

EasyTrim: Developing a Tool to Overcome Anxiety in Children with Autism at the Hairdresser

Ethan Soreide



Undergraduate Dissertation
Artificial Intelligence and Software Engineering
School of Informatics
University of Edinburgh

2021

Abstract

Anxiety is a major comorbidity associated with Autism Spectrum Conditions (ASC), and can make experiences, like going to the hairdresser, extremely difficult for children on the spectrum. The hypersensitivity of their senses, particularly sound and touch, can trigger challenging behaviour while in the hairdresser's salon. Meeting new people and performing new activities is also very challenging children with ASC. This dissertation proposes to explore how a technology-based educational game can be best designed and developed to support children with ASC cope with their difficulties when visiting a hairdresser's salon. A five-stage design approach was adopted, for gathering design requirements, carrying out design workshops, and building and evaluating both low-fidelity and high-fidelity prototypes. This involved experts in HCI, ASC and Education, and children (including one child with ASC). The empirical data obtained from the summative evaluation of the high-fidelity prototype suggests that the game has the potential to overcome anxiety in children with autism when getting their haircut. However, further evaluation studies with children with ASC are required to collect solid evidence to support the game potential.

Acknowledgements

First, I would like to express my endless gratitude to my project supervisor, Dr. Aurora Constantin, who has gone out of her way to provide first-class help and support during this difficult year. Likewise, I extend my thanks to Dr Helen Pain, Aljawharah Alabdullatif, and Yijun Zhao as their the assistance has been invaluable.

Secondly, I would like to thank all the children and experts who took time out of their busy schedules to provide the great ideas and wonderful feedback used in this research.

A special mention to fellow researchers, Aimee Redbond, Andreas Ghira, Kevin Xue, and Sophia Singh, for their support, guidance, and humor in situations that could have resulted in total disaster.

Finally, to my loving, supporting family and my irreplaceable friends for the endless support, encouragement and laughs they've given me over the last four years - this wouldn't have been possible without you.

Table of Contents

1	Introduction	1
1.1	Motivation	1
1.2	Research Aims and Objectives	1
1.3	Dissertation Structure	2
2	Literature Review	3
2.1	Autism Spectrum Conditions	3
2.1.1	Social Communication and Interaction Impairments	3
2.1.2	Restricted and Repetitive Patterns of Behaviour	4
2.1.3	Prevalence and Underdiagnosis	4
2.2	Anxiety and ASC	5
2.2.1	Prevalence of Anxiety in Autistic Children	5
2.3	Educational Interventions	5
2.3.1	Traditional Interventions	6
2.3.2	Technology-based Interventions	6
2.4	Design Principles	6
2.4.1	ASC Design Guidelines	6
2.4.2	Nielson’s Usability Heuristics	7
2.5	Methodology	7
3	Design Workshop	8
3.1	Design Workshop	8
3.1.1	Aims	8
3.1.2	Participants	8
3.1.3	Materials	9
3.1.4	Procedure	9
3.1.5	Data Collection and Analysis	9
3.1.6	Results	9
3.1.7	Impact on Design	11
4	Low-Fidelity Prototype Design and Evaluation	13
4.1	Low-Fidelity Prototype	13
4.1.1	Choice of Platform	13
4.1.2	Design Description	13
4.2	Formative Evaluation	16
4.2.1	Aims	16

4.2.2	Method	16
4.2.3	Data Collection and Analysis	17
4.2.4	Results	17
4.2.5	Impact on Design	19
5	High-Fidelity Prototype	21
5.1	Choice of Platform	21
5.2	Design Description	21
5.2.1	Home Screen	21
5.2.2	Tool Screens	22
5.2.3	Customisation Screens	24
6	Summative Evaluation	26
6.1	Game Testing Workshop	26
6.1.1	Aims	26
6.1.2	Participants	26
6.1.3	Materials	27
6.1.4	Data Collection and Analysis	27
6.1.5	Results	28
6.2	Summative Expert Evaluation	30
6.2.1	Aims	30
6.2.2	Participants	30
6.2.3	Materials	30
6.2.4	Procedure	30
6.2.5	Data Collection and Analysis	31
6.2.6	Results	31
6.3	Discussion	34
7	Discussion and Conclusion	35
7.1	Research Questions	35
7.1.1	Research Question 1	35
7.1.2	Research Question 2	35
7.1.3	Research Question 3	35
7.1.4	Research Question 4	36
7.2	Limitations	36
7.3	Future Work	37
7.4	Conclusions	37
	Bibliography	38
	A Nielsen’s Usability Heuristics	42
	B Design Workshop Activities	43
	C Design Workshop Child Consent Form and Information Sheet	44
	D Design Workshop Parent Information Sheet	50

E Design and Testing Parent Consent Form	58
F Formative Evaluation Expert Consent Form	63
G Game Testing Workshop Consent Form and Information Sheet	66
H Game Testing Workshop Parent Information Sheet	72
I Game Testing Workshop Activities	80
J Game Testing Workshop Feedback Questions	81
K Summative Evaluation Expert Consent Form	82
L Future Work	85

Chapter 1

Introduction

1.1 Motivation

Anxiety is a common characteristic associated with autism spectrum conditions (ASC) due to the repetitive behaviour one displays [35]. This can make what might seem as mundane experiences, like getting your haircut, all the more difficult and can result in poor hygiene, causing collateral damage to relationships and lifestyle [10]. This is attributed primarily to the hypersensitivity of certain stimuli, such as the sounds of various pieces of equipment, and can trigger challenging behaviour that causes disruption [40][10][33]. Existing methods, such as Social Stories [4] or Calming Clippers [1], can be used to reduce the nervousness of a child, but certain anxieties can still prevail.

This dissertation proposes the exploratory tool ‘EasyTrim’, aimed to desensitise children with autism before a hair appointment by emulating the sounds of various tools, such as hair clippers, hairdryers and scissors, in order familiarise themselves with what to expect and how to overcome their anxiety. This has been designed through an iterative process and evaluated with typically developing (TD) and experts in HCI, ASC and Education to provide empirical evidence that such a tool can be created and is appropriate for the target audience.

1.2 Research Aims and Objectives

The overarching aim of this project is to design and evaluate a technology-based intervention to overcome anxiety in children with autism when visiting the hairdresser. This aim can be broken down into the following research questions:

RQ1: *What can make children nervous about going to the hairdressers?*

RQ2: *What methods are currently in place to tackle anxiety in children with autism?*

RQ3: *How can a tool be designed to overcome anxiety in child with ASC during a hair appointment?*

RQ4: *To what extent does the new tool help children with ASC cope with their anxiety*

during a haircut?

RQ4.1: *To what extent is the new tool enjoyable?*

RQ4.2: *To what extent is the new tool engaging?*

RQ4.3: *How suitable is the tool in terms of addressing anxiety in children when visiting a hairdresser?*

1.3 Dissertation Structure

This dissertation is broken down into seven chapters, each detailing important steps of the project:

Chapter 2: This chapter includes a literature review of autism, anxiety contributing to ASC, current interventions, and design principles and methods. This chapter focuses on RQ2.

Chapter 3: This chapter details the design workshop carried out to inform the design of the tool. This chapter focuses on RQ1 and RQ3.

Chapter 4: This chapter describes the design of the low-fidelity prototype and the subsequent formative evaluation. This chapter focuses on RQ2 and RQ3.

Chapter 5: This chapter describes the design and implementation of the high-fidelity prototype. This chapter focuses on RQ3.

Chapter 6: This chapter details the summative evaluations of the high-fidelity prototype. This chapter focuses on RQ4 and the sub-questions RQ4.1, RQ4.2, and RQ4.3.

Chapter 7: This chapter concludes the dissertation by analysing the research findings and results from the evaluation, and proposing steps for future work.

Chapter 2

Literature Review

This chapter presents the background research carried out on autism, anxiety, existing interventions, and design methods. The findings help to answer **RQ2**: *What methods are currently in place to tackle anxiety in children with autism?*

2.1 Autism Spectrum Conditions

Autism spectrum conditions (ASC) are lifelong developmental conditions primarily characterised by difficulties in social communication and interaction along with restricted and repetitive patterns of behaviour or interests [6].

Originally thought to be a symptom of schizophrenia, Leo Kanner first observed what is now known as autism in 1943 when studying eleven children who each displayed unconventional behaviour. Although this behaviour was associated with schizophrenia, he noted that these children showed different symptoms to previous cases observed in childhood [23].

Autism is said to be a heterogeneous condition, given the complex and varied traits associated with it, with some children displaying exceptionally high or exceptionally low intelligence, and differing the verbal or nonverbal natures [19].

The criteria outlined in DSM-V are the core characteristics of ASD, and these indications are apparent in early childhood, impacting day-to-day functioning [6]. These symptoms of ASD are shown to be notably correlated with anxiety and depression in individuals, and can severely impact families by contributing to internal conflict [24].

2.1.1 Social Communication and Interaction Impairments

Social impairments regarding ASD are extensive but ultimately depend on age, intellect, and, most commonly, language ability. Although one may have an understanding of the language, their use of these skills may be impaired and, in some cases, may result in the total lack of speech [6][19][27].

Some young children with ASD are often unable to share their emotions or interact

with their peers. They are less likely to partake in conversations with people or share their feelings, but instead tend to describe certain objects and ideas, which can contribute to the feelings of loneliness. Furthermore, when interacting with adults, they may not be able to process certain social cues, such as when and how to join a conversation or if what they are saying is appropriate [6][9][26].

Not only can those with ASD struggle with verbal communication, they also display nonverbal deficits. Most commonly, individuals are able to maintain eye contact or read facial expressions but also apparent is the lack of pointing at a young age or the failure to follow someone doing so. Although some people can learn a few nonverbal, functional gestures, they are unlikely to use or understand these when communicating [6][12][37][11].

The failure to develop, maintain and understand relationships is common for those diagnosed with ASD. In early developmental stages, children may prefer their own company rather than playing with others and often lack some imagination from age inappropriate pretend playing. As a child progresses in life, they may become fixated and insist on playing by a set of rules or display inappropriate behaviour in certain situations, such as job interviews. When forming friendships, it is not uncommon for individuals to form these with those outside their age group and may not grasp the understanding of what a friendship involves or entails [6][9][42].

2.1.2 Restricted and Repetitive Patterns of Behaviour

Restricted, repetitive patterns of behaviour, interests, or activities is another key indicator that one may be autistic and can show a range of manifestations dependent on age, ability and any current intervention and support. Common and stereotypical repetitive behaviours associated with ASD include persistent, rhythmic movements, such as hand flapping, repetitive use of the same object, and echolalia [6][18].

Due to the excessive reliance and attachment to routines, small changes, even packaging changes of certain foods, may cause distress to those with ASD. Furthermore, attachments and fixed interests to unusual household items, such as washing machines, are common and highly restrictive [6][38]. Such attachments or routines often relate to hypo- or hyperactivity to sensory inputs. These are manifested by an extreme response or reaction to a specific sense, such as excessive touching of an object or overstimulation when hearing music. In some cases, individuals may appear indifferent to pain or temperatures [6][32].

2.1.3 Prevalence and Underdiagnosis

Autism is said to affect just over 1% of the UK population (700,000) but is slightly more prevalent in children (1.6%) [25]. Although it is more commonly diagnosed in men than women, this is likely due to the underdiagnosis of ASC in females [25] [20]. ASC is usually associated with interest in hobbies that are stereotypical with males, but girls with ASC are more likely to imitate the behaviour or share the same interests as their peers, making it more difficult to diagnose as this does not fit with what is assumed to be stereotypical behaviour of ASD [20]. Underdiagnosis is also

suggested to be true for gender-fluid and non-binary individuals, as well as those from ethnic minorities [25].

2.2 Anxiety and ASC

Anxiety is a broad topic that covers a large range of disorders, such as agoraphobia and panic attacks, which have common features of excessive fear and anxiety and behavioural disturbances related to these. These disorders differentiate from one another in the types of objects or situations that induce fear, anxiety, or avoidance behaviour with the most common being generalised anxiety disorder (GAD). GAD causes persistent and excessive anxiety and worrying about situations that an individual finds it difficult to control. Moreover, one may also experience physical symptoms such as restlessness, tiredness and the inability to concentrate [6][7].

