AN INTERACTIVE CLASSROOM TIMETABLE FOR CHILDREN WITH HIGH-FUNCTIONING AUTISM: DEVELOPMENT AND QUALITATIVE EVALUATION OF A COMPUTER-BASED TIMETABLE

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Abstract

Teachers report that advanced knowledge of the day's activities can considerably lessen anxiety for children with autism, especially if this information is highly visual in its presentation. Teaching children with autism often follows a highly structured approach including use of visual planning aids, such as symbolic timetables (Gillberg & Coleman, 2000; Mesibov, Browder, & Kirkland, 2002). Children with autism have been noted to be skilled at using computers and it has been suggested that the computer presents an ideal resource for both educational and recreational use (Attwood, 1998; Higgins & Boone, 1996; D. Moore, 1998; Murray, 1997). However, in spite of widespread use of visual timetables in schools by children with autism, there is little evidence of research being conducted in the area of computerised timetabling for this population. The overall aim of this particular study was to develop an interactive, computer-based timetable and to explore and assess the practical value for children with autism.

The research was of an ethnographic nature and involved a case study approach. The development of the interactive timetable followed a user-centred design. Participating children attended a language and communication class attached to a mainstream primary school in Scotland. Seven males aged between six and nine years of age were involved, with four of the children able to participate in the final evaluations of the interactive timetable. Other participants included special needs teachers, nursery nurses, speech and language therapists, and parents of participating children.

Examination of a symbolic timetable identified several important issues relevant to the design of an interactive timetable, whilst consideration of parental and educationalist views, gathered through interview, highlighted both benefits and concerns. By extending use to the home environment, the interactive timetable was considered to facilitate communication between child and parent. Concerns regarding access, size and position, user ability, and availability of resources were identified. Although findings were inconclusive, it was possible to communicate timetable information in a computer-based form and furthermore, the children appeared to enjoy using the timetable.

Whilst the setting for this study was a single language and communication class attached to a mainstream primary school, this research has implications for a wider debate. The study found generally that the prospect of using information and communication technology to display an interactive timetable which was accessible both at school and at home, offered numerous possibilities for children with autism and their families.

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Glossary of key terms

Asperger's syndrome (AS): a pervasive developmental disorder described by Hans Asperger

Autism: a lifelong, developmental disorder

Autistic spectrum disorder (ASD): a continuum of developmental disorders including Kanner's autism and Asperger's syndrome

Central coherence: a natural tendency to see things as a whole

Echolalia: the repetition of words or phrases just spoken by another person

Executive functions: the abilities required to execute a change of plan from normal routine behaviour

HyperText Markup Language (HTML): a coding language which describes the logical structure of a hypertext document. HTML facilitates understanding, processing and presentation of information by a web browser

Information and communication technology (ICT): refers to a range of technologies involved in aiding and processing electronic communications. Examples include the World Wide Web (WWW), electronic mail, video conferencing, and digital technologies

Information management: a field of research deriving from the disciplines of librarianship and information science

Intonation: the tone or inflection of a person's voice

Mind-blindness: a term frequently used to refer to impairment of 'theory of mind'

Neurodevelopmental disorder: a developmental disorder relating to the nervous system

Pervasive developmental disorder (PDD): an umbrella term describing a group of disorders with persistent and all-encompassing characteristics

Phenylketonuria: a congenital metabolic disorder, characterised by abnormal accumulation of phenylalanine (an essential amino acid), in body fluids

Phonetics: the articulation necessary to produce speech sounds

Pragmatics: "the study of LANGUAGE from the point of view of the users, especially of the choices they make, the CONSTRAINTS they encounter in using language in social interaction, and the effects their use of language has on the other participants in an act of communication" (Crystal, 2003, p.364) [emphasis original]

Prosody: the patterns of stress and intonation in a language

Semantics: the study of meaning in language; the conventional interpretation of words

Somatic symptoms: physical symptoms e.g. nausea

Stereotyped movements: movements which typecast a behaviour

Syntax: the way in which a sentence is structured to convey meaning

Theory of Mind: the ability to appreciate that others have thoughts and feelings which result in actions

Triad of impairments: a group of three specific areas of social deficit found to occur in individuals with autistic spectrum disorder

Web-based: referring to documents or instructions delivered via the Internet, using Web technology

Chapter 1: Introductory chapter

1.1 Introduction

This introductory chapter provides a general overview of this research thesis. The chapter begins with a brief summary of the background to the study, highlighting the origins of the research subject, the reasons why this particular topic was of interest to the researcher, and establishing the significance of the subject. The chapter then moves on to illustrate the context of the research, establishing a framework in which this study can be located and demonstrating how it forms the basis for the literature review which follows. A brief outline of the research setting is presented and the research aims are stated. The research approach is then outlined, providing an overview of the research methodology and demonstrating the theoretical position this study adopts. The scope and limitations of the study are identified and finally an explanation of the organisation of the thesis is provided.

1.2 Background to the study

This study explores and assesses the practical value of an interactive, computer-based timetable, developed for a specific cohort of primary school pupils with autism. A language and communication class attached to a Scottish mainstream primary school was the setting and 21 individuals participated during the course of this study. These comprised seven male pupils aged between six and nine years of age and diagnosed with an autistic spectrum disorder (ASD), seven parents, and seven members of the educational team. The criteria for participating children were a diagnosis of unspecific high-functioning autism (UHFA) or Asperger's syndrome (AS). Diagnostic information was obtained in the first instance from the class teacher and later confirmed by the educational psychologist involved. The phrases 'children with autism' and 'individuals with autism' will be used for the most part throughout this thesis in order to maintain consistency.

The research methodology was essentially qualitative. Qualitative research is defined as being "a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible… qualitative research involves an interpretive, naturalistic approach to the world (Denzin & Lincoln, 2005, p. 3). The researcher studied the use of a visual timetable by children with autism in the natural setting of the classroom, in order to gain an understanding of this phenomenon and of the participants' experiences in using such a timetable. An ethnographic approach to research was followed and a case study design employed. Traditionally, ethnography is associated with anthropological research, involving prolonged, in-depth study of the way of life in remote cultures (Flick, 2006; Neuman, 2004). Whilst employing ethnographic techniques such as field research and participant observation this particular study was, however, concerned with more specific aspects, such as the use of a visual timetable by children with autism and the behaviour patterns of the children, rather than with the way of life in a classroom per se. To begin with, a case study of the class as a whole enabled in-depth investigation of the visual timetable used in this particular setting. Later, case studies of individual children were conducted to witness at first-hand their experiences in using the interactive timetable that was developed. The case study design is discussed in more detail later (section 5.6.1). The development of the interactive timetable followed a user-centred design.

