is also the option to change the volume of sound effects in the settings (Figure 17 below) and reset the game if the user wants to start from the beginning. The settings can be used by either the child or a parent/carer, depending on age. The slider shown in the image below is not very informative, and therefore assumes the player will know to drag the circle to the right to increase the sound. This presents itself as a possible improvement for the game by providing a more informative slider bar showing the sound directions with either icons at the side of the bar or the slider bar's height increasing as the sound gets louder.

Figure 17: Volume Control Bar

4. **Consistency and Standards**

The game has a consistent layout as every question is presented with the title, text, picture, answer buttons and menu button located in the same location throughout the entire game.

5. **Recognition rather than Recall**

Users do not need to memorize any aspect of the game as everything is clearly presented to them in the same manner and location in all scenes. The number of trophies they have obtained is also present throughout each scene, or they can easily check the trophy room. This aspect of the game aids the overall learnability.

6. **Aesthetic and Minimalist Design**

All information presented in the game is relevant and understandable, avoiding ambiguity where possible. The design is simple and colourful, yet not too overbearing for young children with autism. The colour scheme is consistent and not highly contrasting or hard to read. Grandgeorge and Masataka (2016) found red to be the most preferred colour in children with autism followed closely by blue. In one particular study of theirs involving only individuals aged 8-10-years-old, the preferred colour was, in fact, blue. Red was tried and tested for the background of the game, however, was found to be too contrasting against the text. Therefore, its close runner-up was chosen as the background colour. In addition to this, all buttons are clearly labelled and intuitive of what their functionality is.

7. **Flexibility and Efficiency of Use**

The game can be viewed as flexible in that it caters to younger children with pictures and emojis on the answer buttons to accompany the emotion words.

However, there are no accelerators for older children and experienced users. This could be implemented through a more structured levels system and will be discussed further in the upcoming chapters.

8. **Help Users Recognize, Diagnose and Recover from Errors**

Incorrect answers are followed with a short cartoon animation that pops up with a sign indicating the player should try again as they have selected the wrong answer (Figure 15.3). This helps the user to understand that they have selected the wrong answer and that they should try again, and then the screen reverts back to the question so they can choose a different answer. This principle could be further implemented with the inclusion of hints in the game, again this will be discussed further in subsequent chapters.

9. **Error Prevention**

A time delay is added to each pop-up scene, these pop-up scenes include a correct answer, incorrect answer and rewarding of trophies. This is to ensure the child has enough time to read any text and fully absorb the scene before moving on in the game.

10. **Help and Documentation**

There are no instructions provided for using the game, this is due to the game having ‘quiz’ in its title and its basic layout following a common quiz style with multiple-choice questions - which is hopefully obvious for users that have completed a quiz before. There is also the assumption that younger children will be accompanied by an adult or carer when playing the quiz who will give them instructions beforehand. Moreover, the various coping strategies presented in Figure 16 can be viewed as a help guide for managing emotions.

4.7 IMPLEMENTATION

This section details the software and hardware requirements needed for the implementation and testing of the educational tablet game. Considering the game is designed for children with autism, the target hardware in mind was to be a touchscreen interface tablet. This is due to children with autism having difficulties with their fine motor skills and this design would help accommodate that. Furthermore, a tablet device enables remote testing to occur as there is no limitation to one particular location. Aside from technical specifications, tablets are widely used by children and extremely popular, as indicated in the literature review (Chapter Two), therefore the use of a tablet game for this research project enables a fun and enjoyable interaction experience.

4.7.1 SOFTWARE

The quiz game was implemented using Unity, a cross-platform game engine which can be used for various styles and types of game design and development. The version of Unity used for this game implementation was 2019.2.9 and the game was created in 2D, using various supported 2D game assets.

4.7.2 HARDWARE

The target platform for the game was Android and the game was downloaded and built onto an Android tablet device. This device, a Samsung Galaxy Tab A, was used for testing and evaluating the game.

4.8 DESIGN DISCUSSION

This section concludes the Design and Development chapter where all the relevant game design requirements and justifications were outlined and discussed, before the overall game structure and scenarios were detailed. All aspects of the design of the high-fidelity prototype game have been mentioned in this chapter, and any features identified that were considered for implementation but have not yet been implemented are discussed in subsequent chapters under ‘Future Work’.

Chapter Five

5 EVALUATION

This chapter details the studies conducted to test the proof of concept prototype, involving academic experts and neurotypical proxies. These studies were used to evaluate the usability and user experience goals listed previously, in Chapter Four, and to obtain experts' opinions on the game. Any game revisions made as a direct result of feedback from children or experts will be explained in this chapter also.

5.1 EVALUATION WITH TYPICALLY DEVELOPING CHILDREN

5.1.1 AIMS

The aims of this study were to test the tablet game's usability, utility, functionality, satisfaction and learnability by observing the children whilst they were playing the game, and then by asking them a short series of questions post-play. These questions aimed to target the user's overall experience and to acquire any improvements for the game suggested by the children.

5.1.2 METHOD

Participants

The participants of this study were eight typically developing children with ages ranging from 6-15 years old. This varied age range was again highly beneficial in monitoring how attitudes and self-reporting changed with age, alongside observed gameplay strategies. There was an even split in gender with four female participants and four male participants - this enabled the study to be free from gender bias. The exact demographics can be viewed in Table 8 below. Participants were again recruited through an email sent to staff members of the School of Informatics and this email included a brief overview of the research project and evaluation workshop and explained what their child(ren) would be asked to do. It also included the time, location and relevant phone numbers. Six of the children had been involved in the pre-design workshops preceding the evaluation workshop, and those participants are marked with an asterisk in the demographics table below for reference. Ethics approval was sought and granted for this workshop in accordance with the School of Informatics Ethics

Committee. Participant Information Sheets, Parent Information Sheets and Consent Forms were also drafted for this study (please see Appendix).

Table 8: Demographics of TD Children from Evaluation Workshop

Participants	Age	Sex	Siblings
P1 *	8	Female	Yes
P2 *	6	Male	
P3 *	10	Female	
P4 *	10	Male	
P5	12	Female	
P6 *	10	Male	
P7 *	12	Male	
P8	15	Female	

Setting

The evaluation workshops were held in reserved rooms in the University of Edinburgh's Informatics Forum. Only the necessary researchers stated on the Information Sheets were present for the duration of the study.

Materials

Materials used in the evaluation workshops included:

- An iPhone 7 for recording purposes
- A Samsung Galaxy Tab A
- An A4 sheet of paper with questions listed on them, to be asked post-gameplay

Procedure

The evaluation workshops ran over the course of two days. Each child was welcomed on arrival and guided through consent forms and participant information sheets by the researcher before starting to test and evaluate the game. The child was reminded that they could stop participating at any time and that they did not have to give a reason why they wished to do so. They were also prompted to ask any questions they had. Following on from this, each child was sat at a table with the researcher and from here the researcher explained their specific game and its aims, followed by instructions on how to play the game and any other required information they thought would be beneficial in ensuring sufficient and easy gameplay would be achieved by the child. The researcher asked each child if they had played quiz games before, and if they enjoyed playing quiz games; the answers to both were yes and this was the

response from all children. The child was then able to hold the tablet or place it in front of them and then start playing. Whilst the child was playing the game, the researcher was able to make observations relating to the five usability goals, and also keep track of which questions the child struggled with or were hesitant about, if any. The child was informed that they were not being assessed and that keeping track of their answers was to allow the game's questions and or answers to be modified if need be. The researcher was there to help the child with anything they struggled with however, unless it was related to the game, the researcher tried to limit their involvement as to be able to allow the child to lead the gameplay and to guarantee non-biased results. Once the child had completed the game and had sufficient time to explore all the elements of the game, they were asked a few short questions relating to the game design and the gameplay. At the end of the workshop the children were thanked and presented with a certificate for their involvement in the workshop to show their input was highly valued and appreciated. The questions asked and results are discussed in the next section.