Children with autism can experience anxiety more regularly and extreme [35]. As young people with ASD can experience difficulties conveying emotion, it can be hard for their parents or carers to realise they are feeling anxious. In most cases, there are certain triggers that bring this on, some of the most common being changes to routines or environments, new or unfamiliar social situations, sensitivity to certain noises or lights, and fear of new or familiar situations, activities or objects [40], and allow for the display of challenging behaviours to arise [33]. These triggers can make basic procedures, such as getting your haircut, more difficult due to the hypersensitivity of the individual [10].

2.2.1 Prevalence of Anxiety in Autistic Children

Social anxiety is the most common psychiatric disorder to accompany ASD in children with around nearly 30% with both, followed by ADHD (28%). Nearly 40% of children with ASD experience at least one anxiety disorder, with the most common types being related to a specific phobia (29.8%), obsessive-compulsive disorder (OCD) (17.4%) and social anxiety disorder (SAD) (16.6%) [45][43]. A study taken in 2018 observed that over 90% of autistic children met the criteria for two or more anxiety disorders, the most prevalent being SAD (41.7%) and GAD (25.9%)[45][44]. A further study suggests that 70% of children with ASD have at least one concurrent disorder, again the most prevalent being SAD, followed by attention-deficit/hyperactivity disorder (ADHD) [39].

2.3 Educational Interventions

Over the years, a plethora of educational interventions have been designed for children with ASC to better understand and cope with certain difficulties. These can vary in success, but there are key elements of a tool to ensure that they convey the intended outcome, such as associating different treatments at various ages, and rewards for positive [15].

2.3.1 Traditional Interventions

Traditional interventions usually take the form of one-on-one sessions with a practitioner, and differentiate on what activities are carried out, how long these interventions last, and what type of reinforcement is used. There are three main types of traditional, early approaches: developmental-response approaches, to focus on building a positive relationship with the child and those intervening; discrete trial training, to teach a child a skill through repetition; and transitional approaches, by using game like methods to reinforce social interaction [47].

2.3.2 Technology-based Interventions

Technology-based interventions for autism are preferred by an individual due to the predictability and consistency they provide, as well as the lack of social skills or interaction needed to use. These methods can be used to improve certain skills, such as communication and social skills, life and organisational skills, and promote independence [28].

Not only are the use of these tools aimed for children with intellectual disabilities (ID) to improve life skills, they can be also used in conjunction with parents or carers as references. The development of such interventions has significantly increased in the last twenty years with the improvement, creation or furthering of technologies, such as mobile phones, tablets, and virtual reality [22].

Autistic children tend to spend double the amount of time playing video games than TD children. It is believed that this is due to the fact that video games are able to manage moods and anxieties, and promote stress relief [29].

2.4 Design Principles

2.4.1 ASC Design Guidelines

The paper published by Bartoli et al. (2014) proposes a set of design principles that should be considered when designing a game for children with ASC [8]. These include, but are not limited to:

DGA_1: Games should include have a vast choice of customisability and based on the preferences of the child.

DGA_2: There should be game goal that is unique and explicit.

DGA_3: There should be a list of concise instructions throughout the game.

DGA_4: Rewards should be given for successful achievements to increase engagement and motivation.

DGA_5: The game should be easy to repeat and predictable each time.

DGA_6: Visual and sound effects are encouraged, and should be clear and moderately loud.

DGA_7: The game should be easy to navigate.

DGA_8: Text should be clear and simple to understand, images should be large and easy to see, and colours should have a soft tone.

2.4.2 Nielsen's Usability Heuristics

In addition to the aforementioned design guidelines that should be taken into account, it is important to consider the human-computer interaction principles outlined by the ten usability heuristics proposed by Nielsen in 1994 [30]. These are further described in the Appendix A, and will be referenced as **NUH** throughout the paper.

2.5 Methodology

Scaife and Rogers (2001) propose a five-stage approach to designing a virtual environment to support learning in children, and show how general user-centered design methods can be used to tackle specific issues [36]. This form of methodology inspires the structure for this dissertation. The first stage involves the gathering of the high-level requirements needed for design of a tool for the target audience, basing the decisions on existing research and theory as presented in the literature review. This stage is followed by design workshops involving typically developing children presented in Chapter 3. Using the design ideas and requirements, the next step of this process is to design a low-fidelity prototype, as presented in Chapter 4. Following this, is the creation of a high-fidelity prototype, taking into account any feedback from the previous design iteration, that is suitable for testing by children and experts, as presented in Chapter 5. This process will conclude with a final evaluation stage of the high-fidelity prototype with TD children to assess the usability, enjoyment and engagement of the application. Additionally, feedback from experts will also be acquired to determine if the tool is appropriate for the target audience, as presented in Chapter 6.

Chapter 3

Design Workshop

This chapter presents the workshop which was carried out with children to inform the design of the tool. The findings in the workshop help answer **RQ1**: *What can make children nervous about going to the hairdressers?* and **RQ3**: *How can a tool be designed to overcome anxiety in children with ASC during a hair appointment?*.

3.1 Design Workshop

The design workshop was organised to better understand what children worry about, and to gather design ideas and requirements for an educational game.

3.1.1 Aims

The aims for this workshop were to **1)** Find out what makes children worried when visiting the hairdresser, **2)** Find out if children have any strategies to cope with these worries. **3)** Find out design ideas for a game, such as characters, narratives and rewards.

3.1.2 Participants

Table 6.1. details the information about the five children who agreed to take part in the workshop. Of the five participants, P1 is the only child that is diagnosed with ASC, and was given an individual session. This was done because of the social deficits children with autism have, as well as the unpredictability of their behaviours, as mentioned in the literature.

Anonymised ID	Age	Sex	Sibling
P1	6	Male	N/A
P2	12	Female	P3
P3	9	Female	P2
P4	13	Male	P5
P5	13	Male	P4

Table 3.1: Design workshop participants

3.1.3 Materials

Participants were asked to use a personal computer to access the meeting, and bring sheets of blank paper and coloured pencils to complete the activities. Likewise, researchers used their personal computer, as well as a mobile phone to backup recordings.

3.1.4 Procedure

Two researchers participated in this study, with the principal researcher (PR) leading the workshop and the other taking notes.

Ethics approval was received by the School of Informatics Ethics Committee (Ref. 2019/70963). Emails containing consent forms and participant information sheets were sent out on behalf of the researchers by supervisors to contact parents of children aged between 6 and 13 years old. Due to ongoing government restrictions, access to university buildings was unavailable and these workshops were carried out remotely using Microsoft Teams. Both sessions took place in the same day and lasted around thirty minutes each.

After everyone had joined the session and recording had started, a short icebreaker exercise was given to the children to familiarise the researchers and participants with one another before beginning three tasks related to the aims. These focused on a fictional story, following the Fictional Inquiry method [17], in which the participants could relate to, using their own experiences to answer the aims of the workshop. More information about the content of these tasks can be found in the Appendix B.

Once completing the final activity, the recordings were stopped and the children were thanked for their participation. Copies of all the documents and materials from this workshop can be found in the Appendices C to E.

3.1.5 Data Collection and Analysis

The video recordings, researcher's notes, and the drawings from the children were all collected. These recordings were transcribed and analysed together with the other collected materials using thematic analysis [13]. This resulted in the themes **1) Worries and Anxieties** **2) Coping Strategies** **3) Game Ideas** **4) Customisation** **5) Rewards**.

3.1.6 Results

3.1.6.1 Worries and Anxieties

A unanimous answer was that meeting new people was a major contribution to worries caused when entering an unfamiliar environment and was mentioned by every single participant. P5 singled out an experience attending Scouts where they were the only person who did not know anyone else: *“My first day going to Scouts was a bit scary - I didn't know anyone there and everyone else was having fun. It made me feel very left out and nervous.”*

P1 expressed their discomfort at the assortment of loud noises one would hear when visiting hairdressers, particularly the hair clippers: *“I don’t like the noise of loud engines. Tractors have loud engines and they make me scared. ... It is the same with the hair clippers at the hairdresser. The buzzing sound makes me frightened.”*.

Additionally, they also mentioned that the feel of someone else’s hands in their hair makes them feel a bit overwhelmed and uncomfortable: *“When someone puts their hands in my hair it’s weird feeling. I don’t like people touching my hair.”*.

P3 commented that someone unfamiliar with the different tools and equipment a hairdresser would use which might cause worrying: *“The hairdresser has lots of tools on their work space. Lots of them I don’t know what they do. I am scared they might accidentally hurt me or ruin my hair.”*.

3.1.6.2 Coping Strategies

P2 said they would become less worried if they were given a proper introduction to new people, and vice versa, in a unfamiliar setting, as well their surroundings: *“When people are friendly and introduce themselves to you, it makes me less worried because they are usually nice”*.

To combat the loud noises, P1 wears earplugs or sometimes headphones that play music to drown out the sound that he would recommend to others who feel the same way. Ideally, they would like the tools to play different sounds, such as calming music: *“I always have earplugs with me in case there are sounds I do not like. Sometimes I have headphones on with calming music so I don’t hear any of them. I think hair clippers should play calming music instead of the loud buzzing. That would make me feel better.”*.

P3 furthered their previous remark by suggesting that the hairdresser could first show and explain all the equipment that would be using, allowing them to listen and feel what they are like.

3.1.6.3 Game Ideas

P1 expressed interest in having a toolkit to explain and explore different tools that one may encounter in a situation like this. This would be intended to let children know what things they would expect prior to their appointment. This idea was reiterated by P4 with a similar justification: *“I think it would be a good idea to see all the things the hairdresser will use before going to the appointment. You could have different tools and listen to the sounds they would make.”*.

In case of a failure of communication between the customer and hairdresser, P5 suggested having a translation exercise. This could be used by both the customer and hairdresser in order to better understand one another.

P2 proposed including an interactive mirror where users could see how they looked with an assortment of hair styles: *“You could swipe on the different styles that you like and see what you would look like with them.”*

3.1.6.4 Customisation

P1 talked about their love of the video game Minecraft where they could design and create different buildings to their own preference. They suggested that users should be given the ability to similarly do so in this game: *“You should be able to create and customise an office or shop where they can choose their own layout and styles of furniture.”*

P4 suggested that various hairstyles could be unlocked to customise customers or hair-dressers included in a game.

3.1.6.5 Rewards

P1 mentioned that nearly everything about the interface should be customisable, and could be unlocked as rewards: *“Furniture [such as chairs, desks and mirrors] for customisation could be unlocked as rewards for completing tasks”*. Similarly, P4 suggested unlocking hairstyles to customise characters could be unlocked for completing tasks.

P5 mentioned they were always excited about getting the potential of getting a lollipop after their haircut, and this should also be used as a reward in this game: *“The favourite part about getting my haircut is being given a lollipop afterwards.”*

3.1.7 Impact on Design

Based on literature discussed and the results of the design workshop, a set of initial design requirements can be made for a low-fidelity prototype. These requirements can be broken down into four categories: **1) User Requirements; 2) Task Requirements; 3) Interface Requirements; 4) Learning Requirements.**

3.1.7.1 User Requirements

The target audience are children with ASC aged between 4 and 11 years old. This age range partly covers the pre-operational and entire concrete operational stages of cognitive development as outlined by Piaget [34]. Although the pre-operational stage begins at two-years-old, digital literacy is essential part of this tool as it is a technology based intervention, and therefore the age range has been partially increased to take account of this [31]. All children will be able to represent objects by images and words and classify objects by a single feature during this stage, whereas older children will be capable of more logical and methodical thought [31].

3.1.7.2 Task Requirements

The tool is designed to be an exploratory exercise of a barbershop, given the comments in the design workshop about the uncertainty and unfamiliarity. This should feature a high-degree of customisability, rewards for successful engagement, and be easy to repeat, as noted in the ASC specific guidelines in Section 2.4.1..

3.1.7.3 Interface Requirements

The tool should start with a simple home interface, with large, easy to see icons as based on DGA_8. Additionally, any text on the screen should be clear to read and understand, and any colours used should be given a soft tone. Furthermore, the navigation should be easy to follow and laid out appropriately.