Individuals with autism find it difficult to cope with change in their daily routine and so a structured environment is generally advocated, particularly in school (Cumine, Leach, & Stevenson, 2000; Gillberg & Coleman, 2000; Mesibov, Schopler, & Hearsey, 1994). Timetables of a highly visual style are frequently used to assist individuals with autism in coping with the daily class routine, by reducing confusion and helping the children to anticipate change (Cumine, Leach, & Stevenson, 1998; Davies, 1997; Lord, Bristol, & Schopler, 1993; Mesibov et al., 1994). These are referred to as symbolic communication systems (Potter & Whittaker, 2001) and children with autism are often introduced to these at an early age, for example, at nursery school. For the purpose of this study and for consistency in this thesis the term 'symbolic timetable' will be used. Advances in the area of information and communication technology (ICT) have been exceptional over the last decade, offering the potential for new and creative means of presenting information. The prospect of using such technology to create an alternative or complementary means of presenting timetable information for children with autism was, therefore, considered a feasible option.

1.2.1 Origin of the research

An area of research interest within the former Information Management (IM) Department at Queen Margaret University College (QMUC), Edinburgh, concerned the use of multimedia in home and work environments. A member of the Department made informal enquiries at a special school in the Central Region of Scotland regarding timetable use by children with autism. The possibility of using Hypertext Markup Language (HTML) to develop a computer-based adaptation of the class timetable was briefly investigated. As a result, a doctoral study, which focused on the area of interactive, computer-based applications for use by special needs children, was proposed. The study was perceived to be of an interdisciplinary nature and as such integrated well within the QMUC focus on practical health related issues.

This research topic was of particular interest to the researcher, who possesses a keen interest in the area of interactive, computer-based learning environments and more especially in the processes involved in the development and evaluation of web-based information resources. The researcher's Honours dissertation had involved a case study investigating the development and use of an interactive, subject specific web site as a study aid for a cohort of pupils at a high school in Scotland. Subsequent post-graduate experiences further influenced the researcher's interest in this topic. These experiences had comprised the development of an informational, web-based resource for a health related Department within QMUC and the creation of course materials in HTML format to be used in WebCT (a set of tools to facilitate communication, learning and collaboration in a web-based environment), by the IM Department. The opportunity to create and evaluate an interactive, computer-based resource for a population with special needs was seen as an exciting challenge; one which would facilitate the extension of knowledge of multimedia application design and evaluation theory, whilst at the same time providing a practical opportunity to gain appreciation and comprehension of the significant processes of research.

Another influence which should be remarked on here, as it impacts on the researcher's values and conceivably her approach to research, is a former career in nursing. Experience as a nurse had entailed the requirement to study the individual holistically; the researcher's belief is that a person's wellbeing is influenced by many factors and by the interaction of these factors.

1.2.2 Significance of the subject

The use of highly visual communication aids, such as a daily symbolic timetable, is strongly advocated to assist individuals with autism, by providing advanced notice of daily activities in the school environment (Mesibov et al., 1994; Peeters & Gillberg, 1999). It is the researcher's belief that ICT offers great potential for providing complementary or alternative means of displaying and communicating this type of predominantly visual information. Furthermore, the researcher believes that through conducting research into alternative ways of presenting timetable information, a valuable contribution to knowledge in this area can be made. Whilst the setting for this study was a single language and communication class attached to a mainstream primary school, the research does have implications for a wider debate. For this particular user group the prospect of using computer technology and more specifically interactive, web-based resources in both the classroom and at home, offers numerous possibilities. For example, in addition to attempting to address uncertainty related to changes in daily routines, use of such resources could assist children in increasing independence levels and could facilitate enhanced communication with parents. Furthermore, the researcher considers the possibility that individual timetable systems could eventually be developed for use on portable and wireless devices such as laptop computers, Personal Digital Assistants (PDAs), and mobile telephones, thereby extending use of such a structure to a variety of settings.

1.3 Context of the research

The principal foundation for this study is within the discipline of Information Management. Information Management emerged as a field of research in the late 1970s, deriving from the disciplines of librarianship and information science (Macevičiūtė & Wilson, 2002). One definition of Information Management asserts it is "a continuous cycle of six closely related activities: identification of information needs; information acquisition; information organization and storage; development of information products and services; information distribution; and information use"

(Choo, 1998, p. 24). This study set out to investigate the information processes involved in using a symbolic timetable. The information needs of the timetable users were explored and the methods of acquirement and presentation of timetable information were examined. For example, the researcher considered the type of information the timetable communicated, the way in which the information was organised and presented, and the ways in which this information was communicated to the participating children. In-depth investigation of these processes facilitated the development of an interactive, web-based timetable system, as an alternative means of managing and presenting this information resource.

An aim of this study was to consider how ICT might be used to assist children with special needs in overcoming anxiety related to changes in daily class routine; accordingly the research was found to embrace a broad range of disciplines. Consequently, this thesis may be of interest to a wide ranging audience with differing areas of expertise and varying degrees of knowledge of the autistic condition. It is anticipated that this subject may be of interest to professionals working in the field of autism and education and furthermore, that parents of children with autism may also find the topic of interest. In addition, it is possible that the subject could be of relevance for students in the fields of Information Management and Communication Studies. Therefore, general descriptive information about the autistic condition is incorporated into the literature review to provide background knowledge for those unfamiliar with the condition.

Sources from the fields of medicine, psychology, and language and communication studies were consulted in order to develop an understanding of the key problems associated with the autistic condition, those relating to the 'triad of impairments'[1]. Educational sources were consulted in order to examine the current situation regarding educational settings for children with autism and the favoured approaches used in the classroom. Additionally, the area of computer use by children with autism was investigated as an important theme of this study. In recent years a number of research studies have been conducted regarding the use of computer applications by individuals with autism. These studies have mainly concentrated on areas relating to the 'triad of impairments'. More specifically, research has been

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[1] A group of three specific areas of social deficit found to occur in individuals with autistic spectrum disorder and which are discussed in greater detail in chapter 2 of the literature review (section 2.2.1).

conducted concerning computer applications which have been developed to target literacy skills (see for example, Bosseler & Massaro, 2003; Tjus, Heimann, & Nelson, 1998; Williams, Wright, Callaghan, & Coughlan, 2002), social interaction skills (see for example, Hagiwara & Smith Myles, 1999; Parsons, Beardon, Neale, Reynard, Eastgate, Wilson, Cobb, Benford, Mitchell, & Hopkins, 2000) and executive functioning (see for example, Lee, McGee, & Ungar, 2001; Rajendran & Mitchell, 2000). Relatively little research has been carried out regarding the use of ICT in the area of communication relating exclusively to daily routines such as timetable schedules. Development of any system involves a design process and so principles and guidelines relating to system development and human computer interaction theories were also consulted. As a result, the study combines consideration of virtual and real environments for the participants.