5.1.3 RESULTS

Overall, each child managed to complete the game with no major errors and with little input needed from the researcher, suggesting the game was found to be intuitive and that the game concept was easily understood. Many children reported to experiencing similar situations or, when the scenario was first presented, they verbally indicated straightaway what they thought the answer was going to be (example responses are given in sections further below). This is a positive outcome relating to the usability and functionality of the game and highlights that scenes were successful in being relatable to the children. The results, from the researcher's observations, for the rest of the usability goals are as follows:

1. **Utility:** Following from above, there was clear indication that the game can be and/or currently is generalised to the real word through comments made by the children. When asked what P6 liked most about the game he answered: "that it teaches people a lot about adult life and how people feel in certain situations. It's a fun way to get to learn that". This is further supported by P4 who had been in the situation presented in question five and admitted: "this has happened to me and to be honest I like burgers and pizza so it did not bother me a lot, but if I did not like pizza, which would be weird and wrong, then yeah I guess I could feel sad". This makes it evident that the scenes are relatable to the children

and they have personally experienced some of the scenarios or can see how they would be generalised to everyday life. In terms of how many questions were correctly answered, the full list of questions and responses from each participant can be viewed in Table 7 below. The table shows that question eight posed a problem for five participants, closely followed by question seven where three participants picked an incorrect answer before choosing the correct answer. Question four was also highlighted as being difficult by two participants. Overall however, the majority of questions were answered correctly first time – with the exception of the three listed previously – and can conclude that the utility of the system has positive outcomes in that children were able to answer questions correctly.

2. **Learnability:** All participants in the study were successful in navigating through the game easily and all button presses were intentional and took them to where they intended to go/ produce the answer they chose. Due to the consistency throughout the scenes, button functions and placement were easily learned and enabled the player to progress through the game with ease. This can be supported by comments made from P6 and P7 who said, "I like that the layout is self-explanatory and all the buttons take you where you want to go" and "The concept of the game is good as younger kids will be able to understand it and it has a clear layout" respectively.
3. **Satisfaction:** A high level of satisfaction was reported by the participants, particularly relating to the Trophy Room and individual trophies, as well as the cartoon scenes provided in the questions. This will be discussed further with examples in the next section.

Table 9: Tables Showing Participants' Responses. 1 indicates their first choice, 2 indicates their second etc. The asterisk * indicates the correct answer for that question. X indicates the incorrect answers for that questions. N/A indicates that those options were not available for the question in focus. Questions 13-16 have been omitted as these were all answered correct.

		HAPPY	SAD	EXCITED	DISGUST	SCARED	SURPRISED	ANGRY
P1	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	X	X	N/A	**1 ***	N/A	N/A
	Q8	X	**1**	N/A	N/A	2 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A

	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	**SAD**	**EXCITED**	**DISGUST**	**SCARED**	**SURPRISED**	**ANGRY**
P2	Q1	X	**1***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	2*****	1	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	**1,2**	X	N/A	3*****	N/A	N/A
	Q8	X	X	N/A	N/A	1 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	**1**	X	N/A	N/A	X	2*****	N/A

		HAPPY	**SAD**	**EXCITED**	**DISGUST**	**SCARED**	**SURPRISED**	**ANGRY**
P3	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	X	X	N/A	**1 ***	N/A	N/A
	Q8	X	**1**	N/A	N/A	2 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	**SAD**	**EXCITED**	**DISGUST**	**SCARED**	**SURPRISED**	**ANGRY**
P4	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	2 *****	**1**	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	X	X	N/A	**1 ***	N/A	N/A
	Q8	X	X	N/A	N/A	**1** *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	SAD	EXCITED	DISGUST	SCARED	SURPRISED	ANGRY
P5	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	**1**	X	N/A	2 *	N/A	N/A
	Q8	X	**1**	N/A	N/A	2 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	SAD	EXCITED	DISGUST	SCARED	SURPRISED	ANGRY
P6	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	X	X	N/A	**1 ***	N/A	N/A
	Q8	X	**1**	N/A	N/A	2 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	SAD	EXCITED	DISGUST	SCARED	SURPRISED	ANGRY
P7	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	1	X	N/A	2 *	N/A	N/A
	Q8	X	**1**	N/A	N/A	2 *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

		HAPPY	SAD	EXCITED	DISGUST	SCARED	SURPRISED	ANGRY
P8	Q1	X	**1 ***	N/A	N/A	X	X	N/A
	Q2	**1 ***	X	N/A	N/A	N/A	X	X
	Q3	X	X	X	N/A	N/A	N/A	**1 ***
	Q4	N/A	N/A	X	**1 ***	X	N/A	X
	Q5	X	**1 ***	N/A	N/A	X	X	N/A
	Q6	**1 ***	N/A	N/A	N/A	X	X	X
	Q7	X	X	X	N/A	**1 ***	N/A	N/A
	Q8	X	X	N/A	N/A	**1** *	X	N/A
	Q9	X	**1 ***	N/A	N/A	X	X	N/A
	Q10	**1 ***	X	N/A	N/A	X	X	N/A
	Q11	X	X	N/A	N/A	**1 ***	X	N/A
	Q12	X	X	N/A	N/A	X	**1 ***	N/A

Children were asked the following post-gameplay questions, and the results are summarised underneath each question due to overlap in the answers provided by the children.

Did you enjoy the quiz game?

All children reported that they really enjoyed the quiz game and in particular two participants, P3 and P4, "loved the jokey answers" such as "the horse was called Paul" and "because the slide was yellow". These responses were intended to be silly decoy answers and were successful in making the children laugh and enjoy the game more. These results relate to the user experience goals in that the game was found to be fun and enjoyable by all the children.

Was the game too long?

Most participants were in favour of more questions to be added as they found the game to be okay in length. Furthermore, when asked by the researcher if they would like more of a clear level structure, again the majority of participants were in favour of this idea. When the game questions changed to those which targeted the player's comprehension skills by posing context questions, the older participants indicated they preferred this question style - namely P5, P7 and P8. These participants suggested the game should incorporate more of this style of question.

Were there any scenes in particular where you found it hard to guess the emotion of the character?

The general consensus from all participants was that there were no scenes where they found it hard to guess the emotions. However, most participants reported a confusion with certain scenes due to the possibility of there being several correct answers for the question. Five participants, P1, P3, P4, P6 and P7, named question eight as confusing because "I would be sad because I missed

the bus, but I would also be scared in case I got a row" or just generally feeling sad because they missed the bus. P7 stated: "…the school bus one is hard, I personally wouldn't know how I would feel at that question I would probably be both". This is important to consider as this is where individual differences come into play and shows that the children are engaging in the game by contemplating all the possible responses they could have towards a scenario. A solution for this problem suggested by the researcher, and from the pre-design advice from experts, was to include hints in the game for all questions which would give a clue that would help distinguish between the two possible correct answers by hinting more clearly toward the 'right' answer out of the two. This idea was highly endorsed by the children and P7 went on to suggest that "hints could become clearer and more specific depending on how many points or trophies you have".

Do you think the yellow trophy is a good reward, or could there be a better reward?

The trophy and trophy room were highly favoured by the children, with only two participants opting for a different style of trophy. P1 would have liked different toys to be rewarded instead of trophies, and P4 suggested that letting the player pick their own trophy from a list of possible trophies would be a good idea. The positive comments relating to the rewards in the game could signify the children are feeling heightened levels of motivation knowing they have a trophy room to be filled.

