‘To Assess the Engagement Potential of Familiar Auditory Instruction in a Prototype Computer Program Specifically Developed for Moderately Autistic Children’

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Signed: ____

Date: ____

Dedication

To my wonderful and encouraging parents

Elaine and Hugh Duffy.

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LIST OF ABBREVIATIONS

ABA	Applied Behavioral Analysis
ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autistic Spectrum Disorder
AS	Asperger's Syndrome
DSM-IV	Diagnostic and Statistical Manual, Fourth Edition,
DTT	Discrete Trial Training
HFA	High-functioning Autistic or High-functioning Autism
NAS	National Autistic Society
NCSE	National Council for Special Education
SEN	Special Educational Needs
SPSS	Statistical Package for Social Science
SRA	Social Research Association
IEP	Individual Education Plan
PDD-NOS	Pervasive Development Disorder-Not Otherwise Specified
PECS	Picture Exchange Communication System
TOM	Theory of Mind
TD	Typically Developed
TEACCH	Treatment and Education of Autistic and Communication related -handicapped Children
FAMILIAR ACCENT	Can also be referred to as Localised/Regional/National Accent

Introduction

This study sought to discover the level of interactivity and multimedia experience required when developing educational computer programs specifically for the learning needs of moderately autistic children between the ages of five and nine years. An additional aim was to investigate the extent to which the use of a familiar auditory[1] instruction facilitates a potential learning engagement.

The two research questions for this study are:

1. What level of interactivity and multimedia experience is needed to motivate engagement and therefore learning when using educational computer programs?

2. Can the implementation of familiar of a familiar auditory instruction in a computer program increase the moderately autistic child's level of engagement?

The methodology for this research involved mixed methods, encompassing exploratory, descriptive and observational methods. The exploratory research was built around three focus groups comprising teachers, educational therapists and parents of moderately autistic children and a telephone survey with the teachers in the 47 special needs schools across Ireland. The descriptive phase of this research consisted of a nationwide survey that was disseminated to those schools that had children with autism enrolled. In addition, an on-line survey was sent to parents of moderately autistic children across Ireland. The purpose of conducting the exploratory and descriptive research was to determine the necessary requirements for the design and

[1] Familiar auditory instruction or familiar accents can also be referred to as local/ regional or national auditory instruction or local or regional accents.

development of the prototype computer program specific to the learning needs of moderately autistic children. The observational phase of this study centred on answering research question 2 which asks if the implementation of familiar auditory instruction in the computer program increase the moderately autistic child's level of engagement?

Observations with two groups of children (one moderately autistic and the other typically developed) between the ages of five and nine years assessed the engagement and learning potential of using familiar auditory instruction when using the prototype computer program. Eight children were recruited for the observations. The first group were typically developed whose ages ranged from five to eight years of age. The purpose of using this age group stems from the fact that many children under the age of five have not been diagnosed with autism and children with autism between the ages of five and nine/ten years of age 'have developed an awareness, attention and interest outside of themselves.' (Tuedor (2008), p.73).

A striking communication characteristic in autistic children is their poor orientation to the human voice (Klin 1991). Furthermore an understanding narrative is an inherently complex task (Dautenhahn (2002)). A study by Birkett (2007) identified that familiarity with a speaker's voice has been shown to enhance auditory processing. However this was conducted with typically developed adults and not people on the autistic spectrum. Norbury (2003) stated that very few studies have been conducted to investigate the narrative processing skills of children with autism and Arick (2004) stated that few studies have investigated the processing of vocal information from the voice.

A rigorous review of literature pertaining to familiar auditory instruction in interactive programs for children with autism has highlighted that this it is an under-researched area. The research investigates the features of computer programs used by moderately autistic children, that could have a positive or negative impact on engagement and therefore learning. This study concludes with a prototype computer program based on key findings that aims to help moderately autistic children learn a daily living skill. A design framework for the future development of educational computer programs targeted at moderately autistic children also forms part of this thesis.

The overall structure consists of a review of literature (chapter 1 and 2) and three phases of research.

Chapter One provides a review of literature relating to autism, communication and learning. These are important areas to comprehend as they provide essential background knowledge for the development of the computer program for this study.

Chapter Two explains the rationale for exploring the potential of including familiar auditory instruction in computer programs for moderately autistic children and investigates other features of a computer program that may positively or negatively impact on learning. This chapter concludes with a rationale for this study.

Chapter Three describes the research methodology and justifies the three-phase approach adopted for this research. Phase one consisted of exploratory research while phase two employed a descriptive approach and phase three an observational approach. The exploratory phase comprised three separate focus groups: teachers, parents and educational therapists who worked with or cared for moderately autistic children. A telephone survey of all special needs schools in Ireland was also conducted. The descriptive phase consisted of a nationwide survey of teachers in all primary schools in Ireland that had children with autism enrolled. The observational phase centred on the testing of the computer prototype designed for this study with two groups (Autism Spectrum Disorder and Typically Developed). This chapter provides a discussion of data collection, sampling, measurement techniques and the analytical approach for each phase.

Exploratory and descriptive findings are presented and interpreted in Chapter Four. This chapter discusses the findings and the interpretation of findings from both the exploratory and descriptive phase of this research.

Chapter Five consists of the design and development methodology of the computer prototype, which was developed based on the findings of Chapter Four.

Chapter Six presents the methodology for the testing of the prototype. Observation was the approach adopted for the testing of the prototype and occurred using two sample groups of four children respectively – one with autism and the other typically developed.

Chapter Seven presents the findings and analysis of the prototype design and development. This chapter reports the findings of observations undertaken with both the TD and ASD group using the computer prototype developed for the study.

The final chapter, Chapter Eight, provides the conclusion for this thesis. It highlights the important findings of this research, limitations and recommendations for future research. This piece of research has highlighted two key gaps in the design and development of computer based learning programs for children who are moderately autistic.

From a rigorous review of current literature pertaining to computer programs for children with autism, the researcher determined that there was an absence of educational software specific to the learning needs of moderately autistic children. In terms of learning and engagement, the researcher established from the review of literature various communication and learning impairments that moderately autistic children are faced with, such as barriers in communication, processing of information and various sensory impairments. If the impairments of moderately autistic children are not addressed in the design and development of computer based learning, this may impact on the learning outcomes that result from the use of such software. The central tenet of usability is the recognition that users' needs must be prioritised in the design process.

Research findings from this study have highlighted that educational computer programs used in both the school and home have not been specifically developed for this group. Moreover, the majority of educational computer programs used have not been developed in Ireland. This latter finding highlights the second gap, that is: the extent of engagement when using familiar auditory instruction (localised accents) in educational computer programs for this target group. The identification of these gaps and the findings from this research will make a valuable contribution to the future development of Irish designed educational computer programs specifically tailored to the learning needs of moderately autistic children.

Chapter 1 Autism, Communication and Learning

1.1 Introduction

The aim of this first chapter is to identify the underlying characteristics inherent in autism and to address the key impairments individuals with autism have in dealing with challenging social skills. Social skill impairments are discussed in order to gain a full insight into how this particular impairment affects the lack of integration into society, coping with day to day living and the possible effect this impairment can have on learning.

This chapter is divided into three sections. The scope of the first section is to define and address the core impairments that can exclude people with autism from the society they live in. Theoretical and historical perspectives of autism help to explain the cause of specific behavioural signs in autistic individuals such as lack of communication, social interaction and reciprocal social behaviour. The second section specifically addresses communication impairments and the challenges they pose. The third section covers the importance of early intervention and how education is key to helping people with autism. Interventions used in Irish schools are discussed along with the potential of using computers as an intervention tool. Sensory impairments in autism, such as the processing of visual and auditory information, are discussed in order to gain an understanding of the design considerations for the development of educational software for children who are moderately autistic.

The significance of this chapter is to highlight key areas that need to be addressed and understood prior to discussing the potential of using interactive computer programs to help facilitate the learning and communication of social skills such as daily living skills.

1.2 Autism in Context

1.2.1 Autism defined

Autism is amongst the most common childhood development disorders (Gillberg (1998)). It is a disorder, either present from birth or the very early developmental stage, which affects essential human behaviour (Lord *et al.* (2001)). The disorder manifests itself in a variety of behavioural phenotypes defined by impairment in social interaction (Gould (1997), Baron-Cohen (1997), Wing (1999), Jordan, (1999) and Lin (2008)), verbal and non-verbal communication and the ability to communicate ideas and feelings (Lord *et al.* (2001)). The autistic spectrum disorder varies in severity of symptoms and has life-long effects on how children learn to be social beings. Moreover, it also affects how they can take care of themselves and their participation in the community (National Research Centre (2005)).

1.2.2 Historical context

The phenomenon of autism has existed most likely since the origins of human society (Gersbacker *et al.* (2005), Frith (1989)). However, a seminal study conducted by Kanner (1943), a child psychiatrist, has situated the study of autism in the context of a condition dating from the early 1940s. (Volkmar (1990)). Kanner's (1943) seminal clinical study of eleven children with, as he termed autistic disturbances, has greatly influenced the diagnosis criteria of autism (Volkmar (1990)). Kanner gave a detailed description of similar behavioural pattern of these children which was grounded in data and theory of child development (see Kanner (1943). The term autism was borrowed from Bleuler (1912) who used the term to describe idiosyncratic, self-centred thinking as cited in Volkmar (1990).

Kanner (1943) went on to suggest that autistic children inhabited a self-contained world. Kanner, selected the following as characteristics for diagnosis as highlighted in his seminal paper entitled 'Autistic Disturbance of Affective Disorder':

> The children from this group have all shown their extreme aloneness from the very beginning of life, not responding to anything that comes from the outside world. (Kanner (1943), p. 248)

Kanner also outlined that these children have an obsessive desire for routine and sameness and a fascination for objects:

> The children are able to maintain an excellent and intelligent relation to objects that do not threaten or interfere with their aloneness. (Kanner (1943), p. 248)

Since Kanner's study in 1943 the diagnosis criteria of autism have been refined and greatly objectified (Bishop (2008)). Volkmar (1990) adds that Kanner's clinical account of the characteristics of infantile autism, such as social isolation, aversion to change and impairments in communication, have stood the test of time; the original research has been refined or refuted by on-going research (Volkmar, 1990).

1.2.3 Prevalence of autism

There is no specific register of the autistic population in Ireland. However a nationwide survey is underway to determine its prevalence (Irish Autism Action (2010)). Estimated current figures in Ireland are based on the National Autistic Society (UK) prevalence rate in the United Kingdom. Latest figures for the prevalence of the full range of autistic spectrum disorder stand at 91 in every 10,000, which amounts to almost 1 in every 1 in every 100. It is estimated according to the National Autism Society (2005) that compared to other disabilities net growth in the number of persons with autism is on average about 3 per cent greater each year. Felipek *et al.* (1999) state that early identification is highly important to avoid unnecessary suffering to children and families involved, and most importantly to improve the outcome. Autism Ireland state that the number of young children coming into the Irish system each year is significantly greater than the past and that the demand for services to meet the needs of this special population will continue to grown (Autism Ireland).

1.2.4 Autism and the triad of impairments

Wing (1999) states that it is clear that autistic children, as defined by any criteria used in studies conducted over the last few decades, can be characterized by the triad of impairments. Wing and Gould's (1979) influential study, found three areas of development that were associated with social impairments, forming a cluster of characteristics which are now defined as the triad of impairments. Wing (1999) suggests that the most important underlying issue regarding the treatment of autism is recognising that the whole spectrum is linked by the presence of underlying triad of impairments comprising:

- Social interaction
- Language and communication
- Thought and behaviour

Social interaction

Jordan (1999) defines the characteristics of social impairment or social interaction as impaired, deviant and extremely delayed social development, especially interpersonal development. The variations range from autistic aloofness to active but odd characteristics. Wing (1999) adds that this impairment may also manifest itself in the form of indifference to others. This impairment can be summarised as a lack of interactions with others, others accompanied by a difficulty in understanding new and unpredictable information. The consequence of this causes a preference for routine, repetitions and structure and also the inability to imitate other people's behaviour (Wing (1999)). Nash (2002) states that imitation is one of a child's most powerful learning tools.

Impairment of social communication

Wing (1999) contends that all children and adults with autistic disorders have problems with communication. The language they use, she states, may be grammatically correct, however, the problem lies with their use of language. In terms of interacting with others, they have difficulty understanding gestures and emotions, difficulty using gestures and facial expression (Baron-Cohen (1999)) therefore making it difficult for them to make sense of the world they live in (Jordan (1999)).

Social understanding

Social understanding is defined as a lack of interest in new things and a desire for routine and structure. Wing and Gould (1979) describe this impairment as 'rigidity of thought and behaviour and impoverished social imagination' (p.14). In addition, Wing

(1996) posits that people with autism have an inability to piece together information derived from past memory and present events to make sense of experiences. Muller (2002) conducted a study to explore the experiences that 18 high functioning autistic adults had navigating the social world. The findings of this study showed common experiences, which included:

- An overwhelming feeling of isolation.
- Difficulty with instigating social interaction.
- A desire to contribute to their community.
- A need to develop greater social and self-awareness.

1.3 Communication in Autism

An extensive body of literature documents the significant social challenges associated with the autistic spectrum disorder. In terms of social development the core characteristic is an apparent withdrawal (Wing (1996)). Muller (2002) adds that the workings of the social world seemed incomprehensible to people on the autistic spectrum and Rutter (1994) identifies that learning how to exchange in reciprocal social exchange contexts is a challenge facing every person on the autistic spectrum disorder.

The impact of these deficiencies results in social anxiety and isolation (Bellini (2006)). It has been theorised that the levels of anxiety in autistic children stems from their difficulty with social reasoning, familiarity and their necessity for order/routine and predictability (Humphreys *et al.* (2008)). Autistic children lack the ability to lack the ability to link concrete information appropriate to real world situations, as everyday situations are unpredictable and constantly changing (Dautenhahn (2000)).

As outlined in the National Children's Strategy[2] (2008), children need to learn social skills that are essential for effective participation in everyday life. An important social skill is the learning of daily living skills. Koegel *et al.* (1995) posit that a primary concern of parents of children with disabilities is the lack of autonomy in their children, resulting in a burden of care. Increased attention has focused on teaching these children daily living skills.in order to attenuate the burden (Pierce and Schreibman (1994)). Moreover, it gives them equal opportunity to participate in their community and foster a sense of independence (Pierce and Schreibman (1994)).

1.3.1 The communication process

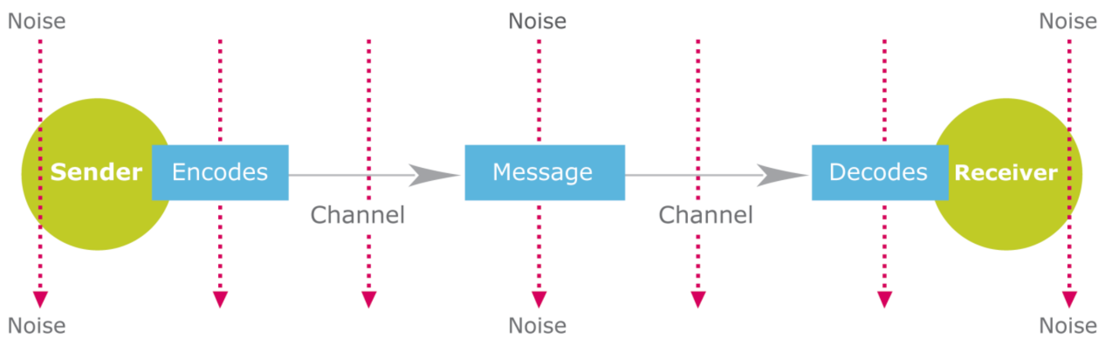
Beck *et al.* (2002) present communication as the ability to communicate with others. Moreover it is the act of being able to act and reflect on actions and the ability to draw conclusions about the actions of others.

The definition of the word 'communication' encompasses the process of interacting with others through verbal and non-verbal behaviour (Adler (1998)). Adler purports that most definitions of communication have a commonality in the elements that unite the process of communication.

[2] The National Children's Strategy is a 10-year plan with the following vision: an Ireland where children are respected as young citizens with a valued contribution to make and a voice of their own; where all children are cherished and supported by family and the wider society; where they enjoy a fulfilling childhood and realize their potential.

These elements encompass the sender, who encodes ideas and feelings into some sort of message and then conveys them to the receiver by means of a channel such as speaking or writing. In turn, the receiver decodes the message. Beck *et al.* (2002) add that encoding and decoding are useful analytical tools to describe the process through which thought is converted from its abstract state and is given a concrete form by the sender (encoder) and then returned to its abstract state by the receiver (encoding). In 1947 Claude Shannon and Warren weaver designed the influential model (Bishop *et al.* (2008)). This model (figure 1.1) is composed of 5 elements namely: the source, encoder, message, channel and receiver. According to Beck *et al.* (2002) and Bishop *et al.* (2008) the Shannon-Weaver model was principally concerned with communication technology. Their model has become the basic model of human communication.

Figure 1.1: Shannon-Weaver Communication Model



Source: Shannon-Weaver (1947)

Shannon and Weaver (1947) contend that communication is perfect if the information affects the receiver in exactly the way intended by the source. However, Bishop et al. (2008) refute this statement. They contend that information is rarely perfect; stating that at any point between coding and encoding, interference and noise can alter the message signal. They argue that this increases the uncertainty in the situation and makes the signal harder for the receiver to reconstruct accurately. Bishop et al's. (2008) argument punctuates the importance of understanding elements that can act as barriers in communication, and also raises the question: can everyone communicate effectively? If not, what are the barriers that prevent the execution of a successful communication process especially for people on the autistic spectrum?

1.3.2 Communication challenges for the autistic learner

In terms of communicating with people on the autistic spectrum, there are many barriers that hinder the flow of communication between the sender and receiver. Various studies conducted over the past forty years report that children with autism portray several learning characteristics that require explicit instructional skills (Arick *et al.* (2004)). Arick *et al.* (2004) explain that failure to make critical discrimination in in both auditory and visual capacities is a barrier when exposed to new learning. An example of the failure to make auditory discrimination is the inability to associate words with objects and people, while the failure to visually discriminate manifest itself in the inability to connect visuals to words or people. Arick *et al.* (2004) highlight the need to include procedures when teaching learners with autism to discriminate visual and auditory stimuli.

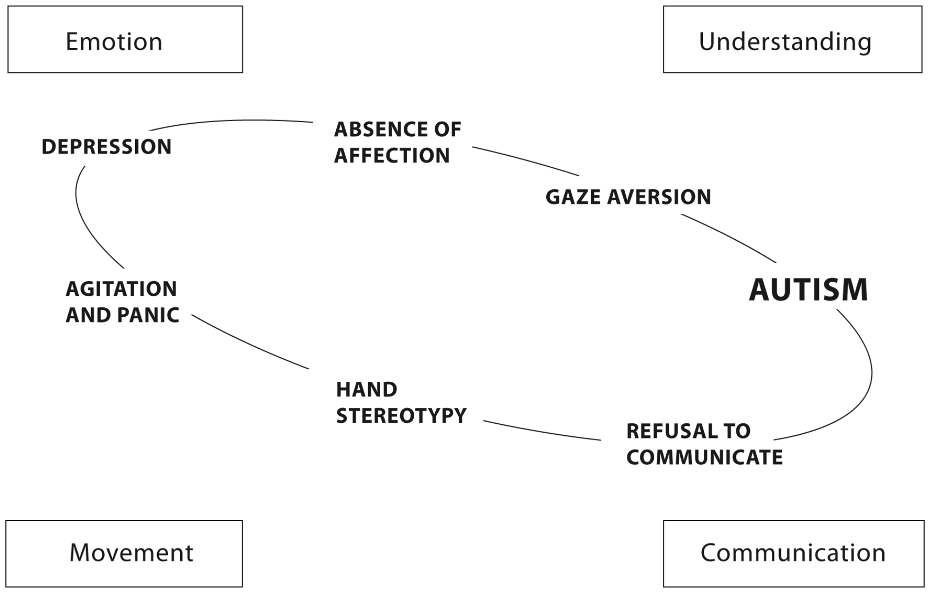
It is imperative to take into account and understand the various stimuli that autistic learners respond or do not respond to (MacDuff *et al*. (1993)). Arick *et al.* (2004) add that people on the autistic spectrum have different responses to sensory stimuli. Arick *et al.* (2004) identified that: 'one learns about the world through one's senses. Thus, a different sensory system can be associated with developing a different understanding of environmental events and human behaviour' (p. 1007).

This poignant comment highlights how people on the autistic spectrum differ in the way they make sense of what is going on around them. Not only does this impact on how they learn but also how they communicate with others. People on the autistic spectrum have various strengths that can enhance their ability to communicate. Research into the cognitive ability and perception skills of persons with autism has found differences compared to control groups on a range of tasks and for a range of domains (Franklin *et al*. (2008)). Franklin *et al.* state that research findings indicate that individuals with autism have been known to outperform control groups on visual search and the reproduction of impossible figures. Furthermore, evidence of enhanced perception and discrimination has been shown for pitch, musical processing and processing of auditory stimuli (Bonnel *et al.* (2003)).

Leekam *et al.* (2006) conducted a study on autistic persons' responses to a wide range of sensory stimuli and confirmed that 'sensory abnormalities are pervasive and multimodal and persistent across age and ability in children and adults with autism. Age and IQ levels are other factors which affect some sensory symptoms.'(Leekam *et al*. (2006), p. 849).

Figure 1.2 highlights the various areas that can impinge on communication and learning and resultant behavioural consequences.

Figure 1.2: Behaviour in developmental disorders



Source: Kerr (2002), p. 44.

Examining this model, it is clear that the refusal to communicate can have a negative impact on movement, emotion and understanding and can lead to negative behaviours for the person with autism (see Figure 1.2). It can be determined too, that there are various factors that contribute to an inability to communicate which include the inability to understand social cues (Wing (1988)) from peers, inability to process gaze (Leekam *et al.* (1998)) which leads to gaze aversion and the inability to show or understand emotion (Baron-Cohen (1991)), all which can lead to a feeling of isolation, panic and agitation (Tsai (2005)). It is possible that these factors can impinge on the autistic child's learning, adding to more stress, anxiety and exclusion (Bellini *et al.* (2010)).

1.4 Autism and Learning

Education remains the one treatment approach with the best track record for dealing with the difficulties associated with autism (Jordan (1997)). Jordan suggests that it is not just a matter of access to education as a statutory right for children with autism but how education can have a central role in remediating the effects of autism (not curing it). In addition to this, the Irish Task Force on Autism (2001) regards education as the key element in the achievement of equal status and maximum personal development for people with autism. Kanner (1943), Eisenberg (1957) and Rutter (1973) suggest that it is imperative that adequate educational opportunities and encouragement of developing skills are a critical factor in lifelong living. Murphy (2007) stresses that, if left untreated, most children with autism not only fail to learn and develop, but also experience deterioration in terms of behaviour. If children with autism are not given individual attention they may revert to their own repetitive activities or solitary existence (Baron-Cohen (1993)).

1.4.1 Autism and preferred learning styles

Learning is a process (Saljo (1999)) by which behaviour can change as a result of experience (Maples and Webster (1980)). In relation to autism and learning Farwell (2008) states that every autistic person learns differently, and thus, has his or her own learning style. Farwell purports that for some, auditory is most valuable. Others rely upon visual style and some learn through kinaesthetic means, or a combination of the three. Edelson (2008) adds that once a learning style has been determined, relying on that modality (for example visuals) to teach could greatly ameliorate the child's learning facility.

However, in the model of communication, as seen in Figure 1.1 there are various barriers, termed 'noise'. Just as in typically developed interpersonal communication, there are various barriers that prevent autistic children from successfully communicating. Barriers such as the inability to understand social cues from peers can add to the feeling of being isolated and can lead to the onset of anxiety, agitation and depression. The inability to process information in visual or auditory form can impact on learning, which again is detrimental to the development of the child with autism. The impact that these barriers can have on the autistic child's learning and communication are discussed in section 1.3.2.

1.4.2 Key interventions in the educational environment

There are various comprehensive intervention programs designed to stimulate changes in children with autism (Rogers (1996)). Autism specific classes in Ireland employ what is generally known as the eclectic approach to teaching. Some of the interventions used in the individual education plans include: Picture Exchange Communication System (PECS) (Bondy and Frost (1994); Treatment and Education of Autistic and Communication related -handicapped Children (TEACCH) (Scholper and Mesibov (1995), Shopler (1997); Social Stories (Gray (1994a)); and Applied Behavioural Analysis (ABA) (Lovaas (1987)). These interventions are aimed at facilitating all or any of communication, social or behavioural skills. There is much debate about which is the most effective (Task Force Northern Ireland (2001)). Jordan *et al.* (1995) stress that there is no strong substantiation that one approach for a child is better than another. Jordan *et al.* (1998) posit that, based on various findings (Jordan and Powell (1995a), Rogers (1996) and Garalnick (1998)), early intensive education which involves parents and includes direct teaching of essential skills, with an opportunity of planned integration, can produce significant developmental change with children on the autistic spectrum.

Strain (1998) recommends that providers of education require the best available information in order to make effective decisions about interventions. He cites four assumptions as a basis for general intervention planning:

- Children with autism are children.
- Children with autism grow up to be autistic adults.
- Children with autism have families.
- Children with autism live in the community.

It is important, however, that an intervention program must be individualised and tailored to the specific needs, strengths and weaknesses of the individual child, given the diversity of conditions within the autistic spectrum (Lord *et al.* (2001), Jordan and Powell (1995a), Jones and Jordan (2008), Parsons *et al.* (2000)). More importantly, data is not readily available on the long-term benefits these interventions can have on the autistic person's life (Jordan (1995), Prizant and Weatherby (1998) and Dawson and Osterling (1997)). However, a positive outcome is one that achieves independence and leads to a normal social life (Ruble and Dalrymplu (1996)).

Howlin (1997) notes the importance of structure in educational programs for children on the spectrum. An early study conducted by Rutter *et al.* (1994) confirmed that children with autism, exposed to structured task orientated programs, made significantly better educational and social progress than children with less structured educational environment.

1.4.3 The case for computers as an educational tool

There is increasing evidence that software and interactive computer technologies represent an effective new approach to education and learning for children with autism (Dautenhahn (2002)). The potential value of computer-based teaching has been demonstrated in numerous studies (Parsons and LaSorte (1993), Heimann *et al.* (1995), Hetzroni *et al.,* (2002), Bossler and Mossaro (2003), Baron-Cohen (2006, 2007), Golan and Baron-Cohen (2006) and Williams *et al.* (2008)). Computer based instruction has been used to teach a variety of skills including:

- Problem solving (Bernard-Opitz *et al*. (1999).
- Enhanced vocal imitation (Parsons and LaSorte (1993)).
- Improved reading and communication (Heimann *et al.* (1995) and Bossler and Massaro (2003).
- How to recognise and predict emotions (Baron-Cohen (2006, 2007).

Murray *et al.* (2006) add that computers can address several deficiency issues that an autistic child is faced with. Moreover, Neo *et al.* (2004) postulate that learning with computer based instruction has introduced a paradigm shift in education that will radically alter teaching and learning modalities.

Murray and Lawson (2006) comment that while it is commonly assumed that computer usage impairs autistic children's social skills, this is a misconception: 'On the contrary it puts them at an equal footing with their peers' (p. 56). As cited in Whalen *et al.* (2006) Bernard-Opitz *et al.* (1999) add despite the promise for computer-based instruction for children with developmental delays, there is concern that computer-based instruction may impede the development of spontaneous language and result in increased social withdrawal, particularly for children with autism. Whalen et al. (2006) refute this claim and state that this contention has not been subject to sufficient research Humphrey (2006) posits that people on the autistic spectrum favour structure and predictability when given instruction.

The computer environment provides structure and predictability (Gray (1995)) and also provides clear and explicit rules (Gray (1995), Silver *et al*. (2001) Hetzroni (2004)). It reduces distracting stimuli, inherent in real world situations (Strickland (1997), Silver *et al.* (2001)), and provides visual cues (Quill (1997), Bernard-Opitz *et al.* (1999), Cole (2003), Sweetenham (2003)). Moreover, a computer environment allows persons with autism to work at their own pace (Wong (1997)), provides motivation (Chen and Bernard-Optiz (1993), Moore and Calvert (2000), Dautenhahn (2004), Silver et al. (2001), Bossler and Massaro (2003)) and presents an environment where children with autism feel comfortable (Heimann *et al*. (1995). In terms of instruction, the computer environment provides error-less learning. In a class based environment an outcome judged incorrect can induce stress in the child, whereas interactive media allow for trial and error learning (Whalen, (2006)). In addition, the computer environment gives the child a sense of empowerment. According to Murray and Lawson (2006) giving a young person a chance to control the way they are represented can transform both the way they are seen by other people and the way they see themselves.

There are various teaching strategies that address communication impairments in autism, such as Applied Behavioural Analysis (ABA), Discrete Trail Training (DTT), and Picture Exchange Communication Systems (PECS). However it is apparent from the review of literature that there is no specific framework for computer instruction that addresses the various errors in communication, which can be translated into specific computer program design and with a customised implementation for children with autism (Mayer (2005) and Davis (2007)).

1.4.4 Considerations for designing for the autistic learner

Auditory impairments

Kiln (1992) states that a striking characteristic in autistic children is their poor orientation to the human voice. Auditory problems associated with autism include hypersensitivity to sound, painful hearing and abnormalities in auditory processing (Tharpe (2006)). Dautenhahn (2002) asserts that understanding narrative is an inherently complex task for children with learning disabilities. Understanding narrative requires an amalgamation and integration of such attributes such as linguistic, cognitive and social skills (Botting (2002), Williams (2004)). However, these are skills that many children who have learning disabilities, especially children with autism, find challenging.

Whitehouse (2008) conducted a study of persons on the autistic spectrum. The aim was to determine whether poor orientation to speech was due to impairment in allocating attention to speech sounds or a sensory impairment in processing phonetic information. The findings highlighted that children with high functioning autism can allocate attention to novel speech sounds. However problems with speech processing involve different pathways.

Environmental disturbance can also affect how audio is processed. Harris (1995) postulates that abnormalities can appear in response to ordinary environmental noise or voice in general. However, Williams *et al.* (2004) argue that while they agree that autistic individuals are less accurate in recognising stimuli in a uni-modal condition (for example, either visual or auditory), they can in fact process information when stimuli are presented together. These findings were a result of a study where a computerised virtual face was synthesised to deliver speech stimuli in auditory and visual conditions. The children with autism showed normal integration of visual and auditory speech stimuli when these were presented in tandem (bi-modal). Williams *et al.* (2004) conclude that children with ASD may benefit from multi modal design approaches to facilitate learning.

Visual impairment and design considerations

Marans *et al.* (2005) claim that using written modalities for people with autism allows otherwise transient auditory information to be presented in a way that is static. This can allow the autistic person to read information long enough until they fully understand what has been presented. Marans *et al.* (2005) also add that this decreases extraneous stimuli that may distract or confuse. In contrast, Grandin (2006) states that her cognition is based on images and not lexical items which she perceives as akin to second language learning.

These comments clearly illustrate that autistic learners have different learning styles and are affected differently by different stimuli. Grandin (2006) notes that: 'One of the profound mysteries of autism has been the remarkable ability of most autistic people to excel visual and spatial skills while performing poorly at verbal skills.' (Grandin (2006) PP.19-20).

Prior (1979) highlights that children with autism display a particular strength in visuospatial cognition. Hagawagari (2006) hypothesises that visuals used in instructional material will facilitate the processing of information. Furthermore, Hanschu (1996) reports that visuospatial information is one of the sensory inputs identified as calming and conducive to emotional attenuation. Quill (1997) adds that including visually cued instruction may support theories of sensory integration and also increase focused attention to a task. Moreover she adds that concrete properties of a visual might facilitate long-term memory retrieval.

In terms of using moving images in instruction, children with autism can lose sight of the overall meaning of the instruction by fixating on smaller details, such as spinning animations rather than the total context of the learning experience (Milne *et al.* (2002)). Norbury (2003) explains that weak central coherence is when a child will fixate on local information rather than the overall global meaning of what is being taught. When telling a story from a picture book, this cognitive style would be evident, as the autistic child would tend to process the information from each page individually rather than drawing overall coherent meaning from the events as a whole. This can have detrimental effects on learning and communication.

1.5 Conclusion

This chapter has identified the underlying characteristics inherent in autism and has addressed the key impairments individuals with autism tend to experience with communication and social skills and the consequences that these impairments have on their day-to-day living. Early intervention is identified as key to helping people with autism learn communication and living skills. The importance of teaching daily living skills at an early age is identified as a skill necessary for facilitating independence. The prevalence of autism and interventions used in Irish schools has been discussed along with the potential of using computer programs as an intervention tool. Sensory impairments in autism such as issues concerning the processing of visual and auditory information were discussed in order to gain an understanding of design prerequisites in the context of developing computer programs for moderately autistic children.

As highlighted in the literature, it is essential that designers understand their target group. Rijn and Strapper (2008) state that it is imperative that designers of educational content understand the needs and preferences of people on the autistic spectrum and Francis *et al.* (2009) state that non-inclusive computer programs may compound and heighten the existing senses of isolation, anxiety and alienation.

Figure 1.2 highlights the various areas that can impinge on communication and learning and the consequences they can have on behaviour. Moreover, from the review of literature to date, it would appear that there is no multimedia-learning model for the development of computer programs for children with autism. One of the underpinning objectives of this research study, is to assess the level of interactivity and multimedia experience that is needed to motivate engagement and therefore learning when using educational computer programs. The implications for design for this target population will be discussed in more detail in the following chapter.

Chapter 2 Designing Interactive Multimedia for Moderately Autistic Children

2.1 Introduction

The aim of this chapter is to provide evidence and perspective from literature for the design, development and localisation of educational computer programs to help moderately autistic children learn new daily living skills. A review of literature pertaining to the potential of interactive multimedia as an educational tool for moderately autistic children is presented under the headings of human computer interaction, cognitive theories, and multimedia learning principles, all of which are vital in the development of educational computer programs.

The current state of educational provision for children with autism in Ireland is presented and highlights the gap in the localising of computer programs used for educational purposes for children with autism. The significance of highlighting this gap leads to the research agenda of this thesis, which is to determine if the localisation of educational computer programs can make a difference in engaging with learning content via computer based instruction. Engagement is a prerequisite for learning, (Landry (2007), Newman *et al*. (1992)) and the question arises as to what level of interactivity is required to sustain engagement when using computer-based instruction.

This chapter is divided into five sections. The first section reviews current literature pertaining to the use of interactive multimedia as an education tool and explores if educational computer programs are designed to meet the cognitive processing impairments in autism. In the second section, various theories relating to the development of educational computer programs are discussed in accordance with the overarching issues children with autism have with the processing of information. A review of current educational computer programs for children with autism is discussed in section four. The fifth section explores the customisation of educational computer programs and the potential this could have for children with autism. This final section underpins the research agenda and rationale for this study.

2.2 The Emergence of Interactive Multimedia as an Educational Tool

2.2.1 Interactive multimedia as an educational tool

Multimedia based instruction holds great potential for improving the way people learn (Mayer (2001,2005)). Learners, he states, are exposed to information through various channels e.g. narrative, pictorial. Various studies have been conducted to ascertain the potential of using a multimedia environment for the purpose of learning (Mayer and Rose (2002), Axa and Weisner (2002), Hede and Hede (2002), Alessi and Trollip (2001), Mayer (2001, 2005), Neo *et al.* (2000), Shanker *et al.* (2004) and Rose *et al.* (2005). Tway (2007) posits that multimedia in general offers an excellent support to traditional teaching methods by allowing each student to explore and learn at a different pace so that every student has the potential to learn to his/her own full potential. Moreover, Ekselius (1994) discusses the positive retention of information when using multimedia as a learning tool. He postulates that interactivity raised the comprehension and retention rate of students to approximately 75 per cent.

It is evident that there is a paradigm shift in education in Ireland as Irish primary schools are embracing the use of computer programs to enhance teaching and learning across the curriculum (NCCA (2004)). There is substantial encouragement for ubiquitous access to computers and connectivity for every student (Department of Education and Science, ROI (2000)).

Each of us is unique in age, ability, and talent preferences. It is imperative that designers understand human diversity if they are to create effective and inclusive designs (Duncan (2006)). Broadly speaking, if education is to offer equal opportunities to everyone, existing learning and teaching methods (in this instance, computer based learning) need to be re-evaluated and the use of technology should be considered as one of the means of making learning more versatile (Smith *et al.* (2007)). Huang *et al.* (2007) sums up the Imperative need to deploy educational computer programs by stating that the ultimate goal of different educational programs is to enhance quality of life for children. Furthermore, like typically developed individuals, children with disabilities such as autism also desire better education and a higher quality of life (Smith (2007)).

As highlighted in the previous chapter, children with autism live in an experiential world that is comparatively different from that of typically developed children (Rijn and Stappers (2008)). It is therefore imperative that designers of educational content understand the needs and preferences of people on the autistic spectrum. Francis *et al.* (2009) state that non-inclusive computer technologies may compound and heighten the existing feeling of isolation/ anxiety and the sense of alienation.

2.2.2 Interactive multimedia designed to meet the skill deficiencies in autism

Schnotz and Bannert (2003) list various factors that contribute to learning when using a multimedia environment. Learners must be able to make conceptual knowledge representations from the forms of media presented and be able to integrate this knowledge into real life representation in order to learn and build effective mental models. In terms of developing inclusive educational computer programs, Kozima (2005) argues that the design and building of interactive environments is not sufficient for learning to occur. Huang *et al.* (2007) adds that environments should be designed in such a way that promotes the cognitive process required for meaningful learning.

Although multimedia as an educational tool has been widely documented there are relatively few tested computer programs for teaching people with autism (Kerr (2002)). As cited in Parsons *et al*. (2000) just four studies have been evaluated on the use of computer based instruction for children with autism. These four studies are: Williams *et al.* (2008); Bossler and Massaro (2003); Hetzroni *et al.* (2002) and Golan and Baron-Cohen (2006).

Barry and Pitt (2005) and Putnam and Chong (2008) raise the very salient point that educational computer programs need to support the deficits and complement the learning styles or strengths of an autistic child. Tuijs and Nelson (1998) suggest that we must adapt the educational computer program design process to address known aspects of autistic learning styles. To reinforce the latter comment, Kunce and Mesibov (1998) state that only by having an up-to-date knowledge of their characteristics, strengths, needs, weaknesses and interests can researchers develop individualised educational programs for the autistic population.

If a curriculum designed to meet the needs of all learners is to become a reality, it is vital that effective measures are taken to manage any inappropriate aspects of the curriculum by optimising its accessibility (Parsons *et al.* (2000)). Technology has proven its worth as an effective tool in supporting learners with disabilities by enhancing their access to the curriculum (Hunt *et al.* (2005)). Although it is an under-researched area, various studies (for example, the four studies referred to above) have validated the potential of visual cued instruction and the positive effect of cognitive gains that it has on the autistic learner. Quill (1997) postulates that this is a catalyst for learning.

Unlike most children who learn to apply and use skills across situations and contexts and can pick up skills incidentally, children with autism often need to be taught skills explicitly and then taught to use these skills across different situations (Parsons *et al.* (2000)). Bosco (2004) emphasises the importance of implementing learning and communication theory in the development of learning content. Learning she states:

> Involves drawing inference by means of construction and manipulation of models, the learner has to give sense to a series of information within a coherent system of meaning and hence construct models from which inference can be drawn. (p. 70).

Usability is a key concept in Human Computer Interaction (HCI). HCI is concerned with making computer programs/interfaces safe, easy to learn and easy to use and is also concerned with understanding, designing, evaluating and implementing interactive computer systems for human use (Preece (1994), Booth (1994)). In order to enhance the quality of the interaction between humans and the computer system, designers need to understand the users' characteristics in terms of ability, disability and age. Not only will this determine the best style and level of interaction but also match the needs of the user (Preece (1994)). Having established the need for special iterations to the design of computer programs for people on the autistic spectrum

(Chapter one), we must also consider the influence that HCI principles will have on the development of inclusive educational computer programs.

2.3 Human Computer Interaction and the Autistic Learner

2.3.1 HCI principles in designing interactive multimedia for the autistic learner

The role of HCI in design is to enhance the quality of the interaction between humans and the computer interface (Preece (1994)). HCI has particular relevance for assistive technology and is important for people with cognitive and learning disabilities (Jacko (2002)). Preece (1994) states that there are no set rules for designing user interfaces but there are guidelines that should be followed and applied where necessary. Preece outlines that interactive design should:

1. Integrate knowledge and expertise from different disciplines that contribute to HCI.
2. Be user-centred – involve the user as much as possible.
3. Be highly iterative so that testing can be done to check that the design meets the users' requirements. (Preece (1994), p. 145).

Computer system complexity can have a particularly negative impact on persons with cognitive and learning disabilities, this can impact on the design of computer program interfaces (Wachowick (2010)).

Putnam and Chong (2008) illustrate various impairments that can impact the development of effective computer programs for children with autism. They point out that each diagnosis for autism is unique to that individual but all such individuals share common characteristics e.g. a positive response to a structured environment and a facility in processing visual information. Other reported similarities include an expressed need for predictability and tendencies for repeating actions or an obsession with particular objects or subject areas (Schaff and Millar (2007)).

Andersson *et al.* (2006) state that general computer programs are rarely suitable for children with autism. Although the content may be at an appropriate level, it may not suit the specific needs of the child. The design and development of interfaces should not only support more effective and efficient user interaction but should also address the individual end user requirements and expectations in the variety of contexts of use to be encountered (Conway (2009)).

Extraneous features on a computer program's interface can cause unnecessary frustration and confusion for users with autism. This is primarily due to the extra effort necessary to focus attention (Gynszpan *et al.* (2008)). The advantages of reducing interface complexity have been documented in literature pertaining to HCI and assistive technology (See Gynszpan *et al.* (2008); Quinn and Wild (1998)). This latter point illustrates the importance of understanding the user's characteristics and ability.
In terms of navigation, Krug *et al.* (1993) posits that navigation buttons on an interface should look like buttons and avoid any design element that will make the user stop and think. Serra and Muzio (2002) postulate that there are two sets of tasks when navigating a computer program for people with cognitive disabilities, namely functional and operational.

Functional tasks are related to learning and content; operational tasks are related to interfacing with the program. It is important that operational tasks are made as transparent as possible in order that the user will focus attention on the functional aspect of the program (Serra and Muzio (2002)). Fischer (1993) adds that systems not only need to be adaptive to meet the needs of the user but also customisable. Krug *et al.* (1993) states that the cardinal rule for all interfaces is: 'Don't make me think' (p. 14) and describes a user-friendly interface as clear, intuitive and easy to navigate and understand.

2.3.2 The important elements of HCI to consider for the autistic learner

Learners with autism have particular cognitive problems and sensory issues especially in the processing of information (Happé (2008)). Happé adds that along the autistic continuum there are varying levels of cognitive ability. Ogletree (1998) states that individuals with autism are a heterogeneous group, and therefore, a 'one size fits all' design and development model would not address the myriad of communication concerns inherent in this population. This emphasises the need to evaluate various theories to determine the best possible outcome for the design of learning content for the autistic population. Therefore, both cognitive theories and issues surrounding sensory impairments must be prioritised when applying HCI principles to a user interface. Ertmer (1993) affirms that addressing these theories provides instructional tactics, strategies and techniques. He stresses the need for a sound theoretical underpinning as intrinsic to the development of a best practice learning strategy.