1.4 Research setting

The key points regarding the research setting are identified here, whilst greater detail regarding participants and setting is presented in the Research Methodology (chapter 5). It was recognised that children participating in the study would need to be able to use a computer, have the ability to recognise symbols used frequently in the classroom setting, have the ability to read, and be able to comply with a degree of instruction. Individuals with unspecific high-functioning autism or Asperger's syndrome were therefore sought, as these children were perceived to be at the more able end of the autistic spectrum and considered more likely to meet these criteria. It was also acknowledged that a setting where a symbolic timetable was being used should be chosen, as this would enable a greater understanding of such a system to be gained prior to the development of an interactive, computer-based version.

A contact at a special school offered guidance on various educational establishments within the Central Region of Scotland which were likely to have pupils with autism and selection of the research setting was based primarily on this advice. The participants who were selected attended a language and communication class attached to a mainstream primary school in Scotland. The setting was set apart from the main school building and consisted of two classrooms, two speech and language therapy rooms and cloakroom facilities. The children in the class joined with those from the main school at playtime, lunchtime and for assembly once a week. Some pupils in the class were being gradually integrated into mainstream, visiting a class for one or two sessions a day and in addition, reverse integration took place on a regular basis. This involved individuals from a mainstream class joining the language and communication class for selected activities.

A great part of this study was conducted in the 'natural' setting of the classroom. It was recognised that it was important to gain the trust of those participating in the study and to become familiar with the environment. It was also anticipated that great use would be made of the symbolic timetable in the classroom and so it seemed practical to observe the use of this timetable system in its natural surroundings before creating an interactive version. Once the interactive version was developed, use of this was also observed in the classroom, the setting where it would normally be used.

1.5 Research aims

The study set out to address the questions, "can timetable information be communicated to children with autism in an interactive and computer-based form?" and if so, "can an interactive timetable assist children with autism in coping with changes in their daily school routine?" The following aims were, therefore, established:

1. To develop a computer-based, interactive timetable system for a class of children diagnosed as having an autistic spectrum disorder (ASD), allowing individual children to personalise their own timetable

2. To evaluate the effectiveness of the interactive timetable system by considering whether its use in any way assisted the participating children in overcoming anxiety related to changes in daily class routine

3. To evaluate the effectiveness of the interactive timetable system as a management and communication tool for the teacher and parents

4. To examine the feasibility of building a general, interactive timetabling system, capable of widespread implementation

In order to achieve these aims certain questions needed to be answered. These were:

- Why do children with autism benefit from using a symbolic timetable?
- What does a symbolic timetable look like and what content does it include?
- How and when is the symbolic timetable used and by whom?
- What should an interactive, computer-based timetable look like and what should it include?
- How and when should an interactive, computer-based timetable be used and who should use it?
- Why does change cause children with autism to become anxious?
- What helps to alleviate anxiety related to change for these children?
- Does an interactive timetable help reduce anxiety related to change?

The focus of this research was initially, therefore, to investigate why and how a symbolic timetable was used by children with autism. Once an in-depth understanding of the symbolic timetable was gained the research then focused on the process of developing and evaluating an interactive, computer-based version of the timetable.

1.6 Research approach

A brief outline of the overall approach to this research study is now provided. The research methodology is outlined and then a framework for the theoretical basis is set out.

1.6.1 Overview of methodology

As stated earlier (section 1.2) this study was primarily a qualitative enquiry, of an ethnographic nature and involved a case study design. A preliminary literature review was conducted at the early stages to develop a comprehension of what the autistic condition involved. In addition, as mentioned earlier (section 1.4), long periods spent in the classroom assisted with contextualising this understanding.

A case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 1994, p. 13). The researcher believed that following a case study approach would enable use of the symbolic timetable to be considered holistically and in-depth, in the natural environment of the classroom. This would allow the researcher to witness at first-hand the participants' experiences in using the timetable.

Methods employed comprised non-participant observation, participant observation, structured observation, self-completion questionnaires, and semi-structured interviews. The data gathered by these various methods were subjected to inductive analysis with the anticipation that this would provide evidence on which theory might be constructed.

1.6.2 Theoretical framework

In order to conduct authoritative research and to be able to justify that research, it is essential that researchers understand the different forms of knowledge which exist and are able to identify reliable sources of knowledge. Individuals hold basic beliefs by which they define the nature of reality (ontological beliefs) and the way in which the world is known (epistemological beliefs); these belief systems are referred to by Guba and Lincoln (1998) as paradigms. Within the social sciences there are recognised to be four competing paradigms which inform and guide qualitative enquiry: positivism, postpositivism, critical theory, and constructivism (Guba & Lincoln, 1998). A brief overview of each paradigm is now given.

Positivism is based on a rationalistic philosophy and holds the view that knowledge can be discovered as an objective truth independent of human understanding (Darke, Shanks, & Broadbent, 1998). Positivism is traditionally associated with the field of science. Researchers adopting this position principally use quantitative methods of enquiry and tend to apply deductive reasoning to analysis of data (Williamson, Burstein, & McKemmish, 2002). Positivist enquiry "is assumed to be value free, so that the researcher remains detached, neutral and objective" (Darke et al., 1998, p. 276). Postpositivism holds essentially the same belief as positivism that there is one reality, but recognises the human limitations of the researcher (Mertens, 2005). Guba and Lincoln (1998) use the term "critical theory" to represent several alternative paradigms, which include neo-Marxism, feminism, materialism, and participatory enquiry. Critical theory recognises multiple realities and value mediated findings (Guba & Lincoln, 1998). The paradigm of constructivism views reality as being subjective; reality is "a social product constructed and interpreted by humans as social actors according to their beliefs and value systems" (Darke et al., 1998, p. 276). It holds the epistemological view that "truth, or meaning, comes into existence in and out of our engagement with the realities in our world" (Crotty, 1998, p. 8). This implies that human knowledge is constructed rather than discovered. This paradigm is traditionally associated with qualitative methods of enquiry and an inductive method of data analysis (Williamson et al., 2002).