Should the reward be more often (i.e. after 2 or 3 correct answers)?

This was a follow up question to the one above. Most of the children liked how the trophies were spaced out and two of them suggested that more trophies should be available. P4 also suggested that medals could be given after two correct answers and then after more answers the trophy should be awarded.

If you guess the wrong emotion, do you think it would be helpful to provide hints for the wrong answers, or to remove two of the buttons to make the choice easier?

This follows on from the previous answers above. The children indicated they would like to see hints throughout the game, so this is a potential feature that could be further implemented. P3 and P7 also liked the idea of having a 50/50 button option and thought this would be fun.

What did you like most about the game?

The trophy room was a main answer from all children, closely followed by the cartoon characters and scenarios in each question. A few of the older participants again reported liking the "jokey answer options" or "fun answers". P4 stated "I love the faces of the characters as you can easily see the emotions on the face" and both P5 and P8 remarked on the buttons having emojis on them as they liked this design. P3 liked the coping strategies provided and identified most coping strategies worked for her personally, except drawing as she does not like to draw. A general comment made by the majority was also that the design and layout of the game was very pleasing and user-friendly, and the blue background was "a good colour choice as this is very calming and a nice shade of blue. The text is clear to read off this background colour".

What did you like least about the game?

The overall answer summarised from each participant was that the questions were too easy. The participants were reminded of the aims of the project and that the target users would be children with autism therefore, the complexity level was purposely kept to a minimum. However, the game can be viewed as having some level of complexity in that several participants did struggle with question eight of the game.

Is there anything you would like to change about the game?

P1 would have liked the background to be changed to rainbows and she also suggested letting the player pick a character at the beginning of the game and this character would then be present in all the scenes. This idea is very creative and could enhance the aesthetic of the game however, implementing rainbows for a background could jeopardise the readability of scenes and may be too overwhelming for children with autism. P2 admitted that he did not like to read the questions and looked mainly at the pictures; with P2 being the youngest participant this is understandable, and perhaps a solution to this could be the addition of a voice-over feature. P4 suggested that the trophy room could be bigger to enable the character walk around the trophy room. In addition to this, P7 posed the idea of the game allowing you to take a picture of your own room and then add the shelf to it, so the background of the trophy room is in fact the player's bedroom. This again is a good suggestion; however, the game has been designed using a 2D platform and would need to be implemented in 3D to enable this feature. Therefore, these can be viewed as suggestions for future work and improvements for the game. P6 said that he would like to change the

coping strategies section of the game to add yoga to the list of strategies and to have short clickable clips of puppets trying out the different strategies.

5.1.4 DISCUSSION AND CONCLUSIONS

From the results of the evaluation workshop with typically developing children it is clear to see that most of the usability and user experience goals have been accomplished. The children were able to work and navigate the game with ease, whilst reporting high levels of satisfaction and enjoyment, and were also able to provide suggestions for further improvements which signifies that they engaged with the game. In addition to this, several individual comments made by the children during their gameplay constitutes towards evidence that the children were learning educational content in a fun and immersive way.

5.2 ADDED GAME FEATURES

This section details features that were added to the game as a result of the suggestions and observations made from the evaluation workshops. These changes were made before evaluating the game with experts.

5.2.1 ADDED FEATURE ONE: VOICE-OVER NARRATION

This feature was implemented to accommodate the younger children in the target age group i.e. five to seven-year-olds or those that have difficulty with reading or simply would prefer to have the text read aloud in scenes. The choice to implement this feature was also based on P2 from the evaluation workshop, aged six-years-old, who admitted: “I just like looking at the pictures, I don’t really read the sentences”. The voice used is a British English woman’s voice from a text-to-speech generator, using slow speed. This style of voice was chosen as it was the clearest voice from all the options and could pronounce most words far better than the other possible options. The voice-over reads aloud the context sentence provided in each question and can be repeated as many times as the player likes. To activate the voice-over the player must click on the speaker icon shown in Figure 18 below, this icon is featured in the same location in all question scenes. A further improvement could be to enable the voice-over to read both the question text and answer options. However, for now, the voice-over only reads the question text.

5.2.2 ADDED FEATURE TWO: HINTS

Figure 18 also shows the addition of a 'Hint' button located in the lower left-hand side of the screen. Again, the choice to implement this feature is due to the number of children from the evaluation workshops who agreed that the incorporation of hints into the game would be beneficial, especially for the questions that could potentially have two correct answers. Figure 18 depicts Question 8 of the game – the question found confusing by over sixty percent of participants – and Figure 19 depicts the hint associated with this question. The hint aims to make the answer less ambiguous if there is the possibility of two correct answers and to help explain certain people could react differently to scenarios (Figure 20) or, as seen in Figure 21, directs the user to look at certain aspects of the character's body posture or facial expression. These types of hints have been implemented to reinforce what facial expressions or postures are typical and common as a result of certain emotions – due to the game's main goal of targeting emotion regulation in children with autism. The hint is accessed by clicking on 'Hint' and then can be closed by pressing 'Close'. The hint can be accessed as many times as the player wishes. Hints could further be improved as currently in the game; the user could keep picking the wrong answer and not move forward. Acknowledging this flaw, an improvement could be to keep a count of how many times the user selects the hint button – and if this number is, for instance, two or more, the incorrect answers could start disappearing from each subsequent click – meaning the player will eventually have to get the answer right. This will also help to alleviate any frustration.