Design for cognitive impairments

Cognitive impairment raises specific issues for the design of HCI interfaces (Gynszpan *et al.* (2008)). It impacts negatively on reasoning and IQ scores (Keats et al 2007). In contrast, learning disabilities are impairments that affect a person's ability to acquire, process or utilise knowledge at a level appropriate to his/her IQ (Keats *et al.* (2007)). Jordan (1999) states that the level of explanation that is most useful for understanding autism from a treatment perspective is the psychological one. Autism she posits is a rich source of psychological theorising, which can help in gaining an understanding of the autistic child's observable behaviour and information processing ability (Jordan (1999)). Wing (1996) adds: 'there can be no doubt that a yet more fundamental impairment of psychological function underlines the triad' (p. 45) and emphasises that autistic people have an inability to put together information from past memories and present events and are unable to make sense of experiences or the world they live in. Furthermore, Volkmar (1990) states that people with autism have strengths in non-verbal abilities, but weaknesses in verbal tasks. For example, people with high functioning autism have good rote memory and can learn new factual information quickly, however, there may not be attachment of meaning to what has been learnt (Janzen (1996)). Various studies imply that they also take information literally (see Kanner (1943), Rutter (1978), Bishop (2001), Happé (1993), Frith (1994), and Wing (1998)).

Two cognitive theories will be reviewed to help clarify the areas that need to be addressed in order to further the development of this study. These are executive dysfunction and central coherence.

Executive dysfunction could possibly impact on the HCI that requires managing causal links between different events on the computer screen (Gynszpan *et al.* (2008)). Gynszpan *et al.* (2008) recommend that designers need to take into account the executive dysfunctions attributed to autism; this will impact on the way the interface modalities[3] will be used. Furthermore, extra modalities that would stimulate the typical user can cause confusion to the child with autism. This theory has been widely accepted as a cognitive explanation for at least some of the behavioural problems and information processing associated with autism (Ozonoff (1995) and Hill *et al.* (2002)). The impairments addressed in this theory are rigidity and preservation, an aversion to new tasks or actions, the tendency to be obsessed with a given task and the need for routine.

Weak central coherence is termed as the non-social features of autism. The behaviours associated include desire for sameness and obsessive repetitiveness (Baron-Cohen (1999)).). Features attributable to weak central coherence include a difficulty in decoding and integrating information into logical and consequential patterns, inattention and understanding social functioning (Gumtau *et al.* (2005)). Gumtau *et al.* (2005) infer that a weak central coherence inherent in autism translates to attending to parts rather than wholes and processing information verbatim for detail rather than gist. Detailed processing may therefore lead to cognitive overload.

Design considerations for sensory impairments

As previously discussed in Chapter One, people on the autistic spectrum have

[3] Modality In human-computer interaction modality refers to the sense through which the human can receive the output of the computer (for example, vision modality) a sensor or device through which the computer can receive the input from the human (Obrenovic and Starcevic (2004)).

impairments in visual and auditory processing. The following impairments impact on the design of the user interface:

Auditory impairments

- Understanding narrative (Dautenhahn (2002)).
- Poor orientation to the human voice (Klin (1992)).
- Hypersensitivity to sound (Harris (1995), Tharpe *et al.* (2006)).

Visual impairments

- Reading (Irlen (1991), Ludlow *et al*. (2006)).
- Distraction by irrelevant moving images (Milne *et al.* (2002), Norbury (2003))

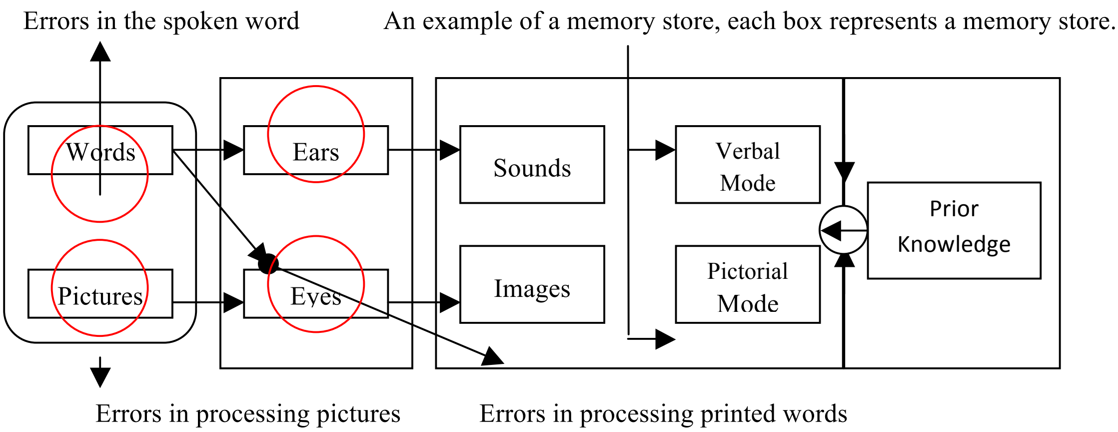
Both cognitive theories and sensory impairments will impact on the design of the user interface in terms of layout, design elements, level of interactivity, complexity, motivation, choice and feedback. These will be discussed at length in Chapter Three.

Although this group have various impairments, Baron-Cohen (1999) states we need to acknowledge that they have strengths too. For example, they are strong systemisers, which mean that they have a good attention to detail, deep narrow interests with exceptional ability. Furthermore, he emphasises that research needs to focus on evaluating the extent to which any form of intervention reduces the triad of impairments and supports the strengths of these children.

Cognitive and sensory impairments and multimedia learning

Determining what works in multimedia learning is the half way point in the process. It is imperative to understand the instructional methods that work and how they can affect people's cognitive processing during learning (Mayer (2005)). Mayer states that decisions made about the creation of multimedia learning content should reflect an underlying conception of how people learn. From a review of the literature it would appear that there is no multimedia-learning model for the development of computer programs for children with autism. However, Mayer's model of cognitive theory for multimedia learning is intended to represent the human information processing system. He states that that the boxes (see Figure 2.1) represent memory stores[4], which include: sensory memory, working memory, and long term memory. Images and words come in the form of a multimedia presentation, which passes through to the sensory memory. Visuals and spoken words are held as exact visual and auditory images for a very short time in the sensory memory. Mayer maintains that the central work of multimedia learning takes place in the long term working memory.

Figure 2.1: Mayer's Cognitive Model for Multimedia Learning



Source: Mayer (2005)

In order for meaningful learning to occur, Mayer (2005) affirms that the designer must reduce extraneous processing and manage essential processing in order to create an effective learning tool.

4 The model also shows all the memory stores as being a single unit whereas research findings in this area do not concur. For example, short-term memory can be broken up into different units such as visual information and acoustic information (Mayer (2005)).

Mayer's principles for multimedia learning

Mayer's principles of multimedia design for learning include principles for reducing extraneous process and principles for fostering generative processing[5]. Figures 2.2 and 2.3 summarises each of the principles.

Figure 2.2: Principles for Reducing Extraneous Processing

Principle		
1.	*Coherence Principle*	Learning improves when extraneous words, pictures and sounds are excluded rather that included.
2.	*Signalling Principle*	People learn better when cues that highlight the organisation of the essential material are added.
3.	*Redundancy Principle*	People learn better from graphics and narration than from graphics, narration and onscreen text.
4.	*Spatial Contiguity Principle*	People learn better when corresponding words and pictures are presented in close proximity rather than at a remove from each other.
5.	*Temporal Contiguity Principle*	People learn better when corresponding words and pictures are presented simultaneously rather than successively.

Source: Mayer (2005, p. 267)

[5] Permission granted by Mayer to use principles (2010)

Figure 2.3: Principles for Fostering Generative Processing

Principle		
1.	*Multimedia Principle*	People learn better from words and pictures than form words alone
2.	*Personalisation Principle*	People learn better from multimedia lessons when words are in conversational style rather than formal style
3.	*Voice Principle*	People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice
4.	*Image Principle*	Learning is not necessarily improved from a multimedia lesson when the speaker's image is added to the screen

Source: Mayer (2005, p. 268)

It is important to note that the cognitive model for multimedia learning devised by Mayer (2005) was developed for a typically developed population and not for a population with special learning needs. [6]

In summary, Mayer (2005) posits that the principles of multimedia learning should be based on the understanding of how people learn from words and visuals. Khan (2010) adds that children with autism have different visual and auditory balance to that of typically developed children. Controlling cognitive load and reducing complicated and irrelevant information are therefore important when developing instructional material for children with autism.

[6] In a conversation with Richard Mayer, the author established that no multimedia model specifically designed for people with cognitive impairments existed at that time.

Davis (2007) postulates that there are overarching issues and challenges in the design of educational computer programs for people with disabilities such as autism. The following section examines issues surrounding the current state of educational computer interventions for children with autism in Ireland

2.4 Educational Computer Programs for the Autistic Learner in Ireland

2.4.1 Computer programs currently used for the autistic learner in the educational environment in Ireland

Roache (2000) states that there is a dearth of policy, research, resources and training in technology-enhanced education for children with Asperger's syndrome (under the umbrella of ASD) in Ireland. The ICT Impact Report[7] report (2006) postulates that more research in this area would allow more accurate assessment of the impact and benefit of Information and Communication Technology in teaching and learning.

The National Council For Special Education (ROI) (NCSE (2009)) has reported that very little independent research has been conducted in Ireland on how autism specific classes operate or the evaluation of interventions (in this case computer instruction) used in classes and at home and their influence on individual outcomes. The few studies that have evaluated the effectiveness of interventions in Ireland have used quantitative research measures to evaluate their outcomes and efficacy (O'Donnell (2008)). Qualitative research can offer more insight into factors that could influence outcome (Curry (2009)): more importantly such research has the potential to determine the relevance of skills learnt during the interventions (National Council for

[7] European Schoolnet (EUN) is a network of 31 Ministries of Education in Europe and beyond. EUN was created more than 10 years ago with the aim to bring about innovation in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers, learners and researchers

Special Education (2009)). From the review of various studies pertaining to educational computer programs for the autistic learner in Irish primary schools, there would appear to be a dearth of evidence-based research on the potential of using Irish based educational computer programs in the educational plans for children with autism. This raises the question: can using educational software developed in Ireland using Irish accents foster an enhanced engagement with learning by children with autism?

2.4.2 Autism and the understanding of prosody

Children with autism have particular difficulty in interpreting incoming prosody. Prosody can be defined as speech rate, rhythm, pitch, loudness and patterns of speech (Crystal (1969), Quirk *et al.* (1995)). Prosody plays an important role in the range of communicative functions that serve to enhance or change the meaning of what is being said (McCann *et al.* (2003)). Individual speakers have idiosyncratic variations of prosody and many languages have regional prosodic variations (Roache (2000)).

Péppe (2001) elucidates that imitation of prosody is poor in people with autism and this he states is consistent with studies conducted by Williams *et al.* (2001). However, he duly notes that children with autism can adopt the accent and speech of characters in video, with great accuracy.

Computer programs based on American or British English offer particular complexities for users from different cultural backgrounds (Shen *et al*. (2006) and in this case for people with cognitive impairments. Variations in language exist due to regional or contextual conditions and these include dialects, regionalism, slang, colloquialism, idioms and accents (Newell (2006)). Reeves and Nass (1996) posit that voices are a great indicator of social presence. Incorporating them into interactive instruction may promote a higher form of processing. Mayer (2005) undertook a test with typically developed children to establish if hearing a speaker's voice narrating instruction on a computer program made an impact on their learning. Their findings showed that when the children were asked to rate the speaker following the auditory instruction, the children rated the speaker higher if he had a standard accent rather than a foreign accent. In terms of transferring knowledge the retention results were mixed.

Aykin (2005) adds that although there has been a lot of empirical research on adaptability and usability in a cultural context it is argued that in a cultural context, there is still a lack of research on appropriate methods to assist designers in dealing with these issues.

2.5 Customisable Interactive Multimedia and its Impact on Learning

2.5.1 The localisation of computer programs

In computing terms, internationalising and localisation are means of adapting computer programs to different languages and considering regional differences in design and layout (Hano (1995)). It is also the process of adapting a computer program for a specific reason or language by adding locale specific components. Jordan (1995) states that for computer programs to be inclusive to all users it must represent itself to users in a language that they understand. Programs should therefore support all regional standards of the countries or regions where they are being used (Esselink (2000)). Interestingly, Scahill (2004) acknowledges that the majority of publishers in the digital world earn a greater portion of their revenue from the sales of localized products than they earns from the sales of the original product._Localisation would thus mean adapting the language used in the program to meet the needs of a relevant locale (Pym (2004)).

In order to ensure the appropriate use of language variations when localising educational computer programs, Shaler (2000) purports that language variance should be evaluated based on the appropriate needs of the local audience (in this case, for children with special needs) and should be evaluated by someone who is not only fluent in the language but who is knowledgeable of and sensitive to its temporal, regional or contextual differences (Scahill (2004)).

Machalicek *et al.'s* (2008) review of instruction interventions for students with autism established that very few studies investigated the cultural backgrounds of people with autism. They add that:

> Inclusion of cultural and linguistic background information varied amongst studies irrespective of curricular area this absence of ethnicity and or race information is troubling given that these aforementioned interventions address such culturally mediated skills as communication and functional skills (p. 410).

2.5.2 The impact of familiarity in interactive multimedia

Moreno and Mayer (2000) postulate that given the constraints on the learner's working memory, instructional computer programs that include extraneous information contained in an agent's[8] image or voice can hinder learning. Interestingly, Moreno and Mayer (2000) ascertained that typically developed students who learn from computer

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[8] An *agent* is an animate entity that is capable of providing instruction in interactive computer programs (Wilges (2005))

instruction that has narrated instruction, rated the interactive lesson favourably, recalled more and learnt more than students who had the same verbal material as onscreen text. Reeves and Nass (1996) posit that voices are a great indicator of social presence and incorporating them into interactive instruction may promote a higher form of processing.

The voice carries various kinds of information. If we disregard the manner in which a message is spoken, such as pitch, tone and emotion then we may miss the importance of the utterance and mistakenly misunderstand the message conveyed (Jaimes and Sebé (2007)). Jaimes and Sebé add that the study of emotion in speech and its effect on the learner is largely under-researched.

Mayer *et al.* (2003) undertook a test with typically developed children to establish if hearing a speaker's voice narrating instruction on a computer program made an impact on their learning. Their findings showed that when the children were asked to rate the speaker following the auditory instruction, the children rated the speaker higher if he had a standard accent rather than a foreign accent and in terms of transferring knowledge the retention results were mixed. Mayer (2003) adds that these results are consistent in terms of social agency theory, which posits that social cues in multimedia messages can encourage learners to interpret HCIs as similar to human-to-human conversations.

Bishop (2008) acknowledges that sound holds great promise for instructional computer programs, as it supports learning in a variety of ways. However, he states that in order to understand the true potential of using sound, it is important to understand the barriers that sound can pose in the processing of auditory information.

Problems associated with autism include abnormalities in auditory processing. A striking communication characteristic in children with autism is their poor orientation to the human voice (Klin (1991)) and understanding narrative is an inherently complex task (Dautenhahn (2002)). According to Sheffer (2004) there are certain comprehension difficulties when listening to an individual with an unusual regional accent or voice quality. However, he states that with frequent exposure to the unusual regional accent the listener becomes accustomed to the idiosyncratic speaking style.

In a study conducted by Nygaard (1994), it was determined that words spoken by a familiar voice were easier to process than words that were spoken by an unfamiliar voice. Sheffert's (2004) study looked at two modalities that affect the processing of speech. His study investigated the effects of voice and face information on the perceptual learning of talkers. The findings indicated that the opportunity to see a person's face articulating the spoken word improved the encoding of the talker's voice. However the study did not measure to what extent, or if at all, an unfamiliar voice impacted on the learning experience.

2.5.3 Can familiarity facilitate learning for the autistic learner?

Agent unfamiliarity can result in negative behavioural response (Hudry (2009)). Hudry (2009) sampled various emotional situations encountered on a daily basis from a control group of typically developed children and children with autism. The subjects' response to agent familiarity and the impact it had on their emotional state was tested. Hudry (2009) found that agent familiarity effect was pronounced across all groups, with greatest empathy reported towards more familiar agents such as a caregiver and least empathy towards the least familiar agent such as an unknown adult. An earlier study conducted by Sigman *et al.* (1992) found that older children with autism spent a similar amount of time gazing at their caregivers and people familiar to them when compared with typically developed children. In terms of neuroscience, Birkett (2007) found that familiarity with a speaker's voice has been shown to enhance the auditory processing area of the brain. Eleven typically developed adults performed two tasks using the same vocal stimuli. The findings of this study showed an area in the brain that was preferentially activated by familiar voices in both tasks. Birkett (2009) postulates that familiar voices may elicit access to detailed sensory expectations, allowing enhanced auditory processing. Norbury (2003) contends that very few studies have been conducted to investigate the narrative processing skills of children with autism.

2.6 Conclusion

A review of current literature has highlighted the important areas that need to be addressed for the development of educational computer programs aimed at children who are moderately autistic. These important areas are presented under headings which include:

- Human computer interaction.
- Cognitive theories.
- Design principles
- The overarching issues children with autism have with the processing of information.

It is clear that both cognitive and sensory impairments will impact on the design of a computer interface for the engagement and learning needs of children who are moderately autistic.

The following is a summary of the key gaps and issues identified in this review of literature:

Williams *et al.* (2008) have highlighted that children with autism can feel at ease using computer based programs and various studies have examined the potential of using computer based instruction to help teach specific skills (Bossler and Massaro (2003); Hetzroni *et al.* (2002) and Golan and Baron-Cohen (2006)). However, from this review of literature it would appear that there is a lack of research relating to which interactive components help or hinder the engagement and the learning process when using computer programs for learning. Barry and Pitt (2005) and Putnam and Chong (2008) highlighted that this is an area that warrants research; they state that educational computer programs need to support identified shortcomings and complement the learning styles or strengths of an autistic child. They add that a 'once size fits all' design and development model would not address the myriad of communication concerns inherent in this population.

It would appear that no design or development framework for computer programs has been established that addresses the cognitive, sensory and any other underlining impairments that are inherent in autism and in this case, moderately autistic children.

To date, no study has been undertaken to establish if familiar accents used in computer instruction can facilitate learning for people on the autistic spectrum**.** A communication characteristic highlighted by Klin (1991) is that people on the autistic spectrum have a diminished capacity to process the human voice. While Dautenhahn (2002) affirms that understanding narrative is at best a complex task and a lack of such a capacity is characteristic of autism. The impetus of investigating the role of familiarity in computer instruction was based on a finding by Arick (2004) who stated that few studies have investigated the processing of auditory information from the voice.

Machalicek *et al.* (2008) identified that educational interventions for people with different educational needs fail to take into account their linguistic ability. This may impede the processing of information and therefore negate the intended purpose of the intervention. It also raises the question; do children with autism understand fully information presented in an unfamiliar regional accent. Can the customisation of an accent facilitate the child's learning? The following chapter, Chapter 3, discusses the exploratory and descriptive methodological approach undertaken to investigate key research questions derived from the literature.

Chapter 3 Research Methodology

3.1 Research questions

3.2 Overview of research methodology

3.3 Ethical issues and considerations

Part A Exploratory Research Methodology

3.4 Focus groups

3.5 Telephone survey

Part B Descriptive Research Methodology

3.6 Postal and on-line survey

3.7 Research methodology summary

3.1 Research Questions

From a review of current literature pertaining to computer programs for children with autism, the researcher determined that there was a gap in the development of educational computer programs specific to the needs of moderately autistic children. In terms of learning and engagement, the researcher identified the various communication and learning impairments that moderately autistic children are faced with. A gap pertaining to the processing of information was also established from the review, which warranted further investigation. The need arising from the identification of this gap is to determine if familiar auditory instruction (familiar accents used in instruction) in computer programs could increase the moderately autistic child's engagement level when learning. The two overall research objectives of this study are as follows:

1. What level of interactivity and multimedia experience is needed to motivate engagement and therefore learning when using educational computer programs?

2. Can familiar accents in auditory instruction when using a computer program increase the moderately autistic child's engagement level?

In order to answer the overall research questions, three phases of empirical work were undertaken:

1. Focus groups
2. Telephone survey
3. Postal and on-line survey

For each of the phases of empirical work, a series of sub objectives were developed. These are articulated in more detail in the following section and are summarised in figure 3.1.

Research question 1: What level of interactivity and multimedia experience is needed to motivate engagement and therefore learning when using educational computer programs?

As highlighted in the review of literature, multimedia-based instruction holds great potential for improving the way people learn (Mayer (2005)). Tway (2007) posits that multimedia in general offers an excellent support to traditional teaching methods by allowing each student to explore and learn at a different pace so that every student has the potential to learn to his/her full. Neo *et al.* (2004) argue that multimedia-based instruction has introduced a paradigm shift in education and will significantly impact on the educational system and the way the teachers teach and the students learn. Dautenhahn (2002) states that for people on the autistic spectrum, computer technologies offer an effective approach to education and learning. There are many positives associated with using multimedia-based instruction for people on the autistic spectrum. Children with autism feel comfortable with a multimedia-based environment; multimedia-based instruction provides structure and predictability (Gray (1995)): it provides clear and explicit rules (Gray (1995), Silver *et al.* (2001), Hetzroni (2004)). Computers allow a person with autism to work at their own pace (Wong (1997)).

In order to establish a design and development framework for the creation of a multimedia-based program for this study a series of focus groups was convened. The following sub-objectives were developed:

Focus Groups: Research Sub-Objectives

1. To determine the most common communication barriers when giving the child instruction to carry out a task.

2. To determine the various teaching methods that have been successful when giving the child instruction to carry out a task and what makes these methods a success.

3. To understand the behaviour of the child when he/she accomplishes a task.

4. To establish if computer based learning offers a positive motivational platform for the child.

5. To establish the components of a computer program that can motivate and engage the child when using a computer program.

6. To establish if there are any features of a computer program that can frustrate the child when using a computer program.

7. To determine the impact that unfamiliar accents in multimedia-based computer programs can have on the child.

8. To define daily living skills that moderately autistic children find most challenging.

It was deemed important that these sub-objectives were addressed as each of us is unique in age, ability, talent and preferences and this is more so for people who have learning disabilities. Furthermore, it is important to highlight that, like typically developed individuals, children with disabilities such as autism also desire better education and a higher quality of life (Smith (2007)). Duncan (2006) states it is imperative that designers understand human diversity if they are to create effective and inclusive design. Broadly speaking, if education is to offer equal opportunities to everyone, existing learning and teaching methods (in this instance, computer based learning) need to be addressed and the use of technology should be considered as one of the means of making learning more versatile (Smith *et al.* (2007)).

The review of literature pertaining to social skills and autism influenced the researcher in seeking to investigate what daily living skills moderately autistic children find most difficult to conduct. By understanding these skills, the proposed computer program could be tailored to meet the needs of this group. As outlined in the National Children's Strategy (2008) (see footnote 1), children need to learn social skills that are essential to effective participation in everyday life. Koegel *et al.* (1995) state that a primary concern of parents of children with disabilities is the lack of autonomy in their children, resulting in a greater burden of care. Increased attention has focused on teaching children daily living skills that attenuate the burden of care (Pierce and Schreibman (1994)). Any amelioration in this skills set offers potential equality of opportunity in community life, fosters independent activity and provides a sense of self-worth.

Data was collected using three focus groups: parents, teachers and educational therapists who care for or work with moderately autistic children between the ages of five and nine years.

Telephone Survey: Research Sub-Objectives

1. To determine if computer programs used in the individual educational plans of children with autism were developed specifically for autistic children.

2. To determine if educational computer programs used in the individual educational plans of children with autism were developed in Ireland.

3. To determine if an Irish accent vocalised instructions on computer programs in use.

These sub-objectives sought to determine whether computer programs used in special needs school across Ireland were designed specifically for children with autism and to ascertain if computer programs used in the teaching plans for autistic children were designed in Ireland. The impetus for these objective emerged from the literature, which highlighted a dearth of research on computer programs specifically developed for the learning needs of children with autism. The literature review brought to light that if computer programs do not address the learning needs of the target group, such as communication and learning impairments, then this could have a negative impact on learning and as a consequence could lead to negative behaviours. Francis *et al.* (2009) state that non-inclusive computer technologies may compound and heighten the existing feeling of isolation, anxiety and the feeling anxiety and alienation.

Difficulty in communication is one of the impairments that children with autism have and the processing of auditory information can prove to be a difficult task. A striking communication characteristic in autistic children is their poor orientation to the human voice (Klin (1991)). This provided the impetus to investigate whether foreign accents used in auditory instruction could impact on the child's engagement and therefore learning when using educational computer programs. In order to answer these objectives, the researcher deemed it important to establish whether educational computer programs used in special needs schools in Ireland have been designed specifically for the learning needs of autistic children and also to determine if computer programs currently used in the education plans of children with autism in these schools, have been developed in Ireland or abroad.

Descriptive Research: Research Sub-Objectives

1. To determine daily living skills that the user finds most difficult to understand and conduct.

2. To determine parents', teachers' and educational therapists' attitudes towards current educational programs used for autistic children.

3. To understand what design features distract the child from learning when using an educational computer program.

4. To determine design requirements that will motivates the child to use an educational computer program.

The impetus for these objectives is based on a recommendation made by Barry and Pitt (2005) and Putnam and Chong (2008) for further research. They highlighted that research into the design and development of educational computer programs specific to the needs of children with autism is an area that warrants further research. They state that educational computer programs need to support the deficits and remedy deficiencies and complement the learning styles or strengths of an autistic child. A nationwide survey was conducted among:

1. Parents of autistic children between the ages of 5 years and 9 years.
2. Teachers of autistic children between the ages of 5 years and 9 years.

Research question 2: Can the implementation of familiar auditory instruction in the computer program increase the moderately autistic child’s level of engagement?

Various studies pertaining to educational computer programs for the autistic learner would appear to point towards a dearth of evidence-based research on the potential of using Irish-based computer programs in the educational plans for children with autism. It raises the question: can using educational software developed in Ireland using familiar auditory instruction (Irish accents) help children with autism engage more effectively with learning?

The purpose of the second research question is to assess whether using familiar auditory instruction (familiar accents) as opposed to unfamiliar auditory instruction (foreign accents) in an educational computer program developed for this study will stimulate the autistic learner’s levels of engagement.

As previously highlighted in the literature, impairments associated with autism include abnormalities in auditory processing. Moreover, people on the autistic spectrum have difficulty in interpreting incoming prosody. Prosody can be viewed in terms of speech rate can be termed as speech rate, rhythm, pitch, loudness and patterns of speech (Crystal (1969), Quirk *et al.* (1995)). Prosody plays an important role in the range of communicative functions that serve to enhance or change the meaning of what is being said (McCann *et al.* (2003)). Individual speakers have idiosyncratic variations of prosody and many languages have regional prosodic variations (Roache (2000)). Computer programs developed in foreign countries contain variations in language that arise due to regional or contextual condition that include dialects, regionalisms, slang, colloquialism, idioms and accents (Newell (2006)). Aykin (2005) adds that although there has been a lot of empirical research on adaptability and usability in a cultural context, it is argued that there still is a lack of research on appropriate methods to assist designers in dealing with these issues.

To answer research question 2, observations of children using the computer program developed for this study were conducted with two groups. The first group were typically developed children between the ages of five and nine years and the second group were moderately autistic children of the same age group.

3.2 Overview of Research Methodology

The methodology for this research involved mixed methods, encompassing exploratory, descriptive and observational research (the latter is addressed in chapter 5). Encumber (2007) outlines that within a mixed methods strategy, if the methods are contrasting, then this can move the analysis forward. He states that one method can be used to inform the other. Jick (1979) established that a mixed method approach provides strengths that offset the weaknesses of both descriptive and observational research. This, he states, is practical as the researcher is enabled to use all methods possible to address a research problem. Adding to this, Creswell (2003) adds that the use of various methods in combination provides a better understanding of the research problem than either approach alone. Furthermore, Denscombe (2007) argues that researchers, who use a mixed method approach in their research, improve their confidence in the accuracy of findings through the use of different methods to investigate the same participant.

Brantlinger *et al.* (2005) state that allowing people with disabilities to voice their opinions by using observational research methods can make a significant impact on disability-related policies and practices. On the basis of Brantlinger's research, this study will use a triangulated approach to collecting data:

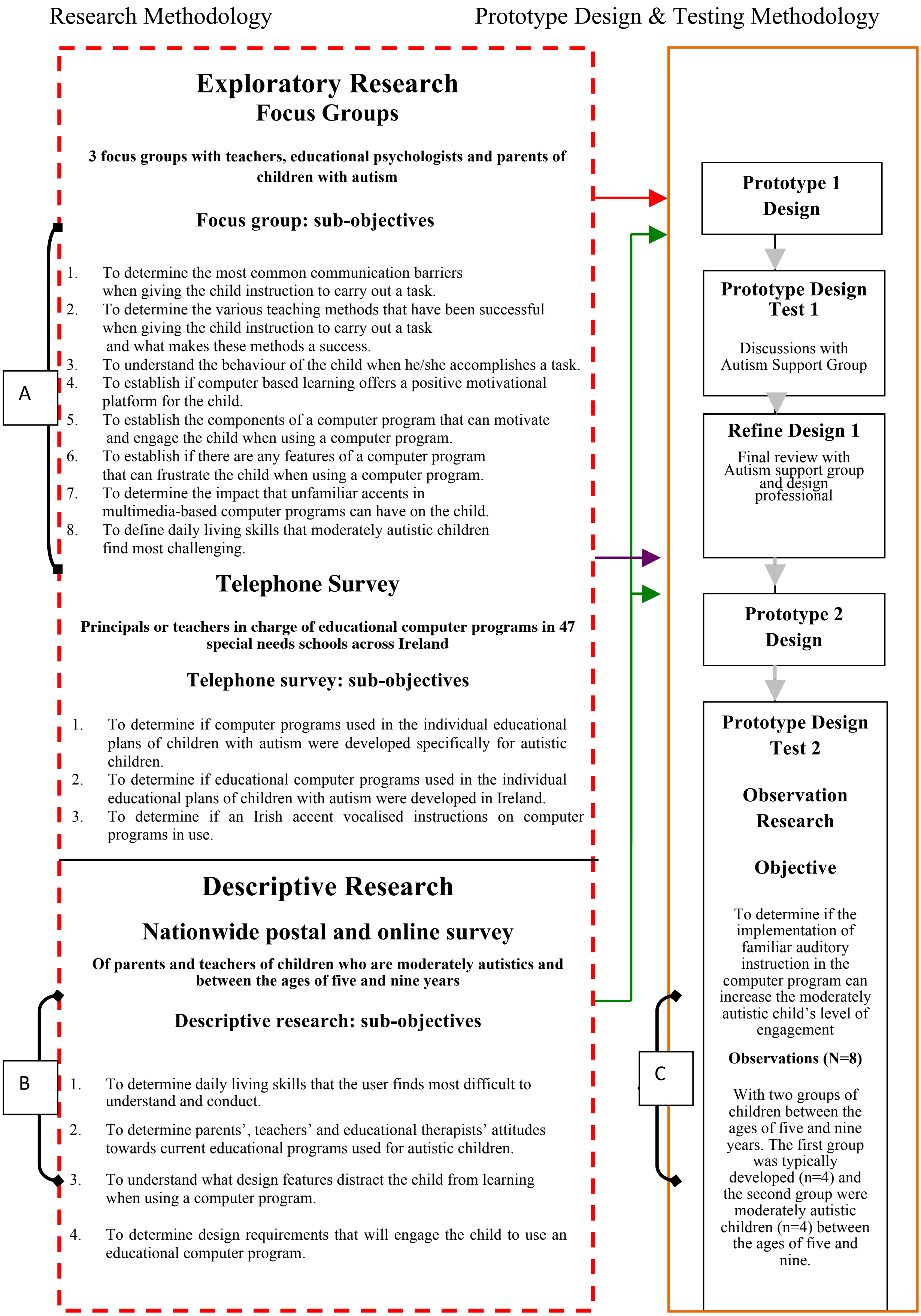
- Gathering data for exploratory research (focus groups and telephone survey).
- Descriptive research (nationwide postal survey and on-line survey).
- Observational data.

Figure 3.1 presents a concise overview of the exploratory, descriptive, design and observational methodology that was undertaken for this study. The exploratory research consists of three focus groups undertaken with teachers, educational therapists and parents of moderately autistic children and a telephone survey with the teachers in the 47 special needs schools across Ireland. The descriptive phase of this research consisted of a nationwide survey that was disseminated to all schools that had children with autism enrolled. In addition an on-line survey was conducted among parents of moderately autistic children across Ireland. The purpose of conducting exploratory and descriptive research was to determine the necessary requirements for the design and development of the prototype program for this study.

The sample for both the exploratory and descriptive phases of this research included professional practitioners, parents and other caregivers who taught or cared for autistic children. Denscombe (2007) argues that there is a need to include family and policy makers in educational research. Denscombe also states that an absence of such a dialogue can create a risk of misunderstanding and therefore a break in communication. It was therefore deemed to be prudent for this research to use the widest possible range of people, who worked and cared for moderately autistic children. This research also took into account that the development of the computer program would be designed for a heterogeneous group; each individual child varies in his/her ability, level of communication and social skills. Having a variety of care givers and professionals who have daily contact with this group can provide accurate data for the varying levels on the autistic spectrum and in doing so can provide valuable information for the development of this program. The parents of children with autism in Donegal (Donegal Autism Support Group) made recommendations on the design layout of the first prototype of the computer program. These recommendations were core to the development of prototype 2.

The final phase of this study is the design and observational phase, which is the subject of chapter Five. The prototype computer program was developed based on the findings of both the exploratory and descriptive phase of this study. The testing of the prototype consisted of an observational study of typically developed children (n=4) and moderately autistic children (n=4) using the computer program developed. The findings from both the exploratory and descriptive research fed into the design of prototype 1 and 2 (see figure 3.1). Prototype 1 was critiqued by Donegal Autism Support Group and the design was refined based on recommendations made by the group to produce prototype 2. The testing of prototype 2 was conducted using observations with two groups of children.

Figure 3.1: Overview of Methodology



3.3 Ethical Issues and Considerations

The key responsibility for ethical awareness rests with each individual researcher as the actions of each affects us all (Social Research Association (SRA), 2003). The SRA adds that if research is to remain of benefit to society, then the responsibility relies with the researcher to conduct his/her work responsibly in conjunction with the moral and legal order of society. If direct contact is made with children then it is imperative to have Garda clearance and ethical approval from the higher education institute involved in the research. This research has been granted both Garda clearance and approval from the Ethics Committee at Letterkenny Institute of Technology.

3.3.1 Ethics and vulnerable groups

Human participants' research has been directed by the principles set out in the central document, the declaration of Helsinki. The Helsinki Agreement (2008) outlines that the well-being of individual research participants must take precedence over all other interests. In addition the rights and health of participants must be respected, especially in the case of vulnerable groups, who cannot give or refuse consent for themselves. Hague (2003) states that all research on vulnerable groups should be conducted in accordance with the following three basic ethical principles:

1. Respect for persons. There are at least two ethical points to consider. Firstly all participants must be treated as autonomous agents. Secondly, the person with diminished autonomy is entitled to protection. All participants regardless of their ability or non-ability must be respected.

2. Beneficence. Researchers should consider the features of proposed research study in terms of ethical considerations and the satisfactory resolution of any ethical issues that may arise in the course of the research.

3. Justice. Participants must be treated fairly. The procedure in the selection of participants must also be conducted impartially.

3.3.2 Confidentiality

The following are measures the researcher took to ensure that data obtained was secured and treated with confidentiality.

Table 3.1: Measures used to ensure that data obtained was secured and treated with confidentiality

Measures	Actions taken
Storage of Data	Duplicate copies were made of any audio or video recordings and kept in separate secure locations. Back up of all research findings were transferred to CD-Rom, a duplicate copy was made and stored in a separate location. These measures were undertaken to ensure that a backup copy exists.
Video Recordings	Video recordings were backed up to a hard copy and stored in a secure place. All data was labelled as confidential.
Transcribed Notes from Observations	All notes were scanned and saved to a disc. The researcher ensured anonymity when transcribing observations. The disc was labelled as confidential and safely stored. The researcher also ensured that field notes did not contain any personal identification of the participants.
Consent Forms	All consent forms were scanned and saved to a disc. The researcher ensured anonymity when transcribing observations. The disc was labelled as confidential and safely stored.

Length of Storage	All data will be retained for 5 years after final completion of the research.
Destruction of Data	After the 5 years, all data will be safely destroyed.
Access to Data	The researcher is the only person who will have access to this data, which is safely stored in a locked metal cabinet.

Social Research Association (SRA (2003))

The researcher made every effort to protect the confidentiality and anonymity of participants (during the findings and analysis chapters of this thesis, the child will only be referred to as 'child 1, 2, 3') partaking in this research and took appropriate measures to store data in a secure manner. By doing this, the researcher had regard to her obligations under the Data Protection Act (2003).

3.3.3 Ethical procedure for part A: exploratory research

From the outset, all participants were assured of their anonymity and measures that were put in place to protect data obtained (see Table 3.1). Informed consent was sought prior to the focus group interviews. Potential participants from the three groups (teachers, parents from the Autism Support Group in Letterkenny and educational therapists at the HSE Autism Support Unit in Letterkenny) were sent a form seeking their consent to participate. All consent forms were sent back to the researcher signed by participants. During the focus group interviews participants were informed that if they felt uncomfortable with any question asked, they were free to withdraw at any time. Participants were informed of the length of the focus group's timeframe and were asked to sign a consent form agreeing to partake in the focus group.

3.3.4 Ethical procedure for part B: descriptive research

All participants who completed the survey were assured of confidentiality and that data obtained would not be shared with any third party. Data garnered from the online survey was downloaded from survey monkey[9] and backed up to CD-Rom. Care was taken not to record the IP address from the respondent's computer in order to ensure complete anonymity. All paper questionnaires were placed in a folder and stored in a secure place in Letterkenny Institute of Technology.

3.3.5 Ethical procedure for part C: observational research

Respect for persons

In the protection of vulnerable groups, the researcher was fully aware that participants should be protected against any harm or undue stress and that their rights would be respected at all times. The researcher ensured that:

- Participants were treated with the utmost respect and were treated equally at all times.
- If the child refused to participate, his/her right was respected without any further questioning.
- The child had the right to withdraw from participation at any time without any question.

Beneficence and Non-Malfeasance

The researcher is aware of the benefit and risk ratio to the researcher, to the participant and to Letterkenny Institute of Technology must be assessed.

[9] Survey monkey is an online questionnaire program, which allows researchers to develop surveys specific to their research, results can be downloaded in Microsoft excel format.

To the participant, the researcher ensured that:

- At the risk of the child becoming stressed during participation in the study, the researcher made certain that the child's participation would be paused. The researcher took all steps necessary to help the child such as informing the teacher and giving the child time out.

- No harm would come to the child as a result of participating in the study. A classroom assistant assisted with the observation study to ensure it ran smoothly.

- No social risk, such as embarrassment would come to the child during the observation study. The researcher ensured that confidentiality would not be violated. The researcher removed any identifying information in the reporting of findings.

To the Letterkenny Institute of Technology, the researcher ensured that:

- Research was conducted with integrity and professionalism at all times.
- Respect for the Institute's ethical guidelines was given at all times.
- Findings were not misconstrued.
- Respect for the Institute was provided at all times.

To the researcher, the researcher ensured that she would:

- Conduct research subject to the Institute granting ethical approval.
- Conduct research only when Garda clearance had been given.
- Conduct research subject to the consent of the school principal, the teacher and parent/guardian of the child who was participating in the study.

Justice

- The researcher ensured fair procedures in participants' treatment and the selection of participants.
- The researcher sought to prevent the overburdening of participants.

3.3.6 Informed consent

The Social Research Association (2003) ordains that any research involving human participants should take place on the informed and agreed consent of the participants involved in the research. Participants should also be made aware that they are free at any time to choose not to participate. In the case of vulnerable groups, extra care must be taken to protect their rights and ensure that their compliance is freely entered into. This must be done by having a guardian or parent sign the consent form. Obtaining the consent of a vulnerable group member without this safeguard cannot be regarded as consent, as it can be construed that the participant is acting under duress.

A letter applying for consent to observe four moderately autistic children using the designed program (see appendix A) was sent to the principals of Woodlands school and Educate Together School primary schools, based in Letterkenny, Co. Donegal. When consent was granted by the principals of each school, a letter applying for consent was sent to the chosen participants' guardian/parents (see appendix B) to request that their child could take part in the research and outlining the nature of the research. Both letters assured participants that all material obtained would be treated with the utmost confidentiality, that the researcher had Garda clearance and approval from the Institute's Ethics Committee and that no harm would come to the child as a result of the research.

Part A: Exploratory Research Methodology

3.4 Focus Groups

Focus group interviewing can be described as a 'conversation with a purpose' (Kahn and Cannell (1957 p. 149). It provides a platform to discuss valuable information such as what motivates people with autism to learn, what distracts them from learning and sensory and communication issues. Denscombe (2007) states that the potential of using this type of data collection method is best exploited when applied to the exploration of more complex and nuanced phenomena, rather than for the collection of straightforward factual data. Furthermore, Denscombe adds that using a focus group as a method of data collection is best suited for the collection of data based on opinions, experience, sensitive issues and privileged information.

The purpose of using focus group interviews for this project was to determine the needs of the user in relation to the design and development of a computer program for children with moderate autism. These findings were fed into the design development of the computer program for this study.

Data collection

Focus groups were conducted with three groups over a period of two months. Using three focus groups helped to safeguard the project from any biased opinions in the development the computer program. These three groups comprised people who work with and care for moderately autistic children. Other researchers embarking on the development of educational programs for people with disabilities have also used various stakeholder groups who have a vested interest in the user (see Andersson (2006) and Rijn (2009)).

The first focus group was conducted with parents of autistic children between the ages of five and nine years. The group was recruited from the Donegal Autism Support Group. Focus group two consisted of educational therapists who worked at the HSE Autism Unit for the North West under the direction of Dr Don McDwyer, consultant child psychiatrist, Letterkenny. The third focus group took place at the autism unit at Woodlands National (mainstream) School, Letterkenny. This group was composed of teachers who worked with autistic children. It was proposed that each focus group should take place in an environment that was familiar to each group in order to maximise comfort and ease during the process. Interviews lasted between one and two hours.

The researcher met with the Donegal Autism Support Group in Letterkenny prior to conducting the focus group interviews. The purpose of this meeting was to ascertain which of the parents from this group had moderately autistic children between the ages of five and nine years. Once this was determined, the researcher invited parents to fill out a pre-screening questionnaire (see appendix C), the purpose of which was to gather information such as the age and gender of the child. Bilson (2005) purports that additional information can be derived from using a pre-screening questionnaire.

Measurement Techniques

Theme sheets were used for the three focus group interviews (see appendix D). These were used to efficiently elicit information from the stakeholders using broad open-ended questions. Broad open-ended questions have proved successful in instigating the flow of conversation (Marshall (2006)). Oppenheim (1992) states that the main advantage of using open-ended questions is the freedom it gives to the respondents. Probes were also used when answers to the question were ambiguous or when the participants veered off track. Oppenheim (1992) states that if an answer to a question does not go far enough, it is necessary to introduce probes to help the respondents answer the questions effectively.

Topics used in the theme sheets were divided into two sections:

- Communication and learning.
- Using computer programs as an educational tool.

These topics were based on the research objectives and also from the review of current literature. The questions flowed from general questions on barriers in communication to specific questions such as using familiar auditory instruction in educational computer programs. Morgan (1998) states that questions that flow from general to specific invite openness and avoid bias. In addition, a well-designed theme sheet will enable the moderator to remain focused but also guides the group members to relax, open up, think deeply and consider alternatives (Krueger (2002)). The groups shared and elaborated on information in relation to the themes, which helped to explain, clarify, and corroborate the issues in question.