This study expresses a constructivist position. The researcher holds the belief that knowledge is constructed through witnessing and experiencing people's actions and interactions at first-hand. To acquire knowledge of these elements, the researcher considered it necessary to interact with persons working and caring for the children participating in this study, in order to gain access to their views and understandings. This study was, therefore, concerned with interpreting the social world from the point of view of those involved; the pupils, the educational team and the children's parents.

The intention of this study was to determine whether the interactive timetable which was designed and developed was perceived to be of value, use or benefit to those participating in the study and to highlight any problems or disadvantages. The study involved children with autism who all behaved in different ways and were affected by different influences. For some the interactive timetable may have been of little benefit, while for others it may have been of great use. Therefore, in following a constructivist position, knowledge of the value and shortcomings of the interactive timetable was developed through witnessing individuals actually using the timetable and by questioning those who had experience of using the timetable.

1.7 Scope and limitations

This study involved spending considerable time within an educational environment, observing and questioning key actors in this environment. The study also aimed to develop and evaluate an interactive, computer-based version of a symbolic timetable, so considerable time was devoted to this task.

Specific limitations of this study were found to be factors relating to access to the participants. For example, access was very much influenced by parental and staff cooperation, by school hours, by term times, and by other factors within the education environment which were out with the researcher's control. Other limitations related to ethical considerations regarding the participating children and the ability of participants to cooperate fully in the study. In addition, there were certain limitations relating to the development and evaluation of the interactive timetable application. Methodological limitations were also noted. For example, the number of children participating in the final evaluations was small. Limitations are discussed further in the discussion (chapter 8).

1.8 Organisation of the thesis

This thesis is set out in nine chapters. It begins with this introductory chapter, outlining the purpose, aims and limitations of the study. The literature review is divided into three chapters (chapters 2, 3 and 4) emphasising the system development methodology approach, with the subject of research being considered from three distinct perspectives: the key user population, the user environment, and the task. Chapter two considers the main user population of the proposed interactive timetable system, beginning with an introduction to the condition of autism (section 2.1). The key difficulties faced by children with autism are examined (section 2.2), and the implications of anxiety for individuals with autism are considered (section 2.3). Chapter three discusses the user environment. Educational settings, approaches and strategies which have emerged to assist individuals with autism are considered (section 3.1), and the use of computers by children with autism is discussed (section 3.2). Chapter four discusses the task of communicating information relating to daily activities to children with autism. Section 4.1 considers communication approaches generally, while section 4.2 considers use of visual support such as a symbolic timetable. Chapter five sets out the research methodology for this study, whilst chapter six presents the system development methodology. The main findings of the study are set out in chapter seven. Chapter eight puts forward a discussion of the key findings and provides a synthesis between these findings and issues raised in the literature review. Chapter nine concludes this thesis.

Chapter 2: Key user population

It is important when developing computer-based systems to understand the needs of the prospective user population (Preece, Rogers, Sharp, Benyon, Holland, & Carey, 1994; Shneiderman & Plaisant, 2005). This chapter reviews the literature with regards to the key user population for the proposed interactive timetable: participants with an autistic spectrum disorder. The chapter is made up of three sections. Section 2.1 provides a general overview of the autistic condition, section 2.2 considers the key difficulties faced by this user population and section 2.3 considers the implications of anxiety for this particular user group.

2.1 Autism, Asperger's syndrome and autistic spectrum disorder: an introduction

This section sets out to provide a general overview of the historical context and current awareness regarding the conditions of autism, Asperger's syndrome and autistic spectrum disorder. The section begins with a broad definition of autism and after summarising briefly the historical context, an explanation of the current classification schemata is given. Details of how diagnosis is made for this condition are provided and the main theories of causation are set out. Examples of prevalence rates found in a range of epidemiological studies are illustrated. Finally, key difficulties faced by those with autism are noted and these will be discussed in greater detail in section 2.2.

2.1.1 What is autism?

"Autism is the name given to a set of neurodevelopmental disorders in which the way that a person communicates and interacts with other people is impaired" (Medical Research Council (MRC), 2001, p.7). Essentially, autism is a lifelong, developmental disability (Frith, 2003) and has been found to affect some children from birth and others from early infancy. The condition is rarely diagnosed before the age of three years (Cox, Klein, Charman, Baird, Baron-Cohen, Swettenham, Drew, & Wheelwright, 1999; Frith, 2003). Autism is often referred to as being a spectrum or continuum of disorders, indicating that there is a variation in the degree of affectation of the condition, which can range from being mild to very severe. Many children with autism are unable to form normal social relationships or to develop normal communication and this can result in isolation for the individual and in a state of self-absorption (Baron-Cohen & Bolton, 1993).

2.1.2 Historical context

A psychiatrist, Eugen Bleuler (1911/1950), is credited with using the term 'autism' to describe certain features of schizophrenia. In particular, Bleuler (1911/1950) observed that severe schizophrenics frequently presented the appearance of self absorption together with a detachment from reality. The word 'autism' is understood to be derived from two Greek words, 'Aut' meaning self and 'Ism' meaning orientation or state. A literal interpretation of these words implies that a person with autism is unusually self absorbed (Trevarthen, Aitken, Papoudi, & Robarts, 1998).

An Austrian psychiatrist, Leo Kanner, first described the condition of autism in a paper published in the United States of America in 1943 (Wing, 1971). In his paper, Kanner (1943) presented a detailed description of 11 children whom he found to share a number of common characteristics and whom he labelled as having 'early infantile autism'. An Austrian paediatrician, Hans Asperger published a paper in 1944, discussing a similar condition, which is now known as Asperger's syndrome (Wing, 1971). An English translation of Asperger's original paper, *'Autistic psychopathy' in childhood* (1944) was included with a publication edited by Uta Frith in 1991. In this paper Asperger (1944/1991) described four children whom he found to share common characteristics; characteristics similar to those described by Kanner.

Much of present day thinking regarding subgroups of autism relates to research carried out by Dr. Lorna Wing and Judith Gould in the London Borough of Camberwell in the 1970s (Cumine et al., 1998; Frith, 1989). This research led to the identification of Kanner's autism and Asperger's syndrome as subgroups of autism, and to the recognition that autism is in fact a continuum, or 'spectrum' of disorders (Wing, 1996a, 1996b). It has also been suggested that certain 'spectrum disorders' such as Asperger's syndrome in fact share many of the characteristics identified in the central disorder of autism, although they may not necessarily meet the full criteria for this (Peeters & Gillberg, 1999).