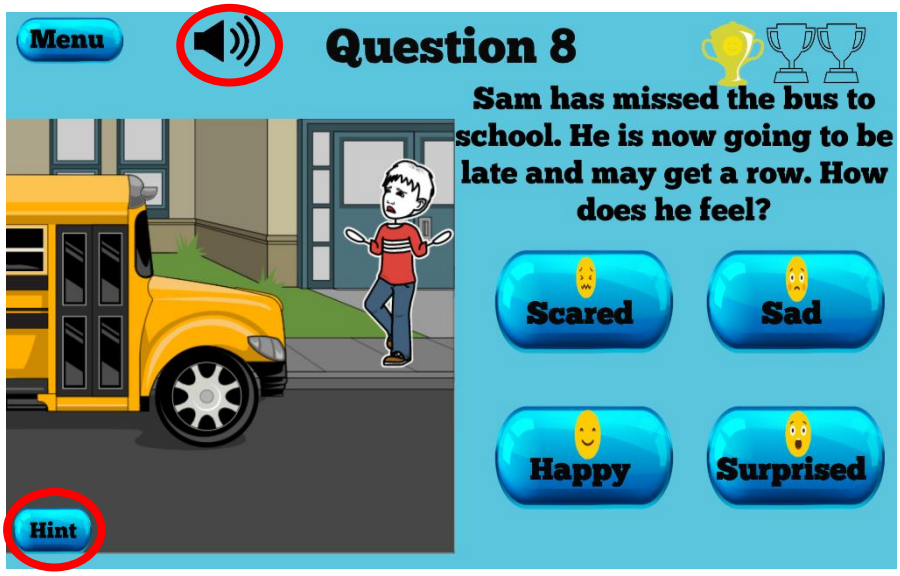


Figure 18: Addition of Voice-Over Icon

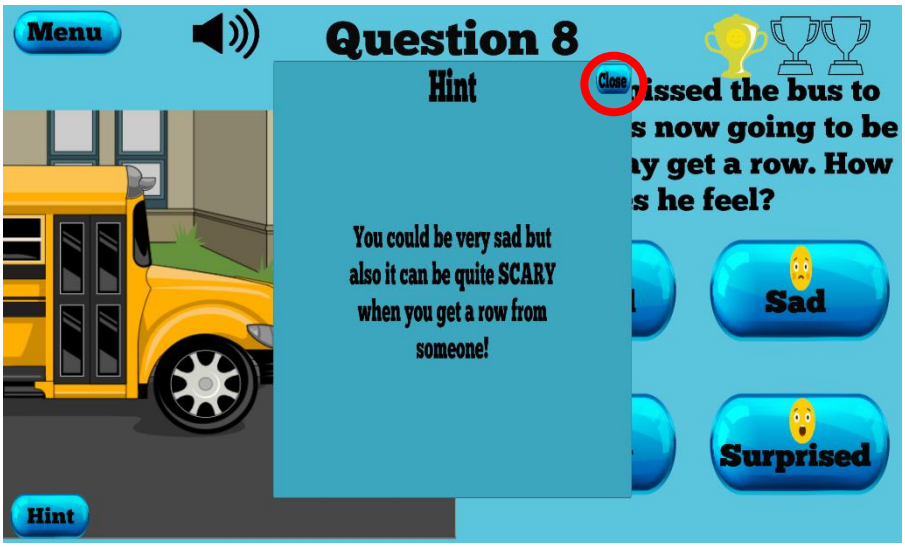


Figure 19: Example Hint for Question 8

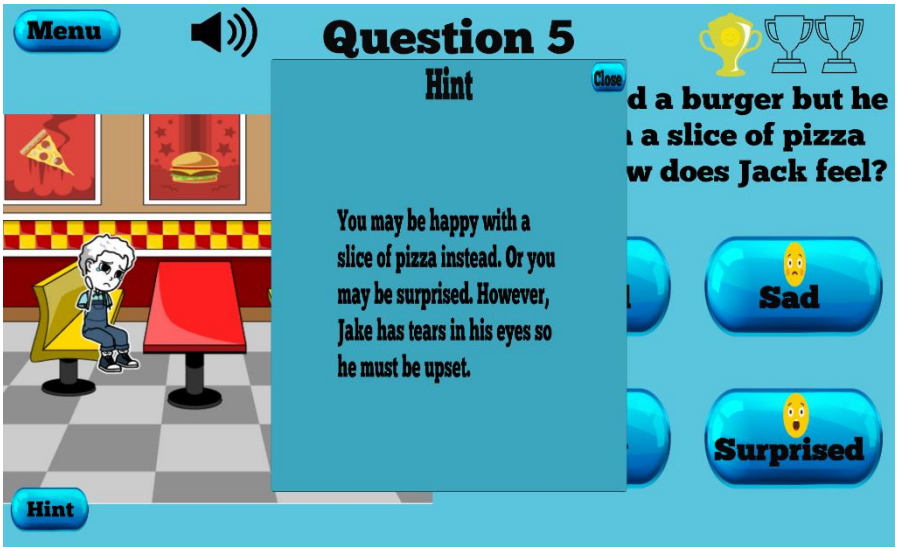


Figure 20: Example Hint explaining different emotional outcomes of the scenario but also hinting towards the correct answer.

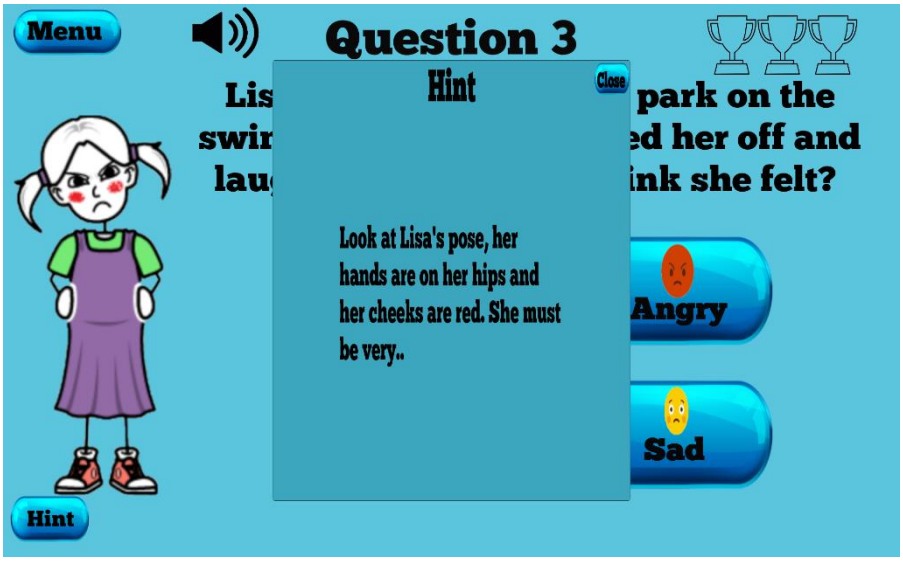


Figure 21: Example Hint directing the player to look more at the character's posture and face.

5.2.3 ADDED FEATURE THREE: DRAWING

To ensure there was an element of customisation in the game, game design requirement number nine, a drawing option was implemented in the coping strategies section of the game, which can be viewed in Figures 22 and 22.1. The purpose of this function is to allow the user to draw their own coping strategies however, the user is free to draw whatever they wish. The user has the option of three colours which can be selected by clicking on the coloured markers and there is an eraser tool. The 'Reset' button reverts to the blank canvas so the user can start again. The choice to implement this feature was as a result of the children from the evaluation workshop indicating they would like the 'Coping Strategies' scene of the game to have some functionality, therefore the implementation of the drawing feature can be viewed as a fun aspect of the game as well as having an important and useful purpose. There is no 'Save' function for the drawing scene, therefore no data can be collected by the game – making this a point of consideration for future iterations of the game.

Figure 22: Button which takes the user to the drawing scene

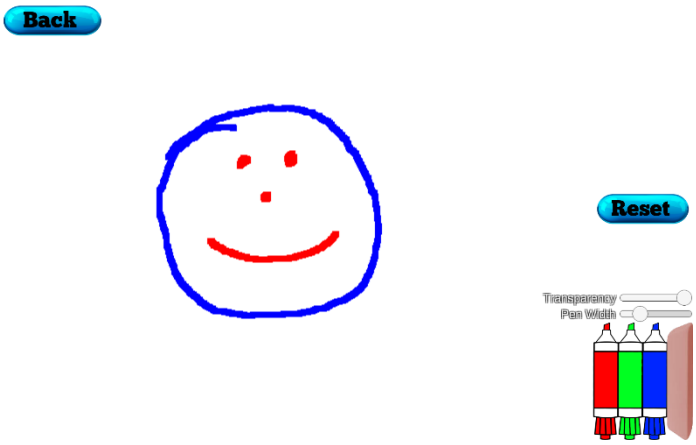


Figure 22.1: Drawing Activity Scene

5.3 EVALUATION WITH EXPERTS

5.3.1 AIMS

As typically developing children and experts were to be used as proxies for testing this educational game - due to the limitations of working with autistic children that were listed previously - the main aim of testing with experts was to determine the appropriateness of the game for children with autism, with respect to each expert's background and individual experience. Alongside evaluating

the appropriateness, experts were asked questions which target the visual design of the game, structure of the game, motivation and rewards, and most importantly, if they think the tablet game has the potential to be an effective learning tool for children with autism.

5.3.2 METHOD

Due to circumstances concerning the unprecedented global pandemic, evaluations with experts had to be conducted online, and with far fewer experts than the researcher had hoped for. Nonetheless, informative and actionable feedback was still successfully obtained and is presented below.