3.1.7.4 Learning Requirements

The application should emulate the sounds of different pieces of equipment that would be heard when getting your haircut. This is intended to allow children to familiarise and prepare themselves with what they might expect in a real-life situation.

Chapter 4

Low-Fidelity Prototype Design and Evaluation

This chapter presents the design and subsequent evaluation of the low-fidelity prototype. The findings from this chapter help answer **RQ2**: *What methods are currently in place to tackle anxiety in children with autism?* and **RQ3**: *How can a tool be designed to overcome anxiety in children with ASC during a hair appointment?*.

4.1 Low-Fidelity Prototype

The low-fidelity prototype was created to visualise the ideas presented in the design workshops and takes in to account the ASC specific design principles as mentioned in Section 2.4.1.

4.1.1 Choice of Platform

Based on the initial design requirements, a low-fidelity prototype of the tool was developed using Figma, a prototyping tool [3]. This was chosen based on previous experience using this software to design wireframes, as well as the ability to connect interfaces to simulate navigation as if it were a fully-developed application. This was considered to be beneficial for evaluation of the prototype to give participants the idea of how the app would function and work. Compared to paper prototyping, Figma would give a better understanding of how a high-fidelity prototype would look and work.

4.1.2 Design Description

4.1.2.1 Home Screen

The application opens up on a screen resembling a barber shop (Figure 4.1.), with an assortment of equipment associated with the hairdressers, as well as a chair and mirror, that can be clicked on to learn more about the tool, based on suggestions from the design workshop. Images of these tools instead of text were chosen to follow

Nielsen's second and sixth usability heuristics (see Appendix A) and the eighth ASC specific principle, as mentioned in Section 2.4.1.. The sources of these images can be found in the appendix.



Figure 4.1: Home Screen for EasyTrim in Figma

The main idea of this tool was to explore a hairdresser's salon and the equipment that would be found there, based on a game idea from the design workshop. With a tool like this, users would be able to get a feel of what they would be likely to experience.

In the top left corner of the screen is a settings button. This will take users to a customisation screen where they will be able to change the background colour of the tool. Again, this was based on the feedback from the design workshop where participants expressed their fondness of customisation, as well as DGA_1. Further explanation about customisation can be found in Section 4.1.2.3.

It should be noted that there are no rewards or clear narrative implemented this point. Although these are necessary to include, based on the design workshops and DGA_4, it was felt clearer guidance was needed for this and to be discussed in the evaluation of the low-fidelity prototype.

Additionally, a simplistic design for the home screen, with little text and clickable objects, in line with DGA_7.

4.1.2.2 Selecting a Tool

Once a tool has been selected, users will be taken to a new screen, similar to what can be seen in Figure 4.2. Here, the piece of equipment is explained to the user by a hairdresser character, as it was mentioned in the design workshop that a guided walk-through of each tool would be beneficial to reducing anxiety. The text used for this explanation is made simple, clear and easy to understand based on DGA_8.

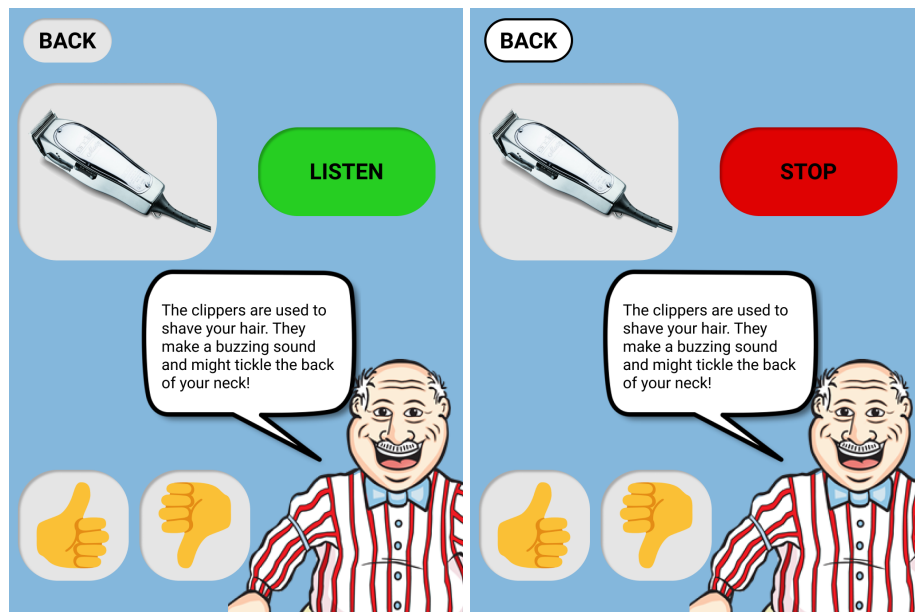


Figure 4.2: Information about clippers (1) where sound is muted; (2) where sound is playing

Users are given the option to listen to the sound of the tool, to emulate the noise of what they might expect in real-life. By clicking the "Listen" button, a sound will play and can be stopped when clicking the same button again, now called "Stop" (Figure 4.2.2). Not only was this chosen based on ideas from the game workshop, this also follows DGA_5 and DGA_6.

Finally, users can vote how they feel about the piece of equipment using the thumbs up and thumbs down buttons, following NUH_2. This can be used as reflection, not only for the child, but also for the parent who will understand what they need to work on before their next visit to the hairdresser. These buttons have been made very large to follow NUH_1 and DGA_8.

The images in Figure 4.2 show the tool information for the clippers, but a similar layout and design is taken for every one of the tools (scissors, hairdryer, water spray). This was done to follow NUH_4.

4.1.2.3 Background Customisation

A key feature included when creating a tool for children with ASC should be the ability to customise, as mentioned in DGA_1. For this prototype, users are given the ability to change the colour of the background. A variety of colours were given to allow a high-degree of customisability, and a soft tone for each colour was given to follow DGA_1 and DGA_8. The starting colour is a soft, neutral blue, given the preference in children with ASC towards this colour [21], and can be changed when clicking on a coloured button. The background for the chosen colour is white, and will turn to grey when another button is pressed. This transition can be seen in Figure 4.3.

Ideally, customisation of the character and shop furniture or tools should be included

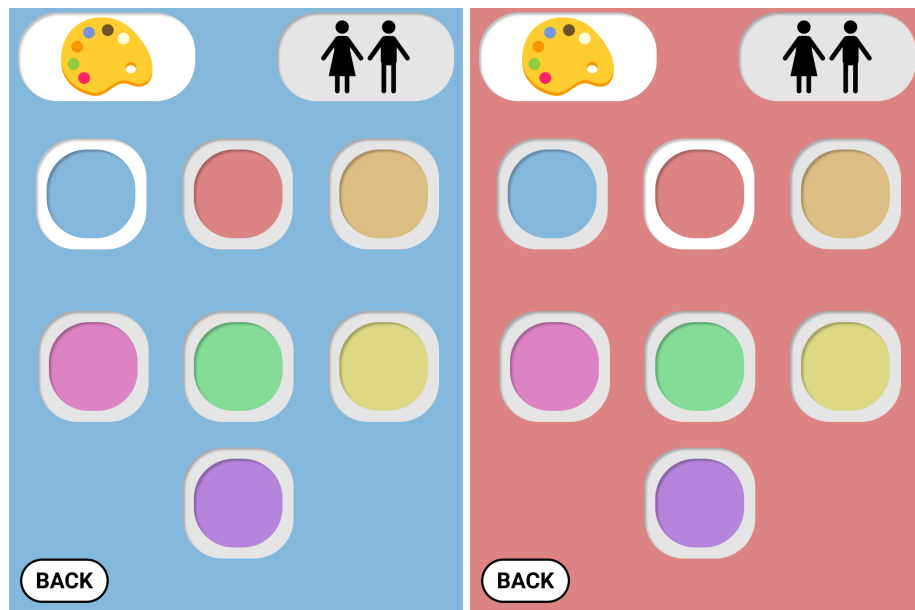


Figure 4.3: 1) Blue background chosen; (2) Red background chosen

as well, as mentioned from the design workshops.

4.2 Formative Evaluation

The formative evaluation was organised to receive feedback of the low-fidelity prototype from experts in fields related to the topic of the project, as well as further knowledge in what needs to be included when designing a tool for this target audience.

4.2.1 Aims

The aims for this evaluation were to: **1)** Gather suggestions for new features to be included when creating a tool for children with autism to cope with anxiety; **2)** Find any usability problems with the low-fidelity prototype; **3)** Find ways to change or improve the low-fidelity prototype to better suit the target audience..

4.2.2 Method

4.2.2.1 Participants

Table 4.1. details the information about the three experts who agreed to participate.

4.2.2.2 Materials

Both expert participants and researchers used a personal computer to access the meeting. A mobile phone was additionally used by the researcher for a back-up recording.

Anonymised ID	Profession/Occupation	Specialist Area
E1	Professor of Education at University of Edinburgh	Background in Psychology; Family member with ASC
E2	PhD Student at University of Edinburgh	Researcher in HCI, ASC and Assistive Technologies.
E3	Lecturer at University of Edinburgh	Background in HCI and Software Engineering

Table 4.1: Experts involved in formative evaluation

4.2.2.3 Procedure

Ethics approval was received by the School of Informatics Ethics Committee (Ref. 2019/70963). Invitations to the meetings were emailed to the expert participants days in advance, along with the participant information sheets and consent forms. These evaluations were conducted over Microsoft Teams and lasted approximately thirty minutes.

A demonstration of the low-fidelity prototype was given, sharing a link with experts to access. After a guided walk-through of the design thoughts and ideas so far, experts were asked to give their feedback on the prototype.

Copies of all the documents and materials from this evaluation can be found in the Appendix F.

4.2.3 Data Collection and Analysis

The video recordings and researcher's notes were all collected. The recordings were transcribed and analysed together with the notes using thematic analysis [13]. This resulted in the following themes: **1)** Specific ASC Design; **2)** Coping with Anxiety; **3)** Customisation; **4)** Rewards; **5)** Additional Features.

4.2.4 Results

4.2.4.1 Specific ASC Design

E1 proposed the idea of planning and building up to an experience getting your haircut a fitting method for an exploratory tool: *“The underlying ideas [of going to hairdresser] are this is a routine or break from routine. A game like this should plan and build up to this, and include a narrative that shows what going to the hairdressers looks like.”*.

Contradictory to the literature, E2 suggested that a game for children with ASC should not be repetitive. It should, however, allow progression to keep users engaged: *“Assistive technology needs to be non-repetitive to be engaging for children with autism. The ability to progress and change keeps them coming back to use again.”*.

Furthermore, they also suggested that there doesn't have to be a narrative structure but should incorporate some elements of this: *“The app could have a game aspect but the*

app itself does not have to necessarily be a game.”. Additionally, they reiterated the need for rewards and customisability several times during the evaluation, .