Sampling

Data was gathered from experts in the field of autism, which was pivotal to the design of the initial prototype (Prototype 1) and the development of Prototype 2. The chosen sample were parents (n=10), teachers (n=4) and educational therapists (n=3) who cared for or worked with moderately autistic children between the ages of five and nine years. People with cognitive impairments, unlike typically developed children, cannot effectively communicate their needs, whereas, parents, educational therapists and teachers who care for or work with moderately autistic children are in a position to interpret their needs. Their close proximity and daily involvement with these children gives them close knowledge of their abilities and weaknesses (Knoors *et al.* (2003)).

The first focus group was carried out in October 2009 in Letterkenny and was conducted with parents who had moderately autistic children between the ages of 5 and 9 years old (10 participants: 1 male, 9 females). The second focus group was with educational therapists (3 participants: 1 male, 2 females) based at the HSE Autism Unit Letterkenny and was conducted in November 2009. The third focus group was conducted in November 2009 with teachers (4 females) at the autism unit in Woodlands primary school, Letterkenny. Each interview lasted between one and two hours.

3.5 Telephone Survey

Data Collection

The instrument used for the collection of data was a telephone survey. The main advantage of using a telephone survey was that it enabled the researcher to collect data cost effectively from geographically scattered samples as recommended by Thomas and Purdon (2004). The researcher concluded that given the length of the survey (3 questions), a telephone survey would be a most effective tool to use.

The Department of Education and Science (ROI) provided a list of special needs schools (see appendix E and I) across Ireland that had children with autism enrolled. 47 schools were listed and all were contacted.

Measurement Techniques

A short questionnaire was used asking three dichotomous questions. The first question probed whether educational computer programs used in the Individual Educational Plans (IEP) were developed specifically for children with autism. The second probed whether the computer program had been developed in Ireland and the third probed whether instruction on the computer program was vocalised in an Irish accent.

Sample

A census was taken of principals or teachers in charge of educational computer programs in the 47 special needs schools.

Two lists of primary schools where children with autism are enrolled exist. The first of the lists categorises all 47 special needs schools that have children with autism on their enrolled and the second list includes all special needs and mainstream primary schools that have children with autism on their enrolled. The first list was used for the telephone survey, the latter list was used for the postal survey. Both lists were current in 2010 and were obtained from the Department of Education and Science (ROI). The results of this survey are presented and discussed in Chapter 4.

Part B: Descriptive Research Methodology

Descriptive research as outlined by Malhotra (2007) is the description of an aspect pertaining to marketing characteristics, functions and phenomena. Churchill and Peter (1998) state that it studies the relationship (if any) between two variables. Accuracy is of utmost importance when conducting any descriptive research (Malhotra (2007)).

Malhotra (2007), Zikmund (2001) and Walker (1993) outline the purpose of using descriptive research:

- To ascertain the perception of product characteristics.
- To realise the decision-making process and influences.
- To portray the characteristics of a certain group.
- To understand and determine the degree of difference in attitudes, needs and opinions of groups.

The four points outlined by Malhotra (2007), Zikmund (2001) and Walker (1993) provided a guideline for the development of the survey for this research.

3.6 Postal and Online Survey

Data Collection

This study involved the use of a postal survey approach to collect data. The advantage of using surveys is that they are relatively low cost, geographically flexible and can reach a widely dispersed sample (Kanuk and Berenson (1975)). Moreover Kanuk and Berenson (1975) assert that data can be procured promptly with a survey. Survey methods have been widely used in autism research, for example (Fombonne (1999), Gillberg (1998), Cialdella (1989), Blaxill (2004), Putnam and Chong (2008) and

Sterling *et al.* (2007)). The latter two authors granted the researcher permission to use part of their questionnaire for this study. There was careful consideration of reliability and validity of questions used in this survey. Questions were rigorously researched and aligned with literature. The survey was pilot-tested with a group of people (n=4) who were excluded from the sample. Many changes were made to the questionnaire to ensure its reliability (see appendix H for all iterations)

Measurement Techniques

A mixture of Likert scales and open-ended questions were used in this questionnaire (see appendix F). Buckingham and Saunders (2004) state that Likert is one of the most simple but effective examples of scaling in social science research. Tittle *et al.* (1969) states that 'this is because they are much easier to construct and that they tend to be more reliable than other scales with the same number of items.' Robson (1993) suggests that the Likert scale looks interesting to respondents and they often enjoy completing a scale of this kind. The purpose of using Likert scales for this research was to measure attitudes relating to the design of existing software that children who are moderately autistic use.

The advantage of an open-ended question is that information gathered by way of responses is more likely to reflect the full complexity of the views held by the respondent (Raja *et al.* (2003)). This type of question also gives respondents free rein to express their views in their own words (Bruce (2008)). Denscombe (2001) states that open-ended questions also have their disadvantages as they can demand more effort on the part of the respondent and also the researcher. These types of questions also leave the researcher with data that is raw and requires a lot of time-consuming analysis before use.

The survey was divided into four sections.

The introduction section to the survey was used to elicit demographic information from each participant. This included gender, age, level on the autism spectrum and any other underlying diagnoses that the child may have.

Section 1

The first section focused on an area that people with autism find particularly challenging, namely daily living skills. As outlined in The National Children's Strategy (2008), children need to learn skills that are essential to participation in everyday life. Data was gathered in relation to the daily living skills that this group found difficult to conduct. Findings were instrumental in the development of the program for this study.

Section 2

The second section entitled *computer programs used at school,* (for the survey directed at teachers) and at home (for the survey directed at parents) focused on understanding users' attitudes and experiences towards computer programs used in both the home and in the school. Question 4 to 8 sought to understand if computer programs used in the individual education plans of children who were moderately autistic had been specifically designed to address their cognitive needs. Question 1 to 4, 11 and 13 were based on a survey conducted by Stirling *et al.* (2008) (permission granted by author in 2010.

Questions 2 and 3 sought to understand the purpose of the computer programs that this group used in schools and at home, for example, were they used for the purpose of learning communication skills or social skills? Question 4 sought to identify whether the computer programs that were used, were designed specifically for children with autism. Questions 5 sought to determine if the computer programs used had foreign accents and question 6 probed if the child copied these accents. Question 7 sought to understand if using familiar localised accents in a computer program would benefit the child.

A more in-depth understanding of programs used was addressed in questions 8a and 8b. Question 11 investigated the length of time the child spent using computer programs and question 12 and 13 asked how often the child used the computer.

Questions 1 to 8 in section three were the most important questions of this section. These questions sought to determine users' strengths, weaknesses and behaviours. Understanding these was essential in the design and development of the computer program for this study to ensure that the design of the program met the needs of this group. The questions that form this section were based on a previous research study conducted by Putnam and Chong (2008). A key finding from Putnam and Chong's study (2008) was that although there have been numerous pilot studies and computer programs designed for children on the autistic spectrum, very little is actually known about how well these solutions are integrated into the lives of children on the spectrum. Putnam and Chong state that creating effective products from a user-centred perspective begins with the focus of the user's goals, which should be aligned with the user's strengths and weaknesses.

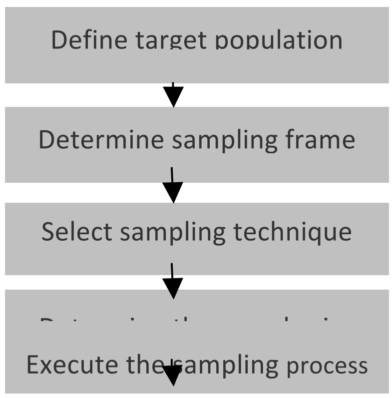
Section 3

Sections three focussed on a range of problematic areas that people on the autistic spectrum find challenging. Questions 1 to 5 focussed on auditory and visual processing and attention span. Information gathered from the literature review formed the basis for these questions (see Bonnel *et al.* (2003), Arick *et al.* (2004), Leekam *et al*. (2006) and Franklin *et al.* (2008)). Question 5 was based on strengths and interests of the moderately autistic child: this question was based on the research of Putnam and Chong (2008). It was important to address these so that the author could build upon and avoid certain design features when developing the computer program for this study. This section used a variety of multiple choice questions and Likert scales.

Sampling

Malhotra (1996) outlines basic steps to follow when drawing a sample from a population. Five of the basic steps that apply to this research are outlined in figure 3.5.

Figure 3.5: Recommended steps for drawing a sample of a population



Source: Malhotra (2007 p. 285)

Survey monkey, an online application, allowed for the online distribution of the same questionnaire directed at parents of moderately autistic children between the ages of five and nine years. An email with the questionnaire link was sent to various autism support groups across Ireland either using Facebook or by emailing the link of the online survey directly to various autism support groups' email addresses inviting them to participate in the research.

Definition of the population

The population is used to represent all those who fall within the category of concern (Oppenheim (1992)). Malhotra (2007) states that it is imperative for a researcher to define the population precisely. He adds that an imprecise target population will result in research that is ineffective at best, and misleading at worst. The population for this research is defined as parents and teachers who care for or work with moderately autistic children between the ages of five and nine years in the republic of Ireland.

Sample unit

Malhotra (2007) defines a sample unit as an element or a unit that contains the element that is available for selection at some stage of the sampling process. For the purpose of this research, the sample units were special needs and mainstream primary schools who had children with autism on enrolled and households that had moderately autistic children between the ages of five and nine years. The sample elements were:

- Parents of autistic children between the ages of five and nine years
- Teachers of autistic children between the ages of five and nine years

The purpose of using this age group stemmed from the fact that many children under the age of five have not been diagnosed with autism and children with autism between the ages of five and nine/ten years 'have developed an awareness, attention and interest outside of themselves.' (Tuedor (2008) P.73).

Parents and teachers have first-hand knowledge of the complex needs of children with autism in terms of communication skills, abilities and impairments.

The sampling frame

A sampling frame is a representation of the elements of the target population (Malhotra (2007)). Oppenheim (1992) states that a sampling frame cannot be drawn if little is known about the population. No sampling frame exists of parents and teachers who care for or work with moderately autistic children between the ages of five and nine. Therefore, the researcher used an alternative method to compile a sampling frame for the purpose of this research. A census was taken of schools with moderately autistic children between the ages of five and nine years on their roll. A convenience sample was taken of parents who had moderately autistic children between the ages of five and nine years.

It was possible to conduct a census as the Department of Education and Science provided the researcher with an up to date list of all primary schools in Ireland that had children with autism enrolled. A census can be described when a survey is conducted with a complete enumeration or collection of details from or about a population (Gknosh (2007)).

A non-probability sampling technique (convenience sampling) was used to sample parents who had moderately autistic children between the ages of five and nine years in Ireland. As there was no sampling frame in existence for this population, the researcher had to use an alternative method.

Non-probability sampling relies on the personal judgement of the researcher rather than chance to select sample elements (Malhotra (2007)). Denscombe (2007) states that there may be many circumstances which can lead to complications when choosing a sample on the basis of probability sampling. In the case of this research, the researcher found that there was a significant information deficit regarding the number of people who have been diagnosed with autism or as being on the autistic spectrum. As of 2011, there are no national statistics on this disorder in Ireland. Autism Ireland bases their rates on UK figures produced by the National Autistic Society (NAS).

Sample size

According to Bartlett *et al.* (2005) using an adequate sample along with high quality data collection efforts will result in more reliable and valid results. Oppenheim (1992) states that it is not the sample's size that is important, rather its accuracy.

Executing the sampling process

The researcher posted questionnaires nationwide to the 156 primary schools listed (see Appendix E) as having children with autism enrolled (109 mainstream primary schools and 47 special need schools) there were 103 responses resulting in a response rate of 66%. For the online survey, the researcher invited parents from Irish autism support groups on Facebook who met who met the criteria to undertake the online survey. Irish Autism Action and Autism Ireland sent a link of the online questionnaire to all its members. 271 parents responded to the survey, however only 104 out of the 271 online surveys could be used, on the basis of having met all the criteria for this survey (child that was moderately autistic, between the ages of five and nine years and from Ireland).

A letter addressed to the school principals (see appendix J) clearly explained the nature of the research and asked for their permission to distribute the questionnaire to a teacher in the school who taught moderately autistic children between the ages of five and nine years. In order to ensure this was a random sample, the teacher was asked to choose the child in the class whose birthday fell next on the calendar for the purpose of filling out the questionnaire. A stamped addressed envelope was included for ease of return. To ensure anonymity, no information was requested regarding the background of the family or any personal information concerning the parents. These measures were outlined in a letter sent to both the teacher and principal of the school.

Wimmer and Dominick (2006) advise that a researcher should follow a structured process to ensure a good return on a postal or online survey. The researcher took into account Wimmer and Dominick's recommendations and developed the following structured process for the survey:

1. A cover letter was sent that clearly explained the nature of the questionnaire, which was personally signed by the researcher (see appendix F). Addington-Hall and Pagu (2007) point out that a personally signed cover letter can improve response rates.

2. The assembled package included: the cover letter, the questionnaire (stapled to keep pages together to ensure ease of use) and a stamped addressed envelope for ease of return. Addington-Hall and Pagu (2007) add that stamped addressed rather than franked envelopes can also improve response rates.

3. Informed consent was sought in the covering letter addressed to the principals, teachers and parents (see appendix J and K).

4. To monitor returns, the researcher invited participants to include their school's address or email address should they desire a copy of findings. This helped the researcher to track all mail surveys sent out.

5. Reminder letters were sent, which included a thank you note for those who participated in the survey (see appendix M). This was sent 10 days after the questionnaire was posted. Gentle reminders can yield an increase in responses (deVaus (2002)).

6. Confidentiality was assured to all participants. The letter attached to the questionnaire explained the purposes of the research and assured participants that all information obtained from the questionnaires would remain confidential and would only be used for the purpose of the research.

Analysis of Data

Data were analysed using SPSS which is a statistical computer package used in descriptive research. Data were cleaned prior to analysis by choosing only the questionnaires that met with the requirements of this research (moderately autistic child between the ages of five and nine years). Collected data were inputted manually into SPSS and were coded by using a codebook developed by the researcher (see appendix N).

3.7 Reliability

Ensuring reliability was imperative in this research methodology. Russ-Eft (1980) states that validity is considered the most important element of research instruments. .

Russ-Eft (1980) adds that if an instrument is not valid then it has literally no value for the task at hand. The development of this questionnaire was founded on previous research studies in the area of autism and education (Baron-Cohen (2006), Bossler and Morero (2006), Putnam and Chong (2008) Davis (2007) and Sterling *et al.* (2007)). Section three and part of section four were modelled on findings from research studies based on educational programs for children with autism (permission granted from both Putnam and Chong (2008) and Sterling *et al.* (2007) which enhanced the construct validity of the questionnaire.

Reliability

Simply stated by Russ-Eft (1980), reliability assesses the degree to which an indicator will yield the same results on repeated application. In order to ensure reliability, the researcher pilot-tested the questionnaire with a selected group of people who were excluded from the sample. Individuals who pilot-tested the questionnaire made excellent recommended changes (see Appendix H). These changes were recommended to enhance the flow of the questions asked, clarification and to diminish ambiguities in instructions and questions. In summary, this methodology set out to explore the following fifteen objectives aimed at answering research question 1:

1. To determine the most common communication barriers when giving the child instruction to carry out a task.
2. To determine the various teaching methods that have been successful when giving the child instruction to carry out a task and what makes these methods a success.
3. To understand the behaviour of the child when he/she accomplishes a task.

4. To establish if computer based learning offers a positive motivational platform for the child.
5. To establish the components of a computer program that can motivate and engage the child when using a computer program.
6. To establish if there are any features of a computer program that can frustrate the child when using a computer program.
7. To determine the impact that unfamiliar accents in multimedia-based computer programs can have on the child.
8. To define daily living skills that moderately autistic children find most challenging.
9. To determine if computer programs used in the individual educational plans of children with autism were developed specifically for autistic children.
10. To determine if educational computer programs used in the individual educational plans of children with autism were developed in Ireland.
11. To determine if an Irish accent vocalised instructions on computer programs in use.
12. To determine daily living skills that the user finds most difficult to understand and conduct.
13. To determine parents', teachers' and educational therapists' attitudes towards current educational programs used for autistic children.

14. To understand what design features distract the child from learning when using a computer program.

15. To determine design requirements that will engage the child to use an educational computer program.

Chapter 4 Research Findings and Analysis

4.1 Introduction

Part A Exploratory Research Findings and Analysis

4.2 Introduction to exploratory findings and analysis

4.3 Focus group findings and analysis

4.4 Pilot survey (telephone) findings and analysis

Part B Descriptive Research Findings and Analysis

4.5 Introduction to survey findings and analysis

4.6 Survey findings and analysis

4.7 Conclusion

4.1 Introduction

The purpose of this chapter is to discuss the findings and interpretation from both the exploratory and descriptive phases of this research. The main objective is to determine the most appropriate use of interactive computer programs to help moderately functioning autistic children learn. In order for this objective to be met it was deemed imperative to assess the cognitive processing and learning needs of this group. This chapter is divided into two sections;

- Part A presents the research findings and analysis of the exploratory phase
- Part B presents the research findings and analysis of the descriptive phase of this study.

Part A – Exploratory Research Findings and Analysis

4.2 Introduction to Exploratory Findings and Analysis

The exploratory research stage was pivotal to the design of the initial prototype of the program. The objective of this section is to discuss the findings and analysis of the exploratory phase of this study.

Section 4.3 discusses the findings from three focus groups. Findings are presented in relation to communication barriers that children with autism face in the processing of information and the impact that this has on learning and the most common daily living skills that these children find most difficult to master.

The findings report on the educational computer programs used by children with autism in schools and homes across Ireland. Moreover this section addresses important design features that need to be included in the development of computer programs. Section 4.4 discusses and interprets the findings of the telephone survey. This section reports on whether computer programs used in special needs school across Ireland were designed specifically for children with autism and if computer programs used in the teaching plans for autistic children were designed in Ireland.

4.3 Focus Group Findings and Analysis

In order to effectively analyse data from a focus group interview Patton (2002) states that the researcher has an obligation to fairly represent the data and communicate what the data reveals given the purpose of the study (Patton (2002)). The researcher structured the findings for this study in sequential fashion by using theme sheets (see Appendix D) as a guide. Following the structure of the theme sheets, the researcher was able to elicit important points that were discussed during the focus group sessions.

4.3.1 Theme 1: communication and learning

Barriers in communication

Of the seventeen participants, eleven felt that attention span and focus were one of the main barriers when communicating instruction to the child they cared for. This finding concurs with Garretson (1990) who postulates that children with autism have difficulties in sustaining attention on imposed tasks, which may be partially attributed to a developmental delay. Eight parents, three educational therapists and the three teachers felt that background noise had a negative effect on the child's focus and attention. However, three from the therapist group and three parents believed that it was not just background noise that the child with autism had to contend with. It was higher frequencies of noise barely audible to us that the children found alarming. This finding also concurs with the literature pertaining to auditory barriers. Autistic children are highly sensitive to noise; they can find noise, which is barely perceptible or unremarkable to others, intolerable (Happé (2002) Baron-Cohen (2006)). One participant from the educational therapist group gave an example of the sound of a lawnmower. To people in general, it is a normal humming sound, however in her experience, to a child with autism the pitch is higher and intolerable. A participant from the teacher's group added that it was back and forth banter that can confuse a child with autism. She stated that the child tries to concentrate on all voices, which is impossible. The resulting effect on the child can be anxiety and frustration.

These points were important for the researcher to acknowledge in the development of the educational computer program. It was important to understand how to utilise sound and pay particular attention to pitch and auditory stimuli. Also it was suggested that the child/parent/guardian should be allowed to control the volume of the sound output so that the sound level would not deter or distract the child when using the program.

Communicating Instruction

Nine out of the ten parents, two of the educational therapists and three teachers believed that explicit instruction was of great importance when communicating a task to a child with autism. One of the participants from this group stated that simple instructions should not be underestimated when communicating with the child who is autistic. One of the participants from the parent group advised that in order for a child to focus on what instruction was given, she had to use trigger words to gain his attention. She stated that when giving instruction it had to be broken into explicit attainable steps so that the overall task could be achieved. Nine parents felt that instruction should be given in simple and unambiguous language that the child understood. Nine parents felt that instructions must have a 'start, next and finish' in order for instruction to be carried out effectively. Two teachers also believed this and inferred that steps in instruction must be progressive. The therapists argued that instruction must be based on the child's ability and no 'one size fits all'. There was general agreement from five parents and two teachers that instruction must be:

- In simple language
- Literal
- In goal orientated small steps
- Reinforced in order for the child to learn.

Language

Two educational therapists and seven parents believed that language used in instruction must be explicit. People on the autistic spectrum can take meaning from words literally. The educational therapists and three parents stated that colloquialisms, which we can take for granted, confuse children with autism as they interpret meaning literally. Examples of such colloquialisms given by the parents included:

- Raining cats and dogs
- Watch yourself
- Take it easy
- Mind your step

Daily living skills

Six parents, two therapists and two teachers believed that children with autism have difficulties in conducting daily living skills. One participant (teacher) explained that there are many physical and cognitive issues that can act as barriers to the learning of daily living skills. Another stated it was paramount that living skills were taught and reinforced in order to instil a sense of independence in the child.

The parents group was most vocal in this area. Eight parents, who answered this question, identified some of the problematic areas that children with autism have with day-to-day living skills:

- Using the bathroom and knowing when to use the bathroom
- Personal hygiene
- Putting on garments
- Turn taking
- Making choices
- Maintaining skills learned

To expand on the latter point, one participant (teacher) asserted that it was not just the learning of daily living skills that was problematic; it was the generalisation of the skills learnt. For example, if the child was taught how to wash his hands in the classroom he was unable to conduct this task on his own in a different location. It was important, she stated, to reinforce the daily living skills taught in various environments to promote generalisation. According to Walden *et al*. (2009) it is not until children with autism can acquire applied skills across a variety of settings that they will make broad long-term progress in behaviour and social communication.

A trend appeared in the parent's group that children could 'get down' if they could not accomplish a task. Eight parents believed that getting things wrong could have a negative impact on the child; one parent gave an example of her child having a tantrum because he could not reach a level on a computer game. One of the participants (teacher) remarked that it was very important to get across to the child that it is ok to make a mistake. In addition, she added that it is important to fade out prompts when teaching daily skills as explicit prompts do not happen in the real world.

Rewards and learning

Five of the parents described the rewards they use with their children, which included: clapping when they got something right, giving them a 'high five', giving them a 'special smile' and verbally rewarding them for getting a task correct. Four parents, one teacher and one educational therapist felt that verbal rewards are effective and motivational and help children remain focused on the task they were undertaking. 'Learning should be fun', was a comment made by one teacher 'when the child is having fun, he is engaged and focused'.

Visuals and learning

The value of using visuals in communication was probed in order to understand if they increased engagement and therefore learning. Seven parents, two educational therapists and two teachers believed that using visuals was effective when giving instruction as they command the child's attention and in addition the child can visually represent the object of the exercise.

4.3.2 Theme 2: computers as a learning tool

Of the sixteen participants, fourteen believed that children with autism feel comfortable using a computer and therefore it could be of benefit as an educational tool. One parent commented:

> My child learnt how to use a computer from a very early age, it came second nature to him, and he picks up anything to do with a computer very easily.

When probed as to why they thought computers would be a good learning environment, a response made by four parents and two teachers was that computers are reliable and do not change, unlike the children's peers. Computers have a structured environment and the child can learn at his/her own pace and not be intimidated by getting something wrong. It emerged that they flourish in an environment that has routine and is predictable. Nine parents group, two teachers and one educational therapist believed that using computers can act as a great intervention for children with autism as it empowers the child and allows him/her to become an autonomous learner.

Distracting features on educational computer programs

A general opinion from the parent group was that failure in not achieving a level on computer programs could be debilitating. Nine parents, one educational therapist and three teachers agreed that failure to achieve a task can result in the child becoming anxious, frustrated and losing motivation in using the program. Four parents suggested that there should be attainable levels on computer-based programs for children with autism. Each level must have achievable goals that are realistic. In addition, one parent made a very salient point, namely that each level must build upon the previous set of tasks taught, which would reinforce what was being taught. One participant (teacher) discussed the negative implications of fast moving animations on a computer program. She stated that a child with autism can: 'Hone in on one small moving object and lose sight of the overall purpose of what is being taught.' She added that in her experience the child will become totally transfixed by this moving object and not want to progress to the next step. Another parent described how her child was oversensitive to the sounds on the computer program, and that the computer program did not offer a choice of muting sounds. Other negative features that were discussed included:

- Too many distracting colours
- Instruction was only text based; should be accompanied by narrative
- No pause button for learning animation; a pause button can give the child the chance to learn at his own pace
- Tasks were too difficult
- No facility to print out instruction for the teacher/carer
- No obvious rewards for reaching a certain level

According to some of the participants' rewards are excellent ways for any child to be motivated when using the computer program, however five participants (two parents, two educational therapists and one teacher) asserted that rewards can also have a detrimental and de-motivating effect on a child with autism, especially if the reward was not readily obtainable. This goes back to the importance of creating levels in the computer program that are attainable.

Rewards used in computer programs

Two of the educational therapists advised that when rewards were presented, there should not be an option to replay them, as children with autism can get consumed by the smallest detail in an animation and therefore can lose sight of the overall purpose of the program. One therapist gave the example of the animated trains on a 'Thomas the tank engine' computer program. She said the child became totally focused on the repetition of the train wheels going around. The child could happily sit for hours just watching the wheels moving. This concurs with Baron-Cohen (2009) who has observed that children with autism are drawn to predictable, rule-based systems, whether these are repeating mathematical patterns, or repeating electrical patterns (e.g. light switches), or repeating patterns in films.

One parent added that using a timer was a motivator for her child in completing a task as the child can visually see time passing. However, another parent argued that this type of motivator would deter her son, as he would get frustrated if he could not finish a task on time. Giving the child the choice of a reward was recommended by two of the participants (therapist and parent). One parent reasoned that teaching choices to children with autism prepares them for real world settings, adding that in everyday life we have to make choices.

Choices

Three participants (parents) suggested that a mistake that is often made with children that have disabilities is not allowing them to make choices. This, one parent claimed can have a negative long term effect on children as they are not being prepared for living in a real world setting. When probed how this could translate in to the design of computer programs, the parents felt that even at the lowest level on the computer program, simple choices should be presented to the child.

Computer programs for children with autism

Eight parents, none of the therapists and three teachers reported that the computer programs they used either at home or school had not been created specifically for children with autism. Participants were then asked if they used Irish computer programs. According to the parent and teacher group computer programs used came from either America or the United Kingdom; one participant (parent) said he had used an Irish program but it was not designed specifically for children with autism.

Accents on computer programs

Participants were asked if unfamiliar accents used on computer programs had a negative impact on the child's learning. Interestingly, eight parents and two teachers acknowledged that this had no impact on learning. When probed about the possibility of the child picking up an accent from foreign computer programs, four parents stated that their children did mimic accents. One parent described how his child from a very early age mimicked an American accent from watching cartoons on television. He said that the use of computer programs had led to him adopting American vocabulary such as 'trash can' instead of bin and 'pants' instead of trousers. One parent remarked that people would not know her son was on the spectrum were it not for his American accent.

One of the therapists stated that computer programs with foreign accents could be detrimental to the child's speech and language development:

> Children with autism have speech and language difficulties, listening to unfamiliar foreign accents can be confusing for for children as they pick up words and accents without knowing the meaning of them.

There was agreement from five parents, that to assume an accent, such as an American accent, can have a negative impact on the child's social being as it can make him/her stand out from their peers at school.

Designing computer programs specifically for children with autism

Three of the teacher group and six of the parent group reported that careful consideration must be given to the level of animations presented on the interface. One parent explained that her child could continually repeat one animation without progressing on to the next stage. Current literature also advocates that autistic children thrive on repetition and can continue to engage in repeating an activity, which can be detrimental to carrying out other activities (Jordan (1997)). Another important factor to consider which emerged from a discussion with the teachers' group is that autistic children can attend to the most minute or non-important details. This can have a negative effect on their progress when using a computer program that contains animations, if a solution is not put in place. This is called lack of central coherence, which means that autistic children tend to focus on the local rather than global information (Happé (1997)). Three from the parent group suggested that for each step of instruction in the design of the program, there should be achievable goals that must have a start, middle and end. They suggested that this could motivate the child to obtain a goal, as the steps are achievable and motivational. Rather than seeing the global (global information) picture the child could concentrate on small local (local information) steps that would lead to the completion of the main task. The proposed design solution aims to appeal to the child's inability to understand concepts.

Table 4.1 Summary of findings from focus groups

Theme 1: Communication and learning	Findings
Sub theme: Barriers in communication	- Attention span and focus were two of the main barriers when communicating instruction to the child with autism. - Background noise had a huge impact on the child's focus and attention. However it is the higher frequencies of sounds that may not be audible to the typically developed child that can be quite alarming to a child with autism.
Sub theme: Communicating instruction	- Instruction must be given in simple language, must be literal and tasks must be goal-orientated and divided into smaller steps. - Language used in instruction must also be explicit; people on the autistic spectrum interpret meaning very literally.
Sub theme: Rewards and learning	- Verbal rewards were deemed to be effective and motivational and could help children remain focused on a task they are undertaking. Learning should be fun, as it can help the child engage and focus on what is being taught.
Sub theme: Visuals and learning	- Using visuals was deemed to be effective when giving instruction, as they command the child's attention and also the child can visually represent the object of the exercise.

Theme 2: Computers as a learning tool	Findings
Sub theme: Distracting features on an educational computer program	- Failure to achieve a task on a computer program can result in the child losing self-esteem and motivation. - Other distracting features: - Too many distracting colours. - Text-based instruction can make it difficult for the child to process information; should be accompanied by narrative. - No pause button provided; a pause button can give children an opportunity to learn at their own pace. - Tasks were too difficult. - No facility to print out instruction for the teacher/carer. - No obvious rewards for reaching a certain level.
Sub theme: Rewards on a computer program	- When rewards are presented in animation form, there should not be an option to replay them. Children with autism can become consumed by the smallest detail of an animation and therefore can lose sight of the overall purpose of the program.
Theme 3: Computers programs for children with autism used at home or at school	Findings
	- Computer programs used at home or at school had not been developed specifically for children with autism.
Sub theme: Accents	- Foreign accents on a computer program had no impact on learning. When probed about the possibility of the child picking up an accent

	from foreign computer programs, four parents stated that their children did mimic the accents. - Two of the therapists stated that having computer programs with foreign accents could be detrimental to the child's speech and language development.
Sub theme: Designing computer programs specifically for children with autism	- Children with autism can attend to the most minute or non-important details on a computer program. This can be detrimental to their progress when using an interactive computer program if a solution is not put in place.

The following are a list of recommendations to emerge from the three groups to make educational computer programs more inclusive for children with autism:

- Large buttons makes it easier to gain control of the computer program (three parents).
- Start, stop and replay buttons should not be included in the design of the computer program (four parents, all of the teacher group and one therapist).
- Use a timer, to give the child a sense of time and to motivate progress (one parent).
- Do not use broad accents on voiceovers as children with autism can mimic accents (five of the parents).
- The computer interface must be visually stimulating but without too many animations as these can distract the child (general agreement from parent and teacher group).
- Music, or any other sounds must be controllable; stop or mute button to be included (mostly agreed by the parent group; one teacher recommended a button to turn off sound).

- Language must be simple, unambiguous and straightforward (seven parents, three teachers).
- Reinforcements must be faded out over time, to promote autonomous learning (two of the educational therapists).
- Instruction must be broken down into small goal-orientated steps (general agreement from parent group).
- Allow the child time to register instruction before launching into a new task (one parent).
- Ensure continuity throughout programs. Keep colours subtle and characters similar throughout. (Three parents, three educational therapists).

Conclusions from the exploratory phase of this research have been translated into the design framework for the development of the initial prototype design.

4.4 Pilot Survey (telephone) Findings and Analysis

As a result of the findings reported in the preceding section, the researcher sought to determine if special needs schools that taught children with autism used computer programs specifically developed to their needs and also to determine if the computer programs they used were developed in Ireland.

4.4.1 Participants' profile

There are 47 special needs schools in Ireland. The telephone survey was conducted over three days, with either the principal of the school or the person in charge of educational computer programs. From the 47 schools a total of 31 responded.

4.4.2 Educational computer programs used in Irish special needs schools

Of the 31 respondents, 23 indicated that the computer programs they used were not designed specifically for children with autism. Four responded that they used computer programs developed for children with learning difficulties but not specifically for children with autism. One respondent did indicate that the computer programs she used was designed specifically to meet the needs of children with autism, while three responded that they did not know if they were developed specifically for children with autism.

4.4.3 Origins of educational computer programs used in Irish special needs schools

Of the 31 respondents, 14 indicated that the educational computer programs they used in the educational plan of children with autism came from the United States, while nine indicated that the majority of the computer programs they used came from the United Kingdom. One respondent stated that the computer program she used was developed in Ireland, but was not specific to the needs of children with autism. Eight responded that they did not know where the computer programs came from.

The findings that computer programs currently used in special needs schools in Ireland have not been designed specifically for the cognitive needs of children and that a high percentage of computer programs used in special needs schools are developed outside of Ireland adds strength to this research.

The findings that have emerged from the exploratory phase of this research will be instrumental in the development of the computer program for this study. How these findings translate into design solution will be discussed in Chapter 5.

Part B Descriptive Research Findings and Analysis

4.5 Introduction to Survey Findings and Analysis

The central objective of the descriptive phase of this research is to determine how programs can be developed specifically for the learning needs of moderately autistic children. This phase reports the findings of two nationwide surveys. These surveys were conducted in Ireland during 2010, with parents and teachers of moderately autistic children, between the ages of five and nine years. There was a 66% response rate from the 156 mainstream and special need schools that had moderately autistic children enrolled. 271 parents responded from Facebook autism support groups across Ireland. However only 104 were deemed suitable as having met all the criteria for this survey.

Findings are reported under the same three headings of both questionnaires, which are:

- 4.6.1 Daily livings skills (users needs).
- 4.6.2 Computer programs used at home/school (users' attitudes and experiences in using computer programs).
- 4.6.3 Interactive computer programs for autistic children (determining users' strengths and interests which will lead to the development of educational computer programs specific to their needs).

All data were coded using the SPSS statistical programme.

Section 4.6.1 focuses on an area that people on the autistic spectrum find challenging, namely daily living skills. The list of daily living skills that were used in this enquiry ranged from daily hygiene to daily functioning skills. This list was developed from the focus group discussions with educational therapists, teachers and parents of autistic children. Section 4.6.2 focuses on understanding users' attitudes to and experience of computer programs used both at home and in the school. The final section, 4.6.3, focuses on a range of problematic areas that people on the autistic spectrum have difficulties with. The first part of this section focuses on auditory/visual processing and attention span. The latter part centres on strengths and interests of the moderately autistic child. Findings (positives and negatives) will inform the development of the user centred computer program.

4.6 Survey Findings and Analysis

4.6.1 Daily living skills at home and school

Ability to conduct daily living skills

The respondents (n=104 (parents) n=108 (teachers)) were asked to rate the level of difficulty that the child in their care had in conducting various daily living tasks using a Likert scale. These ranged from everyday hygiene tasks such as using the bathroom to daily functioning tasks such as dressing and feeding him/herself.

The following daily living skills were rated as 'very difficult' by both sets of respondents.

Table 4.2: Daily living skills that the child has great difficulty with – rated as very difficult.

Daily living skill	Parents (n=104) %	Teachers (n=108) %
Using a knife when feeding	46%	23%
Setting the table	34%	12%
Brushing teeth	23%	23%
Dressing oneself	20%	9%
Pouring a drink	19%	13%

The main findings of both surveys highlight that there are significant impairments in using daily living skills both at home and in the school environment. As outlined in table 4.2, the most common daily living skills identified by parents were using a knife, setting a table, brushing teeth, dressing and pouring a drink. Interestingly, teachers also rated using a knife for feeding purposes as the most difficult daily living skill. Following that, brushing teeth, using a fork, using the toilet and setting the table were reported as the most difficult daily skills. These are significant findings to establish, as they will enable the researcher to develop the computer program.

Interestingly when comparing the findings of both surveys, it has emerged that using a knife whilst feeding was the most difficult task to undertake both at home and in school. The following text discusses the findings of the most common daily living skill (using a knife) as rated by both sets of respondents.

Figure 4.1: Difficulty child has using a knife (parents)

n = 104

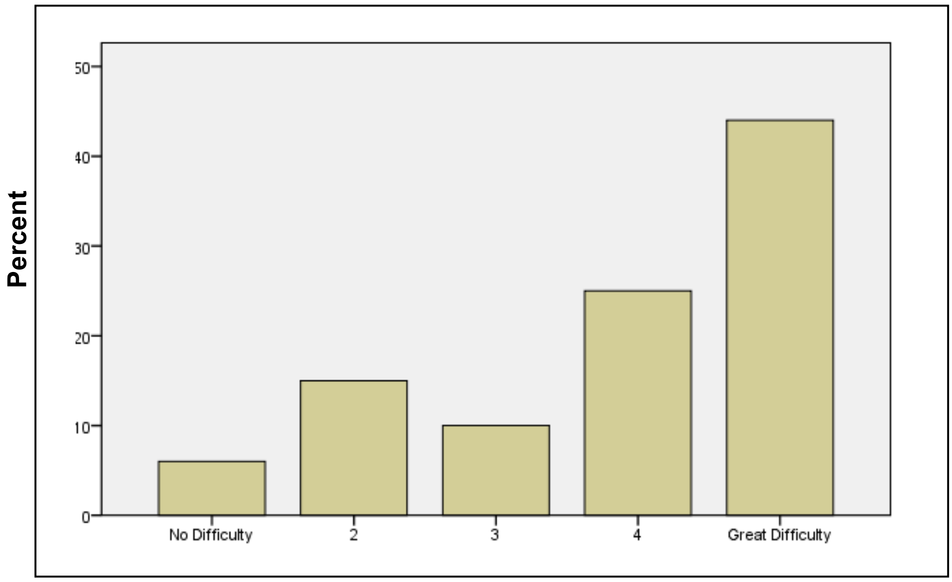
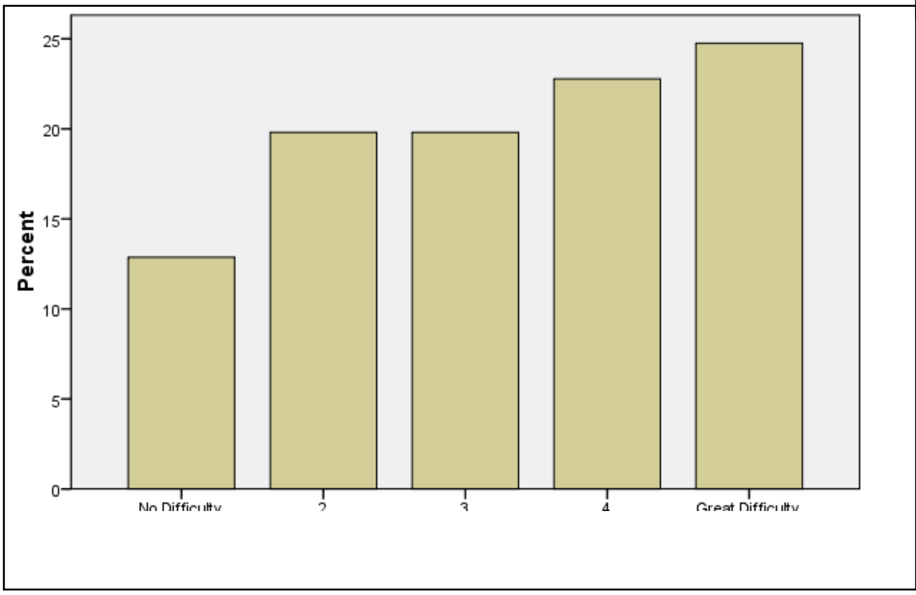


Figure 4.2: Difficulty child has using a knife (teachers)

n = 108



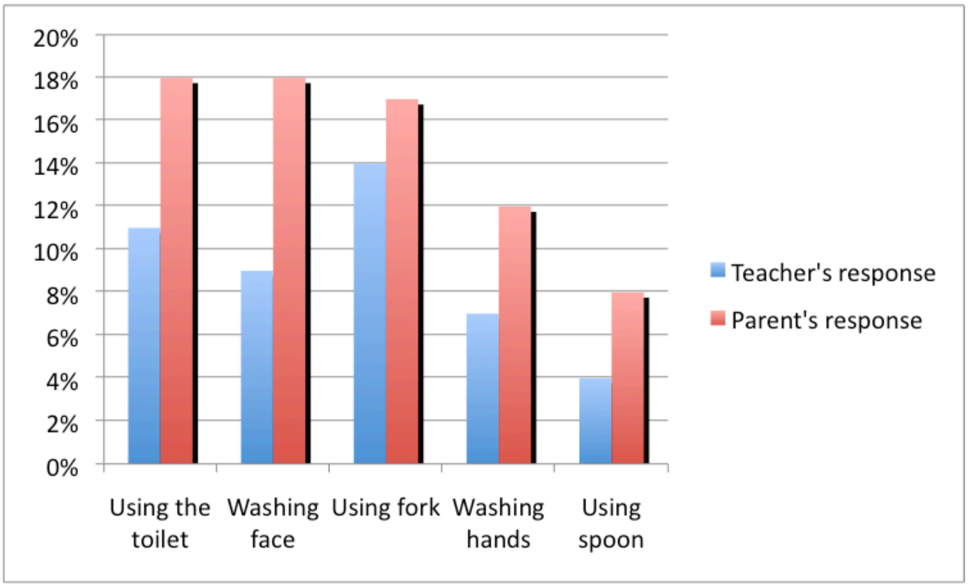
Although both groups of respondents rated 'using a knife' as the most difficult skill to undertake (see figures 4.1 and 4.2), there are some differences in the percentages between the two sets of respondents. It is however understandable that the parents rated a higher percentage (46%) over the teachers (25%) as children only spend on average five hours at school. There are a number of potential explanations why using a knife to feed themselves rated highly with both sets of respondents. One possibility is the significance both parents and teachers place on the child's negative behaviour due to frustration at being unable to use a knife whilst feeding. Both groups of respondents may feel that feeding themselves is one of the most important daily living skills that will give the child a sense of independence. Another possibility could be that there is a measurable difference in the motor skills necessary to undertake holding a knife and using it whilst feeding. The latter conclusion is congruent with various research studies (Twachtman *et al.* (2008), Gillberg (1998), Dawson (2000), Manjiviana and Prior (1995) and Kiln *et al.* (1995)), which have explored the impairment of motor skills such as hand and eye co-ordination, poor hand to mouth co-ordination, praxis, and movement in children with autism. Table 4.3 lists the other daily living skills indicated as difficult to conduct by both sets of respondents.

Table 4.3: All other Daily living skills that the child finds challenging.

Daily living skill	Parents (n=104) %	Teachers (n=108) %
Using a fork when feeding	17%	14%
Using a spoon	8%	4%
Washing hands	12%	7%
Washing face	18%	9%
Using the toilet	18%	11%

When comparing the results from both sets of respondents, it is interesting to note that another feeding utensil rated highly as a daily living skill most difficult to master. This highlights that feeding is a difficult daily living skill. Following that, other daily living skills pertaining to using motor skills rated highly amongst both sets of respondents, such as using the toilet, washing face, washing hands and using a spoon (see table 4.3 and figure 4.3).

Figure 4.3: Comparison between both sets of respondents of all other Daily living skills that the child finds challenging.



4.6.2 Computer programs used at home and school

Section two of the survey is centred on computer programs that children with autism used at home and at school. Parents and teachers were asked to denote what the most effective program that the child used aimed to achieve. Respondents were given a list of five possible choices that the program aimed to achieve: educational development, social skills, daily living skills, communicative skills and entertainment.