2.1.3 Classification of autistic spectrum disorders

There are two major classification systems currently used by clinicians as diagnostic tools. These are the 4th edition (text revision) of the American Psychiatric Association (APA; 2000) *Diagnostic and statistical manual of mental disorders* (DSM-IV-TR) and the 10th edition of the World Health Organization (WHO; 1992) *International statistical classification of diseases and related health problems* (ICD-10). Whilst some differences between these schemes remain, agreement between the two has increased over recent years, enabling diagnosis to become more standardised (Volkmar, Klin, & Cohen, 1997a; Volkmar, Lord, Bailey, Schultz, & Klin, 2004). A number of terms are used to refer to autism and autistic disorders in these classification schemes, as demonstrated in table 2.1.

Table 2.1

Comparing terminology used in DSM-IV-TR and ICD-10 classification systems

DSM-IV-TR	***ICD-10***
Pervasive Developmental Disorder (PDD)	Pervasive Developmental Disorder (PDD)
Autistic disorder	Childhood autism *Also referred to as:* Autistic disorder Infantile autism Infantile psychosis Kanner's syndrome
Asperger's disorder	Asperger's syndrome

Sources: American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association. World Health Organization. (1992). *International statistical classification of diseases and related health problems*. (Vol 1). Geneva: World Health Organization.

A brief explanation of the key terms currently used by the two main classification schemes now follows.

Pervasive developmental disorders (PDD)

This umbrella term is used by both DSM-IV-TR and ICD-10 to describe:

> A group of disorders characterized by qualitative abnormalities in reciprocal social interactions and in patterns of communication, and by a restricted, stereotyped, repetitive repertoire of interests and activities. These qualitative abnormalities are a pervasive feature of the individual's functioning in all situations (World Health Organization, 1992, p.375).

The description given by DSM-IV-TR is very similar, but expands stating that the impairments are relative to the individual's mental age or developmental level (APA, 2000).

Autistic disorder

Autistic disorder is the term used in DSM-IV-TR to refer to a PDD where there is "the presence of markedly abnormal or impaired development in social interaction and communication and a markedly restricted repertoire of activity and interests" (APA, 2000, p.70). The diagnostic criteria for autistic disorder as set out by DSM-IV-TR (APA, 2000) are demonstrated in Appendix 1.

Childhood autism

The term 'childhood autism' is used in ICD-10 to refer to this PDD which it describes as:

> A type of pervasive developmental disorder that is defined by: (a) the presence of abnormal or impaired development that is manifest before the age of three years, and (b) the characteristic type of abnormal functioning in all the three areas of psychopathology: reciprocal social interaction, communication, and restricted, stereotyped, repetitive behaviour. In addition to these specific diagnostic features, a range of other non-specific problems are common, such as phobias, sleeping and eating disturbances, temper tantrums, and (self-directed) aggression (WHO, 1992, p.376).

Other terms which are used interchangeably with childhood autism in ICD-10 are autistic disorder, infantile autism, infantile psychosis and Kanner's syndrome. The diagnostic criteria for childhood autism as per ICD-10 (WHO, 1993) are set out in Appendix 2.

Asperger's disorder

The term Asperger's disorder is used in DSM-IV-TR to refer to the condition described by Hans Asperger and is classified as a PDD. This classification scheme states that Asperger's disorder can be differentiated from autistic disorder by "the lack of delay or deviance in early language development. Asperger's disorder is not diagnosed if criteria are met for autistic disorder" (APA, 2000, p.74). The main features of Asperger's disorder are noted to be "severe and sustained impairment of social interaction and the development of restricted, repetitive patterns of behavior, interests, and activities" (APA, 2000, p.80). The diagnostic criteria for Asperger's disorder as per DSM-IV-TR (APA, 2000) are set out in Appendix 3.

Asperger's syndrome

The term Asperger's syndrome is used in the ICD-10 classification scheme to refer to the condition described by Hans Asperger. Like the DSM-IV-TR classification, ICD-10 categorises this disorder as a PDD. The diagnostic criteria for Asperger's syndrome as set out in ICD-10 (WHO, 1993) are demonstrated in Appendix 4.

It can be seen from these brief explanations and from the diagnostic criteria set out in the appendices that there is strong agreement between the two classification systems. Whilst there are clearly differences between the manifestations of autism and Asperger's syndrome (e.g. no significant delay in language for Asperger's syndrome), differences which do exist between the actual classifications are very slight and really come down to differences in terminology. Whilst some consider that diagnostic labels are not always essential (Aarons & Gittens, 1999), it can be argued that diagnosis does provide an important starting point from which an understanding of the basic difficulties faced by individuals with autism can begin. In particular a diagnosis may prove most helpful to educationalists, when making decisions regarding the most suitable teaching approach to follow (Jordan & Powell, 1995). The fact that differences between the conditions of autism and Asperger's syndrome are not generally agreed upon is not an issue for this study. The main concern is that all individuals on the autistic spectrum suffer to varying degrees from difficulties relating to impairments of social interaction, communication and imagination. In particular, intolerance of change is a characteristic of both subgroups and, therefore, a central concern of this research.

2.1.4 Diagnosis

Diagnosis of autism is very strongly symptomatic, that is, based on the individual's behaviour. It is important, therefore, that diagnosis is made by someone with clinical knowledge of typical childhood development patterns (Frith, 1989). Baird, Charman, Cox, Baron-Cohen, Swettenham, Wheelwright, and Drew (2001) advocate a multidisciplinary approach to assessment with involvement from, for example, paediatricians, speech and language therapists, clinical psychologists, and physiotherapists. Assessment must be rigorous in order that other similar conditions may be excluded. A series of assessments are generally performed and consist of intelligence testing, language testing and medical and neurological examination (Baron-Cohen & Bolton, 1993). All available sources of data relating to the child should be reviewed and in addition, the child's behaviour should be assessed in at least two settings as behaviour can vary noticeably in different locations (Baird et al., 2001).

In some cases parents may notice that something is unusual with their child at an early age. For example, there may have been a significant lack of interest in social interaction from the infant. However, expressions of autism vary a great deal, being very much dependent on an individual's developmental level and chronological age (APA, 2000) as well as environment or setting (Baird et al., 2001; Mesibov, Shea, & Adams, 2001). It is not surprising, therefore, that it is often the case that parents will not be aware of anything unusual with their child until around the age of three years.