Likewise, E3 said they key features for designing a tool for children with autism are rewards and the option to customise: *“There are common characteristics creating a game for children with autism needs to have in order to keep them engaged. An app would need to be game like and customisable to an individuals needs. Rewards are key for this target audience as well and should again be customisable to things they enjoy.”.*

4.2.4.2 Coping with Anxiety

The idea of emulating certain sounds of anxieties and focusing on what might induce anxiety at the hairdresser was well received by all experts. E2 commented that *“the option to view the tool, see what it does, how it might feel and what it might sound like would be a very useful part of the app.”.*

E1 suggested giving children a set of experiences they will able to apply and effectively use to overcome anxieties in real world situations: *“An approach to coping with anxieties is desensitisation and learning about what is going to happen. A scenario of what is likely going to happen at the hairdressers could be given and show each stage unfolding. An aim could be to allow children to control the duration and ranges of these experiences. ”.*

4.2.4.3 Customisation

E1 stated that allowing a customisable background is beneficial to cater to the various preferences: *“The idea to make the background configurable is a good idea that should be further implemented as children will respond in different ways.”.*

A comment made by E3 was there should be more customisable options as this is a very male-centered environment: *“Children should be given the option to choose which environment or setting they prefer and there should be more features accessible to women.”.*

4.2.4.4 Rewards

The importance of including rewards was highlighted throughout each evaluation, and is line with the finding by Constantin et al. (2017) [14]. E1 said *“these could be given as tolerance to certain stimuli, such as sound, or once a child has completed everything in a visual schedule.”.*

4.2.4.5 Additional Features

E2 suggested that having a step-by-step plan of what getting your haircut involves which could be a beneficial exercise to reduce anxiety by familiarising themselves with the procedure: *“A visual timeline, similar to a Social Story, of what is going to happen, such as going to reception, sitting in the waiting area, going to the seat and being given a gown, could be used to give users an idea of what to expect.”.*

E3 proposed including short, humorous video clips of people getting their haircut to relax any nerves and make light of the situation: *“Adding sound and visuals to this tool would be worthwhile additions and it would be beneficial for the user to put themselves in the shoes of both the customer and hairdresser.”*

Additionally, when emulating sounds of different tools, the volume could be changed to see how loud they can tolerate: *“The volume of a tool could be increased to see how a child copes with a particular sound.”*

Finally, they suggested letting children be able to see themselves on the screen and add hairstyle filters to see how they would look with certain haircuts could be a worthwhile addition: *“Having the mirror seen on the home screen utilise the camera built into the tablet could be a good idea.”*

4.2.5 Impact on Design

The results from the evaluation provide additional design requirements for the high-fidelity prototype. Along with those listed in Chapter 3, these can once again be broken down into four categories: **1) User Requirements; 2) Task Requirements; 3) Interface Requirements; 4) Learning Requirements.**

4.2.5.1 User Requirements

The target audience are children with ASC aged between 4 and 11 years old. This requirement was not furthered during this section and the reasoning behind chosen this chosen target audience is highlighted in Section 3.1.7.1.

4.2.5.2 Task Requirements

The tool should continue be designed as an exploratory exercise of a barbershop, as mentioned in Section 3.1.7.2.. This will allow children to view different pieces of equipment, see what it does, how it might sound and how it might feel, by emulating noises of the tools to allow for desensitisation in which users will be rewarded for their tolerance to the stimuli. This objective should be easy to repeat, and the game should offer a high-degree of customisability. Videos should also be included for better engagement.

4.2.5.3 Interface Requirements

The tool should start with a simple home interface, with large, easy to see icons as based on DGA_8. Additionally, any text on the screen should be clear to read and understand, and any colours used should be given a soft tone. Furthermore, the navigation should be easy to follow and laid out appropriately, and be consistent throughout. Buttons to change the volume, and play and pause features should be included. There should also be options to customise the environment to be accessible to both boys and girls, given the feedback.

4.2.5.4 Learning Requirements

The application should emulate the sounds of different pieces of equipment that would be heard when getting your haircut. This is intended to allow children to familiarise and prepare themselves with what they might expect in a real-life situation.

Chapter 5

High-Fidelity Prototype

This chapter presents the design and development of the high-fidelity prototype. The findings from this chapter partially answer **RQ3**: *How can a tool be designed to overcome anxiety in children with ASC during a hair appointment?*.

5.1 Choice of Platform

To create the high-fidelity prototype, the cross-platform game engine Unity was chosen [5]. This can be used to develop 2D and 3D games using C#, and was chosen due to familiarly the researcher had with other object-orientated languages. The engine consists of pre-built functions, along with the option to create your own scripts. Unity provides many advantages to game design with the simple user interface, and the ability to export apps to multiple platforms. Full environments can be created for exploration, which benefits the exploratory tool that planned to be implemented. Additionally, the option to import your own game objects allows for unique customisation that can tailored to the user, a key requirement for creating a game for children with autism as highlighted in Chapters 2 and 3.

5.2 Design Description

5.2.1 Home Screen

Similarly to the low-fidelity prototype, the default home screen for the app features a typical layout for a barbershop on a blue background (Figure 5.1.). However, notable additions are the rewards counter in the top right-hand corner and the prompt for users to click on the different tools to explore to clearly instruct users what they should do, as specified by DGA_3. This prompt looks similar to a button, but has a orange background to differentiate this. The text on this, and throughout the tool, is written in Comic Sans, a font proven to be suitable for children with autism [46].

A simple and not too cluttered layout had been chosen for the home page based on to allow for simple navigation, in line with DGA_7. Once again, images of the tools



Figure 5.1: EasyTrim Home Screen

has been chosen for recognition over recall and those transparent signify these are unimplemented. These have been made large and easy to see, as required by DGA_8. These can be clicked to explore more information about the tools, by transitioning to a different game scene. Additionally, a settings button appears once again to allow customisation of the tool.

5.2.2 Tool Screens



Figure 5.2: Clippers Screen

After selecting a tool to explore, a screen similar to Figure 5.2. appears. This is done by a transition of scenes from a created C# file. Like with the low-fidelity prototype, users are given the option to listen to the sound of the tools and select their feelings towards it. However, new additions including the prompts and rewards bar, which are further explained below. Additionally, a hidden video is also included, as proposed in the expert evaluation.

Sound

Above the play and pause buttons, a caption prompts users to interact with these and listen to the sound of the tool for a reward. A prompt was added because of the need for concise instructions, as outlined by in DGA_3. Furthermore, this follows DGA_2 by explicitly telling the user the goal - by listening to the sound you will be rewarded. When the play button is clicked, it will turn green to indicate there is a change and a recording of the sound of the tool is played. This starts out relatively quiet, being at 10% of the original volume, as to not cause any sensory overloads [16] and follows the design guideline DGA_6 that these sounds should be audible, but not overly loud. The volume can be increased, however, using the slider below the play and pause buttons.

The option to do so was included based on a comment from the formative evaluation, and was implemented by creating a new C# script. This sound is played on a loop until the user clicks the pause button.



Figure 5.3: (1) Pop-up prompting to select reward, and (2) Reward is chosen

For each second the sound plays, the user is rewarded one lollipop for their tolerance to the stimuli, a method of rewarding as suggested in the expert evaluation. After 10 seconds, a pop-up appears (Figure 5.3.1) offering an additional reward for coping with the sound, and prompts users to vote for their feelings towards the tool. Again, this is done as a reward for tolerance to the stimuli and follows DGA_2 to increase engagement. A selection of rewards is given as customisability is a key factor to developing a tool for children with autism, and gives the option to repeat the tasks, which follows DGA_5. Once selected, this prize will appear next to the hairdresser character (Figure 5.3.2) and the task can be repeated to choose multiple rewards.

Video

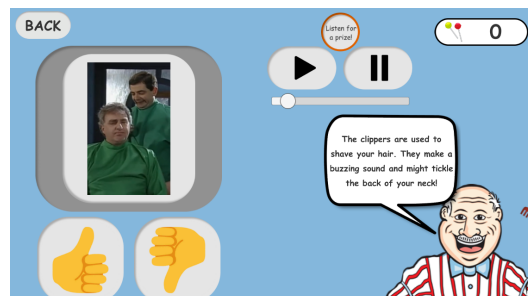


Figure 5.4: Video is playing

Figure 5.2. includes a prompt next to the image of the tool saying "Click Me" and when done, this image is swapped for a humorous video (Figure 5.4.). Based on the suggestion that short, humorous clips should be included in the tool by one of the experts, this aids to relax the child about the use of the tool. Furthermore, the use of visuals increase engagement mentioned in DGA_4 and DGA_6. In the case of the clippers, an edited YouTube video of Mr. Bean¹ using said tool is shown [2]. This video acts as a placeholder for the potential videos that could be added, including more instructional ones. When clicking on the light grey background, the original image

¹[https://en.wikipedia.org/wiki/Mr._Bean_\(character\)](https://en.wikipedia.org/wiki/Mr._Bean_(character))

will reappear. This has only been implemented for the clippers and would preferably be available to view for all types of tools, but because of lack of video materials, this was unavailable.

Voting



Figure 5.5: (1) Thumbs up selected and (2) Thumbs down selected.

Below the image of the tool are two large buttons, one with thumbs up and one with thumbs down (Figure 5.5.). The idea for this is that children would select one of these options to mark how they would feel encountering that tool in a real life experience. This can be changed, however, only one may be selected at a time. This can be used as reference for parents or carers to check how a child feels about a certain tool. The large buttons with recognisable icons was chosen based on the DGA_8.

5.2.3 Customisation Screens

The literature (DGA_1) and expert evaluation extensively highlight customisation as one of the most important parts about designing a tool for children with autism. The different customisation pages (colour and character) are differentiated by tabs. The colour palette will show the colour page (Figure 5.6), whereas the person next to the barber pole will show the character options (Figure 5.7.). The use of icons follows NUH_6 and DGA_8. The selected page is given a white button background, and the unselected one has a grey background.

Colour

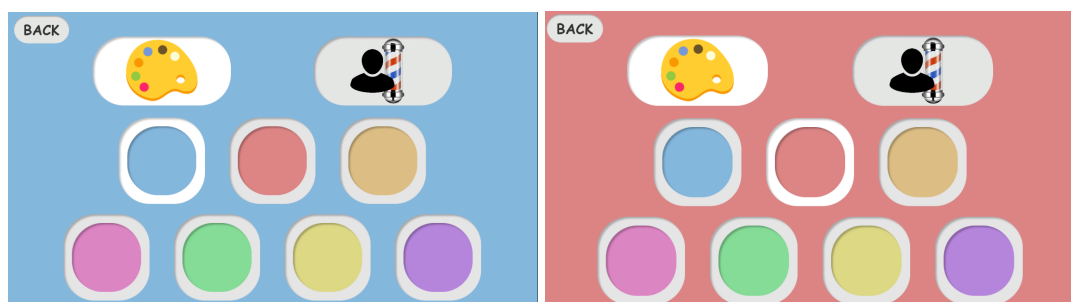


Figure 5.6: (1) Blue background chosen; (2) Red background chosen

Similarly to the low-fidelity prototype, users are given the ability to change the colour of the background, with a vast range of options for customisability. Once again, the

starting colour is a soft, neutral blue, given the preference in children with ASC towards this colour [21] and can be changed when clicking on another coloured button. The background for the chosen colour is white, and will turn to grey when another is pressed.

Character

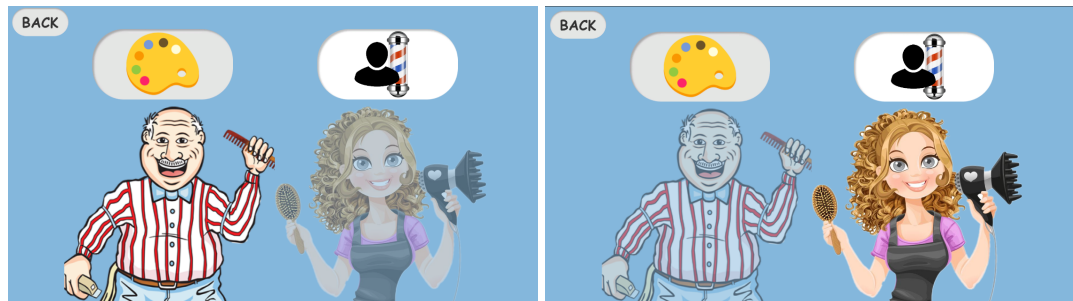


Figure 5.7: (1) Male character chosen; (2) Female character chosen

The character customisation options has a very similar reasoning to the colour choices. Large images are used, following DGA_8, and the unselected character is partially transparent (Figure 5.7.). Although the customisation range is not as great as the options for colours, this gives an idea about the potential of what can be done.

Chapter 6

Summative Evaluation

This chapter presents the evaluations of the high-fidelity prototype involving both children and experts. The findings from this chapter help answer **RQ4**: *To what extent does the new tool help children with ASC cope with their anxiety during a haircut?*, **RQ4.1**: *To what extent is the new tool enjoyable?*, **RQ4.2**: *To what extent is the new tool engaging?*, and **RQ4.3**: *How suitable is the tool in terms of addressing anxiety in children when visiting a hairdresser?*.

6.1 Game Testing Workshop

6.1.1 Aims

The aims for this workshop were to: **1)** Determine if children find this tool enjoyable, engaging, and easy to use; **2)** Determine if the design and functionality is suitable for the target audience; **3)** Determine if this is an appropriate method for overcoming anxiety at the hairdresser; **4)** Find ways to further improve the tool.