Participants

The participants were both academics at the University of Edinburgh, and their full background expertise can be viewed in Table 10 below. E1 had also taken part in the preceding pre-design interviews, therefore their feedback will be of particular importance to see if their previous feedback and suggestions have been satisfied.

Table 10: Experts involved in the game evaluation

Expert	Background
Expert 1 (E1)	Lecturer in Human Computer Interaction as well as having experience with Assistive Technologies, Educational Technology and Technology for Autism.
Expert 2 (E2)	Personal Chair in Interactive Learning Environments with special interest in supporting learning and communication in children with ASC through game-like environments. Member of the Institute for Language, Cognition and Computation.

Materials

Materials included various evaluation questions (which can be viewed below) and a video demonstration. Both were enclosed in an email and sent to experts.

Setting and Procedure

Due to the global pandemic, remote asynchronous methods were utilised to evaluate the game with experts. This involved the experts being sent all the materials they would need to evaluate the game, by email, allowing them to be able to evaluate the game in their own time and space before sending their responses back to the researcher, also via email. These types of online methods have been highly endorsed and successful in terms of remote usability testing (Bruun et al. 2009).

An initial email was sent to each participant asking if they would be willing to partake in the online evaluation and explained the dissertation project in full. Following this, once each participant had replied agreeing to take part, they were each sent an email containing a link to a video demonstration of the tablet game and a set of evaluation questions, which can be viewed below. Also included in the email was an overview of the project aims and what the game was intended to do – that being its educational purpose of striving to help support and strengthen emotion regulation skills for children with autism.

Evaluation questions sent to experts:

1. Do you think this game approach is appropriate for the intended target group?
2. Do you think using a story-based quiz game will be effective as a learning tool for the intended target group? i.e. could the game help children with ASC that have difficulties with emotion understanding?
3. Do you think that children will be engaged and motivated to play the game through the use of the rewards presented in the game?
4. Do you think the overall design and functionality of the game is suitable for the intended target group?
5. Do you think the questions and scenarios posed in the game are relevant and will be easily relatable to younger children?
6. Do you think the game length is too long? And if so, do you think this could be resolved by having a clearer level structure in the main menu?
7. Are there any other improvements or changes you think should be made to the game?

5.3.3 RESULTS

Expert 1

E1 stated that they thought the game approach will be appropriate for the intended target group. Furthermore, E1 found the game to be engaging with the graphic design being “nice and funny” and suggested that children with autism

will perhaps find this easier to understand. E1 commended the use of short and clear sentences, and relevant images in the game. Additionally, E1 praised the buttons and labels describing them as clear, visible and easy to read and understand. From this, E1 was in favour of the quiz game being an effective learning tool for the target audience. In terms of rewards, E1 stated that children get clear feedback immediately and if the answer is wrong, they have the chance to try again - making this very encouraging. Also, E1 believed that presenting children with trophies and stars throughout the game would increase their motivation. However, a suggestion relating to the feedback for a wrong answer was that it should be refined to a gentler invitation for the child to try again such as: "Oops, I am afraid this is not the right answer. Please, try again!". In relation to the scenarios of the game and whether they would be relevant and easily relatable, E1 assured the researcher that the scenarios are very realistic and that most children with autism should be able to easily understand them. Moreover, E1 praised the hints in the game and suggested these will be helpful and are very useful. When asked about the implementation of a clearer level structure in the game, E1 suggested introducing different versions or to make it customisable. This would enable children who can focus for a long period of time to try the game in one go, whereas for others it may be good to have levels and set up units of time; this would allow them to complete some levels, save their progress, then complete the remaining levels at a later time. Suggestions for improving and extending the game were centred around customisation. E1 encouraged the customisation of rewards and characters – this relates to the feedback received from neurotypical children in the evaluation workshops. As well as adding these customisation features, E1 also suggested having a version of the same character throughout the entire game and adding levels of complexity with more varying complex emotions as the levels increase.

Expert Two

Together with E1, E2 also thought that this game-based approach would be appropriate for the intended target group and expressed that similar games have previously been successful in this area and could provide practice for such children due to the general style of the game being familiar. Moreover, E2 confirmed that the questions and scenarios in the game are ones that most children will have had experience of and are likely to be relevant in their day to day lives. E2 highlighted that they found the game's title a little hard to read and suggested changing the colour of the background or the buttons on the screen as they are both relatively similar and could cause readability issues. Again, this

problem could be solved with more customisation features implemented into the game, allowing the user to change the colours in the settings. However, E2 went on to say that the labels on the buttons are fine. E2 suggested that the use of stick people on the 'Main Menu' scene and the end scene may be inappropriate for children with autism. This style of character is only used for the two scenes mentioned as the reactions to these figures are not intended to be analysed nor are these figures included in the questions of the main game. Consequently, due to the lack of a whole body, this perhaps could encourage the player to look solely at the facial expression in these two scenes. However, on reflection, this choice seems unsuitable in relation to the main game aims and could be changed in future game revisions. In terms of the Trophy Room, E2 stated that it had clear purpose and it was evident what it was but suggested the background could be distracting. Again, posing an opportunity for customisation. E2 praised the use of the correct answer screen and noise, and suggested that the screen could reinforce the answer e.g. ("Yes, she is sad"). A further point of consideration was that the trophy giving should be more consistent. As it currently stands, the first trophy is awarded after four correct responses, then the second is awarded after six. E2 suggests sticking to four correct responses, and with the addition of a visual message letting the player know how many more correct answers they need for a trophy e.g. "You need 2 more correct answers to get a trophy!". Alongside E1, E2 suggested that the 'wrong answer' statement could upset children, and also suggested a gentler invitation to try again – this can be viewed as a salient point for consideration in terms of changes needed to be made. E2 praised the use of hints in the game, detailing that it is good the hint directs the player to the facial expression of characters and also reflects the possibility of more than one answer in a scene – this is positive feedback as the addition of hints in the game was to account for this by addressing the feedback from children in the evaluation workshops. E2 also commended the latter questions, question thirteen onwards, by affirming that it is good to move the focus to the context in these questions rather than just simple emotion identification as this requires the player to explicitly identify the reason for the emotion. However, E2 also suggested that it would be good to alert the player to this question style change. Relating to feedback from typically developing children, E2 also suggested that the Coping Strategies scene could benefit from more functionality and recommended this being expanded for future work, but also acknowledged the drawing scene as being beneficial. Lastly, E2 stated that they did not think the game was too long, however, a clearer level structure would be helpful both to reinforce progress and to maintain motivation, alongside providing clearer signposting regarding where the child is in the game – again relating to feedback from E1.

5.3.4 DISCUSSION AND CONCLUSIONS

The outcomes of both the evaluations with typically developing children and interviews with experts were positive and optimistic. The game was found to be enjoyable for the children and successfully met the user experience and usability goals listed in the previous chapter. High levels of satisfaction were reported resulting from the game's design and structure, and its educational value was recognised and accepted – this is evident through comments made in the evaluation workshops by children. Moreover, having experts confirm that they think the game will be suitable for children with autism is very promising and helps to answer the research objectives which were set forth at the beginning of this dissertation. However, a common suggestion made by both experts and children was that they would have liked to see more customisation throughout the game. This is an important and instrumental aspect of an educational game for children with autism and the implementation of more customisable features, acknowledging those suggested in the evaluation stage, within the game is discussed in full in the next chapter.

Although this tablet game is only a proof of concept as testing with autistic children is out of the scope of this dissertation research, the results of these evaluations are encouraging as they suggest this research is heading in the right direction and could have the potential to contribute to the existing digital educational tools for children with autism that are becoming more and more readily available.