Table 4.4: Aim of most effective computer program

Purpose of use	Parents %	Teachers %
Educational development	35	63
Communicative skills	34	52
Daily living skills	32	14
Entertainment	9	32
Social skills	17	38

Surprisingly, only 14% of teachers rated daily living skills as the aim of the most effective computer program. Interestingly, when comparing the findings from both sets of respondents, it has emerged that educational development was the aim of the most effective computer program. This finding reflects the paradigm shift in Irish primary education where schools are embracing the use of computer software to enhance teaching and learning across the curriculum (NCCA (2004)). This finding also corresponds with the findings from the focus groups. Although there is a large percentage difference in the aim of the most effective computer program used at home and in the school, one possible explanation could be that educational software has more resonance in the educational setting. Another possible reason could be that it may be used as a tool for moderately autistic children to support what is being taught in the classroom.

Operating the computer program

Respondents were asked to indicate if the child needed any assistance when he/she last used a computer at home or at school. Interestingly the both sets of respondents indicated that the child needed assistance or a combination of being aided and unaided (see figure 4.5 and figure 4.6). To probe further, the researcher examined if there was a relationship between age and the need for assistance. An interesting finding emerged that, across the board at each age level, the child with autism needs assistance in the school setting, however at home, it has emerged that the youngest age group (five and six year olds) needed the most assistance. One probable reason why the child is more reliant on assistance at school could be that the computer programs used may not be pitched at an appropriate age level, the level could possibly be too advanced for the child's learning needs. It may also be the case that parents are using computer programs at an age level appropriate to the child's needs. Another possible reason could be that the computer programs being used have not been developed specifically for the needs of the child with autism. There may be features of the computer program that the child with autism finds difficult to operate and therefore needs more assistance.

Figure 4.4: How the child mostly operates the computer at home

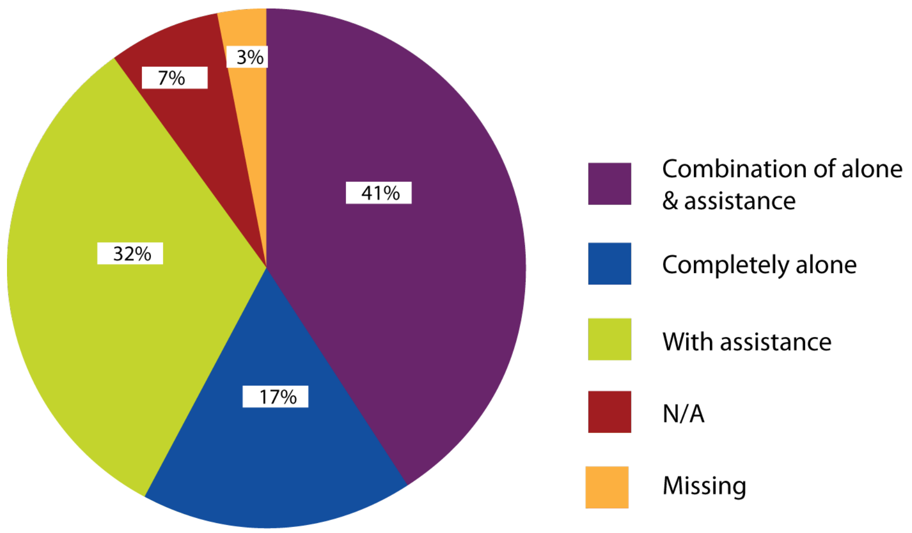
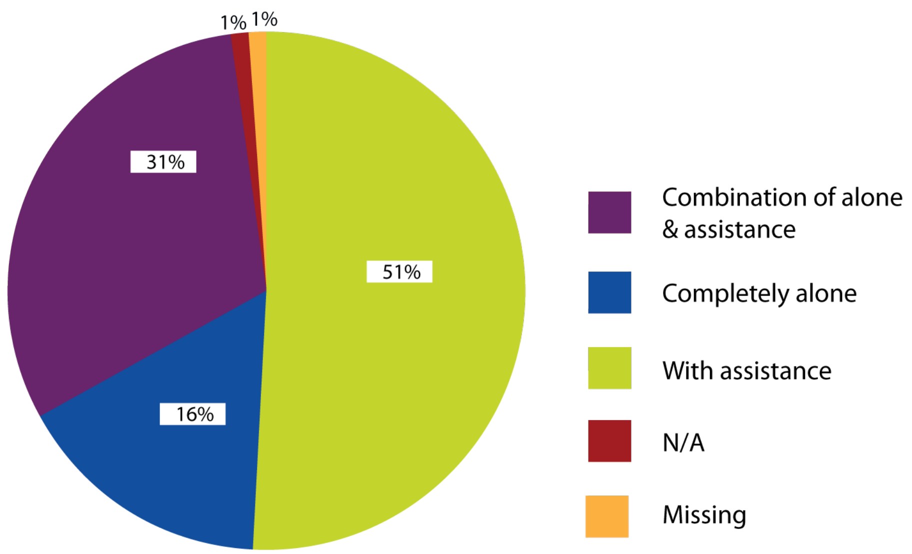


Figure 4.5: How the child mostly operates the computer at school



Features of the most effective computer program that was positive or negative

An indication of an incorrect answer was rated highly by parents as the most unhelpful when using a computer program. This finding corroborates the literature pertaining to errorless learning for autism (see Rizzo *et al.* (2000)) and the findings from the focus groups. Children with autism find negative feedback highly stressful. According to Rizzo *et al.* that unlike other teaching procedures where opportunities for initial mistakes are allowed and then corrected through prompting, for people with cognitive disabilities errorless learning is essential. Immediate prompts must be made to pre-empt errors, prompts must then be faded out until the child makes the correct answer. In comparison, the teachers rated most of the features listed by the researcher as being helpful (see questionnaire appendix F). The researcher surmises that parents have more one-to-one time with their children when using computer programs, whereas the teacher may not have the luxury to afford such time and is therefore not as aware of any impeding features of a computer program.

Table 4.5: Features of the computer program that were helpful or unhelpful to the child (teachers)

	%			
	Helpful	**Unhelpful**	**Not a feature**	**Missing**
Navigation in the form of buttons	60%	6%	28%	6%
Navigation in the form of words	40%	10%	44%	6%
Familiar cartoon characters	39%	6%	49%	6%
Stop button	31%	8%	55%	6%
Quiz	26%	7%	61%	6%
Multiple choice on quiz	39%	7%	47%	6%
Indication of the correct answer	59%	6%	29%	6%
Indication of the incorrect answer	37%	16%	41%	6%

Table 4.6: Features of the computer program that were helpful or unhelpful to the child (parents)

	%			
	Helpful	**Unhelpful**	**Not a feature**	**Missing**
Navigation in the form of buttons	32%	6%	45%	17%
Navigation in the form of words	21%	16%	46%	17%
Familiar cartoon characters	33%	8%	42%	17%
Stop button	28%	8%	47%	17%
Quiz	22%	12%	49%	17%
Multiple choice on quiz	19%	15%	49%	17%
Indication of the correct answer	35%	5%	43%	17%
Indication of the incorrect answer	15%	22%	46%	17%

Are computer programs developed specifically for children with autism?

Arising from the exploratory phase of this study it was deemed necessary to determine if educational computer programs used in primary schools were developed specifically for the learning needs of children with autism and if these programs were developed in Ireland or abroad. It was also important to determine if foreign educational programs with unfamiliar accents could impact on learning and the understanding of the object of the lesson.

Figure 4.6: Was the most effective program used by your child specifically developed for children on the autism spectrum? (Parents)

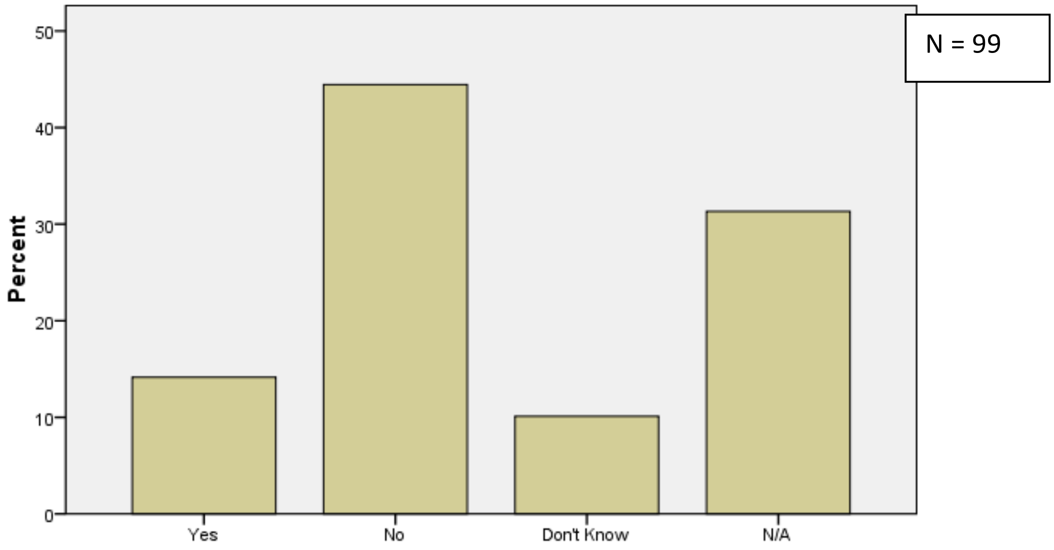
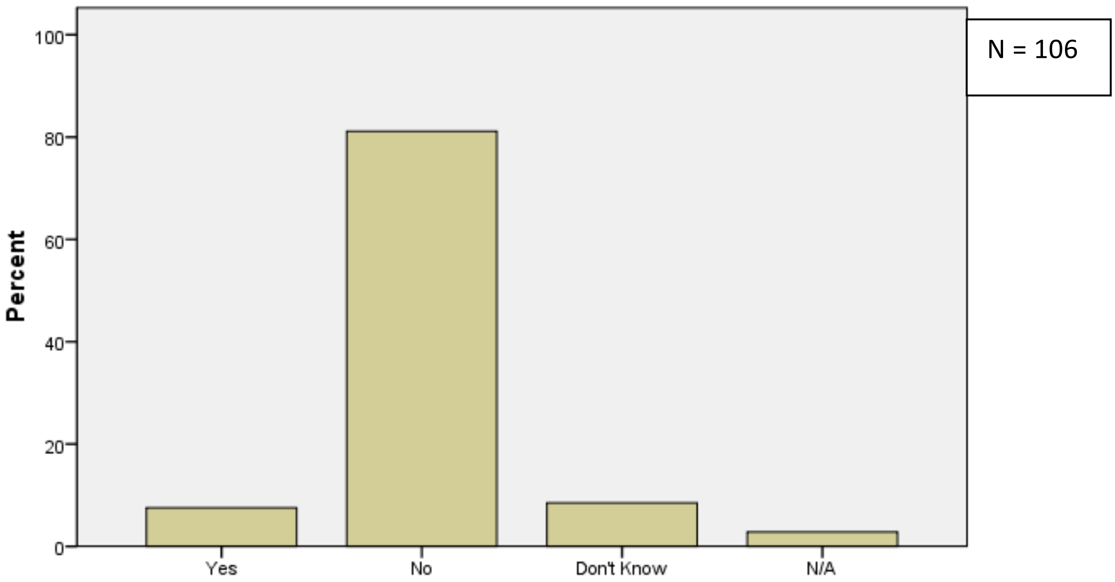


Figure 4.7: Was the most effective program used by children with autism in your class specifically developed for children on the autism spectrum? (Teachers)



It is clear from these findings that computer programs used in schools and in the home are not developed for children with autism. These findings also concur with the findings of the short telephone survey with schools that had children with autism enrolled.

Accents in computer programs

Figure 4.8: Accent used on the computer programs. (Teachers)

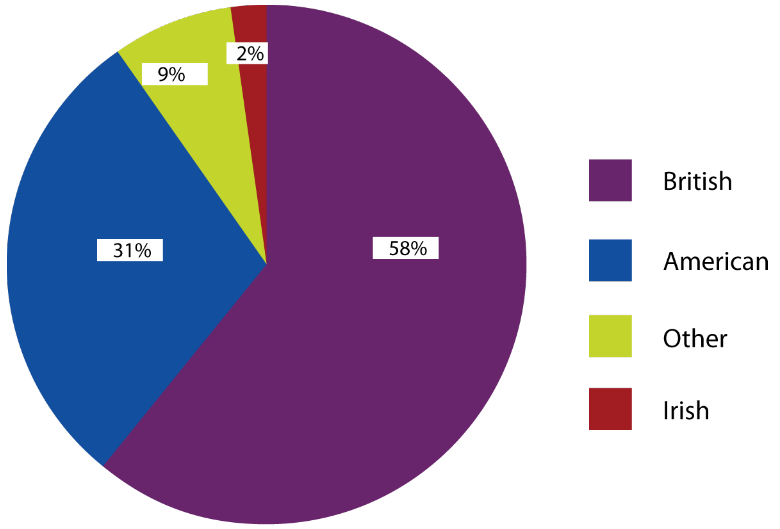
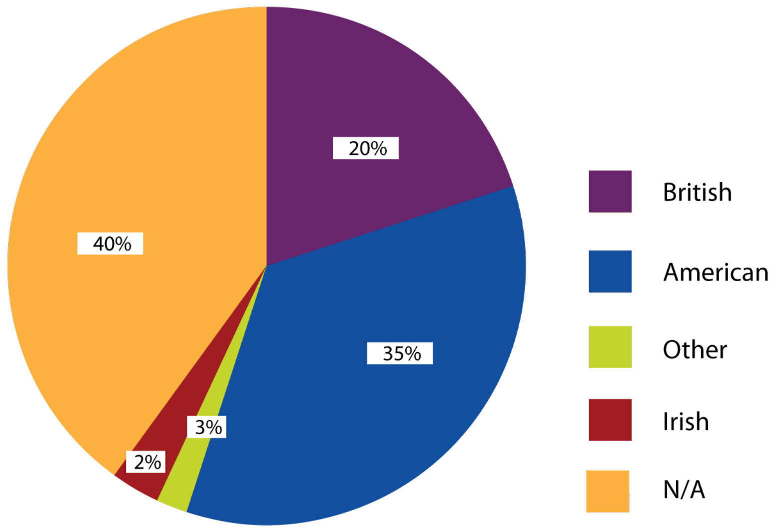


Figure 4.9: Accent used on the computer programs? (Parents)



It is apparent from these findings that that an Irish accent is the norm in narration for only a very small number of computer programs used at home and in school.

As discussed earlier in the literature review, understanding narrative is an inherently complex task in autism. Dautehanhn (2002) and Klin (1991) contend that a striking communication characteristic in children with autism is their poor orientation to the human voice. Children with autism have echolalia tendencies, which mean that they copy the tone/pitch and pattern of speech of any particular accent. Studies of echolalia also testify to impressive auditory imitation ability (Tager-Flusberg (1993)).

To determine whether unfamiliar accents can impact on the child with autism, the researcher asked respondents to indicate whether the children with autism in their care had a tendency to copy accents from the computer programs they use and if they believed that using local accents would be of benefit to the child.

Interestingly, the majority of parents who answered this question (32%) stated that their child had copied accents from computer programs while 21% (see figure 4.9) stated they did not. In comparison, the majority of teachers who answered this question indicated that they did not copy accents from computer programs (59%) while 30.5% stated they did (see figure 4.10).

Figure 4.9: Copying accents (Parents)

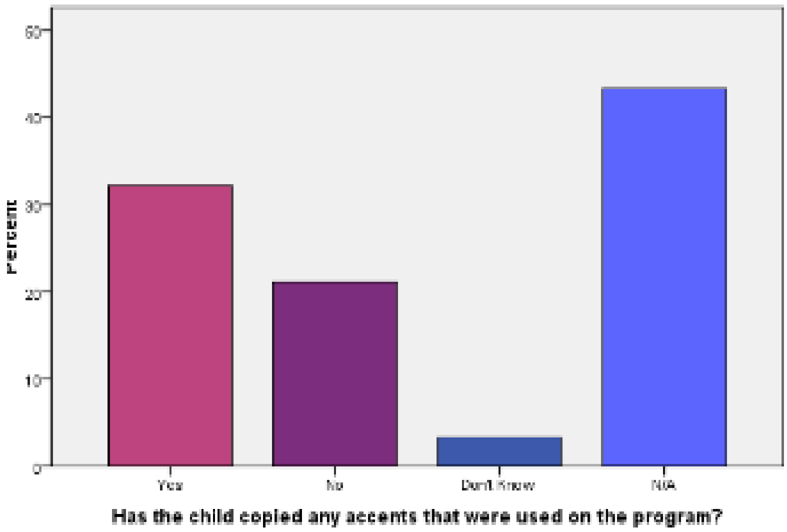
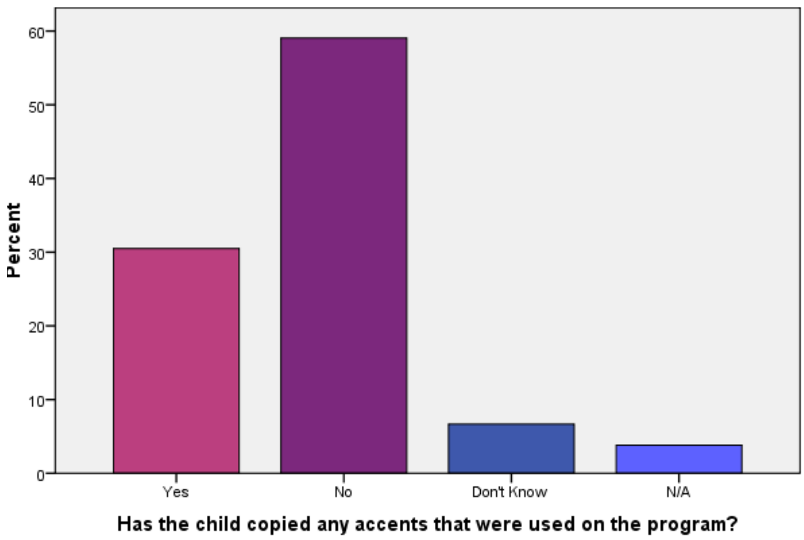


Figure 4.10: Copying accents (Teachers)



One possible explanation for this is that parents spend more time with their child at home using computer programs and are more aware of any idiosyncratic changes in their child's words or pronunciation of words. It is possible that idiosyncratic speech may also encroach on the child's social being by setting him apart from his peers. However, this is can only be determined by conducting a long-term study in the area of idiosyncratic speech and determine if it can set the child apart from his peers.

Respondents were asked to indicate if they believed that using a local accents in a computer program would be of benefit to the child (see figure 4.11 and figure 4.12). A large majority indicated that local accents would indeed benefit the child. This finding is highly significant for this study. It seems likely that an unfamiliar accent can impact negatively on the child's information processing capabilities. This is the subject of further investigation in later chapters.

Figure 4.11: Belief that using a local accent would be of benefit to the child (Teachers)

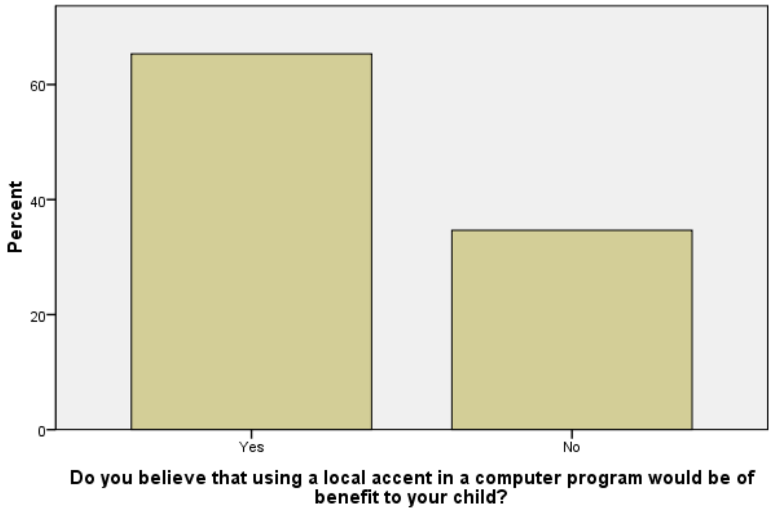
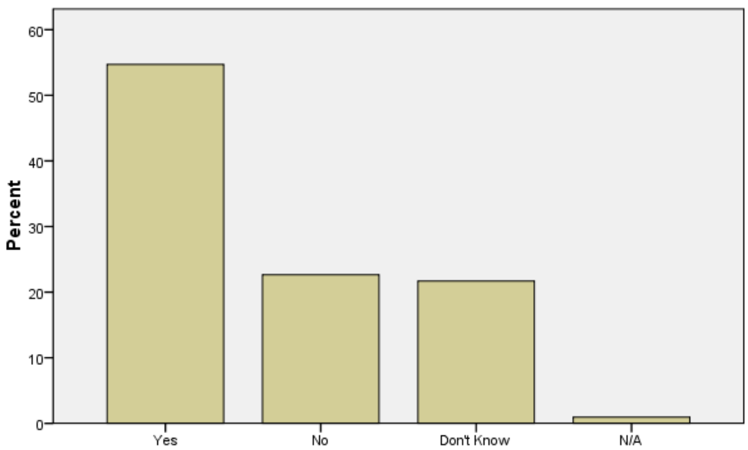


Figure 4.12: Belief that using a local accent would be of benefit to the child (Parents)



4.6.3 Interactive computer programs for autistic children

All respondents were asked to indicate whether or not they agreed that the child could lose sight of the overall purpose of the program by becoming absorbed in one area of the program. The purpose of this question was to analyse if weak central coherence affected the child's processing of information. Children with autism have impairments in central coherence; the behaviours associated with a weak central coherence include the desire for sameness and obsessive repetitiveness (Baron-Cohen (1999)). Gumtau *et al.* (2005) infer that a weak central coherence inherent in autism translates to attending to parts rather than the whole. This is termed local and global coherence.

Figure 4.13: Agreement with the statement: 'the child can easily get absorbed in one area of the computer program (Parents).

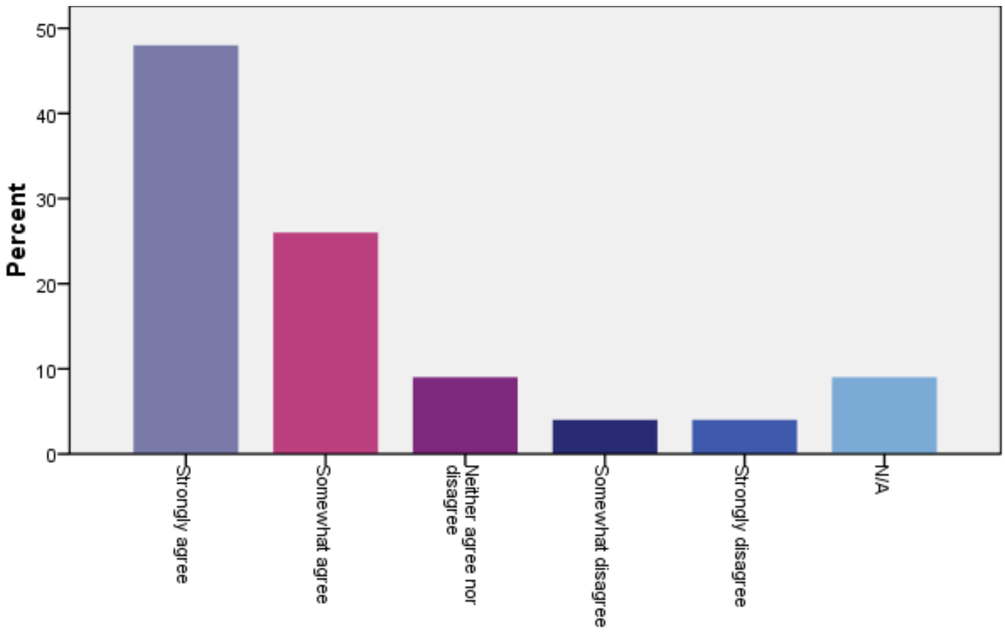
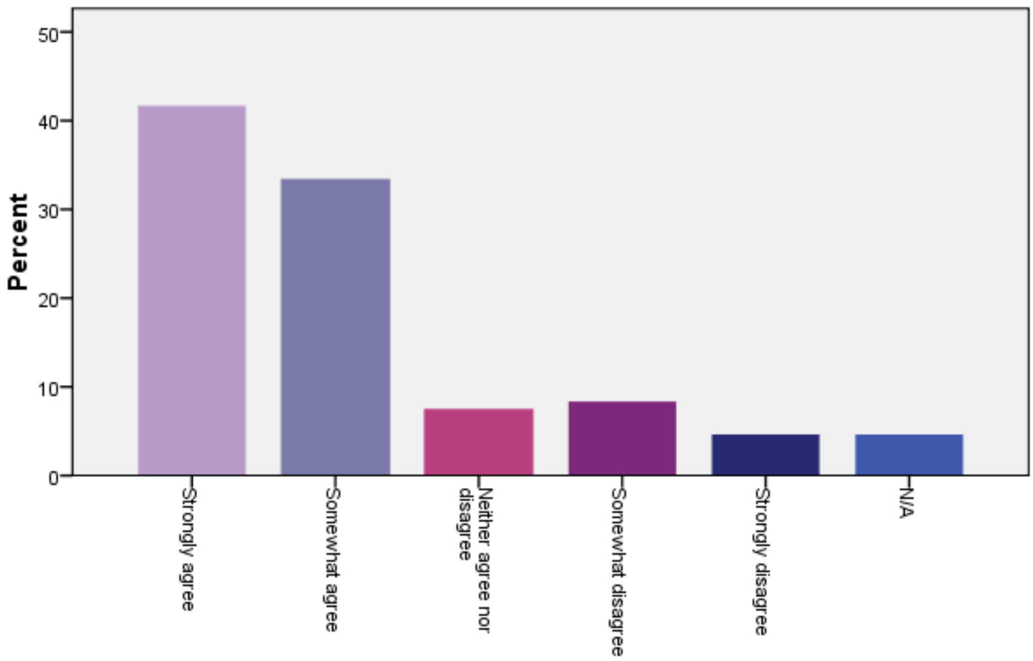


Figure 4.14: Agreement with the statement: 'the child can easily get absorbed in one area of the computer program (Teachers)



There was strong agreement from both sets of respondents that the child can easily become absorbed in one area in the computer program. This has strong implications for the design layout of any computer program developed. In terms of development it is imperative that there are no distracting features in the layout of the program. This finding concurs with the literature pertaining to weak central coherence (see Happé (1996), Frith (1994), Baron-Cohen (1997)).

In order to probe further, parents and teachers were asked to indicate whether or not they agreed that the child could lose sight of the purpose of the computer program.

Figure 4.15: Agreement with the statement: 'the child can lose sight of the purpose of the whole program (Teachers)

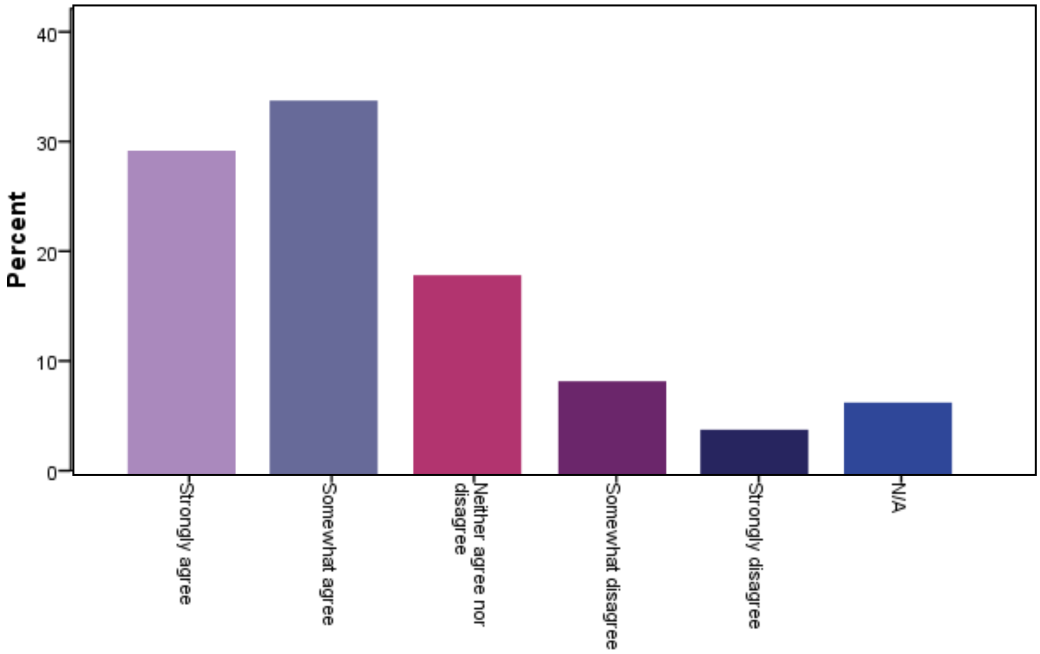
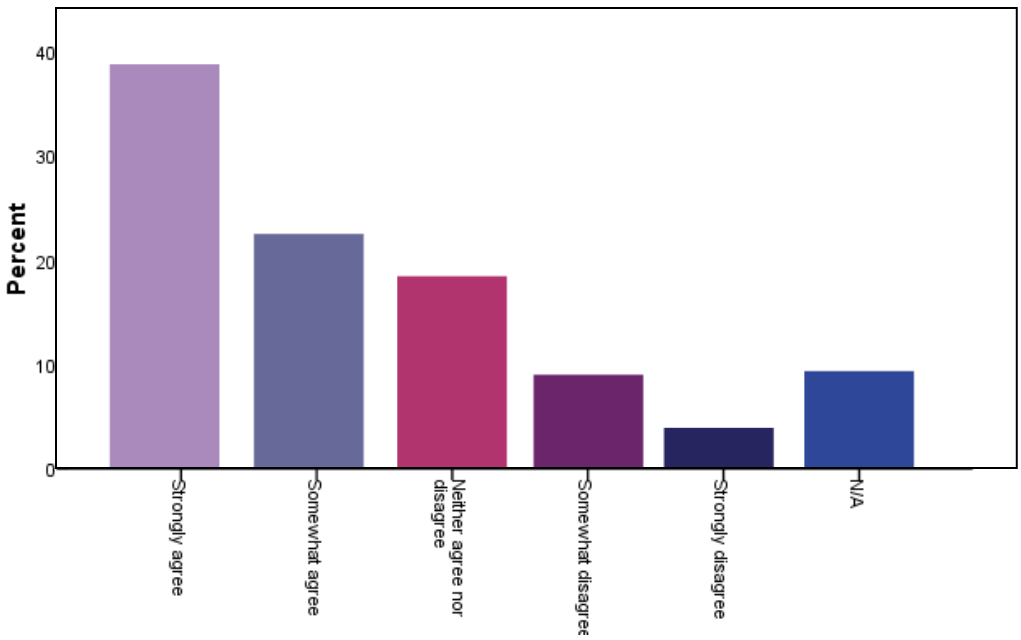


Figure 4.16: Agreement with the statement: 'The child can lose sight of the purpose of the whole program (Parents)



In relation to the attention span of the child when using a computer program, it can be deduced from these findings that teachers somewhat agree and parents strongly agree, that the child can lose sight of the purpose of the whole program.

Distracting features of a computer program

Respondents were asked to indicate if there were any features of a computer program that could possibly distract the child from learning.

Table 4.7: Ratings of the level of distraction of computer program features (Teachers)

	%				
Feature	**Not distracting 1.**	**2.**	**3.**	**4.**	**Greatly distracting 5.**
Too many pictures	9	8	20	24	39
Moving images	10	24	20	25	21
Bright colours	16	23	31	13	7
Background music	12	21	23	21	23
Other sounds	10	19	23	20	27

Table 4.8: Ratings of the level of distraction of computer program features (Parents)

	%				
Feature	**Not distracting 1.**	**2.**	**3.**	**4.**	**Greatly distracting 5.**
Too many pictures	13	11	25	23	29
Moving images	11	14	31	25	18
Bright colours	16	22	27	22	13
Background music	10	18	18	33	21
Other sounds	12	13	23	23	28

In terms of the most distracting features of a computer program, both sets of respondents (teachers 39% and parents 29%) rated ‘too many pictures’ as the most distracting feature and ‘other sounds’ as the second most distracting feature (teachers 27% and parents 28%).

There are various potential explanations for these findings. Mayer (2005) states that learners pay attention to relevant words and pictures in order to make representation. In terms of his cognitive theory the learner must select relevant words and pictures and organise them in order to make visual and verbal representation. However, for people on the autistic spectrum there are impeding processing factors that can inhibit them from doing this, such as weak central coherence and executive dysfunction. These impairments may explain the findings that children with autism find ‘too many pictures and ‘other sounds’ distracting features of a computer program. In terms of weak central coherence, the child may have a weakness in decoding information into logical patterns when presented with an information overload (Gumtau *et al*. (2005)). Moreover, the child may fixate on local information (smaller parts) rather than the global picture (overall meaning) of what is being taught (Norbury, 2003).

In terms of finding ‘other sounds’ distracting, there are a few possible reasons why this may be so. Children with autism have auditory impairments, which include hypersensitivity to sound, painful hearing and abnormalities in auditory processing (Tharpe (2006)). Having ‘other sounds’ present could significantly distract or cause undue stress to the child, therefore rendering the program ineffective for its intended purpose. These findings concur with literature (Tharpé (2006), Moore & Calvert, (2000)) and also the findings from the exploratory phase of this research.

Other noteworthy findings highlight that background music, moving images and bright colours are significantly distracting features of a computer program for the child with autism. These findings concur with Happé (2002) and Baron-Cohen (2006) who assert that noise audible to use can be intolerable to them. Furthermore, the reported finding that moving images can cause distraction to the child also concurs with Milne *et al.* (2002) who states that a child can become fixated on the smallest detail such as a moving animation and lose overall sight of the whole meaning of the program, It could be deduced that the child also fixates on obvious bright colours and lose sight of the program's purpose.

Finally, respondents were asked to indicate the extent to which rewards, feedback and choice are motivating for the autistic child.

Table 4.9: How motivating various factors are for the autistic child (Parents)

	%					
Feature	**Motivating 1.**	**2.**	**3.**	**4.**	**De-motivating 5.**	**Missing**
Rewards	59	13	10	8	4	6
Feedback	35	19	25	9	6	6
Choices	32	16	26	14	5	7

Table 4.9: How motivating various factors are for the autistic child (Teachers)

	%					
Feature	**Motivating 1.**	**2.**	**3.**	**4.**	**De-motivating 5.**	**Missing**
Rewards	60	16	12	5	5	2
Feedback	33	22	19	13	9	4
Choices	23	33	25	10	5	4

Motivating features were rated on a scale of 1 to 5, 1 was motivating and 5 de-motivating. Teachers (60%) and parents (59%) rated rewards as the most motivating feature of the computer program.

Although this finding has major implications for the proposed program design, it was an expected result. Children are motivated by rewards i.e. when rewarded for correctly answering a question. Moreover these findings concur with studies conducted by Chen and Chen and Bernard-Optiz (1993), Moore and Calvert (2000), Dautenhahn (2004), Silver *et al.* (2001) and Bossler and Massaro (2003).

Communicating Instruction

Finally, the researcher raised an important question with both groups of respondents with the aim of ascertaining the best method of communicating instruction whilst using a computer program. Respondents were asked to indicate to whether they agreed or disagreed with the efficacy of the various means of presenting programs on a computer program. Five methods of displaying information on a computer screen were probed:

- With text alone
- With cartoon animations
- With vocal narration
- With text
- With vocal narration and animation
- With rhymes or songs

Both sets of respondents agreed that instruction should be presented across various modalities, audio, narration and text **see table 4.10 and 4.11.** Interestingly, Schlosser & Blischak (2004) found that this method improved the comprehension performance with participants who had autism.

Table 4.10: Agreement regarding the effectiveness of various means of presenting instruction on a computer program (Parents)

	%				
	Strongly Agree 1.	**Somewhat Agree 2.**	**Neither Agree or Disagree 3.**	**Somewhat Disagree 4.**	**Strongly Disagree 5.**
Instructions are effective when presented with **text alone**	10	19	13	26	26
Instructions are effective when presented with **cartoon animations**	39	36	17	6	2
Instructions are effective when presented with **vocal narration**	30	38	18	6	2
Instructions are effective when presented with **text, vocal narration & animation**	48	25	15	5	1
Instructions are effective when presented with **rhymes or songs**	42	30	16	13	1

Missing: n=6

Table 4.11: Agreement regarding the effectiveness of various means of presenting instruction on a computer program (Teachers)

	%				
	Strongly Agree 1.	**Somewhat Agree 2.**	**Neither Agree nor Disagree 3.**	**Somewhat Disagree 4.**	**Strongly Disagree 5.**
Instructions are effective when presented with **text alone**	**4**	**15**	**13**	**22**	**43**
Instructions are effective when presented with **cartoon animations**	**24**	**49**	**10**	**10**	**4**
Instructions are effective when presented with **vocal narration**	**27**	**46**	**12**	**6**	**6**
Instructions are effective when presented with **text, vocal narration & animation**	**49**	**27**	**9**	**10**	**2**
Instructions are effective when presented with **rhymes or songs**	**45**	**30**	**17**	**7**	**1**

Missing: n=3

Strengths and interests

Inspired by research conducted by Putnam and Chong (2008), the researcher sought to determine any commonality of strengths or weakness across the continuum of autism. This was important as any strength or weaknesses could be developed into educational solutions in the development of the proposed computer program.

Thinking visually was the highest rated strength indicated by parents (47%) and teachers (43%). This finding concurs with Franklin *et al.* (2008) who found that individuals with autism have been known to outperform control groups on visual search and the reproduction of impossible figures. Interestingly the second highest rating strength indicated by both sets of respondents was ‘good long-term memory’, This finding is supported by Quill (1997) who adds that visual representation of material might facilitate long-term memory retrieval and Shipley-Benamou *et al.* (2002) who reported that people on the autistic spectrum excel in response to visual intervention.

Other highly rated strengths can be seen in fig 4.17 and 4.18 on the following page.

Figure: 4.17: Child's Strengths (Teachers)

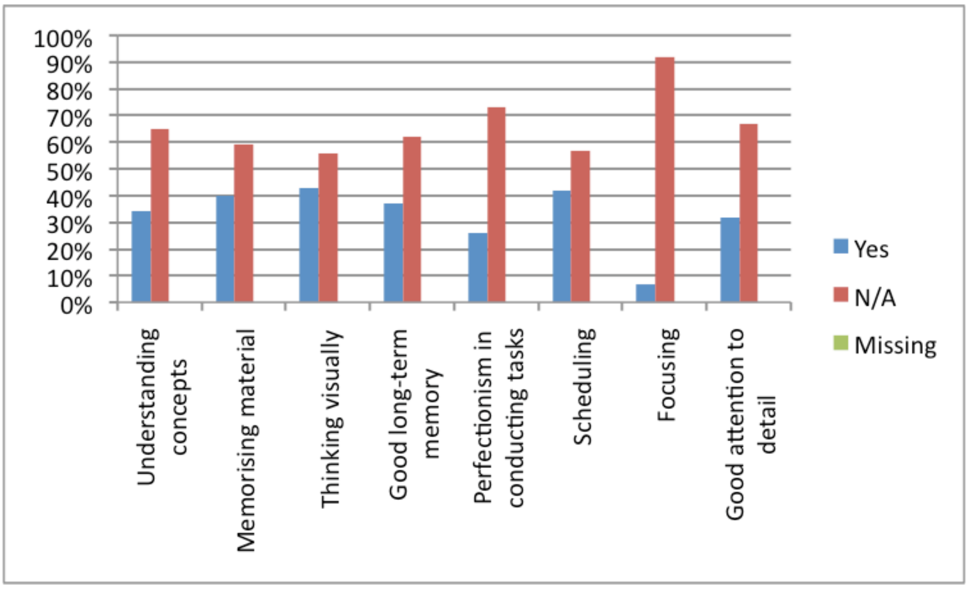
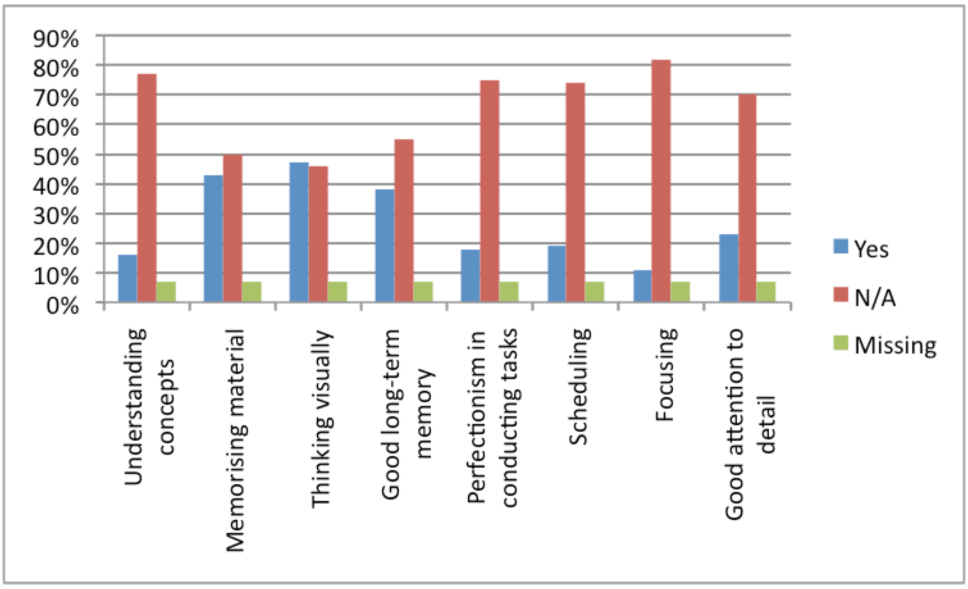


Figure 4.18: Child's Strengths (Parents)



Both sets of respondents were asked to indicate the child's current daily interests. Playing computer games was the highest rated interest by parents (42%) and teachers (45%), this was not a surprising result as literature has highlighted that people on the autistic spectrum are drawn to rule based systems (Baron-Cohen (2009)) The computer environment provides structure and predictability (Gray (1995)) and also provides clear and explicit rules (Gray (1995), Silver et al. (2001) Hetzroni (2004)) and provides them with visual cues (Quill (1997), Bernard-Opitz et al. (1999), Cole (2003), Sweetenham (2003)). Furthermore, 82% of the focus group participants for this study agreed that the children with autism in their care felt comfortable using computers. Numbers were the second highest rating interests while memorising songs and art followed as third and fourth highest rated interest (see fig 4.19 and fig 4.20).