6.1.2 Participants

Table 6.1. details the information about the three TD children who agreed to take part in the workshop. Two children (P2 and P3) who took part in the design workshop returned and are denoted with the same anonymous ID as before. However, unlike last time, the evaluation was conducted individually.

Anonymised ID	Age	Sex	Sibling
P1	11	Male	N/A
P2	12	Female	P3
P3	9	Female	P2

Table 6.1: Game testing workshop participants

6.1.3 Materials

Both participants and researchers used a personal computer to access the meeting. A mobile phone was additionally used by the researcher for a back-up recording.

6.1.3.1 Procedure

Ethics approval was received by the School of Informatics Ethics Committee (Ref. 2019/70963). As with previous studies, emails containing consent forms and participant information sheets were sent out on behalf of the researchers by supervisors to contact parents of children aged between 6 and 13 years old. Due to ongoing government restrictions, access to university buildings was unavailable and these workshops were carried out remotely using Microsoft Teams. All sessions took place in the same day and lasted around twenty minutes each.

After everyone had joined the session and recording had started, a short icebreaker exercise was given to the children to familiarise the researchers and participants with one if they had not previously met. The researcher would then share their screen featuring the application for the child to see and select the option to "Give Control" to the participants.

Before completing any activities or tasks, children were given to option to freely explore the tool and familiarise themselves with it. Upon this initial exploration of the tool, children were encouraged to use the Think Aloud method [41].

When ready to progress, children were given a set of tasks to accomplish. Again, they were asked to Think Aloud when completing the following activities asking users to find the settings and customise the background, locate certain information, and interact with different features. More information about the content of these tasks can be found in Appendix G.

After completing these tasks, children were given a final chance to further explore the tool. Once they had declared they had finish, a set of feedback questions were asked related to their experience, including what they liked and disliked about the tool, their favourite part of the tool, their thoughts on the design and navigation, what age range this best suits, and any changes or improvements to be made. Additionally, they were asked to rate the enjoyment, easiness to use, and engagement of the tool out of five. More information on the content of these questions can be found in the Appendix H.

After answering the final question, the recordings were stopped and the children were thanked for their participation. Copies of the all the documents and materials from this evaluation can be found in the Appendices I and J.

6.1.4 Data Collection and Analysis

The video recordings and researcher's notes were all collected and compiled. These recordings were transcribed and analysed together with the notes using thematic analysis [13]. This resulted in the following themes: **1) Favourite Features;** **2) Design and**

Navigation; 3) Appropriate Age Range; 4) Enjoyment; 5) Ease to Use; 6) Engagement; 7) Changes and Improvements.

6.1.5 Results

6.1.5.1 Favourite Features

P1 said their favourite part of the app was the funny videos attached to the tools, but wishes there were more options to choose from: *“I really enjoyed the funny video. There could be some more of these though. I think there could be more instructional ones but definitely have more humorous ones. You could flick through these to choose which one you want to watch.”*

Customisation is a personal favourite feature of P2 in all games, and was similarly an enjoyed feature here: *“Being able to customise in games is one of my favourite things to do, so I really liked you were able to freely change the colours and characters. There were lots of colours to choose from, but I would like to see more of the character.”*

Additionally, both P2 and P3 expressed enjoyment at the selection of different rewards, with P2 saying: *“Chocolate is my favourite so I would definitely choose that. I like that you can choose different rewards and there were the lollipops too.”*

The information and activities associated with the hairdryer were thoroughly enjoyed by P3: *I think my favourite part was the bit about the hairdryer. The sound wasn't too quiet and wasn't too loud. It was the first one I explore so was quite interesting. I'd like to see some more funny videos about it though. Choosing the characters was fun too.”*

6.1.5.2 Design and Navigation

P1 visibly found particular ease in finding their way around the tool, completing all tasks in the space of around two minutes. They know which icons represented each game aspect. When commenting on the navigation, they said: *“It was really straightforward to find my way around, all the features were easy to find.”*

The simplicity of the navigation was reiterated by P2, saying: *“I liked the design and it was easy to navigate. You could make it even easier by taking voice commands from the user rather than clicking.”*

Regarding the choice of a play and pause button over text, P2 said: *“It is a lot easier for people to understand this as these are universal symbols and might be slightly trickier if you're not so good at reading.”*

Additionally, the use of symbols rather than text was further expanded on by P3: *“The writing is very clear and tells you exactly what you need to do, but it could use more symbols. You could have a picture of a house instead of saying “back” on the home buttons.”*

6.1.5.3 Appropriate Age Range

P1 stated that the tool would be accessible to children of all ages: *“I think children of all ages will be able to use this but older children might find this very easy.”*

However, P2 said that the age range should start somewhere around two-years old: *“As there are some parts that need you to read text, children aged two and above should be able to use this. It could be younger if this was switched for symbols or text-to-speech.”*

An even older age range was suggested by P3, due to the sometimes loud noises: *“I think this should be used by children over five. If kids are too young, they might get frightened by the loud noises.”*

6.1.5.4 Enjoyment, Engagement, and Ease to Use

When asked to rate each of these factors, P1 gave relatively high scores for each of them, as seen in Table 6.2. To support their scores, they said: *“It was straightforward, simple, and I can’t think of anyway to make this any easier. I enjoyed listening to the sounds and I would come back to hear these again.”*

Likewise, P2 also rated each of these factors high, saying: *“The bright, vibrant colours made it engaging. It was pretty fun and really easy to use.”*

Full marks for enjoyment and easiness to use were given by P3, however, they gave the lowest rating for engagement as there were not enough implemented tools or features: *“It was simple to use and I like there was lots of options, which made it more fun, but I think there should be more tools and the current ones should have more features.”*

Anonymised ID	Ease to Use	Enjoyment	Engagement
P1	5 / 5	4.5 / 5	4 / 5
P2	5 / 5	5 / 5	4 / 5
P3	5 / 5	5 / 5	3 / 5
Average	5 / 5	4.83 / 5	3.67 / 5

Table 6.2: Ratings of tool aspects

6.1.5.5 Changes and Improvements

When asked what they would change of the tools, P1 said: *“I think having different environments with different types of tools would improve this. I also think it needs more funny videos, but I do think this would help someone relax before visiting the hairdressers.”*

As the ability to customise was their favourite feature of the tool, P2 said this should be taken further: *“I would add a customer in the chair on the home screen to make it more customisable. I think you should also have them try different hairstyles to see how they look.”*

6.2 Summative Expert Evaluation

6.2.1 Aims

The aims of this workshop were to: **1)** Determine if the tool is appropriate for the target audience; **2)** Determine if the design and usability is suitable **3)** Determine if this tool is enjoyable, engaging, and easy to use for the target audience **4)** Determine if this tool is suitable for overcoming anxiety at the hairdresser; **5)** Find ways to further improve the tool.

6.2.2 Participants

Table 6.3. details the information about the five experts who agreed to take part in the evaluation. Three experts (E1, E2, E3) who took part in the formative evaluation returned and are denoted with the same anonymous ID as before. All are, or have been, faculty or researchers at the University of Edinburgh and had completed similar interviews with researchers in the past on previous projects.

Anonymised ID	Profession/Occupation	Specialist Area
E1	Professor of Education at University of Edinburgh	Background in Psychology; Family member with ASC
E2	PhD student at University of Edinburgh	Researcher in HCI, ASC and Assistive Technologies.
E3	Lecturer at University of Edinburgh	Background in HCI and Software Engineering
E4	Former researcher at University of Edinburgh	Thesis on joint-attention in children with ASC
E5	PhD student at University of Edinburgh	Background in HCI and education

Table 6.3: Expert participants in summative evaluation

6.2.3 Materials

Both participants and researchers used a personal computer to access the meeting. Amobile phone was additionally used by the researcher for a back-up recording

6.2.4 Procedure

As with the formative evaluations, invitations to the meetings were emailed to the expert days in advance, along with the participant information sheets and consent forms. These evaluations were conducted over Microsoft Teams and lasted approximately thirty minutes.

After joining the session, researchers would share their screen with the expert and select the option to “Give Control” of the app to the participant.

Experts were given the option to freely explore the tool, being encouraged to use the Think Aloud method [41]. They were given a guided walkthrough of the tool, its capabilities and the reasoning behind the implemented features.

After exploring the tool, experts were asked a set of feedback questions, including the age range this would be appropriate for the target audience, the appropriateness of the design and usability, if the target audience would find this fun and engaging, if this was an appropriate method to overcome anxiety in children with autism, and any changes or improvements to be made. More information on the content of these questions can be found in the appendix.

After answering the final question, the recordings were stopped and the experts were thanked for their participation. Copies of all the documents and materials from this evaluation can be found in the appendix.

6.2.5 Data Collection and Analysis

The video recordings and researcher's notes were all collected and compiled. The recordings were transcribed and analysed together with the notes using thematic analysis [13]. This resulted in the following themes: **1) Appropriate for Target Audience;** **2) Design and Usability;** **3) Reducing Anxiety;** **4) Changes and Improvements.**

6.2.6 Results

6.2.6.1 Appropriate for Target Audience

E1 said that the tool was easily accessible to the target audience and the repetitiveness will be engaging: *"It is simple, clear and accessible, and will be suitable for young children. The repetitive engagement will compel children."*

However, they noted that it was sometimes difficult to tell what features could be clicked on and this could be better labelled: *"As long as the user knows where the hotspots are, the user has something to do, and there is a response from the screen, be it sounds of videos, it would be engaging."*

As for an appropriate age range, E3 said that the tool is suitable for all ranges of children with ASC: *"I think the tool would be accessible to children with autism of all ages."*

That being said, E4 found that the tool would probably be more appropriate for younger children: *"I'd say it is most suitable for more younger children, around 2 - 7 years old."*

The use of short clips was well received by E4 and will give autistic children insight to what to expect: *"I really liked the idea of the video. One of the things that is more difficult for children with ASC is not being able to put themselves in someone else's shoes, which they could see here."*

Likewise, the addition of having sound clips of different tools was praised by E5, as this is a notable contribution to anxieties related to going to the hairdresser: *"Some*

[ASC children] do have sensitivities with loud noises and going to the hairdresser is one of these.”.

They followed this up by remarking that the tool appropriate for the target audience and would enjoy using this on a tablet: *“This is something the target audience could definitely use, especially on a tablet as autistic children really enjoying using that sort of technology.”.*

6.2.6.2 Design and Usability

A common there was the inconsistency of sound levels throughout. The scissors, for instance, started off very quiet and the volume almost always had to be increased, however the clippers started off loud and progressively got louder. The initial response from E1 was: *“These [the scissors] don’t sound too frightening. You should start with a loud sound and enable users to reduce this. However, it could also be better to start lower and increase it to make it more risky.”.* They then went on to say the sound of the clippers sounded *“very distressing”*, even at the lowest volume.

Additionally, E1 expressed confusion at the play and pause buttons: *I thought these were for the video, not the sound of the tool. It’s not very clear how to play and pause the video.”.*

That being said, E1 found that the tool was comprehensive and generally clear, but there may be confusion about the goals and objectives: *“The overall design and functionality are very clear, but there might be situations where users are confused about what to do or what to do next.”.*

A problem that E2 encountered was that it wasn’t obvious how to increase the volume of a tool: *“It wasn’t clear how to change the volume. I thought the volume slider represented the length of the clip.,*

However, E2 concluded that the tool is clear and simple to use: *“It is very straightforward. Nothing is too complicated and there is no need for further instructions.”.*

The use of audio and visuals was well-received by E4, and appropriate for the target audience: *“The ability to adjust the sound and the surprise video reward are very nice additions and something children with autism will appreciate.”.*

On top of this, they also suggested this could be used as reference for an adult, as well as childre, commenting: *“I like that not only children can do this by themselves, but a parent or carer can go through this in advance by seeing if they have marked tool thumbs up or down so know what they need to prepare for.”.*

From an HCI perspective, E5 found all design choices appropriate for the target audience, but could still be further improved: *“The background, layout and large buttons are all suitable design choices. However, text-to-speech could be used for further accessibility.”.*

Furthermore, the felt the design and functionality was appropriate, but users might get confused about some of the rewards: *“The overall design and functionality of the tool*

is suitable and intuitive for the target audience, but the lollipops rewards was a bit confusing. ”.