Chapter Six

6 DISCUSSION AND CONCLUSIONS

This chapter is the concluding chapter of this dissertation and presents the answers to the research objectives which were listed initially in Chapter One, then revised slightly in Chapter Two in accordance with the findings of the literature review. Conclusions drawn for each research objective are as a result of the workshops with typically developing children and interviews with experts. The chapter ends by discussing possible directions for future work.

This research involved reviewing extensive literature concerning emotion regulation-oriented tools currently available for children with autism and building upon these findings to improve efforts made by developing an educational game to further support and strengthen emotion regulation skills. A participatory design approach was taken throughout this research which involved design and evaluation stages with typically developing children, as well as input from experts on both the design and evaluation also.

6.1 RESEARCH QUESTIONS

The main research questions (stated in Chapter Two) this research intended to answer were as follows:

1. **Will this serious story-based quiz game be effective in promoting and regulating emotion?**
2. **Will this type of game approach be appropriate and usable for the intended target group?**
3. **What game design requirements are needed to ensure productive gameplay will be attained?**

6.1.1 RESEARCH QUESTION ONE

In terms of research question one above, the overall effectiveness cannot be fully determined due to the inability of testing with the intended target group, and therefore testing with proxies to obtain representative results instead. Chapter Four, however, detailed definitions of utility and functionality specifically defined for this research which concerned correct responses in the

game being measured for effectiveness, alongside comments from children expressing how well scenarios relate to them and are useful. From the successful evaluation workshops with neurotypical children, it is evident that the game can be viewed as effective to some degree. This is due to most children getting the answer correct first time, and their retrospective comments made on particular scenes indicating times when they have also experienced similar outcomes/events in their own lives. The next step in attempting to evaluate the full effectiveness of the game would be testing with the target group to see if these results are still as substantial with autistic children.

6.1.2 RESEARCH QUESTION TWO

Similarly, the full extent of the game's appropriateness for the target user cannot be measured due to testing with autistic children being out of the scope of this current research. However, there is the hope that the positive feedback gained from proxies – academic experts who have worked with autistic children and centred their work around producing assistive technologies for learning, alongside typically developing children of the same age as the intended target user – is highly representative, and that the high levels of satisfaction, usability and learnability observed in the evaluation stage will also be apparent if further evaluations are done with autistic children in the future.

6.1.3 RESEARCH QUESTION THREE

From both the literature review findings and the pre-design activities listed in Chapter Three, a set of twelve design requirements were formulated. Aside from obvious requirements such as the intended target user and age of users, prominent requirements included rewards (and such rewards being presented in an intrinsically motivating way), relatable scenarios conveyed with both a picture and short context question, the user being able to track their progress, coping strategies and the game being presented in a coherent and unambiguous style. Each requirement was substantiated by either evidence from the literature or suggestions from experts – the incorporation of systemising and rewards and using characters' whole bodies were based upon both. Every game requirement was successfully satisfied, and each can be viewed as contributing to the positive outcomes of the evaluation stage. Game requirement number nine (customisation), however, was viewed with the potential of being further improved, and this leads to the ensuing section below.

6.1.4 LIMITATIONS

A drawback of this research is that the intended target group were not able to test and evaluate the game – this was out of the scope of this research from the beginning. However, the aims of this research were to design and create a proof of concept prototype and conduct formative evaluations with proxies – and this was successfully completed. With this in mind, all conclusions made about this proof of concept prototype are assumptions based on feedback from experts and typically developing children who were the proxies for this research; with the intentions that feedback received will be highly representative of and give an accurate estimation of the responses of the intended target users.

Additionally, the unforeseen global pandemic had a major detrimental effect on the evaluation stage of this research in that fewer experts were able to give feedback than originally planned, and those evaluations had to take place online without the expert being able to physically interact with the tablet device and gauge its full potential. However, a video demonstration was utilised to express the functionality of the tablet game as best possible. Hence, more work needs to be done to determine the full success of this learning tool for supporting emotion regulation skills for children with autism.

6.2 FUTURE WORK

Overall, the tablet game produced for this research has the potential to be an effective educational tool to support and promote emotion regulation skills for children with autism. However, comments were made by both children and experts in the evaluation stage of this research on how to improve the game further, and these comments were mainly aimed at customisation of the game. Customisation options can be viewed as ‘infinite’ to some extent in that the player could alter anything down to the background and the colour of the text, to suit their individual preferences. Therefore, the following points outlined below delineate areas of further work for future game revisions that were suggested by both children and experts in the evaluation stage:

- Customisation of the rewards received in the game and the player’s ‘Trophy Room’ scene, so they relate to the individual player. This could be letting them choose from a wide selection of pre-defined rewards and/or incorporating their own images into the game. Ultimately, this customisation feature aims to further the motivation and satisfaction received from playing the game.

- Customisation of the character(s) in the game so that one character can be present throughout all the scenes and this character has been designed by the player. Also, this could further the motivation and satisfaction.
- Customisation of the voice-over so that the voice relates to someone the child is familiar with, and also having the option of the voice-over reading the answer options as well as the question text.
- In terms of the incorrect answer feedback for the player, both experts suggested that stating 'wrong answer' could upset children. Therefore, this aspect of the game needs to be changed to ensure informative feedback is presented in a non-detrimental way.
- Incorporating a clearer level structure in the Main Menu section of the game, therefore children can choose the level of difficulty they would like i.e. questions get harder as the levels increase. Also, this would allow children to complete a level, save their progress, and then continue later.
- Suggestions were also made by both children and experts in the evaluation stages concerning the functionality of the 'Coping Strategies' scene of the game. Changes could be made in the future which would allow for each coping strategy listed to provide a short example video or demonstration.

Incorporating the changes stated above could further increase the user's experience, as well as catering more specifically to intended target group.

6.3 CONCLUSIONS

1. This story-based quiz game could have the potential to be an effective learning tool for children with autism, however more testing needs to be conducted to determine the full effectiveness.
2. The style of this story-based quiz game is successful in incorporating emotional scenarios to teach children about emotion regulation and the scenarios are relatable to children.
3. Reward systems implemented into educational games are highly endorsed and are important for fostering motivation in children.
4. Customisation is vital when designing a piece of software for a particular user, and there is a multitude of ways customisation can be implemented.

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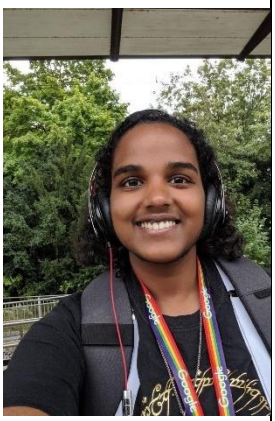
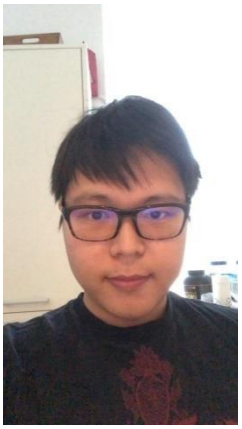
Appendix A

Designing and Testing Games to Help Children

(to be read aloud to the child)

This page is for children. We will ask you to help design and test new computer games, take part in different activities, and answer a few questions. You can decide if you want to say “yes” or “no” to helping and can change your mind at any time.

Who is organising the event? This is Helen, Aljawharah, Brogan, Anna, Sophia, Mourad, Qinxiang and Holly. They want to make computer games that can help children. You can help them by providing ideas for new computer games, taking part in different activities, helping test them, and answering some questions.

			
Aljawharah	Helen	Brogan	Anna
			
Sophia	Mourad	Qinxiang	Holly

How can I help?