Although diagnosis is rarely made before the age of three, awareness of the condition of autism has grown and it is suggested that reliable diagnosis of autism can now be made in children as young as 2 years of age (Charman & Baird, 2002). However, because autism is a developmental disorder, diagnosis is generally more reliable the older a child is (Frith, 2003). The development of more accurate and sensitive assessment tools, such as the Autistic Diagnostic Interview – Revised (ADI-R), the Autism Diagnostic Observational Schedule (ADOS-G) and the Diagnostic Interview for Social and Communication disorders (DISCO) has meant an increase in standardisation of diagnosis and has lessened the dependence on clinical judgment (Medical Research Council, 2001).

Mesibov et al. (2001) assert that early diagnosis is valuable for several reasons. Firstly, diagnosis allows differentiation between alternative conditions, enabling the most appropriate management for an individual to be determined, such as for example, whether there is a need for special education. Secondly, receiving a diagnosis can assist a family to understand their child much better, by helping them to see specific behaviours as being part of the disability. Thirdly, a diagnosis will aid a family when it comes to finding support from others in a similar situation. Lastly, receiving a diagnosis may assist a family in planning for the future, for example with regards to supervision or finances (Mesibov et al., 2001). Baird, Cass, & Slonims (2003) suggest that there is evidence that early suitable intervention can improve outcomes for many individuals with autism. Clearly, therefore, there is a strong indication that early diagnosis is advantageous.

2.1.5 Prevalence

The condition of autism was originally thought to be rare. However, there has in recent years been much debate concerning the prevalence of autism (Paul, 2004). Generally, the view is that autism appears far more common than was originally believed (MRC, 2001). Wing (1997b) however, suggests that differences in prevalence rates can be explained by several factors. For example, there may be differences in methodologies employed by different epidemiological studies. Furthermore, there has been a change in referral practices in Britain, a widening of diagnostic criteria and increased general awareness of the manifestations of autism as a whole (Wing 1997b).

There have been several significant epidemiological studies and these are now summarised. A study conducted by Lotter in 1966 estimated a rate of 4.5 cases of autism per 10,000 children, whilst a study conducted in the London Borough of Camberwell by Wing and Gould in 1979 found a similar rate of 5 cases per 10,000 children (Cumine et al., 1998). Initially, Wing and Gould used criteria as set out for Kanner's autism and with an Intelligence Quotient (IQ) level of less than 70. When the criteria was broadened to include children within the broader spectrum an additional rate of 15 cases per 10,000 was found, which made the rate for the Camberwell study 20 cases per 10,000 (Wing & Gould, 1979). Ehlers and Gillberg (1993) attempted to establish the prevalence of Asperger's syndrome in the Swedish town of Gothenburg and found a rate of 36 cases per 10,000. A further study conducted by Ehlers and Gillberg in Sweden in 1996 also found a prevalence of Asperger's syndrome and other autistic spectrum disorders (IQ above 70) to be at a rate of 36 cases per 10,000 children for those with Asperger’s syndrome and 35 per 10,000 for those with social impairment (Cumine et al., 1998). More recently, studies in other countries have found prevalence rates for autistic disorder ranging from 0.7 cases to 72.6 cases per 10,000 children (Fombonne, 2005). Generally studies of prevalence have indicated that there is a greater number of boys affected by the condition than girls, with a 3 to 4 times higher occurrence being reported in males (Cumine et al., 1998; Shastry, 2005; Wing, 1997b).

2.1.6 Aetiology

No one specific cause of autism has been identified; rather a variety of factors have been suggested (Baron-Cohen & Bolton, 1993; MRC, 2001). Early thoughts were that autism might be the outcome of abnormal parenting, however, since the 1960s these early views have been discredited (Volkmar & Klin, 2005). Overwhelming evidence now suggests that there is both a biological foundation as well as a strong genetic component to the condition (MRC, 2001; Rapin, 1997; Volkmar & Klin, 2005). The Medical Research Council (2001) describe how certain factors may be associated with autism, but are not actually contributory; causes of medical disorders are generally very complex, involving the interaction of several factors. As yet no biological test to determine autism exists (Baird et al., 2003; Paul, 2004). Suggested factors which are thought to be causally related to autism are now put forward.

2.1.6.1 Genetic component

Research indicates that autism is highly heritable and that there is a greater risk of autism between siblings (APA, 2000; Peeters & Gillberg, 1999). Much work has been carried out in this particular area (see for example, Baird et al., 2003; MRC, 2001; Peeters & Gillberg, 1999; Piven & Folstein, 1994). Studies with twins have indicated a higher rate of autism in monozygotic (identical) twins, suggesting a very strong genetic involvement in the condition (Baird et al., 2003; Peeters & Gillberg, 1999; Rutter, 2000; Shastry, 2005). A study of autistic traits in twins versus non-twins by Ho, Todd, and Constantino (2005) found that male-male twin pairs were more inclined to demonstrate autistic symptoms than non-twins (Ho et al., 2005).

2.1.6.2 Associated medical conditions

There are no known physical markers of autism (Baird et al., 2003; MRC, 2001). However, in a minority of cases autism has been found to co-occur with other identifiable conditions. Examples of medical conditions found to be strongly associated with autism include Fragile X syndrome, Downs's syndrome and Rett's syndrome (MRC, 2001; Peeters & Gillberg, 1999). Other medical conditions which have been found to have some association with autism, but which have no evidence of causation include Tuberous Sclerosis, Turner's syndrome, epilepsy, cerebral palsy, sensory impairment of hearing and vision, neurofibromatosis, congenital rubella, phenylketonuria, and certain forms of chromosomal abnormalities (MRC, 2001; Peeters & Gillberg, 1999). Generally speaking, such conditions are found to impair the brain functions necessary for normal social, communicative and imaginative development and so it is important to identify or exclude these conditions when making a diagnosis of autism (Peeters & Gillberg, 1999). An association with epilepsy and autism has been established (Minshew, Sweeney, Bauman, & Webb, 2005; Tuchman, 2000), with studies demonstrating that 1 in 5 to 1 in 6 pre school individuals with autism have developed epilepsy during their first few years of life (Peeters & Gillberg, 1999). Furthermore, epilepsy can emerge in individuals with autism at puberty (Minshew et al., 2005; Tuchman, 2000).