Figure 4.19: Child's Interests (Teachers)

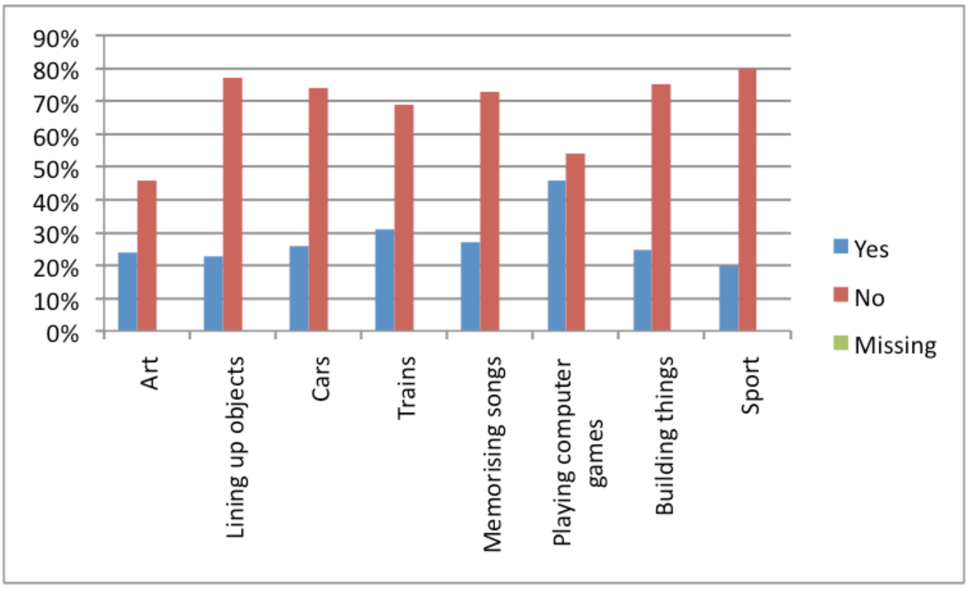
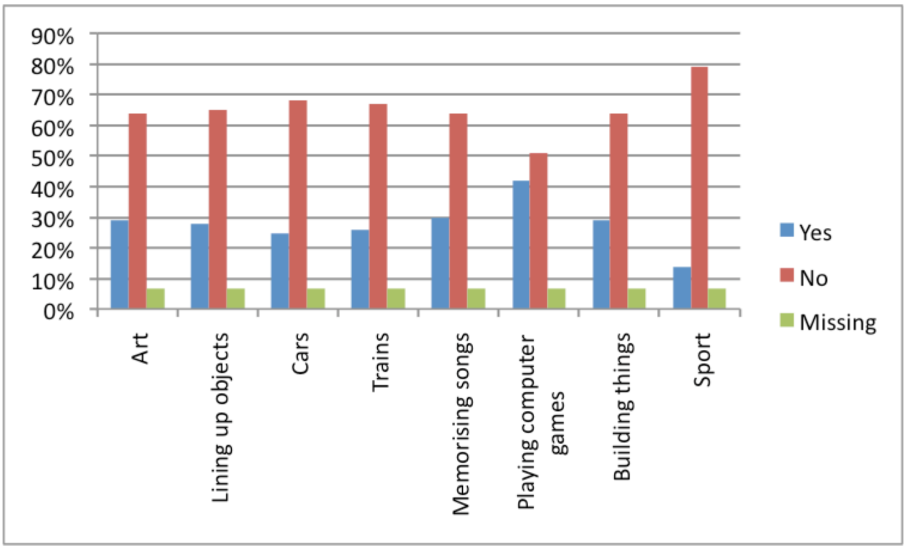


Figure 4.20: Child's Interests (Parents)



4.7 Conclusion

There are significant findings from the nationwide survey, which can be translated into design solutions for the development of the computer program for this study. From these findings and from the review of literature it is apparent that all instructional material conveyed on a computer program must be presented and relayed in a way that reduces confusion and information overload.

Moreover, it must recognize and acknowledge the cognitive and sensory impairments inherent in autism. In line with Thurman *et al.'s* (2005) study, information must also be adjusted to individual levels of understanding. This, they state, must be clear, literal and avoid ambiguity and must be effortless without oversimplification.

Most importantly, the findings from the surveys of parents and teachers suggest that computer programs must be designed to meet the cognitive processing and educational needs of this group in order to optimize engagement and learning. Any extraneous features such as background sounds, negative feedback, cluttered interfaces and any other features that cause cognitive overload must be excluded. If such features exist, the child with autism will need more effort to focus their attention, which could lead to frustration and anxiety. Moreover, extraneous features could impact on the child's impairment in central coherence and executive function, which means that the child could easily lose sense of the overall purpose of the program. The findings from .section 1 – daily living skills – will be instrumental for the future development of this program. Based on these findings the researcher can implement the most difficult daily living skills that children with autism find difficult to undertake. Table 4.12 summarises the findings of the descriptive phase of this research.

Table 4.12: Summary of findings

Section of survey	Area of Investigation	Findings - Survey
Section 1: **Daily living skills**	What is the most common daily living skill that the child finds most difficult to conduct?	Using a knife was rated by both sets of respondents as the most difficult daily living skill. The second most difficult daily living skill was brushing teeth.
Section 2: **Computer programs used at school and at home**	Most effective computer program that the child with autism used.	Educational development; both sets of respondents rated this as the most effective computer program.
	Was this effective program designed specifically for children with autism?	Both sets of respondents stated that the educational program was not developed specifically for children with autism.
	Was the accent on the most effective computer program foreign?	58% of parents reported that the accent was British while 35% of teachers reported it was American.
	Did the child copy the accent that was on computer program?	Teachers reported 'No' while parents reported 'Yes'
	Would a local accent on the computer program benefit the child?	Both sets of respondents strongly agreed that they could benefit from having a localised voice on computer program, as it would help with understanding.
	Features of the effective computer program that were helpful or unhelpful to the child	An indication of an incorrect answer was rated highly by parents as the most unhelpful when using a computer program. Teachers rated most of the features listed by the researcher as being helpful
	How did the child work on the computer?	Both sets of respondents reported that they did need assistance
Section 3: **Interactive computer programs for autistic children**	What was the most motivating feature of the most effective computer program?	Teachers (60%) and parents (59%) rated rewards as the most motivating feature of the computer program.
	Can the child get absorbed in one area of the computer program?	There was strong agreement from both sets of respondents that the child can easily become absorbed in one area in the computer program.
	Can the child lose sight of the overall purpose of the computer program?	Teachers somewhat agreed and parents strongly agreed, that the child can lose sight of the purpose of the whole program
	What was the most distracting feature of the computer program that the child used?	In terms of the most distracting features of a computer program. Both sets of respondents (teachers 39% and parents 29%) rated 'too many pictures' as the most distracting feature
	What method of instruction does the child mostly prefer?	Parents (48%) and teachers (49%) rated visuals, vocal narration and text as the most preferred method of instruction
	What are the child's most common strengths and interests?	Thinking visually was the highest rated strength indicated by parents (47%) and teachers (43%) while Playing computer games was the highest rated interest by parents (42%) and teachers (45%),

For the development of Prototype 1, the findings of the exploratory and descriptive stages of this study will form the design framework for the development of the computer program. The following table presents how the findings from both exploratory and descriptive stages translate into design solutions for the development of this program.

Table 4.13: Findings translated into design Solutions

Focus Group	Findings	Point	Design Solution
Theme 1 Barriers in communication	Poor attention and focus are two of the most common barriers in communication	**1.**	The computer interface will be designed with a very simple layout with clear visual representation of the task to be undertaken and with no extraneous detail that could distract the child from undertaking the task. Animation will be kept to a minimum.
	Extraneous noise can impact on the Child's attention and focus	**2.**	See point 1.
	Instruction must be clear and delivered in simple language	**3.**	The language used will be simple to understand and will also be supported by visual representation.
	Verbal rewards motivates and encourages the child	**4.**	The child will be praised verbally for completing a task.
	Instructions should be visual	**5.**	Instructions will be supported by visual representation of the task that needs to be completed.
	Tasks must be goal orientated	**6.**	All tasks will be goal orientated and broken down into simple tasks that will have a start, middle and end. The child will be encouraged with a friendly voice that will instruct them on the necessary steps that need to be undertaken to achieve the desired goal
Theme 2 Barriers in communication	Failure to achieve a task on a computer program can impact on the child's self esteem	**7.**	See point 6.
	Other distracting features include: • Too many colours • Text based instruction • No pause buttons • Unattainable tasks • No obvious rewards for reaching a certain level	**8.**	Colours will be kept to a simple pallet; care will be given to avoid highly contrasting colours. Instruction will be given verbally and accompanied by text and visual representation. A pause button will not appear on the interface, as it could act as a possible distraction. Prompts will be given until the child makes the correct answer.

			All tasks will be goal orientated and broken into smaller attainable tasks. Verbal and visual rewards will be presented once the child makes the correct answers.
	Animated rewards can be distracting, if the child is allowed to replay them.	**9.**	Animation will be kept to a minimum. An option to replay an animation will not be presented
Theme 3 Barriers in communication	A child with autism can easily pick up accents from foreign computer programs	**10.**	Localised accents will be used in narration. Careful consideration will be taken to keep instructions clear and concise and will avoid any ambiguous colloquialisms
	Foreign accents on computer programs could impact on the child's speech development	**11.**	See point 10.
	Minute details on a computer program can easily distract the child with autism	**12.**	See point 1.
Pilot Survey	**Findings**		**Design Translation**
	74% of Special needs schools in Ireland indicated that the computer programs they use for child with autism have not been designed specifically for them.	**13.**	This finding highlights the importance and the need for the development of computer programs specific to the learning needs of children with autism.
	Only 1 school out of the 31 that responded indicated that the computer program they used with children with autism was created in Ireland	**14.**	This finding emphasises that there is a gap in the development of 'Irish' designed computer programs specifically for children with autism.
Descriptive Research	**Findings**		**Design Translation**
Section 1 Daily living skills	Using a knife was rated by both sets of respondents as the most difficult daily living skill. The second most difficult daily living skill was brushing teeth.	**15.**	These two findings will help in the future development of an educational computer program designed specifically for child with autism.
Section 2 Computer programs used at school and at home	Educational development was rated as the most effective type of computer program for children with autism	**16.**	This finding highlights the importance placed on using computer programs for the purpose of educational development.
	Respondents indicated that the educational programs used were not developed specifically for children with autism.	**17.**	See points 1-10.
	58% of parents reported that the accent was British while 35% of teachers reported it was American.	**18.**	See point 10.
	When asked if a local accent on the computer program would benefit the child, both sets of respondents strongly agreed.	**19.**	See point 10.

	When asked if the child with autism copied the accents of the computer program. Teachers responded 'No' while parents responded 'Yes'.	**20.**	See point 10.
	An indication of an incorrect answer was rated by parents as the most unhelpful when using a computer program.	**21.**	Learning will be errorless, as the child will be prompted to make the right choice by slightly fading out the incorrect answer. Prompts will be faded out until the child makes the correct choice.Once achieved the child will be praised and rewarded for making the correct choice.
	Both sets of respondents indicated that the child with autism needed assistance when operating a computer.	**22.**	'Simplicity' will be key to the design and development of the computer program. Narrated instruction for tasks to be completed will be followed by visual representation. All steps to complete a task will be goal orientated and learning will be errorless - the user will be prompted until he/she completes the task.
Section 3: Interactive computer programs for autistic children	Rewards were rated as the most motivating feature of a computer program	**23.**	Verbal and visual rewards will be presented once the child makes the correct answers.
	The child with autism can easily become absorbed in one area of a computer program	**24.**	See point 1. Animation will be kept to a minimum. The child will not have direct control over the environment. Features such as a replay button will not be included as this could possibly lead to the child endlessly iterating an animation.
	The child with autism can lose sight of the overall purpose of a computer program.	**25.**	See point 1.
	Having too many pictures on a computer screen was rated as distracting to the child	**26.**	See point 1.
	Visuals, vocal narration and text were rated as the most preferred method of instruction	**27.**	Verbal and visual rewards will be presented once the child makes the correct choices. .
	Respondents rated 'Thinking visually' as the child's greatest strength, while playing computer games rated highest as an interest.	**28.**	See point 1.

Chapter 5 Computer program prototype Design and Development Methodology

5.1 Introduction

The purpose of this chapter is to discuss the design and development process of the computer program for this study. The computer program will now be referred to prototype 1 and 2 hereafter. The prototype for this study has been developed around the learning of a new daily living skill. Table 5.1 illustrates how the findings from both stages translate into design solution for the design of the computer program prototype. The approach undertaken for the development of this prototype was based on a framework created by Neal, Cobb and Wilson (2001). Figure 5.1 illustrates the steps that were taken in the design, development and testing of the prototype for this study. The testing methodology will be discussed in chapter 6.

Study Aims

In relation to the research question 1:

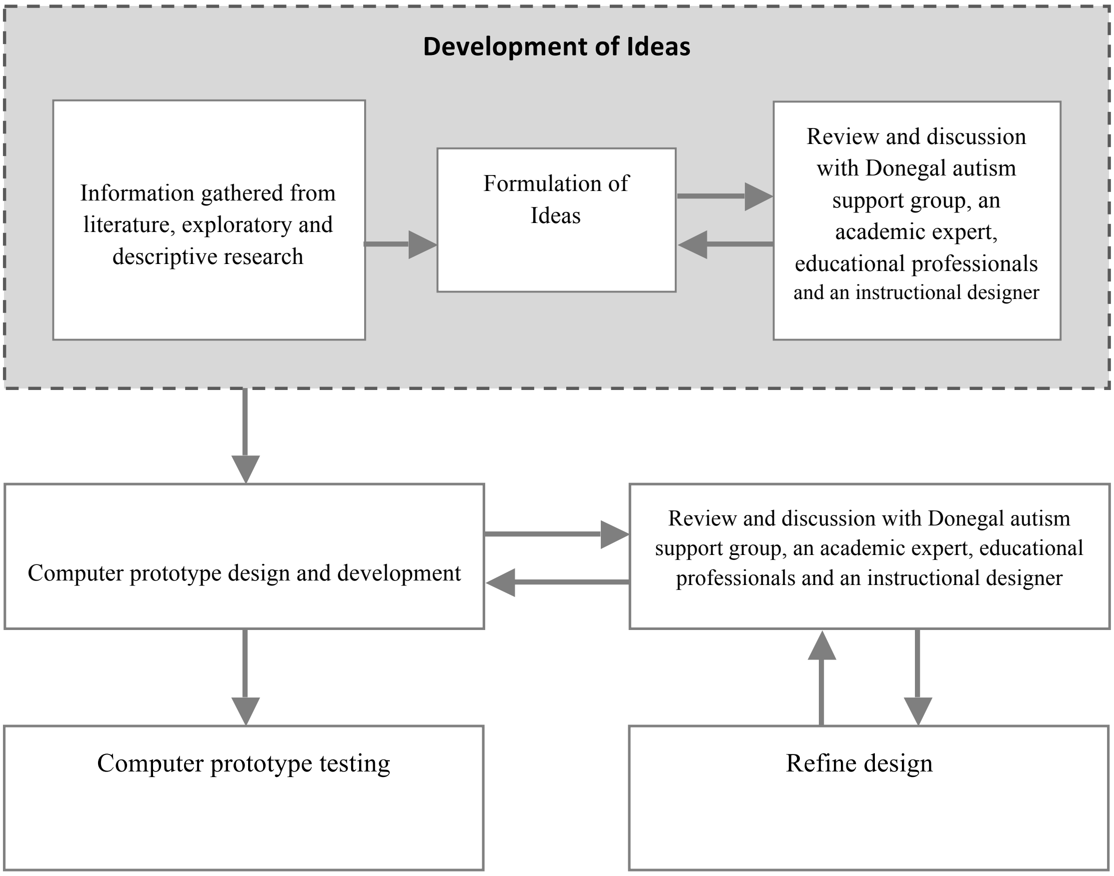
> What level of interactivity and multimedia experience is needed to motivate engagement and therefore learning when using educational computer programs?

Findings from the exploratory and descriptive phase of this study answer this question; Figure 5.1 highlights how these findings have been translated into design solutions. The process used for design and development is divided into three sections:

- Ideas generation phase
- Design and the development phase
- Testing with control and treatment group.

Chapter 6 discusses the testing of the computer prototype with the control and treatment group.

Figure 5.1: Illustrates how theses phases make up the process of design and development of the computer prototype for this study.



Neal, Cobb and Wilson (2001)

5.2 Computer prototype 1 Design and Development

5.2.2 Ideas Formulation Phase

Design decisions were based on findings that emerged from the exploratory and descriptive phase of this research and the literature review. Ideas were formulated using quick sketches and detailed storyboard. Ideas were refined from informal discussions with experts in the field of autism, educational professionals who had daily contact with children who had autism, an academic expert in the field of autism and an instructional designer. The outcome of the idea generation based on findings and discussions with experts not only provided the design specifications required for the prototype but also highlighted a potential gap in the development of educational computer programs for children with autism. Table 5.1 highlights the findings of both the exploratory and descriptive phase of this research and how they translate into design solutions.

The following section discusses the design, development phase, the review and discussion of prototypes, concluding with the development of prototype 2, ready for testing with the control and treatment group.

5.2.3 Design and the development phase

The design and development phase of the prototype was guided by the Neal, Cobb and Wilson (2001) framework and developed in an incremental manner (see figure 5.1). Storyboards and a flow chart (figure 5.9) were used for the development of the prototype in order to translate the research findings into visual representations, and also examining how the program would function. For clarity the researcher has summarised the findings of the exploratory and descriptive phases of this study and describes how they translate into design solutions (figure 5.2). Mayer's (2005) multimedia learning theory (see figure 5.2) guided the development of the interactive learning element of the prototype. All findings are colour-coded and listed alphabetically. The implementation of Mayer's multimedia learning theory in the development of this prototype is highlighted numerically.

Figure 5.2: Three of Mayer's (2005) Multimedia Learning Principles used in the development of prototype

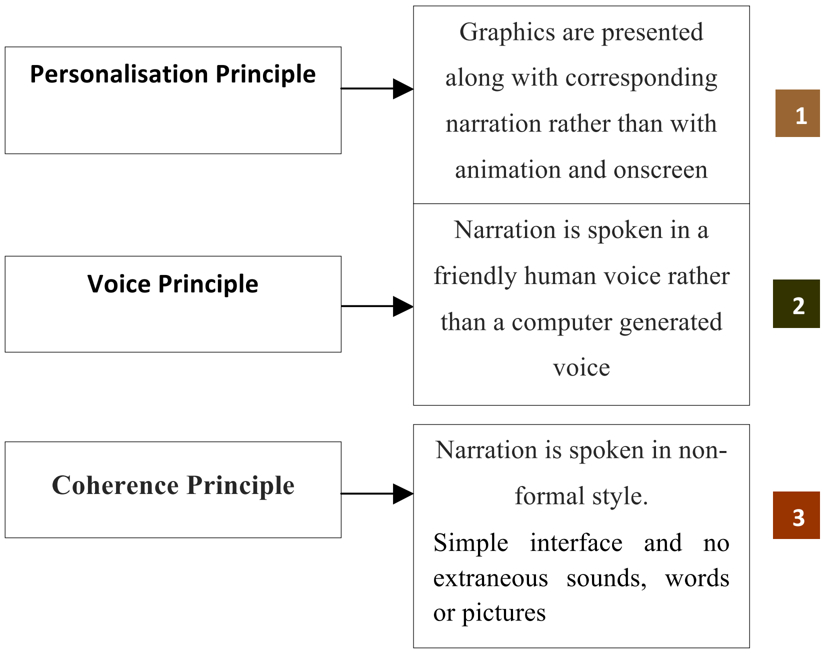
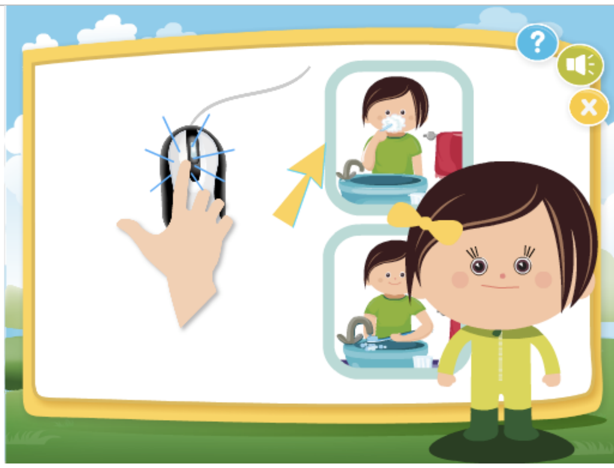
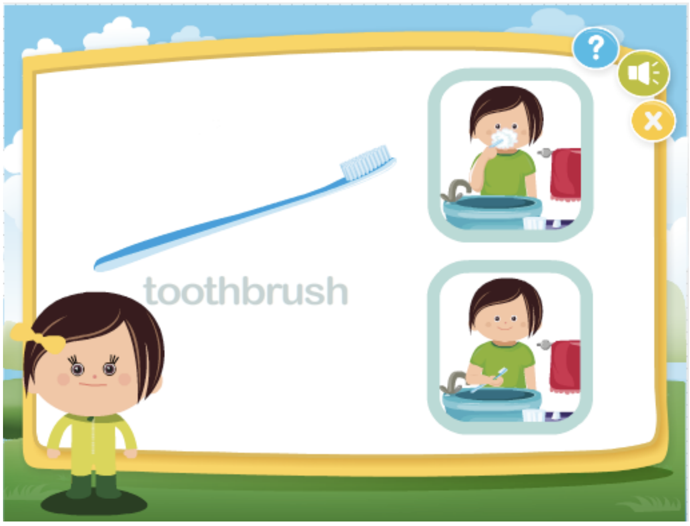
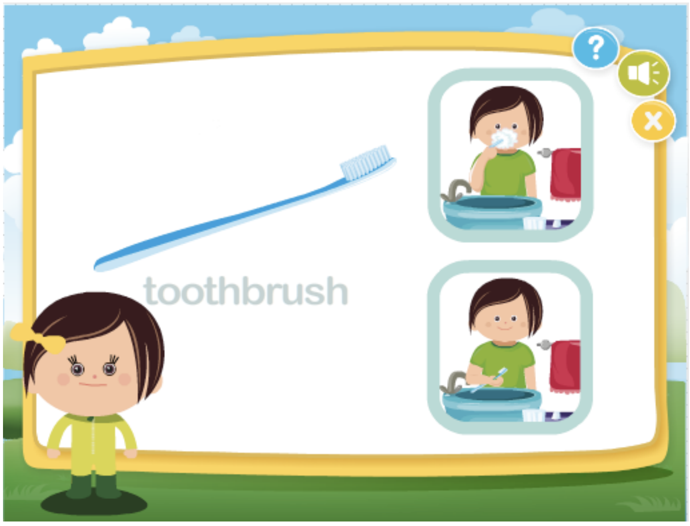


Table 5.1: Interface Design

A	**Instruction must be explicit and in simple language, as a child with autism can interpret the spoken word literally.** Instructions are supported by visual representation of the task that needs to be completed. The language used is simple to understand.	
B	**Likes a goal-orientated environment with simple but achievable goals that have a start, middle and end.** The children will be encouraged with a friendly voice that will instruct them on the necessary steps that need to be undertaken to achieve the desired goal.	
C	**Failure can be debilitating and can cause lack of motivation and** can occasion the onset of boredom, frustration and stress. All tasks will be goal orientated and broken down into simple tasks that will have a start, middle and end. Learning will be errorless, as the child will be prompted to make the right choice by slightly fading out the incorrect answer. Prompts will be faded out until the child makes the correct answer. Once achieved, the child will be praised and rewarded for making the correct choice	

D	**Looks for meaning in the smallest of details and can easily lose sight of the overall meaning of the computer program** The interface will be designed with a very simple layout, with clear visual representation of the task to be undertaken and with no extraneous detail that could distract the child from undertaking the task. Animation will be kept to a minimum.	
E	**Repetition is a common behavioural pattern with autistic children.** The child will not have direct control over the environment. Features such as a replay button will not be included as this could possible distract the child, leading to the playing of the animation over and over.	
F	**Prone to sensory overload, such as sounds and visuals** Parent or teacher can control the accent of the voice over, and can adjust the volume setting of the program.	

G	**Learning style tends to be mostly visual, visual instruction must be accompanied by narrative** Interface is designed without any unnecessary sounds, as all sounds can be controlled by a volume button.	
H	**Can mimic accents** Familiar accents are used in narration. Care will be taken to keep instructions clear and concise and avoid any unfamiliar or ambiguous colloquialisms.	

The letters A through to H indicate the areas that a child with autism can have difficulties with. The design of the interface and navigation was purposely kept simple as children with autism can get easily distracted, focusing on a minute detail of the program (see D and F), have the ability to be easily distracted and have poor sensory discrimination (see F). They are also prone to sensory overload (see F), of which the most common in this context are auditory and visual noise (see F). The processing of information can be impeded when children with autism are presented with rich interfaces rather than with simple interfaces (see F and G). Shifting attention from various stimuli such as fast moving animation can be distracting for this group. As a result the child can lose sense of the overall purpose of the program (see D).

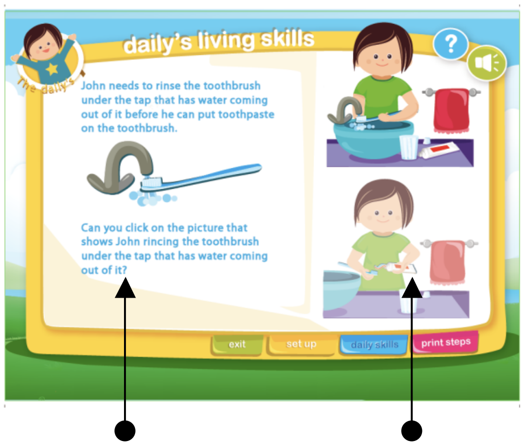
Failure can be debilitating for a child with autism (see B & C), positive feedback must be encouraged. Children with autism take the meaning of words literally therefore language must be simple and avoid any ambiguity or colloquialisms (see A and D). The learning of tasks must be broken into small and achievable chunks with a start, beginning and end. If tasks are not achievable, the child will feel a sense of failure, de-motivation and low self esteem (see B). Some children can mimic accents (see H), which some parents believed this made their children conspicuous among their peers.

5.2.4 Prototype 1 Critical Feedback

The review and evaluation phases were an integral part of the development of the prototype. Functionality and usability are two imperatives deemed as essential for a computer program to be effective (Panerai *et al*. (1996), Lee (2001), Hanna (1997), and Guillemette (2002)). In order to gain valuable feedback in terms of layout, fluidity of navigation, instruction and functionality from various perspectives, the researcher demonstrated layout samples of the interface and how the prototype would function to the Donegal Autism Support Group (n=6), two educational professionals and an instructional designer. The reviewers were shown each layout separately and the researcher asked for feedback on layout, typography, background and navigation. These layouts are shown in Fig. 5.3.

Figure 5.3: Layouts shown to reviewers

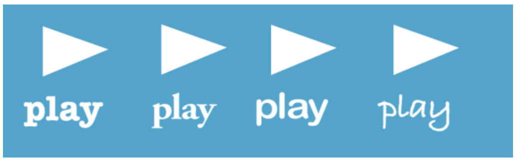
Layout of the interface/first page of the.prototype, illustrating the narrator, navigation and daily living tasks that could be learnt in the home



Instructions for task and an example of fading out prompts

A variation of prompting without fading

Another method of providing instruction, with the narrator playing out the sequence of the task to be learnt



Variations of typography to be used in the interface design

Variations of typography to be used in the interface design

Figure 5.4: Prototype 1 critical feedback layout 1

- "Nice background but the screen looks cluttered."
- "Don't think you need to put the buttons at the bottom for the child as it will be the parents who will be setting it up."
- "Too much writing and the colour makes reading difficult."

Figure 5.5: Prototype 1 critical feedback layout 2

- "Would it be better if the small thumbnails were on the right?"
- " I think you do not need to have the buttons on the screen, as the child may just keep pushing buttons and not do the task."
- " I would take the logo and the writing from the top off as it is too distracting and also the child may just click on it."
- " If the child has to choose from the thumbnails I think that they are too small to highlight any differences."

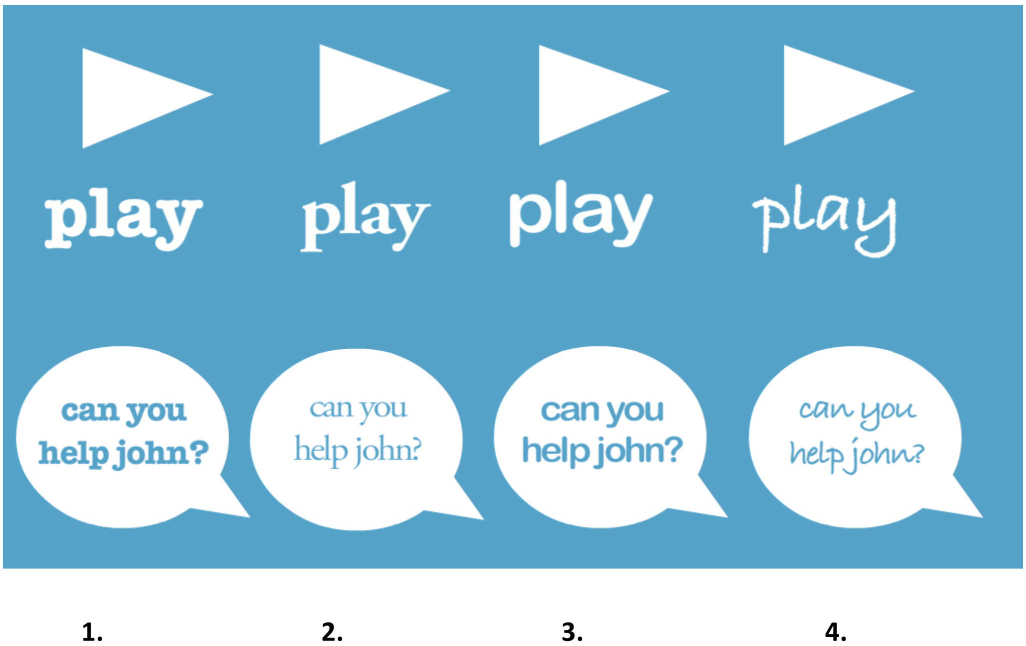
Figure 5.6: Prototype 1 critical feedback layout 3

- "The colour in the background is too bright."
- "Too much happening on the screen."
- "Take the logo and writing away."
- "The buttons on the top right are not really necessary."
- " The child will not get the idea that he has to pick a task by Clicking on the different rooms in the house, I find it confusing."
- "Good idea to have the cartoon character but I think she might be a bit distracting if she is constantly on the screen."

Figure 5.7: Prototype 1 critical feedback layout 4

- "I think that this looks too childish and I prefer the layout of the others."
- "I really do not think that the speech bubble is necessary, what if the child cannot read this?"
- "Don't like the timeline at the bottom right, my child would not understand this."

Figure 5.8: Choosing typography for instructions on the interface



2 of the 6 members of the autism support group and none of the educational professionals liked the 1st sample of typography. Only 1 of the autism support group liked the 4th sample. The 3rd sample was rated the easiest to read. 3 of the autism support group and both of the educational professionals liked the 3rd sample. The instructional designer commented that the typography was clear and easy to read.

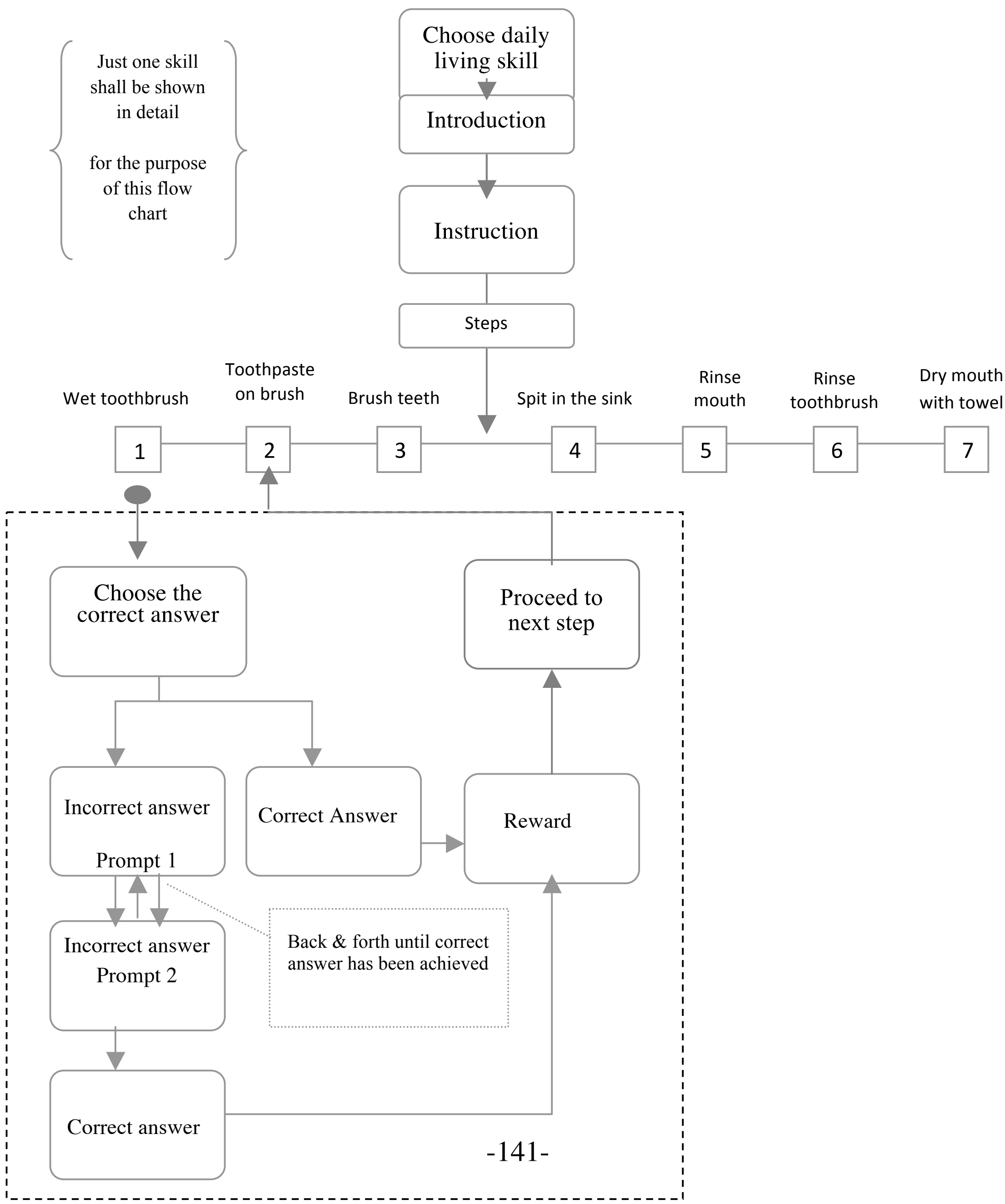
Summary of recommendations:

1. Keep the layout of the main screen simple and not cluttered.
2. Thumbnails would be better placed on the right of the screen.
3. No contrasting colours on the background.
4. Writing not necessary on screen, as the child may not be able to read.
5. The concept of the house at the start of the program would be too difficult for the child to understand.
6. Take away the buttons at the bottom of the screen; child may become too distracted with clicking on them.
7. The logo and the writing on the top of the screen are not necessary and the child will become distracted by trying to click on it.
8. Thumbnails must be much larger so that the child can see the difference between each of them.
9. The cartoon character is not necessary throughout the program, as it may be too distracting.
10. Buttons on the top right hand side may be confusing to the child.

5.3 Computer prototype 2 Design and Development

Following feedback from the group of reviewers, the recommended alterations were made to the layout of the interface. The development of a fully functioning prototype was the next step to undertake. In order to develop the fully functioning prototype, the researcher created and used a detailed flowchart (see fig 5.9) that depicted the functionality of the computer program.

Figure 5.9: Flowchart of prototype 2 development



The researcher used Adobe Illustrator to design the layout of the interface and character design and Adobe Flash CS5 to code and animate the program. A Dictaphone was used to record the voiceovers. The researcher recorded two voiceovers. Each of the voiceover professionals narrated a script developed for this program. The first voiceover (familiar auditory instruction) was a native Donegal voiceover professional (female) while the unfamiliar auditory instruction was recorded by a British voiceover professional (Female) (originally the researcher used an male voice over artist with an American accent, the reason for this change is discussed in p.144). “Sound-edit” was the computer package used to edit audio footage.

The navigation was developed by reflecting on the learning characteristics of the child with autism for example, repetition is a common behavioural pattern with autistic children. Therefore the researcher chose not to give the users direct control over the environment. Distracting navigation features such as a replay button, pause button or back button were excluded from the design of the program to avoid any repetitive behaviour. The participants of the program would only have to ‘point and click’ on the answers by using the mouse button. Care was taken to develop an introduction at the beginning of the computer program showing the user how to ‘point and click’ by using the mouse buttons (see fig 5.10).

Figure 5.10: Simple instructions of how to operate the computer program

An animated visual instruction showed the users how to move the mouse and how to click on the pictures.

Simple instructions of how to operate the computer program are conveyed through an animated demonstration at the beginning of the program (see fig 5.10).

The final design and the fully finished animated prototype was presented to the selected reviewers, the autism support group (n=6), two educational professionals who worked with children with autism and the instructional designer for the final sign off of the prototype. While the reviewers approved the recommended changes, the instructional designer stated that that the narrated instruction was sufficient to guide the users on how to work the program and recommended that it was not necessary to use text as a second form of communication instruction. The researcher made the decision to keep both, as findings from the nationwide survey indicated that text accompanied with narrated instructions was effective for a child with autism.

One change that was recommended by both the autism support group and the instructional designer was to use the same gender for the narrator in both the program with the familiar localised accent and the program with the unfamiliar accent. Both supervisors of this study agreed that this change was important to avoid any possible contamination of the findings.

5.4 Conclusion

This chapter was concerned with the design and development of the computer program prototype. The rationale for the design of the computer program was based on the findings of the exploratory and descriptive phases of this research, the literature review and from the feedback with a panel of reviewers. A comprehensive list of how all findings and how they were translated into design solutions was presented in table 4.13 in chapter 4. The development strategy in relation to both the user interface and the functionality of the program was illustrated in table 5.1. This chapter concludes with the development of the final prototype and the following chapter discusses the methodology used in the testing of the prototype.

Chapter 6: Computer Prototype Design and Development Methodology

6.1 Introduction

6.2 Observations

6.3 Coding the Data

6.1 Introduction

This section discusses the methodology used in the testing of prototype 2. The testing of the program is centred on research question 2:

2. Can the implementation of familiar auditory instruction in the computer program increase the moderately autistic child's level of engagement?

Observation is the methodological approach undertaken for the testing of the prototype which was conducted with two groups, typically developed (TD) and moderately autistic children (ASD).

6.2 Observations

Unfortunately few existing theories have addressed the important issue of behaviour observations in software testing (Tuedor (2008)). However, various studies such as Moore and Calvert (2000), Tuijs and Nelson (1998), Baron-Cohen (2007), Williams (2002) and Tuedor (2008) have used observations with autistic children in the testing of computer software. Technology has evolved significantly over a number of years and the use of video and annotation software for coding tested behaviours has aided researchers by providing them with a referable hard copy of evidence which can back up claims and observations made (Hailpern (2006), Rosenblum (1996)).

Observations was decided upon to enable the researcher to make inferences about what is being observed and the underlying behaviour or emotion that the child displays. For example, the child may find the speed of the instruction as 'too fast a pace' and may therefore display anxious behaviours/emotions.

The researcher is aware that the use of direct observations has some pitfalls such as the intrusive nature of video recording. For example participants may react to being observed and not perform the observed task. To counteract this, a classroom assistant who worked with ASD group was present throughout the observation make the child feel at ease. Parents were present throughout the observations with the typically developed group (TD group).

In terms of validity, this type of research methodology is strong. According to Trochim (2000) that validity is the best available estimation to the truth of a given proposition, assumption or conclusion.

6.2.1 Data collection

Informed by the methodologies used in the previous studies; (Tuedor (2008), Hailpern 2009)), the researcher used direct observation with a small group of typically developed children and moderately autistic children (the purpose of using two sets of children shall be discussed in the section entitled 'Participants' profile').

Observations were recorded using two video Cameras. Footage recorded can be replayed, annotated and linked to specific behaviours. This will allow the researcher to refer back to the event that occurred rather than have to depend on annotated notes, this was a method used by Rosenblaum (1996).

6.2.2 Variables to be tested

Independent Variables

The independent variables are what the researcher changes. For this study they are familiar and unfamiliar accents, these variables will now be referred to as independent variable A and B.

The testing of the independent variables is central to this study as it will determine if using familiar or unfamiliar accents in a computer program will make a difference in the level of engagement a child with autism has with the program.

Dependent Variables

The dependent variable is what is being measured and this is engagement, this variable will now be referred to as dependent variable 1. Engagement can often be viewed as a prerequisite to learning and communicative exchange (Hailpern (2009)). Dependent variable 1 is divided into four sub-variables; looking at screen, auditory focus, smiling and stress/boredom. The sub-variables will now be referred to as 1A, 1B, 1C and 1D.

Dependent sub-variables

1A: Looking at the screen.

This variable measures the amount time the child looks at the screen. When coding, the researcher notes when the child is looking at the screen. This event will begin when the child looks away from the screen and this length of time will be deducted from the overall length of the session. Tuedor (2008) recommends employing the two-second rule to allow time for the action to be recorded.

1 B: Auditory Focus

This measure is used to test auditory attention. Unlike the measurement of looking at a screen, auditory attention is not as obvious an indicator (Hailpern (2009)). Therefore, as recommended by Hailpern (2009), the researcher will have to record this measure indirectly. Hailpern recommends that the auditory focus should be measured by the changes in proximity to and contact with the computer's speaker. It will also be measured when the child moves closer to the screen or speaker when a new sound is made. These measures are deemed to be a prerequisite for determining an interest in computer audio (Hailpern (2009)).

1 C: Smiling

The variable 'smiling' was deemed as a prerequisite to enjoyment (Hailpern (2009), Field *et al.* (2001)). It is thought that higher rates of smiling could reflect that the computer environment was particularly enjoyable at a certain point.

1D: Stress and boredom

This variable indicates the child becoming stressed or bored with the program and is based on variables tested by Tuedor (2009). This measures any negative behaviour such as nervousness, frustration, visual displays of stress or any negative vocalisations. See table 6.1 for both the dependent and independent variables to be tested.

Table 6.1: Dependent variable and independent variables to be tested

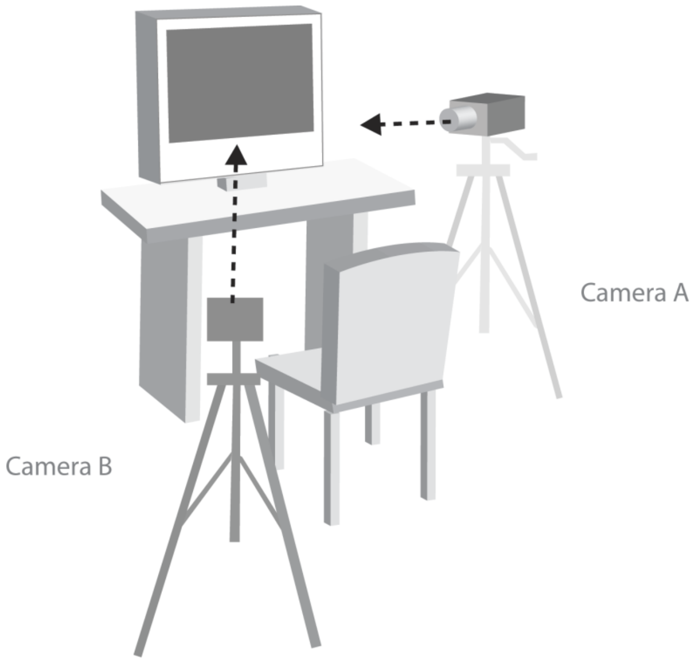
	Independent Variable A			
Dependent Variable Engagement (Comprises four sub variables)	**Familiar Accent**			
	Orientation to the computer screen	Auditory focus	Smiling	Stress /Boredom
	Independent Variable B			
Dependent Variable Engagement (Comprises four sub variables)	**Unfamiliar Accent**			
	Orientation to the computer screen	Auditory focus	Smiling	Stress /Boredom

When an action occurs, for example, the length of time the child faces the screen, this action is measured in terms of the duration of the action rather than the frequency of the action. This is in line with the empirical study conducted by Tuedor (2008).