Brogan: Children with autism may find it difficult to understand and describe what they are feeling. I want to help them get more comfortable with their emotions and learn to identify them. I need you to help me to develop a fun game which helps to better understand emotions by sharing stories of when you have felt different emotions and what you like to do when you are feeling a certain way.

Anna: Some children with autism can sometimes find it difficult to process what they see or hear. Especially if the environment is very busy or if too many things are happening. I want to help them process what they see and hear by allowing them to control the following features of an object, movement, sound, and lights, using buttons. They can choose to control one or more features. I need your help to design a character which has these features, and to build a story around the created character, to help them.

Mourad and Sophia: Some children with autism can sometimes find it hard to understand and manage what they are feeling. I want to help them get better at doing that by teaching them how to pay attention in a particular way. When they do this they will start noticing what is happening around them which can help them calm down when they are sad, angry or frustrated. This can also make them feel happy. But I need your help in designing a fun game that can teach them about this.

Qinxiang: My game is to teach children garbage classification. It is a mobile game and you will use your finger to move bin to collect rubbish. I will give you this game to play. After playing game, I have several questions to ask you feedback about this game.

Holly: I am making a game to help children in hospital feel better. My game is a board game (like snakes and ladders!) and I need your help to make it as fun as possible. I will show you some characters and ask you to pick which ones you like the best. We will also play the board game together and you can tell me what I can do to make it better.

What will happen if I help? You will get to take part in game design and testing workshops and participate in other activities.

You can tell Helen or one of the researchers if you want to stop doing any of the activities. You do not have to tell them why. Please tell them if you want to take a break.
You can also say you do not want to be a game developer or tester any more, and that is OK.

The researchers will ask if it is OK to make an audio or video recording of you helping design the game and answering questions. This is because it is too hard for them to write down everything that happens. They will listen to and look at the recordings later to help them understand what you thought about the game.

What will happen after I am finished helping? The things you make, do and say in the game testing workshops will help them. They will write about what they have learned and use it to design and evaluate their games.

Your mum or dad said it is OK for you to help us.

Do you want to be a game developer/tester? You can say "yes" or "no". It is OK to say "no". It will not hurt the researchers' feelings.

Do you want to ask a question about being a games developer/tester? It is OK to have more questions. You can ask the researchers as many questions as you want about being a game developer. Ask your mum or dad to help you call them on the phone or write an email with your question.

Appendix B

Child Consent Form

To be used as a guide for securing consent or refusal after the child has had a chance to get information about the study. The child may mark (or be helped to mark) this form, or the child's consent/refusal may be video-recorded.

I can choose to be a game developer.

I do not have to help if I don't want to.

I can decide to stop taking part or take a break if I want to, I do not have to say why.

It is okay if I change my mind later and say I do not want to be a game developer anymore.

It is okay if some parts of the game are hard for me!

There are no wrong answers to questions.
Anything I can do is very helpful.

Do you want to be a game developer? YES NO

Helen, Aljawharah, Brogan, Sophia, Anna, Mourad, Qinxiang and Holly will listen to/watch the recordings later. They may show them to other people who make games for children.

Is it okay to take audio recordings? YES NO

Is it okay to take video recordings? YES NO

Write your name:

_____

Appendix C

Designing Educational Games and Tools for Children with Autism

Information sheet for parents and guardians

This information sheet is for parents and guardians; it explains the research project at the University of Edinburgh, in which we would like your child to participate. It gives information about the project in the form of questions you might have and their answers. If you have further questions, we are happy to discuss them and give you more information.

This study was certified according to the Informatics Research Ethics Process, RT number 4258. Please take time to read the following information carefully. You should keep this page for your records.

The researchers on this project and their contact details are as follows:

- Brogan Miller: s1643299@sms.ed.ac.uk (Lead Researcher)
- Mourad Elsherei: s1792753@sms.ed.ac.uk (Lead Researcher)
- Sophia Singh: s1623165@sms.ed.ac.uk (Lead Researcher)
- Anna Ali: s1545423@sms.ed.ac.uk (Lead Researcher)
- Qinxiang Chen: s1614842@sms.ed.ac.uk(Lead Researcher)
- Holly O'Neill: s1531567@sms.ed.ac.uk (Lead Researcher)
- Aljawharah Alabdullatif: s1500319@sms.ed.ac.uk (Research advisor)
- Dr. Helen Pain: helen@staffmail.ed.ac.uk (Research supervisor)

University of Edinburgh, School of Informatics

- *Please return the parent consent form to one of the researchers if you give permission for your child to participate in the project.*

Overview of the project

We are six UG4 students from the University Of Edinburgh working on educational games for children with autism as a part of our Honours projects. Each student pursues research in their chosen area and will develop their own game.

What is the goal of the project?

Brogan: Emotion regulation concerns a person's ability to effectively manage and respond to a social experience by monitoring, modifying and evaluating their emotional reactions. For children with autistic spectrum condition (ASC) this can be very hard and impact upon their behaviour, as well as having a negative effect on

their social relationships. I aim to develop a game which helps children tackle such difficulties by applying them within a narrative context.

Anna: It is very common for children with ASC to also have Cerebral Visual Impairment also called Cortical Visual Impairment (CVI). CVI is a brain based visual condition that affects path-ways involved in processing incoming visual information via neural networks throughout the brain. Children that have CVI Meltdowns are commonly triggered by noise, visual clutter, busy environments with lots of movement, unfamiliar environments, unfamiliar people, and revisiting somewhere previously experienced as stressful. The commonly known emotional reactions to the Meltdown are tiredness, brain fatigue, emotional stress, and totally overwhelming fear. The behavioural outcomes of it are headaches, screaming, lying on the floor or being unable to stand/walk, physically attacking, and escaping. The aim of the project is to follow the fundamental concept, 'Cause and Effect', to develop a smart object – robot cat (robocat) that is interactive via the use of wireless switches. The functionalities of the robot include, producing sound and flashing lights. This will allow the children to be in control of the robot, and potentially supporting the children when processing the visual information received from the smart object.

Mourad: I am investigating how to design an effective and engaging interactive tablet game that is capable of promoting to children with ASC behaviours associated with mindfulness, as a means of supporting emotion regulation.

Sophia: Anxiety is a common concern for children with ASC. As young people face more complex and unfamiliar social scenarios and unexpected events this can worsen and can be an additional source of stress. I aim to develop an interactive app which will help children handle negative emotions associated with high anxiety by applying mindfulness activities in an interactive context.

Holly: The goal of the project is to design an app to be placed within a suite of apps at the Edinburgh Sick Kid's Hospital. The app is a multiplayer board game based in space. The aim of the app is to occupy the children's time and stave off boredom, as well as teach them to play cooperatively with others.

What is the purpose of the workshop?

Brogan: The workshop will involve the children testing my game which is an Emotions Quiz game. In the game, each question scene has characters and a short scenario sentence describing context. The child has to look at both the picture of the character and read the context and question provided and then guess the answer from an option of four emotions. There are also some questions which require the child to provide the reason the character is feeling a certain way instead of just answering 'sad' or 'happy'. The aim of the game is to help children understand that certain scenarios/events evoke certain emotional responses and to help understand how body cues also portray emotion, alongside facial expressions.

Anna: The workshop will guide the children towards personifying the smart object by giving it a narrative context. The aim is to build the smart object with inspiration from the suggestions made by the children. Activities include the children acting out their designed character in pairs, with the other child acting as the user.

Mourad and Sophia: The workshop will involve the children testing our interactive tablet based games; focused on calming activities like breathing and other

mindfulness related activities. The workshop will be beneficial in providing us key insight and feedback into the app and how it can be further improved.