2.1.6.3 Environmental risk

There is speculation that certain environmental factors may cause autism, but little direct evidence has been found to substantiate such claims. Factors suggested include pre-natal risks such as maternal rubella, phenylketonuria, the taking of certain drugs during pregnancy by the mother (e.g. anticonvulsants and thalidomide) and certain post natal infections (Aarons & Gittens, 1999; Baird et al., 2003; MRC, 2001). There is much debate and controversy in this area, as the following examples illustrate:

- A study by Eaton, Mortensen, Thomsen, and Frydenberg (2001) found a strong association between lower birth weight and premature infants, and both autism and Asperger's syndrome
- The Medical Research Council (2001) reports that obstetric complications are more likely to be a consequence than a cause of autism in an infant, citing studies such as Nelson (1991) and Bolton, Murphy, Macdonald, Whitlock, Pickles, and Rutter (1997) (cited in MRC, 2001, p. 25)
- The American Psychiatric Association (2000) suggests that if brain damage were suffered by an infant during pregnancy, delivery, or in the post natal period, then this may be a contributory factor in some cases
- Croen, Grether, and Selvin (2002) conducted a study in California, which looked at risk factors for autism and maternal characteristics. The study found that strong genetic influences in the autistic condition could combine with certain environmental risk factors, such as maternal hormone levels, maternal diet and early prenatal care, to increase the overall risk of autism (Croen et al., 2002)

2.1.6.4 Risk factors in childhood

It has been suggested that there may be a link between certain viral infections and autism, for example, herpes simplex, cytomegalovirus and congenital rubella (Aarons & Gittens, 1999; MRC, 2001).

Immunisation programmes such as the measles, mumps and rubella (MMR) inoculation have in recent years been linked with autism, although there is no firm evidence to suggest an association (Shastry, 2005). A paper by Wakefield, Murch, Anthony, Linnell, Casson, Malik, Berelowitz, Dhillon, Thomson, Harvey, Valentine, Davies, and Walker-Smith (1998) published in the Lancet, and given a great deal of media publicity, suggested a causal link between MMR and autism. However, no evidence to support this claim has been found to date. Indeed, Fitzpatrick (2004) states:

> Although it is not known what does cause autism, it is clear as anything can be that MMR does not cause it. The theory that MMR causes autism is inconsistent with what is known about autism. ….. autism existed before MMR and, whatever the reason for the rise in the numbers of children diagnosed as autistic, this does not correlate with exposure to MMR (Fitzpatrick, 2004, p. 6-7).

An epidemiological study carried out by Taylor, Miller, Farrington, Petropoulos, Favot-Mayaud, Li, and Waight (1999) to investigate trends in autism before and after the MMR immunisation programme in an area of North East London, found no support for a causal association between the MMR vaccine and autism. Taylor et al. (1999) concluded that if indeed there were such an association then it must be very rare.

2.1.6.5 Other risk factors

Mercury has been known for some time to affect the developing brain and result in a variety of problems affecting motor skills. However, there is no conclusive evidence linking mercury to autism (MRC, 2001). Pre-natal scanning and other technological approaches to child birth have been indicated, whilst environmental pollutants have also been suggested as potential risk factors (Aarons & Gittens, 1999). Interest currently focuses on a link with hormones which affect early brain development (MRC, 2001).

2.1.6.6 Suggested physiological and neurological abnormalities

Certain physiological abnormalities have been linked with autism. For example, there have been a number of studies which have shown intestinal abnormalities in individuals with autism (MRC, 2001). Consequently, parental interest in this particular area has led to some children with autism being placed on gluten or casein free diets. There have been some reports of improvements in behaviour with use of such diets, but these have been based on single case studies and personal accounts, so are questionable (MRC, 2001).

No one specific area of the brain has been conclusively indicated as accounting for the wide range of presenting features of autism, rather there are thought to be multiple neurological deficits (MRC, 2001). In particular, several key brain structures have been implicated regarding the deficit in social cognition: the amygdala, the superior temporal sulcus region and the fusiform gyrus (Shastry, 2005). The amygdala is situated in the medial temporal lobe of the brain and is associated with emotion (Shastry, 2005), cognition and social behaviour (Minshew et al., 2005). Abnormality of the amygdala has been considered, especially in view of the fact that social impairment is a key symptom of autism. However, studies in this area have so far been inconclusive (Minshew et al., 2005).

Certain functional abnormalities related to neurochemistry have also been put forward as being causal. It has been suggested that increases in levels of serotonin have been found to have an influence and a variety of studies related to this area are described by Aarons and Gittens (1999) and the MRC (2001).

2.1.6.7 Psychological theories

There are currently three prominent psychological theories of abnormality linked with autism. Firstly, the Theory of Mind theory (ToM) suggests that individuals with autism have impairment in their ability to understand and predict the behaviour of others (Baron-Cohen, 1995; Baron-Cohen, Leslie, & Frith, 1985).

Secondly, Executive Function theory (EF) suggests that behaviour control is impaired in individuals with autism, resulting in difficulties with the planning and controlling of behaviour. As a consequence, rigidity of behaviour and thought processes is frequently demonstrated by individuals with autism (MRC, 2001). A strategy commonly used to assist in addressing this difficulty and of particular relevance for this study, is the use of a visual timetable, which attempts to provide structure to the child’s day (Mesibov et al., 1994).

Thirdly, the Central Coherence theory (CC) attempts to explain the uneven profile of abilities and difficulties which exist in individuals with autism. Essentially CC is the everyday tendency human beings have to put information together, to gain a higher-level meaning, that is to say, the gist of a story rather than all the exact details (MRC, 2001). In individuals with autism, impairment in CC presents as an increase in focusing on detail, rather than 'seeing' the whole picture. These three theories are discussed in greater detail later (section 2.2.2).

2.1.7 Areas of difficulty

The common difficulties which individuals with autism experience are related to the 'triad of impairments'. As discussed later (section 2.2.1), these difficulties are associated with impairments in social interaction, communication and imagination (Wing, 1996b). In addition, many individuals with autism suffer from an unusual sensitivity to sensory stimuli, difficulty with attention span and motivation levels, and some individuals endure high levels of anxiety, together with special fears (Wing, 1996b). These issues are discussed in greater detail in section 2.2.

2.1.8 Conclusion

To summarise, autism is a pervasive and lifelong developmental disorder, which has been found to exist as a continuum. Individuals experience disability to varying degrees, from mild to severe. There has been a general broadening of the concept of autism over recent years, together with an increase in awareness of the condition and as a result the classification schemata have become much more consistent. Diagnosis is generally not made before the age of 3 years, but since the development of more sensitive diagnostic assessment tools, diagnosis can be made as young as 2 years of age. It is generally agreed that early diagnosis is important in order that both the child and their family can achieve the best possible outcome in terms of assistance and education. No one specific cause has been found for this condition, but much research has been conducted in many areas and a variety of potential risk factors have been identified.