6.2.3 Room set up

The room layout for observations was based on a study conducted by Tuedor (2008). The researcher chose to use two 'small and unobtrusive camcorders. The program was run on an Apple Mac laptop. Camera A and camera B (see figure 6.1) were synchronised so that they were recording data at the same precise time. Camera A, was positioned to the side of the participant, this was to capture any new behaviours/emotions as a result of introducing a new variable such as familiar accents. Camera B was positioned behind the participant, this was to capture what the participant was doing and at what stage she/he was at on the computer prototype.

Figure 6.1: Camera set up for observations



6.2.4. The participants

Prior to the recruitment of participants, it was of paramount importance to gain written consent from the parents, teachers and principals of the children involved in this study. The consent forms can be seen in appendix A and B.

Eight children were recruited for the observations. The first group were typically developed whose ages ranged from five to eight years of age. The purpose of using this age group stems from the fact that many children under the age of five have not been diagnosed with autism and children with autism between the ages of five and nine/ten years of age 'have developed an awareness, attention and interest outside of themselves.' (Tuedor (2008), p.73).

The researcher would like to note that the original number for each group was five children, which would be in line with Tuedor's (2008) study. However on the day of the observations one child who was nine years of age from the moderately autistic group did not appear for class. To keep the groups equal in number and age, the researcher only used four out of the five children recruited for the TD and ASD group. The second group was typically developed and aged between five and eight years of age.

6.2.5 Procedure

Following the method used by Santozi 2008), the researcher allowed for an initial demonstration of how to navigate the program, showing the child how to click on the pictures. This short demonstration was given to both groups (TD and ASD). Each participant was observed using the two separate programs. The first session involved an observation of the child using the program with familiar auditory instruction and animated rewards and the second session involves an observation of the child using the program containing the unfamiliar accent and the non-animated rewards.

6.3 Coding the data

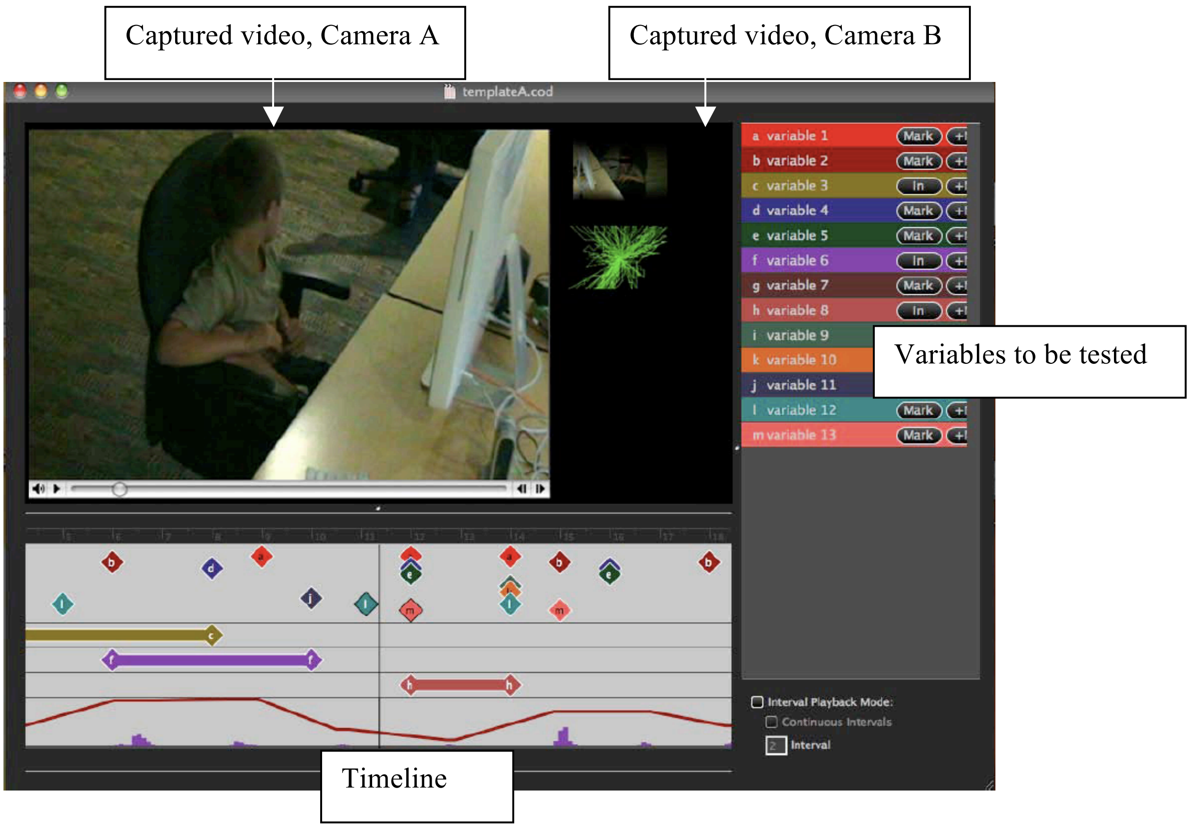
'Human behaviour does not naturally lend itself to being quantifiable.' (Hailpern (2008), p.19). Hailpern states that with with advances in computer technology there are many tools used for video annotation which are the marking of sounds, movements, emotion and so on. Hartman *et al.* (2006) adds that tools which aid the annotation of video raise the bar in the increase of reliability and repeatability. The A^3 (Annotation for ASD Analysis)[10] coding scheme was used to analyse data gathered from video cameras. Vcode and Vdata developed by A^3 are open-source programs

[10] Permission granted by Joshua Halpern for the use of Vcode and Vdata for this study

developed for researchers to annotate and code data using predefined dependent variables (see figure 6.2 for layout). The Vcode application has been developed to provide the researcher with an efficient way to obtain reliable data from observational videos. The layout of the interface allowed the researcher to watch both videos (Camera A and Camera B) to ensure reliability of data coded.

Figure 6.2: Vcode interface

The list on the right side contains the dependent variables, which have been marked on the time line, the diamond shapes represent where events occur.



The Vcode program allows the researcher to input the dependent variables to be tested. Once defined, these are presented as a list on the right side of the interface (see A keyboard hotkey, which allows the researcher to mark where the action takes place along the timeline (see figure 6.2).

Marking the occurrence of events

During the annotation of video, the researcher is presented with two classes of coding events – momentary events and ranged events. Momentary events are marked when a singular event occurs. Ranged events are those that happen over a period of time, thus coding the length of the occurrence.

Timeline

The timeline used in Vcode is very much like a video editing package such as final cut pro which contains a linear timeline. Marking of events are presented in diamond shapes (see figure 6.2). Once an event has occurred the researcher can attach a mark at the beginning and end of the event (onset and offset).

Field notes

Field notes accompanied the data captured by video. These included any obvious positive or negative behaviour as a result of using the computer prototype and prompts given by the researcher if required.

Chapter 7 discusses the findings and analysis of observations that took place with both the typically developed and moderately autistic groups. The chapter concludes with limitations of the research and recommendations for further research.

Chapter 7 Findings & Analysis of Prototype Design and Development

7.1 Introduction

7.2 Prototype 2 Findings and Analysis

7.3 Conclusion

7.1 Introduction

The purpose of this chapter is to report the findings of observations undertaken with two sets of children (TD and ASD) using the computer prototype developed for this study. Observations were conducted over a two-week period with four moderately autistic children and four who were typically developed. This experiment is designed to test the impact of familiarity on the learner by varying the independent variables – familiar and unfamiliar accents.

The reporting of findings and the interpretations of results are divided into four sections. Each section discusses the impact that each of the independent variables had on each of the dependent variables. Focusing on the ASD group, comparisons will be drawn between the impacts each independent variable has on the dependent variable, the final part of each section will compare the findings of each group (ASD and TD) and determine differences, if any. Findings for each child will be listed in a tabular format and reported in terms of duration of each session and the length of time (in seconds) that the child has reacted to the variable. Graphs are used to compare the results from the two groups (ASD Group and TD Group).

The final section interprets the results and the analysis made. This section will report any significant comparisons between the two groups and most importantly if familiar or non familiar auditory instruction made any impact on engagement levels when using the computer prototype.

To protect the privacy of all participants, each child will be identified by number and not name. The Gender was limited to male participants as the researcher found it difficult to recruit female participants meeting the criteria (moderately autistic between the ages of 6 and 9 years of age) in the catchment area where the research was undertaken. Therefore gender was not mentioned during the reporting of findings or interpretation of results. Table 7.1 and 7.2 presents the dependent and independent variables that were tested with each of the two groups.

Table 7.1 Dependent variables and independent variables A and B:

	Independent Variable A			
	Familiar Accent			
Dependent Variable Engagement (Comprises four sub variables)	Orientation to the computer screen	Auditory focus	Smiling	Stress /Boredom
	Independent Variable B			
	Unfamiliar Accent			
Dependent Variable Engagement (Comprises four sub variables)	Orientation to the computer screen	Auditory focus	Smiling	Stress /Boredom

Initial experiment

An initial experiment was set up to analyse the impact of a local accent on children's engagement with the program. However, the observations were not conducted under scientific experimental conditions. It was not possible to isolate the impact of local accent because all other independent variables were not kept constant. Gender and the use of rewards were also varied, thereby making it impossible to determine which independent variable was impacting the dependent variable. Therefore, new sets of observations were undertaken in 2012, where all potential causal variables were held constant and only accent was varied (Familiar and unfamiliar accents). The results of these observations are reported here.

7.2 Prototype 2 Findings and Analysis

7.2.1 Orientation to the computer screen – ASD Group

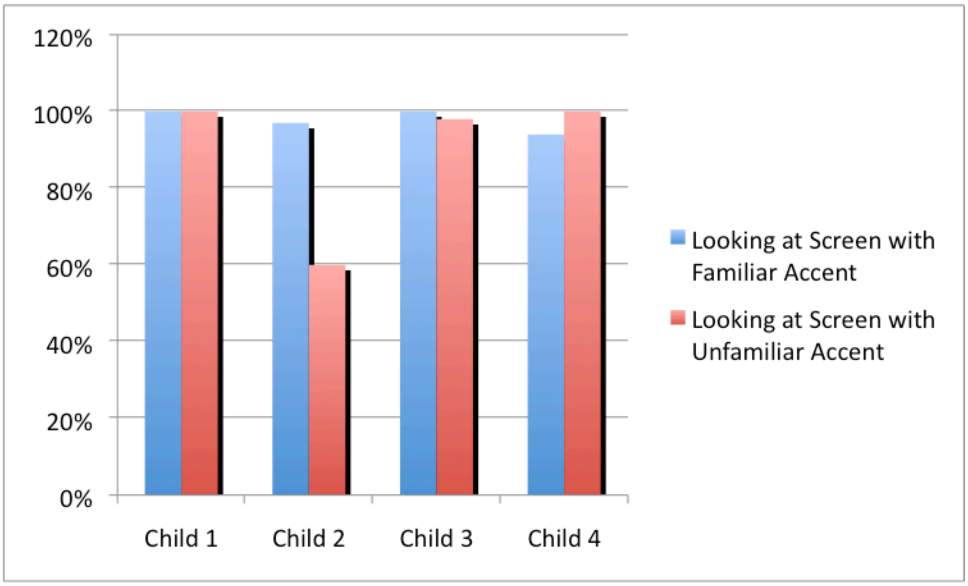
Independent variable A vs. Independent variable B

The finding of the impact of independent variable A: familiar auditory instruction and Independent Variable B: unfamiliar auditory instruction had on the child's engagement has been measured by the length of time the child looked at the screen. The researcher reviewed the observational footage captured on the day and assessed the length of time the child looked at the computer screen when the two separate variables (familiar and unfamiliar auditory instruction) were introduced. Any incidents such as the child's gaze moving away from the computer screen, looking to the side, looking behind, looking above or looking down from the computer screen were measured in seconds and subtracted from the overall time of the session. Hailer (2009), Basket (1996) and Russo (2008) used a similar method for their studies. Table (7.1) shows the findings of variable A and B for each child, highlighting the length of the session, the length of time the child looked at the screen. Figure 7.1, compares the findings for each child under the variable A and B.

Table 7.1: ASD Group - orientation to the computer screen with familiar and unfamiliar auditory instruction

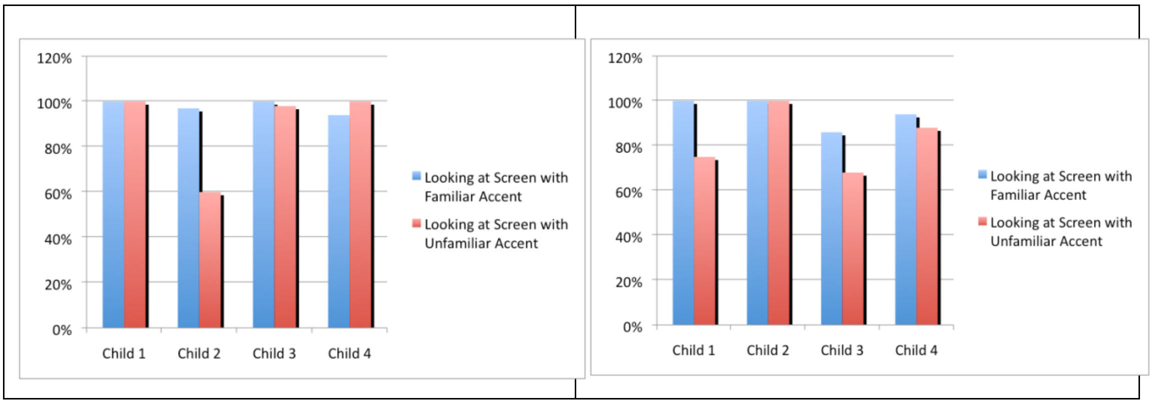
Orientation to the computer screen Familiar auditory instruction			**Orientation to the computer screen Unfamiliar auditory instruction**		
Child	Session duration recorded in seconds	Duration of orientation to the computer screen recorded in seconds	Child	Session duration recorded in seconds	Duration of orientation to the computer screen recorded in seconds
Child 1	88	86	Child 1	74	44.50
Child 2	87	87	Child 2	45.67	45.67
Child 3	74	74	Child 3	47.35	47.35
Child 4	85.7	85.7	Child 4	58.3	58.3

Figure 7.1: Comparison between familiar & unfamiliar auditory instruction for ASD group and the variable 1A; Orientation to the computer screen



The findings of this section show that with familiar auditory instruction, children with autism (bar one child) spent marginally more time looking at the computer screen compared to the TD group. It is interesting to note that when comparing the length of time the children from both groups took to complete the computer prototype under each condition (familiar and unfamiliar auditory instruction), it appears that the majority of the TD group took longer to complete the program when the unfamiliar auditory instruction was introduced compared to the ASD group. One possible reason for this could be that the children with autism spent more time clicking on the pictures to reveal the correct answers while the TD child tried to envisage the answer prior to clicking.

Figure 7.2: Comparison between TD and ASD group



7.2.2 Auditory Focus – ASD Group

Independent variable A vs. Independent variable B

The testing of the variable auditory focus was used in an earlier study by Hailpern (2009) to determine the child's attention when audio was introduced in a computer program. Hailpern determined that auditory focus could be measured by observing the child's proximity to the computer screen.

Table7.2: ASD Group - auditory focus with familiar and unfamiliar auditory instruction

Auditory focus			Auditory focus		
Familiar auditory instruction			Unfamiliar auditory instruction		
Child	Session duration recorded in seconds	Number of times the child moved closer to the screen	Child	Session duration recorded in seconds	Number of times the child moved closer to the screen
Child 1	88	2	Child 1	74.50	0
Child 2	87	0	Child 2	45.67	0
Child 3	74	1	Child 3	47.35	0
Child 4	85.87	2	Child 4	58.30	0

Comparison between ASD and TD Group

Table 7.3: TD Group - auditory focus with familiar and unfamiliar auditory instruction

Auditory focus			Auditory focus		
Familiar auditory instruction			Unfamiliar auditory instruction		
Child	Session duration recorded in seconds	Number of times the child moved closer to the screen	Child	Session duration recorded in seconds	Number of times the child moved closer to the screen
Child 1	79.02	0	Child 1	46	0
Child 2	75.25	1	Child 2	49.14	1
Child 3	77	3	Child 3	39.50	0
Child 4	66	1	Child 4	41.20	0

In terms of auditory focus for this study, it can be deduced that the ASD group were marginally more engaged with the familiar accent as there were more incidences of the child moving closer to the computer screen see table 7.7. Only one participant from the TD group moved towards the computer screen, this occurred with familiar auditory instruction

It could be interpreted that the ASD group found the familiar accent easier to understand or that the sound of the voice was similar to that of their peers and therefore were more attuned to it. On reflection, this small finding casts an interesting light on the findings from Dautehanhn's (2002) study which found that the understanding of narrative is an inherent complex task and in Klin's (1991) study who observed that a striking communication characteristic in children with autism is their poor orientation to the human voice. However, although the ASD group had more incidence of auditory focus under the condition of familiar auditory instruction, it has no bearing on the majority of the group's ability to correctly undertake the two tasks set out in the first program (with familiar auditory instruction). Moreover, the researcher understands that this was tested with a small sample and cannot be generalised to the overall population of people who are moderately autistic.

7.2.3 Smiling – ASD Group

Independent variable A vs. Independent variable B

Figure 7.4 displays the results of the length of time each child smiled when using the computer prototype. Figure 7.4 shows the comparison between both the ASD and TD group.

Smiling was measured as: $$\frac{\text{Length of time smiling}}{\text{Total time of session}} \times 100$$

This formula originated from an earlier study conducted by Tuedor (2008)[11].

[11] See Tuedor (2008) p.84

Table 7.4: ASD Group - smiling with familiar and unfamiliar auditory instruction

Auditory focus			Auditory focus		
Familiar auditory instruction			Unfamiliar auditory instruction		
Child	Session duration recorded in seconds	Duration of smiling recorded in seconds	Child	Session duration recorded in seconds	Number of times the child moved closer to the screen
Child 1	88	17.7	Child 1	74.50	2.4
Child 2	87	18.00	Child 2	45.67	0
Child 3	74	23.97	Child 3	47.35	1.7
Child 4	85.87	0	Child 4	58.30	2.8

Figure 7.3: Comparison between familiar and unfamiliar auditory instruction for ASD group and the variable 1C; Smiling

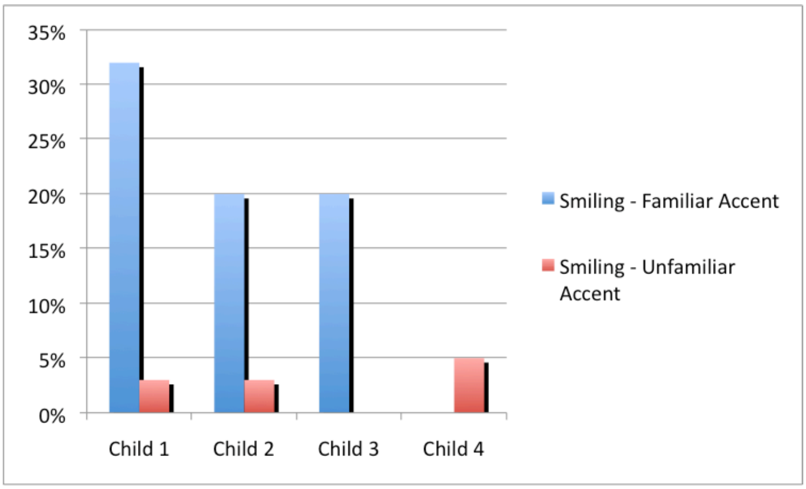
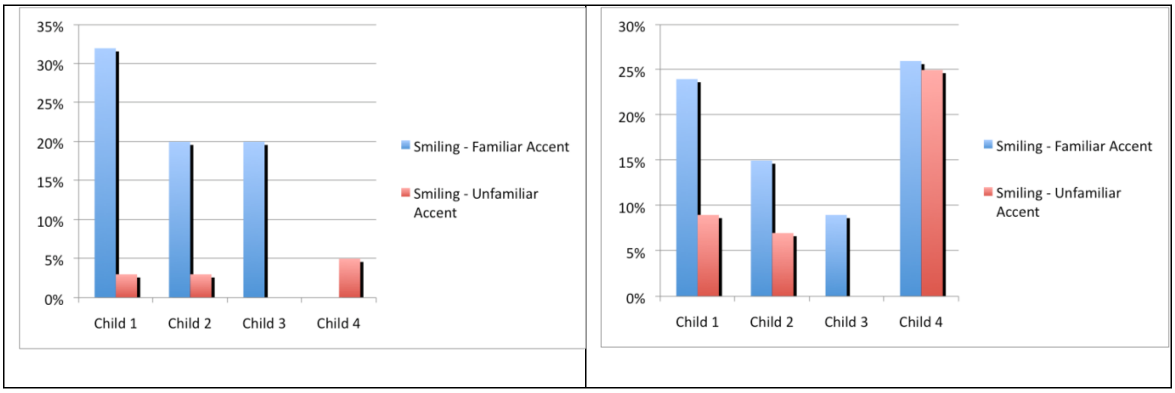


Figure 7.4: Comparison between ASD and TD Group



There is statistical evidence from both groups that there were more incidences of smiling when the familiar auditory instruction was introduced. However one child from the ASD group spent more time smiling when the unfamiliar auditory instruction was introduced, the possible reason for this will be discussed later in this chapter.

Further analysis was necessary to determine what factors, if any, influenced these occurrences. The researcher probed if smiling occurred when any form of animation was displayed, for example; when the child answered the question correctly and the new sequence of questions appeared. Child 1 had no incidences of smiling when the animated sequence of questions appeared. Interestingly this is when he stopped smiling. He smiled mainly when he saw the animated character that narrated the program and also smiled when he answered correctly. It appears that this child was happiest when praised praised for answering correctly. This was the case under both conditions of familiar and unfamiliar auditory instruction. Child 2 smiled when he answered both questions correctly in the first program. This child appeared nonchalant when he answered both questions correctly in the second program (unfamiliar accent). Child 3 smiled mainly when he saw the computer prototype layout for the first time. He smiled when instruction was given visually for each of the steps that had to be taken to complete a task. He smiled too when asked to make a choice of the correct answer and interestingly did not have any incidences of smiling when the program with the unfamiliar accent was introduced. It is interesting to note that one child from the ASD group spent more time smiling when the unfamiliar auditory instruction was introduced. The researcher observed that this child seemed quite bored and nonchalant when using both programs. On further investigation, it became apparent that this child was advanced for his age in computer use and it can be surmised that he found both programs unchallenging.

More occurrence of smiling under the familiar auditory instruction is a noteworthy result, even though incidences of smiling had no reflection on the child's performance of answering questions correctly. It does however show that the child had more motivation and enjoyment when the familiar accent was present.

7.2.4 Stress and Boredom– ASD Group

Independent variable A vs. Independent variable B

Based on the method used by Tuedor (2008), incidents of stress and boredom were first analysed for the duration of any periods of stress, such as hands moving up to face, ears, hand flapping or movement in seat. The duration and the percentage of periods of stress/boredom were calculated using the following formula:

$$\frac{\text{Length of periods of stress/boredom}}{\text{Total time of session}} \times 100$$

Table 7.5: ASD Group – signs of stress/boredom with familiar and unfamiliar auditory instruction

Stress/Boredom			Stress/Boredom		
Familiar auditory instruction			Unfamiliar auditory instruction		
Child	Session duration recorded in seconds	Duration of incidences of stress/boredom	Child	Session duration recorded in seconds	Duration of incidences of stress/boredom
Child 1	88	6.6	Child 1	74.50	11
Child 2	87	11	Child 2	45.67	2.2
Child 3	74	0	Child 3	47.35	14.3
Child 4	85.87	5.5	Child 4	58.30	5.7

Figure 7.5: **Comparison between familiar and unfamiliar auditory instruction for the ASD group with the variable 1D– signs of stress/boredom**

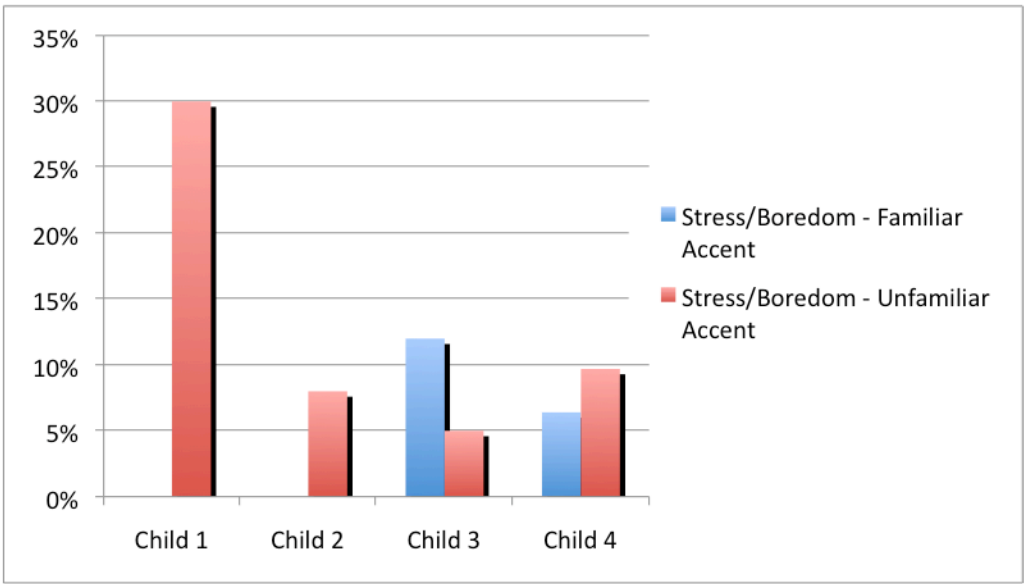
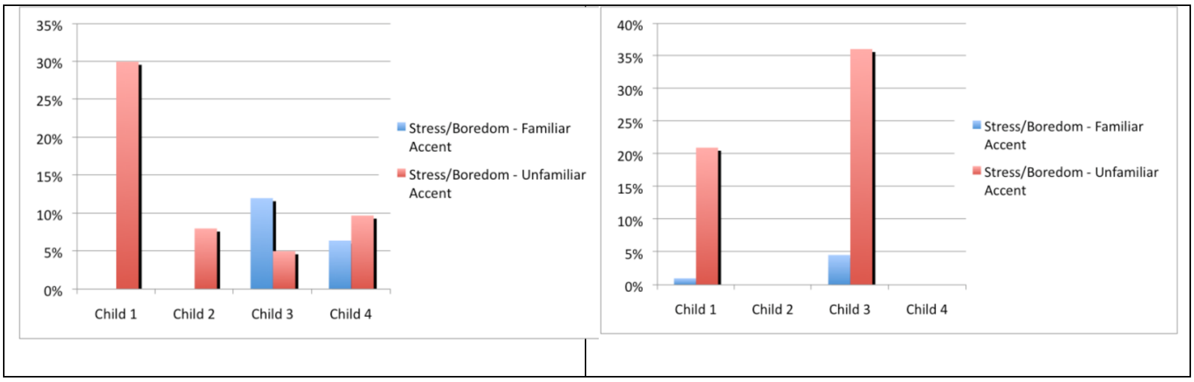


Figure 7.6: **Comparison between ASD and TD Group**



There is evidence that the children with autism had marginally more episodes of displaying boredom and signs of stress when using the program with the unfamiliar auditory instruction. One interpretation of this result may point towards the processing of instruction when it is articulated in a non-familiar accent. The child's display of stress could be translated into frustration with trying to process instruction in an unfamiliar voice. For example, one child from the ASD group moved back in his seat and put his hand over his left ear, then proceeded to put both hands over his ears and then his right hand to his mouth when he was presented with the unfamiliar auditory instruction (see figure 7.7). Another child put his hand to his mouth and also sat back in the chair, while one child in the TD group fumbled his hands.

Figure 7.7: Incidence of stress/boredom under condition of unfamiliar auditory instruction

When comparing the results of the ASD group and TD group, two children from the TD group rated higher levels of stress/boredom when the unfamiliar accent was introduced. One possible interpretation is that these children understood the format of the program from taking part in the testing of the first program and were bored when they had to participate in the second program. Two children from this group were not affected by either of the variables.

Answering questions correctly

It is interesting to note that the independent variables made no impact on either of the groups answering questions correctly. Two children from the ASD group answered all four questions correctly. Two of the questions were presented with familiar auditory instruction and animated rewards while the last two questions were presented with unfamiliar auditory instruction with no animated rewards. One child from the ASD group answered one question correctly under both conditions, while the last child from the ASD group had to be prompted for all questions. This child's focus had been distracted by continuingly clicking on the incorrect answer in order to listen to the auditory prompt, which he found amusing.

7.2.5 Summary of findings

Table 7.6: Summary of findings from observations in the testing of prototype 2

Variables A&B with 1A	Finding (s)
Orientation to the computer screen with the variables familiar and unfamiliar auditory instruction	Both the ASD and the TD group had a marginally higher percentage of looking at the computer screen when familiar auditory instruction was introduced.
	Compared to the ASD group, the majority of the TD group took longer to complete the computer prototype when the unfamiliar auditory instruction was introduced.
	Finding (s)
	In terms of auditory focus it can be deduced that the children with autism were actively more engaged with the familiar accent, as there were more incidences of the child moving closer to the computer screen. Three from the TD moved forward on one occasion. This was under the condition of familiar auditory instruction.

Variables A&B with 1C	Finding (s)
Length of time smiling when using the computer prototype with the variables familiar and unfamiliar auditory instruction	There is statistical evidence from both groups that there were more incidences of smiling when the familiar auditory instruction was introduced.

Variables A&B with 1D	Finding (s)
Duration of boredom/stress using the computer prototype with the variables familiar and unfamiliar auditory instruction	There was a higher occurrence of signs of stress and boredom with the ASD group compared to the TD group when the unfamiliar auditory instruction was introduced to the computer prototype.

7.3 Conclusion

Although the issue of familiar or unfamiliar accents had no significant bearing on answering questions correctly, it is positive to note that the majority of the children from both groups and under both conditions (with the familiar auditory instruction and unfamiliar auditory instruction) answered questions correctly on the first or second attempt. It is interesting to note that the simple layout of the computer prototype for this research did not alter the child's ability to follow instructions when prompted. The simple layout had been designed and developed based on the findings of the focus groups and the descriptive research for this research and therefore adds strength to those findings. During the focus group discussions and from the findings of the descriptive phase of this study, it emerged that children with autism can easily become distracted by various features of a computer prototype such as sounds, distracting backgrounds, fast moving animations and any extraneous and non-essential features of the program. These features can essentially lead the child to lose sight of the overall purpose of the program. It can therefore be duly noted, that the simple layout of the program for this research did not impact on the ability of the majority of the children in this study to answer questions correctly.

In terms of engagement which is a prerequisite to learning (Landry (2008)) it was significant to find that the children with autism had higher levels of orientation to the computer screen and had less episodes of stress or boredom when the independent variable of familiar auditory instruction was introduced.

Finally, all respondents were simply asked which of the two voices they liked most. From the ASD group two of the children preferred the familiar voice while the latter two preferred the unfamiliar voice. With the TD group, three of the four children preferred the familiar accent while one preferred the unfamiliar. One comment from the TD group was that the familiar voice sounded friendlier, another stated that the unfamiliar voice sounded too deep.

To conclude, neither the familiar or unfamiliar auditory instruction variable had a bearing on answering a question correctly, this was the case for both the ASD and TD Group. However, there is significant evidence that both sets of children spent more time being engaged with the computer prototype when the familiar auditory instruction variable was introduced. Newman *et al*. (1992) states that 'that engagement is a construct used to describe an inner quality of concentration and effort to learn' (p.70). This presents a positive case for promoting the localisation of educational software not only for children with special needs but for all children. In terms of developing educational software specifically for children with autism these findings can go towards a framework for the further development of educational software specific to the learning needs of this group. These findings can be viewed as identifying a gap in the market for developing educational software for children with autism in Ireland.

Chapter 8 Conclusions, Limitations and Recommendations

8.1 Introduction

This chapter revisits the two research questions posed by the author and discusses the overall conclusions that were made. Limitations of this study and recommendations for future research are discussed in the latter section of this chapter, section 8.4. The chapter concludes with a summary of findings as they pertain to the two research questions.

8.2 Conclusion Research Question One

Q1: What level of interactivity and multimedia experience is needed to motivate engagement and therefore learning when using educational computer programs?

The methodological approach undertaken to address this question was structured in the form of exploratory and descriptive research. Focus group interviews with parents, teachers and educational therapists and a short telephone survey of principals or teachers in charge of educational computer programs in the 47 special needs school across Ireland formed the exploratory phase of this research. A Nationwide survey was conducted with a sample of special needs and mainstream primary schools who had children with autism enrolled and households households with moderately autistic children between the ages of five and nine years.

This part of the study sought to determine communication barriers that hindered the processing of information and therefore learning. An additional aim was to define the most common daily living skills that should be implemented into the design of program and to gain a further understanding of the end user.

A review of the current state of educational computer programs used in the educational plans for moderately children autistic children at home and in schools across Ireland was also undertaken. The focus group discussions were integral in eliciting important design features that needed to be included or excluded in the development of the program for this study. Focus group discussion took place over two months (October 2009 to November 2009) with parents (n=10), teachers (n=4) and educational therapist (n=3).

The discussions revealed numerous features that need to be addressed and included in the development of educational programs for children with autism. The findings from this phase of the research provided the foundations for the design and development of computer program for this study.

Communication and learning

It was acknowledged from the review of literature pertaining to communication and learning, that people on the autistic spectrum have variations in sensory impairments and that up to 75% have co-occurring learning disabilities (Adler (1998), Dewy (2005)). This review of literature highlighted the many barriers that impede successful communication with people.

In terms of barriers in communication, 64% of respondents from the survey agreed that two of the main impediments were attention and focus. This concurs with Garretson (1990) who determined that children with autism have difficulties in sustaining focus and attention on imposed tasks. 82% of participants agreed that background noise had a major impact on attention. 35% added that it was not just background noise that impedes attention: it was higher frequencies of noise that may not be apparent to us, but can be alarming to these children. This latter finding also concurs with Happé (2002) and Baron-Cohen (2006) who state that children with autism are highly sensitive to noise; they can find noise, which is barely audible to us but intolerable to them. These findings had a valuable input on the development of the prototype for this study. The researcher gained an insight into how best to utilise sound and paid particular attention to variances in pitch and rhythm with the recordings of voiceovers for the computer program.

In terms of communicating instruction, 82%of all respondents agreed that instruction must be explicit with simple, unambiguous language and divided into small goal orientated steps. Teachers from the focus group stressed that instruction must be progressive with a start, middle and end. In relation to the language used in instruction, there was general agreement (2 teachers, 7 parents and 3 educational therapists) that care must be taken with using colloquialisms, as a child with autism can take instruction literally. This is a noteworthy finding for this study, as on closer inspection of educational software developed in foreign countries, there are apparent colloquialisms used which may cause confusion to the child with autism. Colloquialisms such as 'trash can', 'mind your step', 'watch yourself', 'hold the door' were mentioned as phrases that we take for granted but can confuse a child with autism.

Daily living skills are important skills for children with autism to learn as they promote independence. 71% of respondents agreed that the children in their care had difficulties in in mastering these skills.

One respondent stated that it was not just the learning of daily living skills that was problematic but it was the generalising of skills learnt. The example she gave was that her child was taught to wash his hands at school but was unable to conduct this task in a different location. This latter finding concurs with Walden *et al.'s* (2009) recommendation that when children with autism can apply acquired skills across different settings, they will make broad, long term improvements in behaviour and social communication. Acknowledging the necessity to teach children with autism daily living skills provided the impetus to determine what daily living skills children with autism find most challenging. This question was posed in the descriptive phase of this research.

Computers as a learning tool

This section of the research revealed findings that could potentially increase attention, focus, motivation and engagement when using a computer program. Findings from this section also highlighted the various impeding features of a computer program that can impinge on learning.

82% of participants agreed that the children with autism in their care felt comfortable using computers.

However, a trend emerged from the majority of respondents that there were negative features on computer programs that had the potential to distract the child from continuing to use the program. In terms of distracting features, 76% of participants felt that negative feedback following an incorrect answer resulted in the child feeling frustrated and de-motivated. Respondents all agreed that failure could be debilitating for a child with autism. Other off-putting features that parents/teachers and educational therapists felt could distract the child from using a computer program included extraneous features such as fast moving animation. This could cause the child to lose sight of the overall program by focusing on the animation. Unattainable tasks which parents in particular believed would induce a sense of failure if the child could not complete a task. If instruction is only presented in text it could be off putting to a child with autism that does not have the level of comprehension to process information in this form. Therefore it was recommended that, if text were used, it should be accompanied by narration.

Motivational features should be included in software for children with autism. It was agreed by respondents that rewards for getting a task correct motivated the child to stay on the given task and engage more with the program. It emerged however, that when rewards were presented in animation form, they should be timed to remain on the screen for only a short period of time as respondents felt that children with autism could easily lose their focus. Moreover, a stop or replay button would would lead to iteration of the animation which could consume the child for hours.

This finding concurs with Baron-Cohen's (2009) attitude on repeating patterns. He states that children with autism are drawn to predictable, rule based systems whether these are repeating mathematical patterns, electric patterns (light switches) or repeating patterns in film.

Software currently used by children with autism

A highly significant finding emerged when participants were asked about the software they currently used with the children with autism in their care. 62% of respondents indicated that the software they currently used had not been developed specifically for the learning needs of children with autism. Most significantly, the majority of software they were using was developed in the United States or the United Kingdom. It also emerged that unfamiliar accents used on computer programs did not have a negative impact on the child's learning. This was indicated by 58% of participants. However, 40% of parents stated that their children mimicked the accents they heard on both computer programs and TV. 50% of parents did agree that mimicking accents could have a negative impact on the child. One parent asserted that this makes her child conspicuous among his peers while another stated that nobody would know her son was autistic were it not for 'his American accent'

Designing computer programs specifically for children with autism

Participants were asked to discuss features they would like to see included in educational computer programs for children with autism. The list of recommendations can be found in the findings chapter.

The most significant findings were:

- The design of the interface should be stimulating but without too many distracting features such as animation.
- Music and other sounds must be controllable.
- No broad accents to be used as a voiceover, as a child with autism can mimic accents.

The finding that software used by parents of children with autism was not developed specifically for their learning needs and the fact that software used was developed in either the UK or USA prompted the researcher to investigate if this too was the case with software used in schools. To determine this, the researcher conducted a short telephone survey of all 47 special need primary schools across Ireland. Of the 31 schools that responded, 23 stated that the software they used was not developed specifically for the needs of autistic children and 21 schools indicated that the software they used came from either the United States or the United Kingdom.

These findings have provided positive confirmation that there is a gap in the market for the development of educational software for children with autism. Both the focus group and the short telephone survey have confirmed this noteworthy finding. The researcher acknowledges that this was confirmed by only a small proportion of the population and needs further investigation. To evaluate users' needs and attitudes in relation to computer programs for moderately autistic children on a larger scale, the researcher conducted two nationwide surveys aimed at parents and teachers of moderately autistic children between the ages of five and nine years.

Significant and important findings emerged from the both surveys and concurred with the major findings from the focus group and telephone survey. The aim of the survey was to gain an understanding of users' attitudes and experiences towards software used at home and in school and to determine the users' needs by focusing on goals, strengths, weaknesses and behaviours and to determined users'needs in relation to the learning of daily livings skills.

Computer programs used at home and at school

In order to verify the findings from the focus group discussions and telephone survey, the researcher sought to determine at a nationwide level with teachers and parents of moderately autistic children between the ages of five and nine years if computer programs used at home or at school were developed specifically for the needs of moderately autistic children. This information was gathered using a survey. Significantly 79% of teachers and 44% of parents confirmed that the programs they used in the school or at home were not specifically developed for the moderately autistic children in their care. Moreover, the highest percentage (57%) of computer programs used in Irish schools originated from the United Kingdom while 33% of parents indicated that the computer programs they used originated from the United States. It was interesting to note that only 2% of software used in schools and 3% of computer programs used at home were developed in Ireland. When asked if the moderately autistic child in their care mimicked the accents on the computer programs, 28% of parents stated that they did mimic, 18% stated no and 42% marked N/A.

In contrast 57% of teachers stated that the children they taught did not mimic accents from computer programs. Significantly 64% of parents and 54% of teachers indicated that the implementation of familiar accents in educational computer programs could benefit the child's learning. It emerged from both sets of respondents that computer programs for educational development was deemed the most essential and effective program to use with this group.

In relation to using current computer programs at home and in the school there was a strong agreement from both sets of respondents that the child can easily become absorbed in one area of the computer program. An indication of an incorrect answer was rated by parents as the most problematic feature on a computer program. In terms of the most distracting feature of computer programs both sets of respondents rated first ‘too many pictures’ on the program’s interface and ‘other sounds’ as the second most distracting feature. In relation to motivating features, parents rated rewards for getting a question correct and teachers rated feedback throughout the program as the most motivating features.

Designing computer programs for moderately autistic children

The purpose of this section was to determine any common interests and strengths of moderately autistic children and to elicit a list of recommended changes that parents and teachers would make if they were developing educational computer programs for children with autism.

The highest rating common strength as indicated by parents (52%) was good long-term memory. Teachers (43%) rated thinking visually as the most common strength. Interestingly, both sets of respondents indicated that playing computer games was the most common interest (58% of parents and 46% of teachers).

Recommended changes to computer programs from both sets of respondents included:

- Clear and simple instructions
- Short and to the point phrases
- Close-ended questions
- Simple layout with no flashing animations
- Volume control
- Give the child time to respond to questions
- Positive feedback
- Visual prompts
- Familiar accents
- Lessons on the program to be based on the Irish education system.

In summary, the exploratory and descriptive phase of this study has identified that computer programs currently used at home and at school have not been developed specifically for children with autism. Moreover, it was determined that computer programs came from other countries such as United States or the United Kingdom. It was also agreed by parents that such foreign computer programs could promote the mimicking of accents. All respondents from both the focus group discussions and survey agreed that the adoption of a familiar accent in computer programs could benefit the child's learning. Parents, teachers and educational therapists agreed that there are many distracting features on current programs used by moderately autistic children and supported the development of a computer program specific to the cognitive needs of a child with autism.

These findings had strong implications for the design layout and the development of the computer program prototype for this study, as it provided the necessary information to develop a framework specific to the needs of children who are moderately autistic. In addition these significant findings have given an insight into the state of computer programs currently used by moderately autistic children in schools and in the home. Moreover, these findings have determined that there is a significant gap in the development of educational computer programs for children with autism.

The final stage of this research was the development of the computer program prototype. This development and design of the prototype was based on the findings of both the exploratory and descriptive phase of the research. The prototype development underwent two iteration stages and concluded with the testing of the prototype with a sample of moderately autistic children (n=4) and typically developed children (n=4). The first run of observations took place in March 2011, but due to the possible contamination of results the main observation took place with the same participants in March 2012.

In summary; the testing phase of the prototype was to determine whether moderately autistic children are more actively engaged with the program when auditory instruction is presented in a familiar accent. This phase answered research question 2.

8.3 Conclusion Research Question Two

Q2: Can the implementation of familiar auditory instruction in a computer program increase the moderately autistic child's level of engagement?

To answer research question 2, one independent variable 'engagement' (engagement variable had 4 sub variables see chapter 6) and two independent variables; familiar accents in auditory instruction and unfamiliar accents in auditory instruction were used in the testing of the computer program prototype to determine if familiar or unfamiliar accents impacted on the child's engagement with the computer prototype.