6.2.6.3 Reducing Anxiety

Regarding the overall purpose of the tool, E1 remarked that the intended use of the app was clear and could help overcome anxiety: *“I can see what you’re trying to do in terms of relaxing and desensitising the user, and fits well into a traditional sense of how you would help an autistic individual about the unexpected.”*.

E2 found the ideas to listen to the sounds of the tools a good idea as this is a contribution to anxiety: *“When visiting the hairdresser, Hearing sounds is one of the most anxiety-inducing things children will hear at the hairdresser, so it will help that they can explore the tools and hear the sounds.”*.

Although this could help to reduce anxiety, E3 highlighted the use of this would be short: *“Suitable to overcome anxiety but not something a child would spend too much time using..*

E4 said it would be important to further evaluate the tool to determine if it is suitable for overcoming anxiety in autistic children, but the design choices made seem appropriate to do so: *“It depends on the child if this is a suitable way to relax, however it is simple and easy to use. I can see how you can make your own through customisation. I don’t see why it wouldn’t be helpful, but it is hard to tell without further testing..*

E5 found that this will not only benefit the children overcoming their anxieties, but allow parents to further understand their worries: *“Likely to help reduce anxiety at the hairdressers, but it should reinforce use for parents as well. It will allow them to know exact anxieties of the child and what they’re afraid of.”*.

6.2.6.4 Changes and Improvements

To further usability, E1 suggested that instructions should be made clearer: *“The next steps, hotspots, and exit conditions should be made clearer.”*.

As this is an exploratory tool, E1 suggested this could be further improved by considering available virtual reality tools: *“Potentially this could be adapted using augmented or virtual reality to properly simulate an experience.”*.

A key comment made throughout was the ability to include text-to-speech features. E1 suggested that: *“You could have the barber speak the text in the speech bubble.”*.

Although the choice of including videos was well received, there was still room for improvement. E1 suggested that instructional videos might be better suited instead of humorous ones: *“Not much is added by a humorous video, you could possibly make your own instructional videos.”*.

The combination of the play and pause button was suggested by E2 to avoid confusion: *“There should just be one button for play and pause. Either that, or distinctly show which one is selected.*

They also proposed the louder the tool, the more the user is rewarded: *“Increasing volume gets you more points.”*.

To emulate the feeling of some tools, both E3 and E5 suggested including vibrations on a handheld device, with E5 remarking: *“If used as a mobile app, you could emulate touch by including vibrations or haptic feedback. This could be changed like the volume..”*

To further reward users, E3 suggested having an additional prize for exploring all the tools: *“Have a checkbox on the home screen for all tools visited and include an extra reward after exploring them all.”*.

Another addition would be to have a character on the home screen introducing themselves and describing the app, with E3 commenting: *“I don’t see much of the hairdresser character. They could maybe be present on the home page and talk about what you need to do.”*.

E4 suggested including personal videos or photos of previous trips to make an easier connection to the reality they are going to experience: *“You could include a log of positive memories experience at the hairdresser, which will allow the child to have a more positive attitude to going.”*.

6.3 Discussion

The aim of the evaluation studies was to investigate the overall enjoyment, engagement and suitability of tool to help children with autism overcome their anxiety at the hairdresser. As seen in Table 6.2., the children had a positive response to the tool, however, as the average scores suggest, it could be made more engaging. It was suggested that the inclusion of more video, of which all participants showed enthusiasm towards, would allow the tool to become more engaging. Additionally, the experts unanimously agreed that the repetitiveness, use of videos, and rewards, all suggest that the tool is suitable for the intended target audience.

All participants found the tool easy to use, with the children having no further suggestions being made to make this easier. However, experts suggested this could be further improved by including clear instructions that highlight the next steps and hotspots of the tool.

The empirical data obtained from the game testing workshop with TD children, and summative expert evaluation was overall positive and suggests that the tool has the potential to overcome anxiety in children with autism when they visit the hairdresser. That being said, the tool is not without its flaws, and potential improvements for further work have been given to allow further engagement and enjoyment. Further testing is necessary with the target audience to accurately highlight the potential use.

Chapter 7

Discussion and Conclusion

This chapter presents the answers for the research questions, the conclusions drawn, and the potential for future work.

7.1 Research Questions

7.1.1 Research Question 1

RQ1: *What can make children nervous about going to the hairdressers?*

The design workshops gave an insight to the possible worries children have. These consisted mainly of social anxieties, such as being in unfamiliar environments with new people. A similar reasoning is given when visiting the hairdresser, but additionally involves the uncertainty of the function of the equipment, as well as sensory issues, such as the loud sounds of the clippers or hairdryer, or the feel of someone touching your hair.

7.1.2 Research Question 2

RQ2: *What methods are currently in place to tackle anxiety in children with autism?*

The findings from the literature and formative evaluation highlight the current methods in place to tackle anxiety in autism. Technological-based interventions are cited as an important way to do so, given the lack of social skills needed to interact with such, and the preference children with autism have towards technology.

7.1.3 Research Question 3

RQ3: *How can a tool be designed to overcome anxiety in child with ASC during a hair appointment?*

The findings from the literature, design workshops, and evaluation of the low-fidelity prototype resulted in a list of design requirements. These requirements were grouped into one of four categories relating to the user, task, interface, or learning. Particular

emphasis was placed on the the ability to allow a vast opportunity to customise, and the use of rewards when successfully completing a task to increase engagement. The majority of the design requirements outlined in Chapter 4 were implemented, however, given the limited time and scope of the project, the core functionalities to create a tool for children with autism to overcome anxiety were given priority. These were all successfully included, but the feedback from the summative evaluation suggested certain aspects, such the usability and customisation, could be further improved. This further discussed in Section 7.3.

7.1.4 Research Question 4

RQ4: *To what extent does the new tool help children with ASC cope with their anxiety during a haircut?*

RQ4.1: *To what extent is the new tool enjoyable?*

RQ4.2: *To what extent is the new tool engaging?*

RQ4.3: *How suitable is the tool in terms of addressing anxiety in children when visiting a hairdresser?*

Based on the empirical data from the summative evaluation, the results suggest the tool has the potential to help children with ASC cope with anxiety while getting their haircut. The results from the TD children indicate that this tool is easy to use, engaging and enjoyable, with the use of sounds and videos, the ability to customise, and available rewards contributing to the positive response on these factors. Additionally, the importance of these features are highlighted by the experts who suggest the use of these is suitable for addressing anxiety in both TD and autistic children.

7.2 Limitations

Given the circumstances surrounding the COVID-19 pandemic, several aspects of research were limited. Workshops and evaluations had to be adapted to be conducted remotely as access to university buildings was off-limits. This could be considered detrimental to the study as a topic like this heavily relies on physical interaction, particularly in the workshops involving the children.

In addition, access to practitioners, children with autism and their carers was limited given the scope of the project, as well as the restricted time frame. Therefore, a suitable, summative evaluation aimed at the target audience was unable to be conducted. That being said, the project was designed as a proof of concept, to design and evaluate the tool with TD children, which has been successful. The results gathered from evaluations should be considered assumptions, but represent an estimated assessment of responses from the target audience.

7.3 Future Work

The results obtained from the summative evaluation suggest that the proposed tool has the potential to successfully overcome anxiety in children with autism the hairdressers. That being said, there was significant room for improvement, based on the feedback of the both the low-fidelity and high-fidelity prototypes. Customisation and rewards are key to developing a tool for this target audience, as suggested by literature and from experts, and although both elements in present in the game, it has been recommended to take these ideas further to better cater the target audience. Furthermore, additional features and components were suggested to improve the overall enjoyment and engagement of the tool, such as the option to emulate touch by haptic feedback responses, a personal log of positive memories, and the use of augmented or virtual reality to properly simulate an experience. A further list inclusions and additions can be found in the appendix. Additionally, more design studies should be organised to inform the design of the game involving children with ASC, parents and practitioners, and further evaluation studies with autistic children to assess the impact of the tool on the intended target audience.

7.4 Conclusions

The project explored how a technology-based intervention can be designed and developed to help autistic children overcome anxieties when getting their haircut. The exploratory, desensitisation tool, 'EasyTrim', has been iteratively developed and evaluated using an approach inspired by Informant Design, involving children, including child with autism, and experts in HCI, ASC and education, which revealed that the tool has potential to support children with ASC at the hairdressers to cope with their anxiety. The contributions of this project are as follows:

1. Identifying the causes of anxiety children have at the hairdresser, and the methods currently in place to overcome these anxieties.
2. Based on empirical data and a literature review, a design concept for an exploratory tool to support children with ASC cope with anxiety at the hairdresser was created and subsequently implemented.
3. The evaluation with TD children and experts in HCI, ASC and Education, provides empirical evidence that the tool has potential to support children with ASC overcome their anxiety during a hair appointment.
4. A list of future work with directions for further development of the game and further studies to improve the tool and extend the evaluation.

Bibliography

- [1] Calming clippers. <https://www.calmingclipper.com/>.
- [2] Cutting men's hair — mr. bean official cartoon. <https://www.youtube.com/watch?v=dYj2Zck1zeI>.
- [3] Figma. <https://www.figma.com/>.
- [4] Social stories. <https://www.autism.org.uk/advice-and-guidance/topics/communication/communication-tools/social-stories-and-comic-strip-conversations>.
- [5] Unity. <https://unity.com/>.
- [6] American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-V*. American Psychiatric Association, 5th edition, 2013.
- [7] Borwin Bandelow and Sophie Michaelis. Epidemiology of anxiety disorders in the 21st century. *Dialogues in clinical neuroscience*, 17(3):327, 2015.
- [8] Laura Bartoli, Franca Garzotto, Mirko Gelsomini, Luigi Oliveto, and Matteo Valoriani. Designing and evaluating touchless playful interaction for asd children. *Proceedings of the 2014 conference on Interaction design and children*, 2014.
- [9] N. Bauminger, C. Shulman, and G. Agam. Peer interaction and loneliness in high-functioning children with autism. *Autism Dev Disord*, page 489–507, 2003.
- [10] Jessica Buckley, James K Luiselli, Jill M Harper, and Andrew Shlesinger. Teaching students with autism spectrum disorder to tolerate haircutting. *Journal of Applied Behavior Analysis*, 53(4):2081–2089, 2020.
- [11] G. Celani, M.W. Battacchi, and L. Arcidiacono. The understanding of the emotional meaning of facial expressions in people with autism. *Autism Dev Disord*, page 57–66, 1999.
- [12] Chung-Hsin Chiang, Wei-Tsuen Soong, Tzu-Ling Lin, and Sally J. Rogers. Non-verbal communication skills in young children with autism. *Journal of Autism and Developmental Disorders*, 38(10):1898–1906, 2008.
- [13] Victoria Clarke and Virginia Braun. Thematic analysis. *Encyclopedia of Critical Psychology*, page 1947–1952, 2014.