Holly: The workshop will involve children playing the board game app together, and offering feedback on the appearance and design of the game, as well as offer new suggestions to what can be improved for the game.

How can my child help?

The game designing workshops will comprise a variety of activities which will help to inform the design of our prototype games and provide potential ideas to enhance fun and engaging gameplay for an educational game.

Workshop Information

What happens during the workshop?

Workshops will take place in the Informatics Forum. Your child will get to engage in numerous game testing activities and provide feedback and ideas for c. 20/30 minutes. If your child is willing to talk to us about the activities, we will ask them a few questions. They will each have a chance to test two or more of the developed games, if they are happy to do so.

Video and audio recordings

We would like to either video or audio record the session, to provide a record for later analysis and allow us to freely interact with your child during the session without worrying about taking notes. If you prefer that we do not use videos or pictures of your child for publications, presentations or teaching purposes, you can indicate this on the permission form. In that case, the video would be seen only by us during the analysis. If you are not comfortable with your child being audio (and possibly video) recorded at all, then your child should not participate in this particular study.

We ask parents to read this information sheet so you can make an informed decision about whether participation as a game designer is a good idea for your child.

If you say "yes" when returning the permission form, we will explain the game tester role to your child, and ask them if they want to help. We will remind your child that they can stop being a tester at any time, without having to give any reason, and that we will always listen to them. We will check that the child agrees to be audio (and possibly video) recorded. This explanation will be based on the child information sheet included in this packet. We feel strongly that children should be given a real choice about whether to participate. Even if you say "yes" on the permission form, your child may still say "no" if s/he does not want to be a game developer. We will respect your child's decision.

If you say "no", we will not contact you again about this study and will not ask your child to be a games designer.

Will this project teach my child new skills?

This project is not a type of therapy or intervention. We will not be teaching children new skills or improving existing skills. The information we learn from this project may be used in future games/smart objects that could help children with ASC.

What happens when the project is over?

After the study has finished and we have analysed the information we collected, it will be used to evaluate and further develop the design of the game/smart object and eventually be presented in a final report. This report along with the data and recordings may be shared or presented in scientific journals or conferences. We never share children's names, schools or other personal information.

How will personal information be protected?

Confidentiality is extremely important to us and all data will be processed in accordance with Data Protection Law. Recordings and other information (such as forms with children's names) will be stored safely on password-protected computers or in locked cabinets. Your consent information will be kept separately from your responses in order to minimise risk. Access will be limited to the people involved in the research (listed above). Recordings and other information will be identified only by participant codes or pseudonyms, and will be separated from identifying information (such as name). Your data may be archived for a minimum of 2 years.

Who paid for this research?

This study is part of the undergraduate work for the main researchers (listed above). It is indirectly paid for by the University of Edinburgh and the funding is not attached to a specific project or to any outcomes of that project. Conducting this research brings no financial benefit to the researchers or to the university.

Who can I contact?

If you have any further questions about the study, please contact any of the lead researchers or the research supervisor Dr. Helen Pain.
If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be made available on https://web.inf.ed.ac.uk/infweb/research/study-updates.

Alternative formats.
To request this document in an alternative format, such as large print or on coloured paper, please contact any of the lead researchers or the research supervisor.

General information

Once again, this study is completely voluntary and you and your child are under no obligation to take part. Even if you say yes now, you may withdraw your child from the study at any time and for any reason by contacting us. Your child may also withdraw at any time by saying that s/he does not want to be a game tester any more.

For general information about how we use your data, go to: edin.ac/privacy-research

Thank you for taking the time to read this.

Appendix D

Game Testing Workshop Permission Form (for parents)

	Please circle
Have you read the information sheets?	YES / NO
Have you received enough information about the study?	YES / NO
Do you understand that participation is completely voluntary, and your child can leave the study at any time, without having to give a reason?	YES / NO

Please sign this page to indicate that you understand and accept the conditions of this study, including audio and video recording. By signing, you agree that the researchers may explain the study to your child and invite him or her to take part as a game tester.

With reference to further anonymous use of video and audio data, please circle yes or no in response to the following (note: even if you say 'No' to this, your child can still participate in the study, but the video and audio data will only be seen by the research team):

> I **AGREE** that short recordings of my child can be used as examples in documents and presentations for research and/or teaching purposes.
>
> YES / NO

If you **give permission** for this study, please fill out the sections below and **return this form to the researchers.**
If you **DO NOT** wish to give permission, **you do not need to do this**. We will not ask your child to participate.

Full name of participating child:

Child's date of birth (DD/MM/YYYY): _____/_____/_____

Your relationship to the child: _____

Your name (please print clearly): _____

Contact telephone number: _____

E-mail address: _____

Signature:

Date: _____ /_____/_____

Appendix E

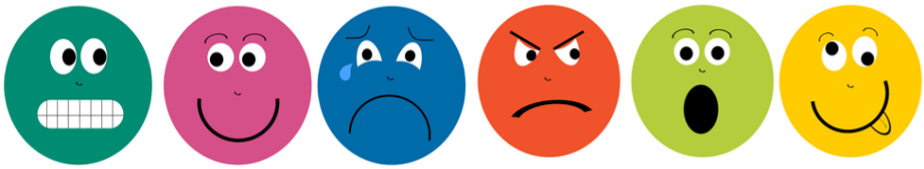
THE UNIVERSITY of EDINBURGH informatics | GAME DESIGNER AWARD

HAPPY SAD EXCITED WORRIED SCARED SURPRISED ANGRY HAPPY SAD EXCITED WORRIED SCARED SURPRISED ANGRY

Presented to

Child Name

For being an excellent games designer! Well done!



Professor Helen Pain
November 2019

THE UNIVERSITY of EDINBURGH informatics | Games Tester Certificate

Presented To

CHILD NAMES

For being a Great Games Tester on the Educational Games Project! Well Done!

Professor Helen Pain
March 2020

Appendix F

Unity Project Resources

Resource	Weblink
Blue Button Image	https://www.cleanpng.com/png-product-design-rectangle-button-png-images-transpa-7193922/
Game Font	https://www.fontsquirrel.com/fonts/chunkfive
Game Title Font	https://www.fontspace.com/khryskreations/kbchatterbox
Trophy Room Shelf Image	https://www.netclipart.com/isee/Tmxmmm_jpg-library-stock-shelf-clipart-shelf-clipart-png/
Trophy Room Books Image	https://www.nicepng.com/ourpic/u2q8i1a9e6y3u2a9_picture-royalty-free-library-collection-of-objects-cartoon/
Trophy Room Teddy Image	https://www.vexels.com/png-svg/preview/134460/cartoon-teddy-bear
Well Done Animation	https://www.netclipart.com/isee/bhJRRw_transparent-well-done-clipart-png/
Try Again Animation	https://www.pngarts.com/explore/131580
Button Emojis	https://pngtree.com/so/emoji
Confetti Animation	https://www.pikpng.com/pngvi/mibTx_free-download-confetti-background-png-transparent-png/
Streamers Animation	http://clipart-library.com/transparent-streamers-cliparts.html
Voice-Over Image	https://www.cleanpng.com/png-volume-computer-icons-sound-icon-volume-1377378/
Trophy Outline	https://www.kissclipart.com/trophy-icon-outline-clipart-trophy-clip-art-a0pj37/
Voice-Over	http://www.fromtexttospeech.com/
Characters and Scenes	https://www.storyboardthat.com/
Drawing Unity Asset	https://assetstore.unity.com/packages/tools/painting/free-draw-simple-drawing-on-sprites-2d-textures-113131
All Sound Effects	https://www.zapsplat.com/