Engagement

Engagement is acknowledged as a prerequisite to learning (Landry (2007 and Newman *et al*. (1992)). Engagement was measured on the length of time the child was orientated to the computer screen, the number of episodes of auditory focus, the length of time smiling and periods of boredom/stress. Correct answers were measured against having animated reward and having no animated rewards.

There is statistical evidence that children with autism spent more time orientated to the computer screen with the familiar auditory instruction variable compared to the unfamiliar auditory instruction.

In terms of auditory focus for this study, it can be concluded that the ASD group were more actively engaged with the familiar accent as there were more incidences of the child moving closer to the computer screen. Three from the TD group moved forward on one occasion under the condition of familiar auditory instruction. Upon analysis there were more incidences of smiling with both groups when the familiar auditory instruction was introduced. This is a positive result, even though incidences of smiling had no bearing on the child's performance in making correct answers. It does however show that the child had more motivation and enjoyment when the familiar accent was present.

There is marginal evidence that the ASD group has more episodes of displaying boredom and some signs of stress when using the program with the unfamiliar auditory instruction. One interpretation of this result may point towards the processing of instruction when it is articulated in an unfamiliar accent. The child's display of stress could be translated into feeling frustrated with trying to process instruction in an unfamiliar voice. Another interpretation could be that the computer prototype was too simple for this group to use, therefore leading to episodes of boredom.

Upon analysis it is evident that the dependent variables (familiar/unfamiliar auditory instruction, animated reward and no animated rewards) made no impact on either of the groups answering questions correctly.

To conclude, although the observations with both groups did not show positive gains in making the correct answer with the familiar auditory instruction when compared to the unfamiliar auditory instruction variable, there is significant evidence that both sets of children spent more time engaged in the computer program with the familiar auditory instruction variable. This presents a very strong case for promoting the localisation of educational software not only for children with special needs but for all children. In terms of developing educational software specifically for children with autism, this research presents a valid design and development framework for the future development of educational computer programs for moderately autistic children. Most importantly, this research has pinpointed that there is a gap in educational computer programs used in schools and homes across Ireland for this group Educational computer programs used by this group have not been developed specifically for their educational needs and most MOST SIGNIFICANTLY, THE majority of programs used have been designed and developed in countries other than Ireland.

8.4 Research Limitations

The researcher's experience of conducting this study was mostly positive, rewarding and with good outcomes. However, as with most research, limitations emerged from the study. The following are the limitations of this study.

Sample size

The sample size was one of the constraints of this study. A sample of each age group between the ages of five and nine years was desired for this study. However, the autism unit where the study was conducted had children of varying levels on the autism spectrum. Therefore, a convenience sample of just four moderately autistic children met with the criteria for this study (between the ages of five and eight years and moderately autistic). Although this is a limitation, the researcher feels confident that testing with a larger sample can be conducted in future research studies.

Gender

The researcher found it difficult to recruit female participant for the ASD group, the two schools where the children were recruited had mainly females who had high functioning autism. Therefore this study could only test the prototype with male participants.

Development of the prototype

This research study concluded with the development of a prototype, which is ready for further development. It was hoped that the computer program would be developed to encompass various daily living skills. It was however deemed by the researcher to be outside the scope and timeframe for this study. The positives gained out of this limitation is that more time was invested in researching the important design and interactive features that needed to be included or excluded in the development of computer programs that are specific to the needs of this group. The interface of the program has been rigorously assessed by professionals and parents who work with or care for moderately autistic children. The finding of each of the research methods used has produced a blueprint/framework for the development of computer programs for moderately autistic children. Without this knowledge the prototype would be deemed defunct and not worthy of further development.

Testing of the prototype

The prototype was initially tested in March 2011. However the program had to be re-tested in March 2012 as the variables tested were not kept constant, which made it impossible to determine which independent variable was impacting the dependent variable. This decision was made by both the supervisors and an internal panel of lecturers at LYIT. The change of the design of the prototype was just the gender of the voice over artist and the inclusion of animated rewards for both the program with the familiar and non-familiar accent.

Time

Time was another limiting factor for this study. The researcher's background is in digital media and graphic design and her knowledge of autism was limited. A lengthy period was spent learning about autism and cognitive impairments, which was deemed necessary in order to develop the computer program. One positive is that as a result of the time spent researching autism and cognitive impairments, the researcher is in a position to state that all avenues have been explored.

The researcher would liked to have spent more time on the design side of the program but understands that the findings of this study (exploratory, descriptive and observational methods) have created a framework/blueprint for future development of computer programs specifically for the learning needs of children who are moderately autistic.

Finally

The researcher understands that it would be necessary to appraise individuals over a lengthy period to time to determine if they were able to sustain a skill learnt via computer instruction. Beadle and Browne's (2005) study of adults with learning difficulties showed a positive gain in acquiring living skills over a span of several years.

Findings that have emerged from this study could prove valuable for the future development of educational computer programs for moderately autistic children. The researcher also believes that this study merits further investigation not only with a larger sample but to be conducted over a lengthy period of time to build upon the validity of this research.

8.5 Recommendations for Further Research

The researcher has identified four areas that merit further research:

The first area for further research is the transferring of skills learnt via educational computer programs into real world settings. The NCSE report (2009) highlighted a gap in research stating that although positive conclusions could be drawn from recent studies on the use of computer approach to teaching (see above references in 7.4), there is a gap in research that provides evidence that skills learnt from a computer program can be transferred in to a real world setting. People on the autistic spectrum tend to lack the capacity to link a specific item of learning with a real world situation, as the latter is in a constant state of flux.

The second area involves the area of neuroscience inspired by Birkett (2007). Birkett conducted a neuro-scientific study on 11 typically developed males. This study involved giving instructional tasks using voices that were familiar to the participants. An MRI Scan determined that the auditory processing area of the brain (auditory cortex) was preferentially activated and engaged by familiar voices as opposed to unfamiliar. This shows that auditory familiarity enhances auditory processing. The auditory cortex is an important part of the hearing process and is deemed essential in the processing of language (Belin *et al.* (2006). Drawing on Birkett's study a possible recommendation for further research would be to investigate if familiar accents in auditory instruction activate this part of the brain in children who are moderately autistic. This could provide many possible avenues for further research.

The third area for further research would be to assess the educational potential of translating educational computer programs used in the Irish speaking areas of Ireland to the various dialects that are synonymous with the Gaelltacht areas. This area for potential research emerged as a recommendation from an educational therapist who has worked with children in these areas.

The final area for further research is to investigate if idiosyncratic speech encroaches on the child's social being by setting him apart from his peers.

The researcher of this study endeavours to take this study further by collaborating with other researchers in the area of e-learning and the older population with cognitive disabilities.

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APPENDICES

Appendix A: Letter of consent for observations addressed to School Principal

lyit | Institiúid Teicneolaíochta Leitir Ceanainn
Letterkenny Institute of Technology

2nd March 2011

Dear Mrs Fitzsimmons,

I wish to thank you and your teachers for participating in the focus group which has contributed to my research in autism funded by the National Children's Strategy. I am nearing the final stage of this academic research, which will culminate in the testing of a very simple computer program to determine if familiar accents and animated instruction can facilitate learning. This will enable the further development of educational software specific to the needs of children with autism.

I would like to ask your permission to observe three moderately autistic children between the ages of five and nine years. This observation will involve the researcher recording each child using the simple computer program and shall take no longer than ten minutes per child. It will be necessary to further test each child within the same week using the same program that has been slightly adjusted. I propose the week starting Monday 14th March 2011 and will work around the child's allocated computer time.

Your contribution will be invaluable and will greatly help in the development of an Irish-designed educational program, which will be presented to the Minister for Children as part of the National Children's Strategy. A summary of the findings and a **free copy** of the prototype program will be provided to your school on completion of this research.

Garda clearance and approval from the ethics committee at Letterkenny Institute of Technology has been granted for this research project. All observational material will be treated with confidentiality. I would be more than happy to meet with you to discuss the nature of this observation, I can be contacted on 086–3222 082 or email nicola.duffy@lyit.ie. I look forward to hearing from you.

Once again, I thank you and appreciate your kind attention and assistance with this important research.

Yours sincerely,

Nicola Duffy

Appendix B: Letter of consent for observations addressed to Parent/Guardian

Institiúid Teicneolaíochta Leitir Ceanainn
Letterkenny Institute of Technology

Dear Parent/Carer

The Office of the Minister for Children (ROI) is currently funding a researcher project undertaken by Nicola Duffy, a research student based at Letterkenny Institute of Technology. This research project seeks to determine the educational potential of localising accents in educational computer software for children with autism.

As part of this research, it is necessary to observe a variety of non-autistic and children with autism in order to find out if familiar localised accents can enhance engagement and therefore learning when using educational computer software.

The researcher would like to make it clear that the observations will not involve any psychological testing or assessment of the children and the children will not be named. The goal of this research is to trial the potential of familiar localised accents in educational computer software in order to help improve the development of educational software specifically for children with autism.

For research purposes the trials will be videotaped to help the researcher examine the results of the trial. There will be two 10-minute trials conducted over one week.
The children will not be left unsupervised and safety factors are carefully considered. The evaluation and real world testing of the computer software is a vital part of its development and we appreciate your support.

We would be grateful if you could complete the section at the bottom of this letter and return it to …………

If you have any questions about the project or the testing sessions please do not hesitate to contact us, details below.

Yours sincerely

Nicola Duffy
Research Masters Student
Letterkenny Institute of Technology
Nicola.duffy@lyit.ie

With respect to this project:

I consent to allow my child…………………………………………………

- To take part in two 10 minute trial sessions using an educational computer program developed for the above project [ ]

- To be videotaped during the trials [ ]

(* Please tick boxes if you agree)

Appendix C: Pre-Screening questionnaire for focus group

Name:

____

Address: ______________________________________

Telephone number: ______________________________

Childs name: __________________________________

Male/Female: **Age:**

____

1. At what level on the autistic spectrum has your child been diagnosed?

   High Functioning *Moderate Functioning* *Low Functioning*

2. Has your child been diagnosed with any other disability?

   ____

3. Please can you tick 8 of the daily living tasks that your child may find Difficult.

Daily Living Activities	
Using the toilet	When to put hood up
Washing teeth	Dressing lower body
Hairbrushing	How to fasten trouser button
Nose care	How to pull up zip
Hand washing	How to pull on socks
How to dry hands with a towel	How to take socks off
How to dry hands with hand dryer	How to put on shoes
Washing body and face	How to tie laces on shoes
How to Dress upper body	How to put hand up at school
How to fasten shirt with buttons	When to ask to go to toilet
How to put coat on	How to get a drink of water
	How to ask for help

4. Please can you list any other daily living skill which your child may find difficult

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And supported by:

Office of the Minister for Children and Youth Affairs
Oifig an Aire Leanaí agus Gnóthaí Óige

lyit
Institiúid Teicneolaíochta

Daily living activities

1.
2.
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12

5. Have you used any visual methods for teaching your child daily practical skills?

____

____

6. Can your child use a computer? Has he/she ever used a computer programme to learn a skill?

____

____

Many thanks for filling this short questionnaire out please can your return it this evening once completed.

I sincerely appreciate your help and time with this research project.

Nicola Duffy
Institute of Technology
Letterkenny
Co.Donegal

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lyit
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Appendix D: Focus group theme sheets

Section A. Communication and Learning

1. In general, what are the most **common barriers** you have experienced with communication?
   - What are the **barriers** you find hinder the flow of communication between the child and yourself? (NOISE, ATTENTION, FOCUS, COMPREHENSION)
   - In general if the child is in **unfamiliar surroundings** do you find that this inhibits them?

2. In your experience, when instructing your child to carry out a task, is he or she able to **follow your instruction.** (Are they able to follow your instruction?)

   - What factors do you think **distract** them from understanding the communication of the task?
     For example, when you are showing your child how to do this task, does your **child get distracted from** other noises that may be happing around them? Or is it that your child **does not understand/comprehend** what is being taught and therefore refuses to communicate?

   - Do you feel that there are any **auditory barriers** that distract your child from communicating? Such as environmental noises;
     For example, when there are **various people speaking in a room** and you ask your child to do a task, do you find that he gives equal attention to all auditory noises that are going on around him? **Do they tune out?**

   - In your experience, if the child is unable to understand a task, do they resort to **any behaviours** or **coping strategy**?

   - Are there any other factors **that you think distracts your child in communication?**

3. In your opinion, In terms of learning a daily living skill such as washing teeth or going to the toilet, **what do you feel makes it hard for the child to understand**?
    - For example is it that they understand the steps to carrying out this task?
    - Do they understand the concept?
    - Is there **anything else you feel acts as a barrier** to learning these tasks?
    - What do you feel would **make it easier** for the child to help them understand how to do this?
    - When a task has been learnt**, can they continue doing it** or do they need prompting?

4. In terms of accomplishing a task, is there evidence that the child is pleased?

    - If they do not accomplish a task correctly, is there evidence of disappointment?

5. What do you feel constitutes as a **good teaching method** when teaching your child a task, <u>for example one to one instruction</u> by giving the instruction orally, one to one **with visuals**, modelling the task to be conducted or a **combination of all three?**

    - Do **visual cues** used in instruction increase focussed attention to the task and communication between you and your child.
    - What is the most important thing **you can do to motivate** the child to understand?
    - Do you find that **when you reward a positive behaviour** that your child will repeat this more frequently?
    - Loovas *et al.*(1973) stated that " behaviours that are rewarded tend to be repeated more frequently than behaviours that are ignored and punished" – do you agree with this statement?
    - What **type of reward do you find helpful**? What would the most engaging reward be? For example when they see a familiar toy does this make them happy?

Section 2 - Computers as a learning tool

6. In your opinion, do you feel that using computers is a good way **to motivate** a child to learn?
    - What is it do you feel makes computers appealing or not so appealing? (Engaged by animation? Sounds? Or do this act as a barrier?
    - (For example the ability to stop, start and replay? Animations? Fun Rewards? Audio instruction?)
    - In your opinion, is there anything that you feel will distract your child when using a computer to learning a skill?

7. In your opinion what do you feel would make the computer software I am designing more appealing to autistic children?
    - Do you feel that incorporating a learning strategy such as ABA or discreet trial training would make the design more inclusive?
    - Do you think that backward or forward chaining is a good idea to facilitate learning daily living skills such as using the bathroom?
    - What about other sensory items such as sound or visuals such as colour, how could I make these more appealing to autistic children.

8. When learning from **an international computer program** such as programs created in United States of America, does the unfamiliar accent confuse your child?
    - Do you feel that using computer packages for other countries such as America or United Kingdom can teach your child **new idioms** or can they **foster unusual accents?**
    - Do they pick up idioms that are derived from these packages, such a trashcan instead of bin?

9. Finally, **if you were a designer**, what would you feel would help with the teaching of practical skills is there anything else you feel will help with the teaching of daily skills that I can implement into my package?

Appendix E: List of Special Need Schools

No.	County	Roll No.	Special Pre-School Classes for Children with Autism	No. of Classes	COMMENTS NOTED
1	Cork	04186N	Berings NS	1	Due to open Sept 2009
2	Cork	16159D	Scoil an Chlochair, Mallow, Cork	1	
3	Cork	17600S	Scartleigh NS, Saleen, Cloyne, Co Cork	1	
4	Cork	20162O	Sonas Jnr Special School, Carrigaline, Co Cork	4	
5	Cork	19415K	Scoil an Athar Tadhg, Carrig Na Bhfear, Cork City	1	
6	Donegal	17728V	Woodland NS, Letterkenny, Co Donegal	1	Due to open Sept 2009
7	Dublin	17732M	Scoil Chiarain, Collins Avenue, Donnycarney, D5	2	
8	Dublin	19355S	Ballyowen Meadows, Stillorgan, Co Dublin	2	
9	Dublin	19939V	Good Shepherd NS, Churchtown Road, D14	1	Due to open Sept 2009
10	Dublin	20064O	Our Lady of Consolation NS, Collins Avenue East, Donnycarney, D5	2	
11	Dublin	19578P	St Helen's JNS, Martello, Portmarnock, Co Dublin	1	
12	Dublin	19611K	Scoil Naomh Colmcille, Newbrook Rd, Donaghamede, D13	1	
13	Dublin	19490B	St. Mary's, Ballyboden, D16	2	
14	Dublin	16651H	St. Clares NS, Harolds Cross Road, Dublin 6W	1	
15	Galway	16943U	St Nicholas' NS, The Claddagh, Galway	1	
16	Kerry	17915U	Freastogail Muire Mixed NS, Killahan, Abbeydorney, Tralee, Co Kerry	2	
17	Kildare	00779U	Presentation Girls PS, Maynooth	1	Due to open Sept 2009
18	Kildare	18449W	St Conleth's NS, Derrinturn, Carbury.	1	
19	Monaghan	19162H	Threemilehouse N.S, Threemilehouse	1	
20	Monaghan	19469K	Naomh Oliver Plunkett, Loch Morn, Castleblaney	1	
21	Offaly	20267F	Scoil Bhride NS, Edenderry, Co. Offaly	2	
22	Tipperary	06658P	Kildangan NS, Puckane, Co. Tipperary	1	
23	Tipperary	19230V	Scoil Chormaic Special School, Golden Road, Cashel, Co. Tipperary	2	
24	Tipperary	19615S	Scoil Aonghusa Special School, Cahir Road, Cashel, Co. Tipperary	1	
25	Waterford	19244J	St. Joseph's Special School, Parnell Street, Waterford	1	
23	Waterford	13635R	Ballyduff NS, Kilmeaden, Co. Waterford	1	
24	Westmeath	20188J	Mullingar ETNS	1	Due to open Sept 2009
25	Wicklow	17181B	St Joseph's NS, Templerainey, Co Wicklow	1	Due to open Sept 2009
26	Wicklow	19522L	St Catherine's Special School, Newcastle, Greystones	3	
27	Wicklow	20278K	Newtownmountkennedy, Wicklow	1	Due to open Sept 2009
			Total No of Classes	**42**	

No.	County	Roll No.	Mainstream Schools with Special Classes	No. of Classes	Comments Noted
1	Carlow	17514C	Clonegal NS, Clonegal, Co Carlow	1	
2	Carlow	20295K	Carlow Educate Together NS, Unit 5 Shamrock Business Park, Graiguecullen, Carlow	1	
3	Cavan	17625L	Knocktemple N.S., Virginia, Co Cavan	1	
4	Clare	14622N	St Flannan's, Inagh, Ennis, Co Clare	2	
5	Clare	17563P	Ogonnolloe NS, Tuamgraney, Scariff, Co Clare	1	
6	Clare	18739I	St Senan's NS, Corrib Drive, Shannon, Co Clare	1	Due to open in September 2009
7	Clare	20041C	St Senan's Primary School, Convent of Mercy, Kilrush, Co Clare	1	
8	Clare	17801F	Scoil Na Maighdine Muire, Broadford, Co Clare	1	
9	Cork	04186N	S N Bhiorainn, Berrings, Co Cork	1	
10	Cork	12015F	Liscarroll N.S., Mallow	1	
11	Cork	13450F	Rushbrooke Convent Mercy NS, Rushbrooke, Cobh, Co Cork	2	
12	Cork	17600S	Scartleigh NS, Saleen, Cloyne, Co Cork	3	
13	Cork	13747F	Riverstown NS, Glanmire, Co Cork	1	
14	Cork	14000C	St Marie's of the Isle NS, Sharman Crawford Street, Cork	1	
15	Cork	16901E	Scoil Padraig Naofa, Skibbereen, Co Cork	2	
16	Cork	17868O	Presentation PS, Fermoy, Co Cork	2	2nd Class opening September 2009
17	Cork	15597W	St Colman's BNS, Macroom, Co Cork	3	
18	Cork	18217B	Scoil Padre Pio, Churchfield, Cork City	2	
19	Cork	18279A	St Mary's Church of Ireland NS, Waterpark, Carrigaline, Co. Cork (Carrigaline 3 NS)	2	
20	Cork	13828F	Douglas BNS, Douglas, Co Cork	3	
21	Cork	18377A	Scoil Iosef Naofa, Fermoy	1	
22	Cork	19415K	Scoil an Athar Tadhg, Carrig Na Bhfear, Cork City	2	2nd class from 27/3/09
23	Donegal	11843O	SN Neill Mor, Killybegs	1	
24	Donegal	16242N	St Patrick's NS	1	
25	Donegal	19333I	Dooish NS, Ballybofey, Co Donegal	1	
26	Donegal	19553W	St. Crona's NS, Dungloe, Co Donegal	1	
27	Donegal	19963S	Scoil Aodh Rua agus Nuala, Donegal Town, Co Donegal	1	
28	Donegal	19967D	Scoil Íosagáin, Buncrana, Co Donegal	3	
29	Donegal	17728V	Woodland NS, Letterkenny, Co. Donegal	2	
30	Dublin	20131D	Dublin 7 Educate Together NS, Cabra	1	
31	Dublin	17355I	Our Lady of Good Counsel Girls / Muire na Dea Comhairle G, Mourne Road, Drimnagh, D12	2	
32	Dublin	17732M	Scoil Chiarain, Donnycarney, D5	3	
33	Dublin	19314E	Scoil na Maighdine Mhuire B, Ballinteer, D16	2	
34	Dublin	19535U	St Cronan's Senior NS, Brackenstown, Swords	1	
35	Dublin	19456B	St Cronan's, Brackenstown, Swords	2	Due to open Sept 09
36	Dublin	19577N	Scoil Iosa, Tymon North, Tallaght, D24	1	Due to open September 2009
37	Dublin	19578P	St Helen's JNS, Portmarnock, Co Dublin	2	
38	Dublin	19929S	St Brigids Senior Girls, Finglas West, D11	2	
39	Dublin	20066S	Lucan Educate Together, Lucan, Co Dublin	2	
40	Dublin	20064O	Our Lady Of Consolation NS, Collins Avenue East, Donnycarney, D5	4	
41	Dublin	20098I	Castleknock Educate Together NS, Beechpark, Castleknock, Dublin 15	2	
42	Dublin	20168D	Glasnevin Educate Together, (Formerly Dublin North Central Educate Together), Glasnevin, D11	1	
43	Galway	20000L	Galway Educate Together NS, Thomas Hynes Road, Galway	1	
44	Galway	16943U	Scoil Nioclas Naofa, The Claddagh, Galway	2	
45	Galway	20042E	Scoil an Chroi Naofa, Ballinasloe	1	
46	Galway	17444H	Carrabane NS, Galway City	1	
47	Galway	17613E	Scoil Chaitríona Naofa, Aughrim, Ballinasloe, Co. Galway	1	
48	Galway	17845C	Soil Mhuire, Briarhill, Galway	1	
49	Galway	17282H	St. Patricks's N.S., Tuam, Co. Galway	1	
50	Kerry	06227L	Scoil Mhaocheadair Baile na nGall, Tralee, Co Kerry	2	
51	Kerry	17710C	Scoil an Chuileannaigh, Killarney, Co Kerry	2	
52	Kerry	13615L	Scoil Eoin Balloonagh, Tralee, Co Kerry	2	
53	Kerry	18832V	Castlemaine N.S.	1	
54	Kildare	20114D	Scoil Brid, Oldtown, Naas, Co Kildare	2	
55	Kildare	18515J	Scoil an Linbh Iosa, Prosperous, Naas, Co Kildare	2	
56	Kildare	19459H	Leixlip GNS, Leixlip, Co Kildare	2	
57	Kildare	19675N	Scoil Bhride, Kilcullen, Co Kildare	2	
58	Kildare	18288B	Scoil Mhichil Naofa, Athy, Co Kildare	5	
59	Kildare	19995I	North Kildare Educate Together, Clane Road, Celbridge	2	
60	Kildare	18093J	Clogherinkoe NS, Moyvalley, Co Kildare	2	
61	Kildare	20271T	Scoil Na Naomh Uilig NS, Newbridge	1	
62	Kilkenny	00788V	Lisdowney NS, Ballyragget, Co. Kilkenny	1	
63	Kilkenny	18660S	St Nicholas NS, Windgap, Co Kilkenny	1	
64	Kilkenny	19626A	St Canice's Co-Ed NS, Granges Road, Kilkenny	1	
65	Kilkenny	15160G	Marymount N.S., The Rower, Via Thomastown, Klikenny	1	
66	Laois	19750B	Scoil Mhuire, Abbeyleix, Co Laois	2	Due to open Sept 09

67	Laois	13741Q	Rath NS, Ballybritas, Co Laois	1	
68	Leitrim	19423J	Drumshanbo Central NS	1	New class to open Sept 09
69	Longford	19279F	Scoil Naomh Treasa, Clontumpher, Ballinalee	2	
70	Longford	20124G	St. Marys NS, Edgeworthstown, Co. Longford	1	
71	Louth	14207B	Scoil Mhuire gan Smal, Kilsaran, Co Louth	2	
72	Louth	18107R	Scoil Realt na Mara, Dundalk, Co Louth	1	
73	Mayo	18754E	Bunacurry NS, Achill, Co. Mayo	1	
74	Mayo	19451O	Holy Family NS, Newport, Co Mayo	1	
75	Mayo	19951L	Swinford NS, Swinford, Co Mayo	1	
76	Mayo	19812U	Foxford NS, Foxford, Co Mayo	1	
77	Mayo	20125I	Crossmolina NS, Crossmolina, Co Mayo	1	
78	Meath	17623H	O'Growney NS, Athboy, Co Meath	1	
79	Meath	19671F	St Paul's NS, Abbeylands, Navan, Co Meath	1	
80	Meath	20032B	Dunboyne JNS, Dunboyne, Co Meath	1	
81	Meath	05630L	St Michael's BNS, Trim, Co Meath	4	
82	Meath	17969U	Scoil Mhuire, Navan, Co Meath	2	
83	Monaghan	19162H	Threemilehouse N.S, Threemilehouse	1	
84	Monaghan	19469K	Naomh Oliver Plunkett, Lough Morn, Castleblaney	2	
85	Offaly	20267F	Scoil Bhride, Edenderry, Co Offaly	1	
86	Offaly	15656M	Ballinamere NS, Tullamore, Co Offaly	2	
87	Roscommon	12754U	Summerhill NS, Athlone, Co Roscommon	1	
88	Roscommon	18571T	Knockcroghery N.S.	1	
89	Sligo	19985F	Our Lady of Mercy School, Sligo	2	
90	Tipperary	17523D	Dromakeenan NS, Roscrea	1	
91	Tipperary	06658P	Kildangan NS, Puckane, Nenagh, Co Tipperary	1	
92	Tipperary	09190G	Boher NS Ballina Kilaloe Co Tipperary	2	
93	Tipperary	15299O	Gaile NS, Holycross, Thurles	1	
94	Tipperary	16077B	Ardfinnan NS, Clonmel, Co. Tipperary	1	
95	Tipperary	16166A	Carrig N.S., Carrig, Birr, Co. Offaly	1	
96	Waterford	13635R	Ballyfduff NS, Kilmeaden, Co Waterford	2	
97	Waterford	17351A	St Mary's NS, Ballygunner, Co Waterford	2	
98	Westmeath	18212O	Presentation School, Mullingar, Co Westmeath	1	
99	Westmeath	16304J	St Joseph's NS, Milltownpass, Co Westmeath	1	
100	Wexford	16605A	Kilrane NS, Rosslare Harbour, Co Wexford	2	
101	Wexford	16673R	Cushenstown N.S.,	1	
102	Wexford	08221J	St Senan's PS, Enniscorthy, Co Wexford	3	
103	Wexford	19739N	Scoil Mhuire, Coolcotts, Co Wexford	3	
104	Wexford	20214H	Gorey Educate Together School, St Walerans, Ballytegan Road, Gorey	1	
105	Wicklow	17181B	St Joseph's NS, Templerainey, Co Wicklow	2	
106	Wicklow	20278K	Newtownmountkennedy Primary School, Newtownmountkennedy, Co. Wicklow	2	
107	Wicklow	20178G	Wicklow Educate Together, Wicklow Town	1	
108	Wicklow	13224T	Ballintemple NS, Avoca, Co Wicklow	1	
109	Wicklow	19754J	Bray School Project, Bray, Co. Wicklow	1	
			Total No of Classes	**171.0**	

No.	County	Roll No.	Special Schools with Special Classes	No. of Classes
1	Carlow	19315G	St. Laserians Special School, Carlow	2
2	Cavan	19439B	Holy Family, Cootehill, Co Cavan	4
3	Clare	19414I	St Anne's Special School, Ennis, Co Clare	3
4	Clare	19233E	St Clare's Special School, Ennis, Co Clare	5
5	Cork	19433M	Holy Family, Charleville, Co Cork	3
6	Cork	20074R	St Gabriel's, Curraheen Road, Cork	1
7	Cork	19760E	Scoil Triest, Lota, Glanmire, Cork	9
8	Cork	20331L	Cork Cabas School	
9	Donegal	19592J	St Bernadette's, Letterkenny, Co Donegal	2
10	Donegal	19724A	Little Angels, Letterkenny, Co Donegal	3
11	Dublin	17971H	Holy Angels, Glenmaron, Chapelizod, D20	1
12	Dublin	18569J	St Declans Special School, Ballsbridge, Dublin 4	3
13	Dublin	18671A	St Michael's House, 17 Grosvenor Road, Rathgar, D6	1
14	Dublin	18763F	St. Michael's House,Ballymun Rd., Dublin 9	3
15	Dublin	19039I	St Vincent's Home NS, Navan Road, D7	1
16	Dublin	19355S	Ballyowen Meadows, Stillorgan, Co Dublin	6
17	Dublin	20028K	Setanta, Stillorgan, Co Dublin	6
18	Dublin	20279M	St Michael's House Sp School, Briarfield Villas, Kilbarrack, D 5	5
19	Galway	20070J	Rosedale School	1
20	Galway	19047H	St Joseph's, Newcastle, Co Galway	2
21	Kerry	19376D	St Ita's & St Joseph's	1
22	Kerry	19548G	Nano Nagle, Listowel, Co Kerry	2
23	Kerry	19547E	St Francis Special School, Beaufort, Co Kerry	2
24	Kildare	19455W	St Mark's Special School, Newbridge, Co Kildare	1
25	Kildare	19277B	St Anne's Special School, The Curragh, Co Kildare	2
26	Kildare	18988G	St Raphael's School, Celbridge, Co Kildare	3
27	Kilkenny	19523N	School of the Holy Spirit, Gaol Road, Kilkenny	1
28	Kilkenny	19383A	St Patrick's Special School	2
29	Laois	20100P	Kolbe Special School, Block Road, Portlaoise, Co. Laois	1
30	Limerick	18692I	Catherine McAuley SNS, Ashbourne Ave, Sth Circular Rd, Limerick	2
31	Limerick	19200M	St Vincent's Special School, Lisnagry, Co Limerick	2
32	Limerick	20311F	Red Hill School, Patrickswell Rd., Limerick	3
33	Longford	19429V	St Christopher's SS, Battery Road, Longford	1
34	Louth	18936K	St Ita's Special School, Crushrod Avenue, Drogheda	2
35	Louth	19214A	St Mary's Special School, Drumcar, Co Louth	1
36	Mayo	19375B	St Brid's, Castlebar, Co Mayo	3
37	Mayo	19773N	St Nicholas', Ballina, Co Mayo	1
38	Meath	19560T	St Mary's Special School, Johnstown, Co Meath	2
39	Roscommon	19789F	St Michael's Special School, Castlerea, Co Roscommon	3
40	Sligo	19206B	St Cecilia's School, Cregg House, Sligo	1
41	Tipperary	19230V	Scoil Chormaic, Cashel, Co Tipperary	8
42	Tipperary	19370O	St Anne's, Roscrea, Co Tipperary	3
43	Tipperary	19615S	Scoil Aonghusa, Cashel, Co Tipperary	2
44	Waterford	19244J	St Joseph's Special School, Waterford	2
45	Waterford	19108B	St Martin's Special School, Waterford	2
46	Wexford	19240B	St Patrick's Special School, Enniscorthy	1
47	Wicklow	19522L	St Catherine's, Newcastle, Co Wicklow	1
			Total	**116**

Schools with classes for pupils with Aspergers syndrome.

No.	County	Roll No.		No. of Classes
1	Dublin	18726W	SN Seosamh Na Mbrathar, Fairview, Dublin 3	2
2	Dublin	19158Q	St Peter's BNS, Greenhills, Dublin 12	2
3	Wexford	20003R	St Aidan's PS, Enniscorthy, Co Wexford	1
			Total No of Classes	**5**

No.	County	Roll No.	2nd level Mainstream Schools with Special Classes	No. of Classes	Comments Noted
1	Clare	62020F	St. Joseph's , Tulla, Ennis	1	
2	Cork	62540I	Deerpark CBS	1	
3	Cork	62420V	Christian Brothers Secondary School, Mitchelstown	1	
4	Cork	62061T	Colaiste na Toirbhirte, Bandon	1	
5	Cork	71110H	Nagle Community College, Mahon, Blackrock	1	
6	Donegal	71240U	Vocational School Stranorlar	1	
7	Donegal	71140Q	Crana College, Buncrana	1	
8	Dublin	70180A	Colaiste Eoin, Cappagh Rd., Finglas, Dublin 11	1	
9	Dublin	60390F	St.Joseph's CBS, Merville Ave., Fairview, D3	1	
10	Dublin	60471F	St Davids CBS Artane, D5	1	
11	Galway	71330V	Colaiste na Coiribe, Galway City.	1	
12	Galway	62970K	Colaiste Ioghaid, Galway City	1	
13	Galway	62880J	Garbally College, Ballinasloe, Galway	1	
14	Kildare	91371B	Colaiste Chiarain, Leixlip	1	
15	Kildare	61661P	Salesian Secondary School, Celbridge	1	
16	Kildare	70720G	St. Farnans VEC, Prosperous, Naas	1	
17	Kildare	70710D	St. Patricks, Community College, Naas	1	
18	Kilkenny	70570N	Scoil Aireagail, Kilkenny	1	
19	Laois		Portlaoise Vocational School	1	
20	Leitrim		Mohill Community College	1	Opening Sept 09
21	Louth	91441T	Ardee Community College	1	
22	Mayo	64690O	Scoil Mhuire agus Padraig, Swinford	1	
23	Mayo	72050U	St. Brendans, Belmullet	1	
24	Meath	91508C	Boyne Community School ,Trim	1	
25	Meath	71980O	O'Carolan College	1	
26	Meath	76088T	Ratoath College	2	
27	Monaghan	72171J	Largy College, Clones	1	
28	Offaly	91515W	Gallen Community School, Ferbane	1	
29	Sligo	65170Q	Summerhill College, Sligo	1	
30	Sligo	65181V	Mercy College, Sligp	1	
31	Tipperary	91497A	Cashel Community School	2	
32	Waterford	72230W	St. Declans, Community College, Kilmacthomas	1	
33	Waterford	91509E	Blackwater Community School, Lismore	1	
34	Waterford	72241E	St. Pauls Community College, Waterford	1	
35	Wexford	63640R	CBS, Post Primary, Wexford	1	
36	Wexford		Bridgetown Vocational College	1	Opening Sept 09
37	Wexford	91492N	Gorey Community School	1	Opening Sept 09
38	Wicklow	76076M	Colaiste Chroabh Abhann, Kilcoole,	1	
				40	

Appendix F: Questionnaire sent to teachers

Dear Teacher,

For the purpose of completing this questionnaire, please choose at random, just **one** moderately autistic child who is between the age of 5 and 9 years. This questionnaire should take no longer than 15 minutes to complete.

I would be most grateful if you could return this questionnaire no later than the **23rd March 2010**; a stamped addressed envelope is enclosed for ease of return.

I understand how much you must be burdened with questionnaires but your cooperation in completing this questionnaire will benefit teachers and children with moderate autism and will further the development of educational computer programs for all autistic children. Your time is greatly appreciated.

All responses to this questionnaire will be treated **with the strictest of confidentiality.** Should you have any queries please do not hesitate to contact me on 086–3222 082 or email nicola.duffy@lyit.ie.

Background Information

01) What age is the child?

☐ 5 yrs ☐ 6 yrs ☐ 7 yrs ☐ 8 yrs ☐ 9yrs

02) What is the child's gender?

☐ Male
☐ Female

03) In which county is your School?

Co.___________________________

04) Is your School?

☐ Mainstream school **with** autistic unit
☐ Mainstream school **without** autistic unit
☐ Special needs school
☐ Other (Please specify) ____

05) Has the child any other related diagnosis?

☐ Dyslexia ☐ ADHD ☐ Other (Please Specify) _________________________________ ☐ None

Section 1 Daily living skills

01) How much **difficulty** (if any) does the child have at carrying out these tasks?

[*Please rate difficulty on a scale of 1-5]*

		No Difficulty **1**	**2**	**3**	**4**	Great Difficulty **5**
i.	Putting on clothes	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
ii.	Setting table	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
iii.	Using knife	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
iv.	Using fork	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
v.	Using spoon	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
vi.	Pouring a drink	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
vii.	Using the toilet	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
viii.	Washing hands	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
ix.	Washing face	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
x.	Brushing teeth	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

02) In Question **01) i.** above **('putting on clothes'),** if you rated difficulty as 2, 3, 4 or 5, **Please rate** the difficulty the child has with the following items: [*Please rate difficulty on a scale of 1-5 for appropriate item]*

	No Difficulty				Great Difficulty
Putting on a top	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Putting on trousers	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Putting on dress	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Putting on socks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Putting on undergarments	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Tying laces on shoes	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Putting on coat	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Using a zip	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

03) Please specify any other daily living skills (if any) that the child finds difficult:

(Please specify)____ ☐ None

____

Section 2 Computer programs used at school

01) Has the child used interactive programs on any of the following devices that you are aware of?

[Please tick all that apply]

☐ Personal computer ☐ Other mobile phone

☐ iPhone ☐ Other (Please Specify) ______________________________

[If none of these apply go to Q.9]

02) Taking what **you consider to be the most effective program,** please indicate what the program aimed to achieve. *[Please tick all that apply]*

☐ Educational development
☐ Social skills
☐ Daily living skills
☐ Communicative skills
☐ Entertainment (for example, gaming)
☐ Other (Please Specify) ______________________________

03) What is the name of the program that **you consider to be the most effective?**

(Please specify)______________________________

☐ Don't know

04) Was this program **specifically** designed for children on the autistic spectrum? *[Please specify]*

☐ Yes
☐ No
☐ Don't know

05) If a voice was used on the program, what was **the accent** of the voice? *[If more than one accent was used, please tick all that apply.]*

☐ American
☐ British
☐ Irish
☐ Other (Please Specify)______________________________
☐ N/A *[If you marked N/A go to Q.7]*

06) Has the child copied any accents that were used on the program? *[Please specify]*

☐ Yes ☐ No ☐ Don't know

07) Do you believe that using a local accent in a computer program would be of benefit to the child? *[Please specify]*

☐ Yes ☐ No ☐ Don't Know

If you answered **Yes,** Please explain the reason why.

____

____

08) **(A)** Which of the following were **features** of the program?

(B) For each of the features ticked**, please indicate if they were not helpful or unhelpful** to the child.

(A)	Please tick all that apply	**(B)** Helpful	Unhelpful
a. Navigation in the form of buttons	☐	☐	☐
b. Navigation in the form of words	☐	☐	☐
c. Familiar cartoon characters	☐	☐	☐
d. A stop button to stop animations	☐	☐	☐
e. A quiz	☐	☐	☐
f. Multiple choices on quiz	☐	☐	☐
g. Indication of correct answers	☐	☐	☐
h. Indication of incorrect answers	☐	☐	☐

09) If you were re-designing this program for autistic children what changes would you make to it?

Please specify

10) Does the child have access to a computer at school?

☐ Yes ☐ No *[If you ticked No go to Section3]*

11) How many hours approximately has the child spent on the computer in the last full week at school?

☐ < 1hr ☐ 1 – 2 hrs ☐ 3 – 4 hrs ☐ 5 – 6 hrs ☐ 7 – 8 hrs ☐ > 9 + hrs

12) Taking the most recent occasion that the child has used the computer at school, did the child work: *[please tick]*

- ☐ Completely alone
- ☐ With assistance
- ☐ A combination of working alone & with assistance

13) How does the child operate the computer most often? *[Tick one only]*

☐ The mouse only	☐ The keyboard only
☐ Touch screen	☐ Mouse and keyboard
☐ Mouse and arrow keys	☐ Other (Please Specify) ______________________

Section 3 Interactive computer programs for autistic children

01) In relation to the **attention span** of the child when he/she is using a computer program, please indicate the extent of your **agreement or disagreement** with the following statements: *[please tick]*

	Strongly Agree 1	Somewhat Agree 2	Neither Agree nor Disagree 3	Somewhat Disagree 4	Strongly Disagree 5	N/A
The child can easily get absorbed in one area of the computer program.						
The child can lose sight of the purpose of the whole program.						

02) There are features on a computer program that may distract the autistic child. Please rate each of the following in terms of how **distracting** they are to the autistic child you have selected.

[Please rate all that apply]

	Not Distracting **1**	**2**	**3**	**4**	Greatly Distracting **5**
Too many pictures	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Moving images	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Bright colours	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Dark colours	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Background music	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Other sounds	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

03) Please rate each of the following in terms of **how motivating** they are to the autistic child you have selected.

[Please rate on a scale of 1-5]

	Motivating				Demotivating
	1	**2**	**3**	**4**	**5**
Rewards	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Feedback	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Choices	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

04) There are various ways that instruction can be presented effectively on a computer program. Please indicate the extent of your agreement or disagreement with the following statements.

[Please tick from 1-5 for each of the statements below]

	Strongly Agree 1	Somewhat Agree 2	Neither Agree or Disagree 3	Somewhat Disagree 4	Strongly Disagree 5
Instructions are effective when presented with **text alone.**					
Instructions are effective when presented with **cartoon animations.**					
Instructions are effective when presented with **vocal narration**.					
Instructions are effective when presented with **text, vocal narration & animation.**					
Instructions are effective when presented as **rhymes or songs**.					

05) What are the child's current interests? *[Please tick all that apply]*.

☐ Numbers ☐ Cars ☐ Sport ___________________*(please specify)*

☐ Art ☐ Memorising songs

☐ Lining up objects ☐ Playing computer games

☐ Trains ☐ Building things

Any Other (Please Specify)____

____

06) What are the child's current strengths? *[Please tick all that apply]*.

- ☐ Understanding concepts
- ☐ Memorising material
- ☐ Thinking visually
- ☐ Good long-term memory
- ☐ Perfectionism in conducting tasks
- ☐ Scheduling
- ☐ Focusing
- ☐ Good attention to detail

Any Other (Please Specify)____

____

07) What is the primary way in which the child communicates? *[Please tick one only]*.

- ☐ Wordbook
- ☐ Picture book
- ☐ Keyboard devices
- ☐ Normal speech
- ☐ A combination (Please specify)______________________________
- ☐ Other

Thank you for completing this questionnaire. Your contribution is greatly appreciated. All information provided will be treated in the strictest of confidence and will not be shared with any other party.

*Please fill out the following to receive **a free copy** of the prototype program and a summary of the findings from this questionnaire.

Name of School: ____

Email Address: ____

Email will **not be used** for any other purpose.

Appendix G: On-line Questionnaire sent to parents

Autism and Education

Introduction

I would like to thank you for agreeing to partake in this research.

This academic research is funded by the Office of the Minister for Children and the National Children's Strategy and will lead to the development of an interactive computer program, which will help moderately autistic children to learn daily living skills. This will be a valuable educational tool that can support the daily routine of your child, which can be used at home and at school.

The main objectives of this survey are to:
• To determine the essential daily living skills that autistic children find most difficult to understand and conduct.
• To gain a perspective on current educational programs used to teach skills to autistic children.
• To determine which (if any) elements on these programs distract or help the child to learn.