- [14] Aurora Constantin, Hilary Johnson, Elizabeth Smith, Denise Lengyel, and Mark Brosnan. Designing computer-based rewards with and for children with autism spectrum disorder and/or intellectual disability. *Computers in Human Behavior*, 75:404–414, 2017.
- [15] Christina M Corsello. Early intervention in autism. *Infants & Young Children*, 18(2):74–85, 2005.
- [16] Virginia A Dickie, Grace T Baranek, Beth Schultz, Linda R Watson, and Cara S McComish. Parent reports of sensory experiences of preschool children with and without autism: A qualitative study. *American Journal of Occupational Therapy*, 63(2):172–181, 2009.
- [17] Christian Dindler and Ole Sejer Iversen. Fictional inquiry—design collaboration in a shared narrative space. *CoDesign*, page 213–234, 2007.
- [18] Robin L. Gabriels, Michael L. Cuccaro, Dina E. Hill, Bonnie J. Ivers, and Edward Goldson. Repetitive behaviors in autism: relationships with associated clinical features. *Research in Developmental Disabilities*, 26(2):169–181, 2005.
- [19] Stelios Georgiades, Peter Szatmari, and Michael Boyle. Importance of studying heterogeneity in autism. *Neuropsychiatry*, page 123–125, 2013.
- [20] Judith Gould and Jacqui Ashton-Smith. Missed diagnosis or misdiagnosis? girls and women on the autism spectrum. *Good Autism Practice (GAP)*, 12(1):34–41, 2011.
- [21] Marine Grandgeorge and Nobuo Masataka. Atypical color preference in children with autism spectrum disorder. *Frontiers in Psychology*, 7, 2016.
- [22] Ouriel Grynszpan, Patrice L Weiss, Fernando Perez-Diaz, and Eynat Gal. Innovative technology-based interventions for autism spectrum disorders: A meta-analysis. *Autism*, 18(4):346–361, 2014.
- [23] Leo Kanner. Autistic disturbances of affective contact. *Nervous Child*, page 217–250, 1943.
- [24] Adrian B. Kelly, Michelle S. Garnett, Tony Attwood, and Candida Peterson. Autism spectrum symptomatology in children: The impact of family and peer relationships. *Journal of Abnormal Child Psychology*, page 1069–1081, 2008.
- [25] Margaret Laurie and Peter Border. Autism research briefing. *UK Parliament POST*, 2020.
- [26] Rebecca P. Lawson, Jessica Aylward, Jonathan P. Roiser, and Geraint Rees. Adaptation of social and non-social cues to direction in adults with autism spectrum disorder and neurotypical adults with autistic traits. *Developmental Cognitive Neuroscience*, 29:108–116, 2018.
- [27] Rachel C. Leung, Vanessa M. Vogan, Tamara L. Powell, Evdokia Anagnostou, and Margot J. Taylor. The role of executive functions in social impairment in autism spectrum disorder. *Child Neuropsychology*, pages 336–344, 2016.

- [28] Kristie Brown Lofland. The use of technology in the treatment of autism. In *Technology and the treatment of children with autism spectrum disorder*, pages 27–35. Springer, 2016.
- [29] Micah O Mazurek, Christopher R Engelhardt, and Kelsey E Clark. Video games from the perspective of adults with autism spectrum disorder. *Computers in Human Behavior*, 51:122–130, 2015.
- [30] Jakob Nielsen. Enhancing the explanatory power of usability heuristics. *Conference companion on Human factors in computing systems - CHI 94*, 1994.
- [31] Ofcom. Children and parents: Media use and attitudes report. 2015.
- [32] M. O’Neill and R.S.P Jones. Sensory-perceptual abnormalities in autism: A case for more research? *Autism Dev Disord*, page 283–293, 1997.
- [33] Elizabeth O’Nions, Francesca Happé, Kris Evers, Hannah Boonen, and Ilse Noens. How do parents manage irritability, challenging behaviour, non-compliance and anxiety in children with autism spectrum disorders? a meta-synthesis. *Journal of Autism and Developmental Disorders*, 48(4):1272–1286, 2018.
- [34] John Piaget. Cognitive development in children. *JOURNAL OF RESEARCH IN SCIENCE TEACHING*, pages 176–186, 1964.
- [35] J Rodgers, M Glod, B Connolly, and H McConachie. The relationship between anxiety and repetitive behaviours in autism spectrum disorder. *Journal of autism and developmental disorders*, 42(11):2404–2409, 2012.
- [36] Mike Scaife and Yvonne Rogers. Informing the design of a virtual environment to support learning in children. *International Journal of Human-Computer Studies*, 55(2):115–143, 2001.
- [37] Atsushi Senju and Mark H. Johnson. Atypical eye contact in autism: Models, mechanisms and development. *Neuroscience Biobehavioral Reviews*, 33(8):1204–1214, 2009.
- [38] Marian Sigman, Angeline Dijamco, Maya Gratier, and Agata Rozga. Early detection of core deficits in autism. *Mental Retardation and Developmental Disabilities Research Reviews*, 10(4):221–233, 2004.
- [39] Emily Simonoff, Andrew Pickles, Tony Charman, Susie Chandler, Tom Loucas, and Gillian Baird. Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child Adolescent Psychiatry*, 47(8):921–929, 2008.
- [40] Kate Simpson, Dawn Adams, Elizabeth Wheeley, and Deb Keen. Parent perspectives on the presentation, triggers, impact, and support of anxiety in young children on the autism spectrum. *Journal of Child and Family Studies*, 29(2):572–582, 2020.

- [41] Paul Solomon. The think aloud method: A practical guide to modelling cognitive processes. *Information Processing Management*, page 906–907, 1995.
- [42] Collette Sosnowy, Chloe Silverman, Paul Shattuck, and Tamara Garfield. Setbacks and successes: How young adults on the autism spectrum seek friendship. *Autism in Adulthood*, 1(1):44–51, 2019.
- [43] Francisca J. A. Van Steensel, Susan M. Bögels, and Sean Perrin. Anxiety disorders in children and adolescents with autistic spectrum disorders: A meta-analysis. *Clinical Child and Family Psychology Review*, 14(3):302–317, 2011.
- [44] Danielle Ung, Jeffrey J Wood, Jill Ehrenreich-May, Elysse B Arnold, Cori Fuji, Patricia Renno, Tanya K Murphy, Adam B Lewin, P Jane Mutch, and Eric A Storch. Clinical characteristics of high-functioning youth with autism spectrum disorder and anxiety. *Neuropsychiatry*, 3(2), 2013.
- [45] Roma A. Vasa and Micah O. Mazurek. An update on anxiety in youth with autism spectrum disorders. *Current Opinion in Psychiatry*, 28(2):83–90, 2015.
- [46] Leanne Walsh and Mary Barry. Demystifying the interface for young learners with autism. 2008.
- [47] Paul J Yoder, Andrea S McDuffie, T Charman, and W Stone. Treatment of responding to and initiating joint attention. *Social and Communication Development in Autism Spectrum Disorders: Early Identification, Diagnosis, and Intervention*, pages 117–142, 2006.

Appendix A

Nielson's Usability Heuristics

NUH_1: Visibility of system status.

NUH_2: Match between system and the real world.

NUH_3: Match between system and the real world.

NUH_4: Match between system and the real world

NUH_5: Error prevention.

NUH_6: Recognition rather than recall.

NUH_7: Flexibility and efficiency of use.

NUH_8: Aesthetic and minimalist design.

NUH_9: Help users recognize, diagnose, and recover from errors.

NUH_10: Help and documentation.

Appendix B

Design Workshop Activities

Activity 1 [5 - 7 Minutes]

Imagine that an alien has landed on this planet and they are frightened because this is not anything like their home. There are lots of new surroundings and things are very different. They are also afraid they might get ill because the air on Earth is very different. Can you draw or write down some of things that you think the alien would be worried about and ways would you be able to help them feel less nervous?

Activity 2 [6 - 8 Minutes]

Imagine our alien has come in for an appointment with [a hairdresser/dentist], but they are very sensitive. They do not like being touched or loud noises. They can be quite fidgety and uncomfortable with new surroundings. They also have lots of questions and can get quite worried.

First, I am going to ask you to draw a friendly character to be your dentist or hairdresser. Then, I would like you to draw or write down some of things that you think the alien would be worried about their appointment and how you would help them as their hairdresser or dentist.

Activity 3 [8 - 10 Minutes]

However, as you are trying to explain this to your new alien friend, you realise they don't really understand English, but they do have a tablet which they can use to communicate.

Do you think you would be able to use the ideas you had to make a game for this tablet to help your new alien friend calm down? What sorts of characters, rewards or settings would this game have?

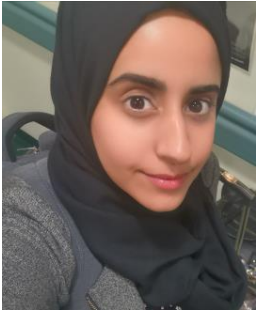







Appendix C

Design Workshop Child Consent Form and Information Sheet

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, Aurora, Aimee, Sophia, Ethan, Andreas and Kaiwen. 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 to test them, and answering some questions.

			
Aljawharah	Helen	Aurora	Aimee
			
Sophia	Ethan	Andreas	Kaiwen

How can I help?

Some children with autism can find that lots of different things can make them worried. They might find simple activities like talking to other people and changes to their usual activities harder than most children. Sometimes they find it hard to understand and manage what they are feeling. We would like to design some fun games to help these children with their worries, and we would like you to help us! We would like to hear your ideas for ways to make some of these situations less scary and we would like you to help us to make our games fun.

What will happen if I help?

You will get to take part in game design and testing workshops and participate in other activities. You will get to talk with other children about your ideas, and we might ask you to do some drawings to show us your designs.

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 anymore, and that is OK.

The researchers will ask if it is OK to make a 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.

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, Aurora, Aljawharah, Ethan, Andreas, Sophia, Aimee and Kaiwen will listen to/watch the recordings later. They will not show them to other people.

Is it okay to take video recordings?

YES

NO

Write your name:

THANK YOU 😊!!

Appendix D

Design Workshop Parent Information Sheet

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 XXXX. 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:

- Aimee Redbond: s1713640@sms.ed.ac.uk (Lead Researcher)
- Andreas Ghira: s1732228@sms.ed.ac.uk (Lead Researcher)
- Sophia Singh: s1623165@sms.ed.ac.uk (Lead Researcher)
- Ethan Soreide: s1741258@sms.ed.ac.uk (Lead Researcher)
- Kaiwen Xue: s1615893@ed.ac.uk (Lead Researcher)
- Dr. Aurora Constantin: aurora.constantin@sms.ed.ac.uk (Research supervisor)
- Aljawharah Alabdullatif: s1500319@sms.ed.ac.uk (Research advisor)
- Prof. 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 five UG4/Minf 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 and the purpose of the workshops?

Many different circumstances can cause children with autism to suffer with anxiety. These include social situations, changes to their routines, and disruptive events such as the COVID-19 pandemic. The goal of our project is to design technology-based tools to help children with autism cope with and manage their anxiety in different situations.

Kaiwen: I am designing and developing a game to support children with autism to overcome anxiety during Covid-19 pandemic. This game is intended to be designed in collaboration with children. The purpose of this workshop is to conduct some activities with children with the purpose of understanding what makes them worried during Covid-19 pandemic and how they cope with their worries. In these activities, children will write and draw to express their ideas using either pen and paper or a software program, depending on their preference. These ideas will be used to build a game to help children with autism cope with anxiety during pandemic.

Aimee: I aim to develop an interactive app which will help children with ASC to cope with changes. The purpose of the app is to reduce the anxiety caused by changes, and to help children with autism to become more flexible and resilient when faced with changes in the future. The aim of the workshop is to guide the children towards identifying new situations which might cause them anxiety, discussing coping strategies for these changes, and designing ways to reward them for coping. The workshop will be useful for designing the app to suit children, and for building a tool that will help children adapt to changes.

Andreas: The aim of the project is to develop a technology that would help children interact in an online environment, facilitating the reduction of their anxiety levels in social situations. The purpose of this workshop is to gather information from children regarding social anxiety. The main aims are:



- Determine social situations where children might feel anxious
- Determine practices that help them cope with those situations

Ethan: I am aiming to create a tool or game for children with autism to help overcome, manage or understand their anxiety, especially regarding social situations. Similarly to Andreas, my workshop will consist of tasks that explore social situations and any worries related to these. These activities aim to establish what social settings can trigger any anxiety in children and why, as well as identifying any strategies or methods they have to overcome these.

Sophia: Dungeons and Dragons is a popular tabletop roleplaying game that has potential to be an effective tool for delivering therapy in an interactive and story driven game environment. I aim to build an online tool to help conduct dungeons and dragons games while incorporating mindfulness techniques to aid with anxiety. The workshop will guide the children towards creating interactive games and stories focused on calming activities like breathing and other mindfulness related activities. The workshop will be beneficial for designing the app and building interactive tools that the children consider calming and engaging.

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 small groups (3 – 4 children) online using Microsoft Teams. At least one researcher and one supervisor will be present for all workshops. Your child will get to engage in numerous game development activities, such as group discussions and drawing designs, and provide feedback and ideas for c. 30 minutes. In order to facilitate these activities, we would request that you provide



sheets of blank paper and colouring pencils for your child to use during the session. We may request that any materials created by your child during the session be uploaded for our review after the session. If your child is willing to talk to us about the activities, we will ask them a few questions. They will each participate in X (will edit depending on each workshop structure) workshops, if they are happy to do so.