Your contribution will be invaluable and will greatly help in the development of an Irish-designed educational program that can be used at home and at school.

This survey should take no more than 10-12 minutes.
* If you have two children on the spectrum, please choose just one child to fill out this survey, thank you.

If you would like to receive a free copy of the prototype software Please email: Nicola.Duffy@lyit.ie
a link will be sent to you on completion of this research.

Many thanks
Nicola Duffy BA(Hons) PGdip

What age is your Child?

- ◯ 5 yrs
- ◯ 6 yrs
- ◯ 7 yrs
- ◯ 8 yrs
- ◯ 9 yrs
- ◯ 9+yrs

Is your child:

- ◯ Male
- ◯ Female

At What level on the autistic spectrum has your child been diagnosed?

- ◯ Low functioning autism
- ◯ Moderately functioning autism
- ◯ High functioning autism
- ◯ Other (please specify)

Autism and Education

Background Information

In which COUNTY do you live?

[Please type in the box below]

Autism and Education

Background Information

Does your child attend:

- ◯ Mainstream school with autistic unit
- ◯ Mainstream school without autistic unit
- ◯ Special needs school
- ◯ Other (please specify)

Background Information

Has your child any other related diagnosis?

[Please specify]

- ◯ Dyslexia
- ◯ ADHD
- ◯ Learning difficulties
- ◯ No Other
- ◯ Other (please specify)

Daily living skills

How much difficulty (if any) does your child have at carrying out these tasks?

[Please rate difficulty on a scale of 1-5]

1= No Difficulty
5= Great Difficulty

	1	2	3	4	5
Putting on clothes	◯	◯	◯	◯	◯
Setting table	◯	◯	◯	◯	◯
Using a knife	◯	◯	◯	◯	◯
Using a fork	◯	◯	◯	◯	◯
Using a spoon	◯	◯	◯	◯	◯
Pouring a drink	◯	◯	◯	◯	◯
Using the toilet	◯	◯	◯	◯	◯
Washing hands	◯	◯	◯	◯	◯
Washing face	◯	◯	◯	◯	◯
Brushing teeth	◯	◯	◯	◯	◯

Daily living skills

In the previous question titled 'putting on clothes', if you rated difficulty as 2, 3, 4 or 5. Please rate the difficulty your child has with the following items:

[Please rate difficulty on a scale of 1-5 for appropriate item]

1= No Difficulty
5= Great Difficulty

	1	2	3	4	5	N/A
Putting on a top	◯	◯	◯	◯	◯	◯
Putting on trousers	◯	◯	◯	◯	◯	◯
Putting on dress	◯	◯	◯	◯	◯	◯
Putting on socks	◯	◯	◯	◯	◯	◯
Putting on undergarments	◯	◯	◯	◯	◯	◯
Tying laces on shoes	◯	◯	◯	◯	◯	◯
Putting on coat	◯	◯	◯	◯	◯	◯
Using a zip	◯	◯	◯	◯	◯	◯

Daily living skills

Please specify any other daily living skills (if any) that the child finds difficult:
(for example: pouring a drink or asking to go to the toilet)

[Please specify in the box below]

Autism and Education

Computer programs used at home

Has your child used interactive programs on any of the following devices that you are aware of?

[Please tick all that apply]

- [ ] No
- [ ] Personal computer
- [ ] iPhone
- [ ] Other mobile phone
- [ ] Other (please specify)

Autism and Education

Computer programs used at home

Taking what you consider to be the most effective program, please indicate what the program aimed to achieve.

[Please tick all that apply]

- ☐ Educational development
- ☐ Social skills
- ☐ Daily living skills
- ☐ Communicative skills
- ☐ Entertainment (for example, gaming)
- ☐ Other (please specify)

computer programs used at home

What is the name of the program that you consider to be the most effective?

[Please specify]

- ◯ Don't know
- ◯ Please specify

Computer programs used at home

Was this program specifically designed for children on the autistic spectrum?

[Please specify]

- ◯ Yes
- ◯ No
- ◯ Don't know

Computer programs used at home

If a voice was used on the program, what was the accent of the voice?

[If more than one accent was used, please tick all that apply.]

- [ ] American
- [ ] British
- [ ] Irish
- [ ] N/A
- [ ] Other (please specify)

computer programs used at home

Has the child copied any accents that were used on the program?

[Please specify]

- ◯ Yes
- ◯ No
- ◯ Don't know

computer programs used at home

Which of the following were features of the program?

[Please tick all that apply]

- ☐ Navigation in the form of buttons
- ☐ Navigation in the form of words
- ☐ Familiar cartoon characters
- ☐ A stop button to stop animations
- ☐ A quiz
- ☐ Multiple choices on quiz
- ☐ Indication of correct answers
- ☐ Indication of incorrect answers

Computer programs used at home

For each of the features ticked, please indicate if they were HELPFUL or UNHELPFUL to the child.

	Helpful	Unhelpful	N/A
Navigation in the form of buttons	○	○	○
Navigation in the form of words	○	○	○
Familiar cartoon characters	○	○	○
A stop button to stop animations	○	○	○
A quiz	○	○	○
Multiple choices on quiz	○	○	○
Indication of correct answers	○	○	○
Indication of incorrect answers	○	○	○

Computer programs used at home

Do you believe that using a familiar local accent in a computer program would be of benefit to the child?

[Please specify]

- ◯ Yes
- ◯ No

If you Answered YES, Please explain the reason why.

Computer programs used at home

If you were re-designing a computer program for children with autism what changes would you make to it?

Computer programs used at home

Does the child have access to a computer at home?

- ◯ Yes
- ◯ No

computer programs used at home

How many hours approximately has your child spent on the computer in the last week?

- ◯ < 1hr
- ◯ 1-2hrs
- ◯ 3-4hrs
- ◯ 5-6hrs
- ◯ 7-8hrs
- ◯ > 9+hrs

Computer programs used at home

Taking the most recent occasion that the child has used the computer at Home, did your child work:

[please tick]

- ◯ Completely alone
- ◯ With assistance
- ◯ A combination of working alone & with assistance

How does your child operate the computer most often?

[Tick one only]

- ◯ The mouse only
- ◯ The keyboard only
- ◯ Touch screen
- ◯ Mouse and keyboard
- ◯ Mouse and arrow keys
- ◯ Other (please specify)

Interactive computer programs for autistic children

In relation to the attention span of your child when he/she is using a computer program,

please indicate the extent of your AGREEMENT or DISAGREEMENT with the following statements:

	Strongly Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Strongly Disagree	N/A
The child can easily get absorbed in one area of the computer program.	◯	◯	◯	◯	◯	◯
The child can lose sight of the purpose of the whole program.	◯	◯	◯	◯	◯	◯

Interactive computer programs for autistic children

There are features on a computer program that may distract a child with autism.

Please rate each of the following in terms of how distracting they are to your child.
[Please rate all that apply]

1=Not Distracting
5=Distracting

	1	2	3	4	5
Too many pictures	○	○	○	○	○
Moving images	○	○	○	○	○
Bright colours	○	○	○	○	○
Dark colours	○	○	○	○	○
Background music	○	○	○	○	○
Other sounds	○	○	○	○	○

Interactive computer programs for autistic children

Please rate each of the following in terms of how motivating they are to the autistic child you have selected.
[Please rate on a scale of 1-5]

1= Motivating
5= Demotivating

	1	2	3	4	5
Rewards	◯	◯	◯	◯	◯
Feedback	◯	◯	◯	◯	◯
Choices	◯	◯	◯	◯	◯

Interactive computer programs for autistic children

There are various ways that instruction can be presented effectively on a computer program.

Please indicate the extent of your agreement or disagreement with the following statements.

[Please tick from 1-5 for each of the statements below]

	Strongly Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Strongly Disagree
Instructions are effective when presented with TEXT ALONE.	○	○	○	○	○
Instructions are effective when presented with CARTOON ANIMATIONS.	○	○	○	○	○
Instructions are effective when presented with VOCAL NARRATION	○	○	○	○	○
Instructions are effective when presented with TEXT, VOCAL NARRATION & ANIMATIONS.	○	○	○	○	○
Instructions are effective when presented as RHYMES OR SONGS.	○	○	○	○	○

Interactive computer programs for autistic children

What are your child's current interests? [Please tick all that apply].

- [ ] Numbers
- [ ] Cars
- [ ] Sport
- [ ] Art
- [ ] Memorising songs
- [ ] Lining up objects
- [ ] Playing computer games
- [ ] Trains
- [ ] Building things

Other (please specify)

Interactive computer programs for autistic children

What are your child's current strengths? [Please tick all that apply].

- [ ] Understanding concepts
- [ ] Perfectionism in conducting tasks
- [ ] Memorising material
- [ ] Scheduling
- [ ] Thinking visually
- [ ] Focusing
- [ ] Good long-term memory
- [ ] Good attention to detail

Any Other (please specify)

Interactive computer programs for autistic children

What is the primary way in which your child communicates?

[Please tick one only].

- ○ Wordbook
- ○ Normal speech
- ○ Picture book
- ○ Keyboard devices
- ○ A combination (Please specify in box below)

Appendix H: Iterations made to Questionnaire

Questionnaire Version 1

Iterations proposed by Supervisors – Billy Bennett and Patrick Campbell

Date: 22nd January 2010

Summary of iterations in version 1

The overall structure of the questionnaire was divided into three sections for clarity of use. Each of the three objectives of this questionnaire has been aligned with each of the three sections. The first section's titled was changed to 'Determining daily living skills.' The second section was entitled 'Attitudes relating to computer programs used' and the third 'to determine design requirements'. Background information, such as the age of the child, underlying diagnoses and level on spectrum would be elicited in the first page of the questionnaire. Demographic information would be deduced on the final page of the questionnaire. Changes to the wording of questions were made in each section to facilitate ease of reading and clarity.

Questionnaire Version 2

Iterations proposed by Supervisors – Billy Bennett and Patrick Campbell

Date: 2nd February 2010

Summary of iterations in version 2

The main changes to each section were rewording and layout of questions to ensure clarity and ease of filling out the questionnaire. For example, in question 3 on the first page, to assist the respondent in filling out questionnaire, it was deemed useful to place boxes for the respondent to tick.

It was decided to restructure the questionnaires sections; section 1 would now be entitled ‘Daily living skills’, the second ‘Attitudes relating to computer software used’ and the third ‘Interactive computer programs for children with autism’

Questionnaire Version 3 and 4

Iterations proposed by Supervisors – Billy Bennett and Patrick Campbell

Date: 12th and 27th February 2010

Summary of iterations in version 3 and 4

The structure of the sections were changed to section 1 now entitled ‘ Daily living skills’, section 2 as computer programs used as school/home (depending on who the questionnaire was sent to) and the final section as interactive computer programs for autistic children.

On the first page, background information, a new question was inserted to elicit what type of school the child attended. The question relating to to the child’s level on the spectrum was omitted for the questionnaire going to schools as a letter accompanying the questionnaire would specifically ask that the respondent should pick a moderately autistic child when completing it.

Information regarding what relationship the respondent was to the child and if the respondent was over the age of 18 was omitted as this information was deemed unnecessary.

The order of daily living skills in section 1 (daily living skills) were changed to run in a logical sequence, for example, 'brushing your teeth comes before putting on your clothes.' In addition, boxes were added to this question as it was deemed easier for the respondent to tick rather than circle an answer. Question one; 'daily living skills' was separated into two questions to elicit more information, it was decided to elaborate on the question 'putting on clothes' as this was deemed by parents and teachers during the focus group discussions a very difficult task to conduct. Therefore if the respondent ticked that their child found it difficult to put on clothes, they were then prompted to elaborate on which item of clothes they found most difficult to conduct.

In the second section entitled 'computer programs used at school/home', it was considered that question one was not very well defined and lacked clarity. It was therefore advised to ask the respondents to identify what software they used for their children in terms of what it aimed to achieve, for example respondents were asked to tick if the software was for communication or educational purposes.

Questions 3 through to 16 were changed in a logical structure and most were reworded to ensure clarity.

Question 9 in the second section was designed to be an open-ended question asking the respondents what they would include in computer software for a child with autism. Although open-ended questions are difficult to quantify, it was decided in this instance to keep the question open-ended, as as this would would elicit some very important information.

The main changes in the final section included formatting tables and highlighting important words in each question to make it easier for the respondents to complete the questionnaire.

Finally a box was added at the end of the questionnaire asking schools/parents to fill out the name of their school/or their name and their email address if they wished to receive a link to the software and a copy of the findings.

Appendix I: List of primary schools that have children with autism enrolled

No.	County	Roll No.	Mainstream Schools with Autism classes attached
1	Carlow	17514C	Clonegal NS, Clonegal, Co Carlow
2	Carlow	20295K	Carlow Educate Together NS, Unit 5 Shamrock Business Park, Graiguecullen, Carlow
3	Cavan	17625L	Knocktemple N.S., Virginia, Co Cavan
4	Clare	14622N	St Flannan's, Inagh, Ennis, Co Clare
5	Clare	17563P	Ogonnolloe NS, Tuamgraney, Scariff, Co Clare
6	Clare	18739I	St Senan's NS, Corrib Drive, Shannon, Co Clare
7	Clare	20041C	St Senan's Primary School, Convent of Mercy, Kilrush, Co Clare
8	Clare	17801F	Scoil Na Maighdine Muire, Broadford, Co Clare
9	Cork	04186N	S N Bhiorainn, Berrings, Co Cork
10	Cork	12015F	Liscarroll N.S., Mallow
11	Cork	13450F	Rushbrooke Convent Mercy NS, Rushbrooke, Cobh, Co Cork
12	Cork	17600S	Scartleigh NS, Saleen, Cloyne, Co Cork
13	Cork	13747F	Riverstown NS, Glanmire, Co Cork
14	Cork	14000C	St Marie's of the Isle NS, Sharman Crawford Street, Cork
15	Cork	16159D	Mallow Convent Primary, Bathview, Mallow
16	Cork	16901E	Scoil Padraig Naofa, Skibbereen, Co Cork
17	Cork	17868O	Presentation PS, Fermoy, Co Cork
18	Cork	15597W	St Colman's BNS, Macroom, Co Cork
19	Cork	18217B	Scoil Padre Pio, Churchfield, Cork City
20	Cork	18279A	St Mary's Church of Ireland NS, Waterpark, Carrigaline, Co. Cork (Carrigaline 3 NS)
21	Cork	13828F	Douglas BNS, Douglas, Co Cork
22	Cork	18377A	Scoil Iosef Naofa, Fermoy
23	Cork	19415K	Scoil an Athar Tadhg, Carrig Na Bhfear, Cork City
24	Donegal	11843O	SN Neill Mor, Killybegs
25	Donegal	16242N	St Patrick's NS
26	Donegal	19333I	Dooish NS, Ballybofey, Co Donegal
27	Donegal	19553W	St. Crona's NS, Dungloe, Co Donegal
28	Donegal	19963S	Scoil Aodh Rua agus Nuala, Donegal Town, Co Donegal
29	Donegal	19967D	Scoil Íosagáin, Buncrana, Co Donegal
30	Donegal	17728V	Woodland NS, Letterkenny, Co. Donegal
31	Dublin	20131D	Dublin 7 Educate Together NS, Cabra
32	Dublin	16651H	St Clare's Primary School, Harolds Cross Rd, D6W
33	Dublin	17355I	Our Lady of Good Counsel Girls / Muire na Dea Comhairle G, Mourne Road, Drimnagh, D12
34	Dublin	17732M	Scoil Chiarain, Donnycarney, D5
35	Dublin	19314E	Scoil na Maighdine Mhuire B, Ballinteer, D16
36	Dublin	19535U	St Cronan's Senior NS, Brackenstown, Swords
37	Dublin	19456B	St Cronan's, Brackenstown, Swords
38	Dublin	19577N	Scoil Iosa, Tymon North, Tallaght, D24
39	Dublin	19578P	St Helen's JNS, Portmarnock, Co Dublin
40	Dublin	19929S	St Brigids Senior Girls, Finglas West, D11

41	Dublin	20066S	Lucan Educate Together, Lucan, Co Dublin
42	Dublin	20064O	Our Lady Of Consolation NS, Collins Avenue East, Donnycarney, D5
43	Dublin	20098I	Castleknock Educate Together NS, Beechpark, Castleknock, Dublin 15
44	Dublin	20168D	Glasnevin Educate Together, (Formerly Dublin North Central Educate Together), Glasnevin, D11
45	Dublin	19473B	Scoil Bhride Donaghmede Dublin 13
46	Dublin	17055T	St Marys Saggart Co Dublin
47	Galway	20000L	Galway Educate Together NS, Thomas Hynes Road, Galway
48	Galway	16943U	Scoil Nioclas Naofa, The Claddagh, Galway
49	Galway	20042E	Scoil an Chroi Naofa, Ballinasloe
50	Galway	17444H	Carrabane NS, Galway City
51	Galway	17613E	Scoil Chaitríona Naofa, Aughrim, Ballinasloe, Co. Galway
52	Galway	17845C	Soil Mhuire, Briarhill, Galway
53	Galway	17282H	St. Patricks's N.S., Tuam, Co. Galway
54	Kerry	06227L	Scoil Mhaocheadair Baile na nGall, Tralee, Co Kerry
55	Kerry	17710C	Scoil an Chuileannaigh, Killarney, Co Kerry
56	Kerry	13615L	Scoil Eoin Balloonagh, Tralee, Co Kerry
57	Kerry	18832V	Castlemaine N.S.
58	Kerry	19846O	Scoil Realta na Maidine Listowel Co Kerry
59	Kildare	20114D	Scoil Brid, Oldtown, Naas, Co Kildare
60	Kildare	18515J	Scoil an Linbh Iosa, Prosperous, Naas, Co Kildare
61	Kildare	19459H	Leixlip GNS, Leixlip, Co Kildare
62	Kildare	19675N	Scoil Bhride, Kilcullen, Co Kildare
63	Kildare	18288B	Scoil Mhichil Naofa, Athy, Co Kildare
64	Kildare	19995I	North Kildare Educate Together, Clane Road, Celbridge
65	Kildare	18093J	Clogherinkoe NS, Moyvalley, Co Kildare
66	Kildare	20271T	Scoil Na Naomh Uilig NS, Newbridge
67	Kilkenny	00788V	Lisdowney NS, Ballyragget, Co. Kilkenny
68	Kilkenny	18660S	St Nicholas NS, Windgap, Co Kilkenny
69	Kilkenny	19626A	St Canice's Co-Ed NS, Granges Road, Kilkenny
70	Kilkenny	15160G	Marymount N.S., The Rower, Via Thomastown, Klikenny
71	Laois	19750B	Scoil Mhuire, Abbeyleix, Co Laois
72	Laois	13741Q	Rath NS, Ballybritas, Co Laois
73	Leitrim	19423J	Drumshanbo Central NS
74	Longford	19279F	Scoil Naomh Treasa, Clontumpher, Ballinalee
75	Longford	20124G	St. Marys NS, Edgeworthstown, Co. Longford
76	Louth	14207B	Scoil Mhuire gan Smal, Kilsaran, Co Louth
77	Louth	18107R	Scoil Realt na Mara, Dundalk, Co Louth
78	Mayo	18754E	Bunacurry NS, Achill, Co. Mayo
79	Mayo	19451O	Holy Family NS, Newport, Co Mayo
80	Mayo	19951L	Swinford NS, Swinford, Co Mayo
81	Mayo	19812U	Foxford NS, Foxford, Co Mayo
82	Mayo	20125I	Crossmolina NS, Crossmolina, Co Mayo
80	Mayo	18712L	Knockrooskey, Westport, Mayo

81	Meath	17623H	O'Growney NS, Athboy, Co Meath
82	Meath	19671F	St Paul's NS, Abbeylands, Navan, Co Meath
83	Meath	20032B	Dunboyne JNS, Dunboyne, Co Meath
84	Meath	05630L	St Michael's BNS, Trim, Co Meath
85	Meath	17969U	Scoil Mhuire, Navan, Co Meath
86	Meath	16825O	Scoil Bhride, Kilbride, Clonee, Co. Meath
87	Monaghan	19162H	Threemilehouse N.S, Threemilehouse
88	Monaghan	19469K	Naomh Oliver Plunkett, Lough Morn, Castleblaney
89	Offaly	20267F	Scoil Bhride, Edenderry, Co Offaly
90	Offaly	15656M	Ballinamere NS, Tullamore, Co Offaly
91	Roscommon	12754U	Summerhill NS, Athlone, Co Roscommon
92	Roscommon	18571T	Knockcroghery N.S.
93	Sligo	19985F	Our Lady of Mercy School, Sligo
94	Tipperary	17523D	Dromakeenan NS, Roscrea
95	Tipperary	06658P	Kildangan NS, Puckane, Nenagh, Co Tipperary
96	Tipperary	09190G	Boher NS Ballina Kilaloe Co Tipperary
97	Tipperary	15299O	Gaile NS, Holycross, Thurles
98	Tipperary	16077B	Ardfinnan NS, Clonmel, Co. Tipperary
99	Tipperary	16166A	Carrig N.S., Carrig, Birr, Co. Offaly
100	Waterford	13635R	Ballyfduff NS, Kilmeaden, Co Waterford
101	Waterford	17351A	St Mary's NS, Ballygunner, Co Waterford
102	Westmeath	18212O	Presentation School, Mullingar, Co Westmeath
103	Westmeath	16304J	St Joseph's NS, Milltownpass, Co Westmeath
104	Wexford	16605A	Kilrane NS, Rosslare Harbour, Co Wexford
105	Wexford	16673R	Cushenstown N.S.,
106	Wexford	08221J	St Senan's PS, Enniscorthy, Co Wexford
107	Wexford	19739N	Scoil Mhuire, Coolcotts, Co Wexford
108	Wexford	20214H	Gorey Educate Together School, St Walerans, Ballytegan Road, Gorey
109	Wicklow	17181B	St Joseph's NS, Templerainey, Co Wicklow
110	Wicklow	20278K	Newtownmountkennedy Primary School, Newtownmountkennedy, Co. Wicklow
111	Wicklow	20178G	Wicklow Educate Together, Wicklow Town
112	Wicklow	13224T	Ballintemple NS, Avoca, Co Wicklow
113	Wicklow	19754J	Bray School Project, Bray, Co. Wicklow
No.	**County**	**Roll No.**	**Special Schools with Autism Classes**
1	Carlow	19315G	St. Laserians Special School, Carlow
2	Cavan	19439B	Holy Family, Cootehill, Co Cavan
3	Clare	19414I	St Anne's Special School, Ennis, Co Clare
4	Clare	19233E	St Clare's Special School, Ennis, Co Clare
5	Cork	19433M	Holy Family, Charleville, Co Cork
6	Cork	20074R	St Gabriel's, Curraheen Road, Cork
7	Cork	19760E	Scoil Triest, Lota, Glanmire, Cork
8	Cork	20331L	Cork Cabas School
9	Donegal	19592J	St Bernadette's, Letterkenny, Co Donegal
10	Donegal	19724A	Little Angels, Letterkenny, Co Donegal

11	Dublin	17971H	Holy Angels, Glenmaron, Chapelizod, D20
12	Dublin	18569J	St Declans Special School, Ballsbridge, Dublin 4
13	Dublin	18671A	St Michael's House, 17 Grosvenor Road, Rathgar, D6
14	Dublin	18763F	St. Michael's House,Ballymun Rd., Dublin 9
15	Dublin	19039I	St Vincent's Home NS, Navan Road, D7
16	Dublin	19355S	Ballyowen Meadows, Stillorgan, Co Dublin
17	Dublin	20028K	Setanta, Stillorgan, Co Dublin
18	Dublin	20279M	St Michael's House Sp School, Briarfield Villas, Kilbarrack, D
19	Galway	20070J	Rosedale School
20	Galway	19047H	St Joseph's, Newcastle, Co Galway
21	Kerry	19376D	St Ita's & St Joseph's
22	Kerry	19548G	Nano Nagle, Listowel, Co Kerry
23	Kerry	19547E	St Francis Special School, Beaufort, Co Kerry
24	Kildare	19455W	St Mark's Special School, Newbridge, Co Kildare
25	Kildare	19277B	St Anne's Special School, The Curragh, Co Kildare
26	Kildare	18988G	St Raphael's School, Celbridge, Co Kildare
27	Kilkenny	19523N	School of the Holy Spirit, Callan Road, Kilkenny
28	Kilkenny	19383A	St Patrick's Special School
29	Laois	20100P	Kolbe Special School, Block Road, Portlaoise, Co. Laois
30	Limerick	18692I	Catherine McAuley SNS, Ashbourne Ave, Sth Circular Rd, Li
31	Limerick	19200M	St Vincent's Special School, Lisnagry, Co Limerick
32	Limerick	20311F	Red Hill School, Patrickswell Rd., Limerick
33	Longford	19429V	St Christopher's SS, Battery Road, Longford
34	Louth	18936K	St Ita's Special School, Crushrod Avenue, Drogheda
35	Louth	19214A	St Mary's Special School, Drumcar, Co Louth
36	Mayo	19375B	St Brid's, Castlebar, Co Mayo
37	Mayo	19773N	St Nicholas', Ballina, Co Mayo
38	Meath	19560T	St Mary's Special School, Johnstown, Co Meath
39	Roscommon	19789F	St Michael's Special School, Castlerea, Co Roscommon
40	Sligo	19206B	St Cecilia's School, Cregg House, Sligo
41	Tipperary	19230V	Scoil Chormaic, Cashel, Co Tipperary
42	Tipperary	19370O	St Anne's, Roscrea, Co Tipperary
43	Tipperary	19615S	Scoil Aonghusa, Cashel, Co Tipperary
44	Waterford	19244J	St Joseph's Special School, Waterford
45	Waterford	19108B	St Martin's Special School, Waterford
46	Wexford	19240B	St Patrick's Special School, Enniscorthy
47	Wicklow	19522L	St Catherine's, Newcastle, Co Wicklow
No.	**County**	**Roll No.**	**Special Pre-School Classes for Children with Autism attached to mainstream primary school**
	Clare	19414Ì	St Annes Special School Corrovorrin Ennis Clare
1	Cork	04186N	Berings NS
2	Cork	16159D	Mallow Convent Primary, Mallow, Cork
3	Cork	17600S	Scartleigh NS, Saleen, Cloyne, Co Cork
4	Cork	20162O	Sonas Jnr Special School, Carrigaline, Co Cork
5	Cork	19415K	Scoil an Athar Tadhg, Carrig Na Bhfear, Cork City
6	Cork	17868O	Presentation Primary, College Road, Fermoy, Co. Cork

7	Donegal	17728V	Woodland NS, Letterkenny, Co Donegal
8	Dublin	17732M	Scoil Chiarain, Collins Avenue, Donnycarney, D5
9	Dublin	19320W	Our Lady of Good Counsel BNS, Johnstown, Dun Laoghaire
10	Dublin	19355S	Ballyowen Meadows, Stillorgan, Co Dublin
11	Dublin	19939V	Good Shepherd NS, Churchtown Road, D14
12	Dublin	20064O	Our Lady of Consolation NS, Collins Avenue East, Donnycarn
13	Dublin	19578P	St Helen's JNS, Martello, Portmarnock, Co Dublin
14	Dublin	19611K	Scoil Naomh Colmcille, Newbrook Rd, Donaghamede, D13
15	Dublin	19490B	St. Mary's, Ballyboden, D16
16	Dublin	16651H	St. Clares NS, Harolds Cross Road, Dublin 6W
17	Galway	16943U	St Nicholas' NS, The Claddagh, Galway
18	Galway	20328W	St Theresa's Special School, 25 Moher, Ballinasloe
19	Galway	20330J	St Oliver's Special School, The Glebe, Tuam
20	Kerry	17915U	Freastogail Muire Mixed NS, Killahan, Abbeydorney, Tralee,
21	Kildare	00779U	Presentation Girls PS, Maynooth
22	Kildare	18449W	St Conleth's NS, Derrinturn, Carbury.
23	Meath	16825O	Scoil Bhride, Kilbride NS, Clonee, Co. Meath
24	Monaghan	19162H	Threemilehouse N.S, Threemilehouse
25	Monaghan	19469K	Naomh Oliver Plunkett, Loch Morn, Castleblaney
26	Offaly	20267F	Scoil Bhride NS, Edenderry, Co. Offaly
27	Tipperary	06658P	Kildangan NS, Puckane, Co. Tipperary
28	Tipperary	19230V	Scoil Chormaic Special School, Golden Road, Cashel, Co. Tipperary
29	Tipperary	19615S	Scoil Aonghusa Special School, Cahir Road, Cashel, Co. Tipperary
30	Waterford	19244J	St. Joseph's Special School, Parnell Street, Waterford
31	Waterford	13635R	Ballyduff NS, Kilmeaden, Co. Waterford
32	Westmeath	20188J	Mullingar ETNS
33	Wicklow	17181B	St Joseph's NS, Templerainey, Co Wicklow
34	Wicklow	19522L	St Catherine's Special School, Newcastle, Greystones
35	Wicklow	20278K	Newtownmountkennedy, Wicklow
No.	**County**	**Roll No.**	**Aspergers classes**
1	Dublin	18726W	SN Seosamh Na Mbrathar, Fairview, Dublin 3
2	Dublin	19158Q	St Peter's BNS, Greenhills, Dublin 12
3	Wexford	20003R	St Aidan's PS, Enniscorthy, Co Wexford

Appendix J: Letter inviting Principal of School to undertake questionnaire

Dear Mrs Fitzsimmons,

I wish to thank you and your teachers for participating in the focus group which has contributed to my research in autism funded by the National Children's Strategy. I am nearing the final stage of this academic research which will culminate in the testing of a very simple computer program to determine if familiar accents and animated instruction can facilitate learning. This will enable the further development of educational software specific to the needs of children with autism.

.

I would like to ask your premission to circulate this questionnaire to one teacher in your school who teaches a child who is moderately autistic and is aged between five and nine years.

Your contribution will be invaluable and will greatly help in the development of an Irish-designed educational program, which will be presented to the Minister for Children as part of the National Children's Strategy. A summary of the findings and a **free copy** of the prototype program will be provided to your school on completion of this research.

I would be most grateful if you could forward the survey pack enclosed, which includes a stamped addressed envelope, the survey and covering letter, to all teachers in your school who teach moderately autistic children between the ages of 5 and 9 years. I would be very grateful if the survey could be returned, using the stamped address envelope before **23rd March 2010.**

All responses to this survey will be treated with confidentiality. Should you have any queries please do not hesitate to contact me on 086–3222 082 or email nicola.duffy@lyit.ie.

Once again, I thank you and appreciate your kind attention and assistance with this important research.

Yours sincerely,

Nicola Duffy, BA(Hons) Pgdip

Appendix K: Letter inviting Teacher of School to undertake questionnaire

lyit
Institiúid Teicneolaíochta Leitir Ceanainn
Letterkenny Institute of Technology

Office of the Minister for Children and Youth Affairs
Oifig an Aire Leanaí agus Gnóthaí Óige

12th March 2010

Dear Teacher,

I would like to thank you for agreeing to partake in this research. I am a Masters by Research student at Letterkenny Institute of Technology and have been funded by the Minister for Children and the National Children's Strategy to conduct academic research in the area of autism and education. This academic research will lead to the development of an interactive computer program, which will help moderately autistic children to learn daily living skills. This will be a valuable educational tool, which can be used with children at home and in school.

For the purpose of completing this survey, please choose at random, just **one** moderately autistic child who is between the age of 5 and 9 years. This survey should take no longer than 15 minutes to complete.

The main objectives of this survey are to:

- To determine the essential daily living skills that autistic children find most difficult to understand and conduct.
- To gain a perspective on current educational programs used to teach skills to autistic children.
- To determine which (if any) elements on these programs distract or help the child to learn.

Your contribution will be invaluable and will greatly help in the development of an Irish-designed educational program, which will be presented to the Minister for Children as part of the National Children's Strategy. A summary of these findings and a **free copy** of the prototype program will be provided to your school on completion of this research.
I would be most grateful if you could return this survey no later than the
23rd March 2010, a stamped addressed envelope is enclosed for ease of return.

All responses to this survey will be treated with confidentiality. Should you have any queries please do not hesitate to contact me on 086–3222 082 or email nicola.duffy@lyit.ie.

Once again, I thank you and appreciate very much your kind attention and assistance with this most important research.

Yours sincerely,

Nicola Duffy BA (Hons), PGdip

Appendix L: Letter inviting Parents/Guardians to undertake questionnaire

Dear Parent or Guardian,

I would like to thank you for agreeing to partake in this research. I am a Masters by Research student at Letterkenny Institute of Technology and have been funded by the Minister for Children and the National Children's Strategy to conduct academic research in the area of autism and education.

This academic research will lead to the development of an interactive computer program, which will help moderately autistic children to learn daily living skills. This will be a valuable educational tool that can support the daily routine of your child, which can be used at home and at School.

The main objectives of this survey are to:

- To determine the essential daily living skills that autistic children find most difficult to understand and conduct.
- To gain a perspective on current educational programs used to teach skills to autistic children.
- To determine which (if any) elements on these programs distract or help the child to learn.

Your contribution will be invaluable and will greatly help in the development of an Irish-designed educational program. All responses will be treated with confidentiality and no child will be identified by name, address or similar.

If you would like to receive a **free copy** of the prototype software please email: Nicola.Duffy@lyit.ie a link and summary of the findings will be sent to you on completion of this research.

The link to the survey: http://www.surveymonkey.com/s/autism_education

Thank you in advance for you time and help

Sincerely,

Nicola Duffy

Appendix M: Friendly Reminder

lyit
Institiúid Teicneolaíochta Leitir Ceanainn
Letterkenny Institute of Technology

Office of the Minister for Children and Youth Affairs
Oifig an Aire Leanaí agus Gnóthaí Óige

24rd March 2010

Dear Principal,

This is a friendly reminder to please complete and return the autism and education survey sent on 12th March 2010.

This reminder has been sent to all in the selected sample population, If you have completed this survey, I would like to thank you for your participation which is very much appreciated.

The closing date for this survey has now been extended to **26th March 2010.** Your participation is invaluable and essential to further research in this important area, the findings from this Nationwide survey will help in the development of an Irish-designed educational program, which will be presented to the Minister for Children as part of the National Children's Strategy.

A summary of the findings and a **free copy** of the prototype program will be provided to your school on completion of this research.

I would be most grateful if the survey could be returned, using the stamped address envelope attached to the survey by last post on **Friday 26th March 2010.**

Once again, I thank you and appreciate your kind attention and assistance with this important research.

Yours sincerely,

Nicola Duffy, BA (Hons) Pgdip

Appendix N: Codebook

Codebook – Questionnaire for Schools

Background Information

Q1 What age is your child:

Measurement Level: **Ratio**

Value	**Label**
1	5 yrs
2	6 yrs
3	7 yrs
4	8 yrs
5	9 yrs
9	Missing Data

Q2 What is the child's gender?

Measurement Level: **Nominal**

Value	**Label**
1	Male
2	Female
9	Missing Data

Q3 In which county is your School?

Measurement Level: **Nominal**

Value	**Label**
1	Dublin
2	Wicklow
3	Wexford
4	Carlow
5	Kildare
6	Meath
7	Louth
8	Monaghan
9	Cavan
10	Longford
11	Westmeath

12	Offaly
13	Laois
14	Kilkenny
15	Waterford
16	Cork
17	Kerry
18	Limerick
19	Tipperary
20	Clare
21	Galway
22	Mayo
23	Roscommon
24	Sligo
25	Leitrim
26	Donegal
99	Missing Data

Q4 Is your School?

Measurement Level: **Nominal**

Value	**Label**
1	Mainstream school **with** autistic unit
2	Mainstream school **without** autistic unit
3	Special needs school
4	Other
9	Missing Data

Q5 Has the child any other related diagnosis:

Measurement Level: **Nominal**

Value	**Label**
1	Dyslexia
2	ADHD
3	Other
4	None
9	Missing Data

Codebook – Questionnaire for Schools

Section 1 Daily Living Skills

Q1 How much **difficulty** (if any) does the child have at carrying out these tasks?

Measurement Level: **Ordinal**

i. Putting on Clothes

Value	Label
1	No Difficulty
5	Great Difficulty
9	Missing Data

ii. Setting Table

Value	Label
1	No Difficulty
5	Great Difficulty
9	Missing Data

iii. Using Knife

Value	Label
1	No Difficulty
5	Great Difficulty
9	Missing Data

iv. Using Fork

Value	Label
1	No Difficulty
5	Great Difficulty
9	Missing Data

v. Using Spoon

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

vi. Pouring a drink

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

vii. Using a toilet

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

viii. Washing hands

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

ix. Washing face

Value	**Label**
1	No Difficulty
5	Great Difficulty

9 Missing Data

x. Brushing teeth

Value Label

1 No Difficulty
5 Great Difficulty
9 Missing Data

02) In Question **01) i.** above **('putting on clothes'),** if you rated difficulty as 2, 3, 4 or 5, **Please rate** the difficulty the child has with the following items: [*Please rate difficulty on a scale of 1-5 for appropriate item]*

Measurement Level: **Ordinal**

1. Putting on a top

Value Label

1 No Difficulty
5 Great Difficulty
9 Missing Data

2. Putting on trousers

Value Label

1 No Difficulty
5 Great Difficulty
9 Missing Data

3. Putting on dress

Value Label

1 No Difficulty
5 Great Difficulty
9 Missing Data

4. Putting on socks

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

5. Putting on Undergarments

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

6. Tying laces on shoes

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

7. Putting on a coat

Value	**Label**
1	No Difficulty
5	Great Difficulty
9	Missing Data

8 Using a zip

Value	**Label**
1	No Difficulty

5	Great Difficulty
9	Missing Data

Section 2 Computer programs used at school

Q1 Has the child used interactive programs on any of the following devices that you are aware of?

Measurement Level: **Nominal**

Value	**Label**
1	Personal computer
2	IPhone
3	Other Mobile phone
4	Other
9	Missing data

02) Taking what **you consider to be the most effective program,** please indicate what the program aimed to achieve.

Measurement Level: **Nominal**

Value	**Label**
1	Educational development
2	Social skills
3	Daily living skills
4	Communicative skills
5	Entertainment (for example, gaming)
5	Other (Please Specify)
9	Missing Data

04) Was this program **specifically** designed for children on the autistic spectrum?

Measurement Level: **Nominal**

Value	**Label**
1	Yes
2	No
3	Don't know
9	Missing Data

05) If a voice was used on the program, what was **the accent** of the voice?

Measurement Level: **Nominal**

Value	**Label**
1	American
2	British
3	Irish
4	Other
5	N/A
9	Missing Data

06) Has the child copied any accents that were used on the program?

Measurement Level: **Nominal**

Value	**Label**
1	Yes
2	No
3	Don't know
9	Missing Data

07) Do you believe that using a local accent in a computer program would be of benefit to the child?

Measurement Level: **Nominal**

Value	**Label**
1	Yes
2	No
3	Don't know
9	Missing Data

08) **A)** Which of the following were **features** of the program?

(B) For each of the features ticked**, please indicate if they were not helpful or unhelpful** to the child.

Measurement Level: **Nominal**

(a) Navigation in the form of buttons

Value	**Label**
1	Helpful
2	Un-Helpful
9	Missing Data

(b) Navigation in the form of words

Value	**Label**
1	Helpful
2	Un-Helpful
9	Missing Data

(d) Familiar cartoon characters

Value	Label
1	Helpful
2	Un-Helpful
9	Missing Data

(e) A stop button to stop animations

Value	Label
1	Helpful
2	Un-Helpful
9	Missing Data

(f) A quiz

Value	Label
1	Helpful
2	Un-Helpful
9	Missing Data

(g) Multiple choices on quiz

Value	Label
1	Helpful
2	Un-Helpful
9	Missing Data

(h) Indication of correct answers

Value	Label
1	Helpful
2	Un-Helpful
9	Missing Data

(i) Indication of incorrect answers

Value	Label

1	Helpful
2	Un-Helpful
9	Missing Data

10) Does the child have access to a computer at school?

Measurement Level: **Nominal**

Value	**Label**
1	Yes
2	No
9	Missing Data

11) How many hours approximately has the child spent on the computer in the last full week at school?

Measurement Level: **Interval**

Value	**Label**
1	< 1
2	1 – 2 hrs
3	3 – 4 hrs
4	5 – 6 hrs
5	7 – 8 hrs
6	9 > hrs
9	Missing Data

12) Taking the most recent occasion that the child has used the computer at school, did the child work.

Measurement Level: **Nominal**

Value	**Label**
1	Completely alone
2	With assistance

3	A combination of working alone & with assistance
9	Missing Data

13) How does the child operate the computer most often?

Measurement Level: **Nominal**

Value	**Label**
1	The mouse only
2	The keyboard only
3	Touch screen
4	Mouse and keyboard
5	Mouse and arrow keys
6	Other
9	Missing Data

Section 3 Interactive computer programs for autistic children

01) In relation to the **attention span** of the child when he/she is using a computer program, please indicate the extent of your **agreement or disagreement** with the following statements.

Measurement Level: **Ordinal**

(a) The child can easily get absorbed in one area of the computer program.

Value	**Label**
1	Strongly Agree
2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
6	N/A

9	Missing Data

(b) The child can lose sight of the purpose of the whole program

Value	**Label**
1	Strongly Agree
2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
6	N/A
9	Missing Data

02) There are features on a computer program that may distract the autistic child. Please rate each of the following in terms of how **distracting** they are to the autistic child you have selected.

Measurement Level: **Ordinal**

(a) Too many pictures

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

(b) Moving images

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

(c) Bright colours

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

(d) Dark colours

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

(e) Background music

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

(f) Other sounds

Value	**Label**
1	Not Distracting
5	Greatly Distracting
9	Missing Data

03) Please rate each of the following in terms of **how motivating** they are to the autistic child you have selected.

Measurement Level: **Ordinal**

(a) Rewards

Value	**Label**
1	Motivating
5	De-motivating
9	Missing Data

(b) Feedback

Value	**Label**
1	Motivating
5	De-motivating
9	Missing Data

(c) Choices

Value	**Label**
1	Motivating
5	De-motivating
9	Missing Data

04) There are various ways that instruction can be presented effectively on a computer program. Please indicate the extent of your agreement or disagreement with the following statements.

Measurement Level: **Ordinal**

(a) Instructions are effective when presented with **text alone.**

Value	**Label**
1	Strongly Agree
2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
9	Missing Data

(b) Instructions are effective when presented with **cartoon animations.**

Value	**Label**
1	Strongly Agree
2	Somewhat Agree

3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
9	Missing Data

(c) Instructions are effective when presented with **vocal narration**.

Value	**Label**
1	Strongly Agree
2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
9	Missing Data

(d) Instructions are effective when presented with **text, vocal narration & animation**.

Value	**Label**
1	Strongly Agree
2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
9	Missing Data

(e) Instructions are effective when presented as **rhymes or songs**.

Value	**Label**
1	Strongly Agree

2	Somewhat Agree
3	Neither Agree nor Disagree
4	Somewhat Disagree
5	Strongly Disagree
9	Missing Data

05) What are the child's current interests?

Measurement Level: **Nominal**

Value	**Label**
1	Numbers
2	Art
3	Lining up objects
4	Trains
5	Cars
6	Memorising songs
7	Playing computer games
8	Building things
9	Sport
99	Missing Data

06) What are the child's current strengths?

Measurement Level: **Nominal**

Value	**Label**
1	Understanding concepts
2	Memorising material
3	Thinking visually
4	Good long-term memory
5	Perfectionism in conducting tasks

6	Scheduling
7	Focusing
8	Good attention to detail
9	Missing Data

07) What is the primary way in which the child communicates?

Measurement Level: **Nominal**

Value	**Label**
1	Wordbook
2	Picture book
3	Keyboard devices
4	Normal speech
5	A combination
6	Other
9	Missing Data