Video and audio recordings

We would like to video 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. Microsoft Teams does not allow for solely audio to be captured, but the video recording will only be used to transcribe the audio from the session, and then will be deleted. The video would be seen only by us during the analysis. If you are not comfortable with your child being video recorded at all, then your child should not participate in this particular study. Although we will only be video recording for the purpose of transcribing the session, we would ask that your camera is switched on throughout the session, so that we can ensure your child is not becoming upset or distracted.

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 designer role to your child and ask them if they want to help. We will remind your child that they can stop being a developer 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 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 transcripts 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 encrypted computers. 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 developer 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 E

Design and Testing Parent Consent Form

Parent Consent Form

* Required

1. Have you read the information sheets? *

Yes

No

2. Have you received enough information about the study? *

Yes

No

3. 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

4. Do you consent for your child to take part in this study? *

Yes

No

Details

By filling in the sections below, you indicate that you understand and accept the conditions of this study, including video recording. You agree that the researchers may explain this study to your child and invite him or her to take part as a game developer.

5. Full name of participating child: *

6. Child's date of birth: *

Format: M/d/yyyy

7. Your relationship to the child: *

8. Your full name: *

9. Email address: *

10. Date: *

Format: M/d/yyyy

4/7/2021

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.



Appendix F

Formative Evaluation Expert Consent Form

Participant Consent Form

Toward a Technology to Overcome Anxiety in Children with Autism

Researchers: Andreas Ghira & Ethan Soreide
(s1732228@sms.ed.ac.uk, s1741258@sms.ed.ac.uk)

Supervisor: Dr Aurora Constantin
(aconsta2@staffmail.ed.ac.uk)

In this interview, we aim to further our knowledge on the relevant topics of the project and get feedback on our project ideas so far. All data will be anonymised with pseudonyms (such as E1, E2, etc.). The interview will take place on Microsoft Teams. If you consent to being audio recorded, recordings will be stored safely on password protected computers. You may withdraw from this research study at any time without explanation and you can ask any data you have supplied to that point be withdrawn /destroyed. You can omit or refuse to answer to any question that is asked of you. All data from this study may be archived for a minimum of two years. Please feel free to ask any question related to this study at any time.

I confirm that I have been informed about this project by the researchers and that I have had the opportunity to ask questions, and that any questions I had were answered to my satisfaction.

Please Select: YES / NO

I understand that my participation is voluntary, and that I can withdraw at any time without giving a reason. Withdrawing will not affect any of my rights.

Please Select: YES / NO

I consent to my anonymised data being used in academic publications and presentations.

Please Select: YES / NO

I understand that my anonymised data can be stored for a minimum of two years.

Please Select: YES / NO

I agree to take part in this study.

Please Select: YES / NO

Participant's Signature:

Date:

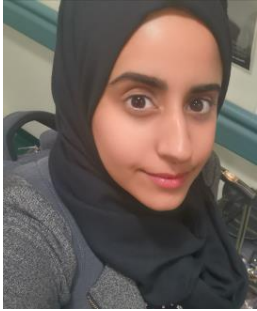







Appendix G

Game Testing Workshop Consent Form and Information Sheet

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, Aurora, Aimee, Sophia, Ethan, Andreas and Kaiwen. 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 to test them, and answering some questions.

			
Aljawharah	Helen	Aurora	Aimee
			
Sophia	Ethan	Andreas	Kaiwen

How can I help?

Some children with autism can find that lots of different things can make them worried. They might find simple activities like talking to other people and changes to their usual activities harder than most children. Sometimes they find it hard to understand and manage what they are feeling. We would like to design some fun games to help these children with their worries, and we would like you to help us! We would like to hear your ideas for ways to make some of these situations less scary and we would like you to help us to make our games fun.

What will happen if I help?

You will get to take part in game testing workshops and participate in other activities. You will get to talk with other children about your ideas, and we might ask you to do some drawings to work out your ideas.

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 anymore, and that is OK.

The researchers will ask if it is OK to make a 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.

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 tester.

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 tester 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, Aurora, Aljawharah, Ethan, Andreas, Sophia, Aimee and Kaiwen will listen to/watch the recordings later. They will not show them to other people.

Is it okay to take video recordings?

YES

NO

Write your name:

THANK YOU 😊!!

Appendix H

Game Testing Workshop Parent Information Sheet

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 XXXX. 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:

- Aimee Redbond: s1713640@sms.ed.ac.uk (Lead Researcher)
- Andreas Ghira: s1732228@sms.ed.ac.uk (Lead Researcher)
- Sophia Singh: s1623165@sms.ed.ac.uk (Lead Researcher)
- Ethan Soreide: s1741258@sms.ed.ac.uk (Lead Researcher)
- Kaiwen Xue: s1615893@ed.ac.uk (Lead Researcher)
- Dr. Aurora Constantin: aurora.constantin@sms.ed.ac.uk (Research supervisor)
- Aljawharah Alabdullatif: s1500319@sms.ed.ac.uk (Research advisor)
- Prof. 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 five UG4/Minf 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 and the purpose of the workshops?

Many different circumstances can cause children with autism to suffer with anxiety. These include social situations, changes to their routines, and disruptive events such as the COVID-19 pandemic. The goal of our project is to design technology-based tools to help children with autism cope with and manage their anxiety in different situations.

Kaiwen: I have designed and developed a web game, the purpose of this game is to help children with autism overcome their anxiety and understand dentist meaning when they go to the dentist. Children will be asked to explore the game, complete some game tasks and provide some feedback on what can be changed, added or improved. **To play this game, children will need a computer with window operation system and download a document by email in advance and put it on the desktop. A short text " --enable-webgl --ignore-gpu-blacklist --allow-file-access-from-files" need to be copied and then paste. The steps are right-click on the Google browser to select properties, the copy then at the end of target (T), notice the first two space.**

Aimee: I have developed an interactive web application which aims to help children with ASC to cope with changes. The purpose of the app is to reduce the anxiety caused by changes, and to help children with autism to become more flexible and resilient when faced with changes in the future. In this workshop, the children will be asked to explore the app, complete some simple tasks, and offer feedback based on their experience interacting with the application. In order to use the application, children will need access to a web browser such as Chrome, Safari, etc. I will provide the link to the application during the workshop.

Andreas: I have developed a Minecraft map that simulates social situations (going to school, going to the hairdresser, playing soccer) that children might find stressful in



real life and I have designed calming rooms that tries to teach the player self-calming techniques (i.e. counting in your head from 1 to 10, breathing exercise, relaxing in a quiet place). Children will be asked to explore the game by following the instructions given on the screen and provide feedback on their experience. **To play the game, children will need Minecraft Java Edition (the Official version) installed on their computer.**

Ethan: I have designed an interactive exploratory tool of what a child might experience when getting their haircut. This emulates some of the anxieties one may feel at the hairdresser and rewards you for tolerance of the stimuli. Children will be asked to explore the app, complete some activities and then provide feedback on what can be changed, added or improved. Like Kaiwen, a web browser (preferably Chrome) will be used to access the tool from a downloaded ZIP file. A detailed walkthrough for this will be given for this prior to the evaluation.

Sophia: Dungeons and Dragons is a popular tabletop roleplaying game that has potential to be an effective tool for delivering therapy in an interactive and story driven game environment. Based off the design workshops from late last year, I have built a platform to help conduct dungeons and dragons games for autistic children. The workshop will help me test the tool and retrieve feedback on how it can be improved. Similar to Ethan and Kaiwen, a web browser (preferably Chrome) will be used to access the tool from a downloaded ZIP file. A detailed walkthrough for this will be given for this prior to the evaluation. Additionally, having a sheet of paper and some pencils will be useful.

How can my child help?

The game evaluation 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 individually online using Microsoft Teams. At least one researcher and one supervisor will be present for all workshops. Your child will get to



engage in the numerous different games that have been made and provide feedback and ideas for c. 30 minutes. In order to facilitate these activities, we would request that you provide sheets of blank paper and colouring pencils for your child to use during the session. We may request that any materials created by your child during the session be uploaded for our review after the session. If your child is willing to talk to us about the activities, we will ask them a few questions. They will each participate in X (will edit depending on each workshop structure) workshops, if they are happy to do so.

Video and audio recordings

We would like to video 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. Microsoft Teams does not allow for solely audio to be captured, but the video recording will only be used to transcribe the audio from the session, and then will be deleted. The video would be seen only by us during the analysis. If you are not comfortable with your child being video recorded at all, then your child should not participate in this particular study. Although we will only be video recording for the purpose of transcribing the session, we would ask that your camera is switched on throughout the session, so that we can ensure your child is not becoming upset or distracted.

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 designer role to your child and ask them if they want to help. We will remind your child that they can stop being a developer 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 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 improve the different games and eventually be presented in a final report. This report along with the data and transcripts 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 encrypted computers. 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 developer 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 I

Game Testing Workshop Activities

1. Find the game settings, change the background colour of the tool, and return to the home screen. You can optionally change the hairdresser character.
2. Locate the information about the hair clippers.
3. Find and watch the video about the clippers.
4. Listen to the noise of the clippers for ten seconds, and then pause the sound. You can optionally increase or decrease the volume of the tool.
5. Select your feelings towards the tool using the voting system and return to the home screen.

Appendix J

Game Testing Workshop Feedback Questions

1. What are two stars and a wish about this app? These are two features that you did like and one thing you would like to see added.
2. What was your favourite tool and why?
3. What was your favourite, or the most fun, part of the app and why?
4. On a scale of 1 to 5, how **easy** was the app to use? Why did you feel this way?
5. On a scale of 1 to 5, how **fun** was the app to use? Why did you feel this way?
6. On a scale of 1 to 5, how **engaging** was the app to use? Why did you feel this way?
7. How did you find the design and usability of the app? What are some likes and dislikes about these?
8. What age group of children do you think this is best suited for? Why did you feel this way?
9. Do you think this would be a good way to relax yourself before going to a hair appointment?
10. Are there any changes or improvements you would make to the app?

Appendix K

Summative Evaluation Expert Consent Form

Participant Consent Form

Toward a Technology to Overcome Anxiety in Children with Autism

Researchers: Ethan Soreide
(s1741258@sms.ed.ac.uk)

Supervisor: Dr Aurora Constantin
(aconsta2@staffmail.ed.ac.uk)

This interview aims to evaluate the prototype I have developed to overcome anxiety in children with ASC when they visit the hairdresser. Participants will be asked to explore the tool, provide answers based on research questions, and give feedback on how accessible this tool is to the target demographic. All data will be anonymised with pseudonyms (such as E1, E2, etc.). The interview will take place on Microsoft Teams. If you consent to being audio recorded, recordings will be stored safely on password protected computers. You may withdraw from this research study at any time without explanation and you can ask any data you have supplied to that point be withdrawn /destroyed. You can omit or refuse to answer to any question that is asked of you. All data from this study may be archived for a minimum of two years. Please feel free to ask any question related to this study at any time.

I confirm that I have been informed about this project by the researchers and that I have had the opportunity to ask questions, and that any questions I had were answered to my satisfaction.

Please Select: YES / NO

I understand that my participation is voluntary, and that I can withdraw at any time without giving a reason. Withdrawing will not affect any of my rights.

Please Select: YES / NO

I consent to my anonymised data being used in academic publications and presentations.

Please Select: YES / NO

I understand that my anonymised data can be stored for a minimum of two years.

Please Select: YES / NO

I agree to take part in this study.

Please Select: YES / NO

Participant's Signature:

Date:

Appendix L

Future Work

1. Allow for further customisation of the characters and environment.
2. Use augmented reality to create Instagram style filters that utilise the camera of a device so users can see themselves wearing different hairstyles.
3. Include text-to-speech features for text.
4. Include more videos, especially instructional ones. These could be created by the researcher.
5. Adapt the reward system so a user will receive more points for louder volume.
6. Include haptic feedback and vibrations to emulate the feeling of touch.
7. Include a visual timeline.
8. Allow users to create a log of positive memories of the hairdresser, including photos and videos.