This section has provided a general background to autism and from this certain factors of particular relevance to this study can be noted. The classification schemata illustrate that there are varying degrees of the autistic condition. However, it can be seen that individuals with autism share characteristics and in particular an intolerance to change. This issue is of particular relevance for this study and a factor which use of an interactive timetable could possibly address. A further matter of note is that there is an increase in the awareness of the autistic condition, together with a move toward earlier diagnosis, suggesting the importance of investigating potential strategies for assisting individuals with autism. Finally, it can be seen that research is being conducted in many areas regarding those with autism; whilst it is necessary to gain a deeper understanding of the autistic disorder and to develop means of assisting individuals this is a matter of concern. There is the likelihood that many children with autism and their families have been approached to participate in research of some nature. The researcher recognises that this is a sensitive and emotional area and acknowledges the need to respect the wishes of those participating in this study.

2.2 Areas of difficulty faced by individuals with autism

This section of the literature review discusses the key problems which individuals with autism confront. The section begins by discussing in greater detail the 'triad of impairments' referred to in the preceding section as being a principal area of difficulty. In addition, problems regarding repetitive behaviour, sensory stimuli, and anxiety and fears are considered. The implications of these problems for children with autism are discussed and current approaches towards assistance are briefly noted. Strategies for assistance are discussed in greater detail in chapter three.

2.2.1 The triad of impairments

As established earlier (section 1.3), the 'triad of impairments' is the term commonly used to refer to a group of three specific areas of social deficit found to occur in individuals with autism. Despite variations in the expression of autism among individuals, the common problems which affect social interaction, communication and imagination, are believed to influence all those with autism (Wing, 1996b).

> The triad can occur on its own but is often accompanied by other features. It can be found together with any level of ability, from profound general learning disability to average or even superior cognitive skills in areas not directly affected by the basic impairments. It can occur with any other physical, psychological, or psychiatric condition (Wing, 1997b, p.1761).

A summary of the 'triad of impairments' is set out in table 2.2. The levels listed in the table begin with a description of the more severely impaired at level one and progress to less impaired children described under level four. However, it should be stressed that individuals vary greatly in ability levels and children will be found who function at any stage of these categories (Aarons & Gittens, 1999).

Table 2.2

The 'triad of impairments'

IMPAIRMENT OF SOCIAL INTERACTION

1. Aloofness and indifference to others
2. Accepting of social approaches by others (passive)
3. Makes social approaches to others which are one-sided, and may be to indulge strange and unusual interests, e.g. railway timetables, vacuum cleaners, lavatory disinfectants, airport X-ray scanners, the marks socks make on ankles, etc.
4. Makes social contact, but lacks understanding of subtle rules of social behaviour

IMPAIRMENT OF SOCIAL COMMUNICATION

1. Absence of any desire to communicate with others
2. Communication confined to the expression of needs only
3. Makes factual comments, not part of a social exchange, and often irrelevant to the social context
4. Talks a great deal, but regardless of response of listeners, and has difficulty in engaging in reciprocal conversation. (This can be very subtle indeed, especially in individuals who have had access to social skills training)

IMPAIRMENT OF SOCIAL IMAGINATION

1. Copying and pretend play are absent
2. May copy the actions of others, but without real understanding of their meaning and purpose (may bath doll, make pretend cups of tea for example)
3. Repetitive and stereotyped enacting of a role, but without variation or empathy, e.g. a TV character, or even an object such as an aeroplane
4. Awareness that things go on in the minds of others, but has few strategies to discover what these may be. (Minimally affected people appear to have ability to recognise others' feelings, but this is learnt rather than empathetic)

Source: Aarons and Gittens, 1999, pp.8-9.

2.2.1.1 Impairment of social interactions

Social interaction implies an engagement with other human beings in a reciprocal and social way. It is a process which "involves participants altering their behaviour to adapt to the activities of a partner, and in doing this a coherent sequence of activities is created" (Messer, 1994, p. 36). Impairment in social interaction is reported to occur in 21.2 cases of every 10,000 children under the age of 15 (Wing & Gould, 1979). When there is a neurological impairment such as that found in individuals with autism, difficulties in developing social relationships and interacting with other people can occur (Waterhouse & Fein, 1997).

Main features

In great contrast to typically developing infants, the child with autism finds little interest in social interaction or the social environment (Volkmar, Carter, Grossman, & Klin, 1997b). There is a perceptible lack of attention to others and in particular, people are treated by individuals with autism as if they were objects (Baron-Cohen & Bolton, 1993). In fact during assessment many parents report retrospectively signs of social deviance arising in the first few months of life.

A particular feature which may be observed is a lack of eye contact, or an abnormal eye gaze (Baron-Cohen & Bolton, 1993; Volkmar et al., 1997b). It was originally believed that individuals with autism avoided eye contact, but lately it has been suggested that eye contact is affected by situational factors, such as structured interaction by an adult, or the nature of task demands (Volkmar et al., 1997b). It is generally believed that individuals with autism are unable to understand how to use eye-contact to communicate with other people and so are unable to read the intentions of others in their eyes (Baron-Cohen & Bolton, 1993; Volkmar et al., 1997b).

A general lack of awareness or empathy for the feelings of others is another feature common to individuals with autism. Baron-Cohen and Bolton (1993) describe how many children with autism pay attention to the non-social aspects of people. For example, individuals with autism may know the names and detailed information about certain people, but at the same time fail to enter into any kind of social relationship with such persons (Baron-Cohen & Bolton, 1993).

An absence or oddness of attachment is another noticeable feature of this particular impairment (Volkmar et al., 1997b). Although an individual may not be able to form social attachments, an attachment to a particular object may be formed instead, with particular interest in the smell, taste and feel of such an object.

One feature which is very distinctive in autism is a lack of ‘joint attention’. This refers to a situation where individuals fail to point out things to other people, such as parents or peers. There is no sharing or showing of things to others (Kent, 2004).

Frith (2003) suggests that coordination of gaze and attention reflects not just a joint interest in an object, but also an awareness of the other person's attitude towards the object. This lack of 'joint attention', therefore, implies a significant impediment in the ability to engage others socially (Baron-Cohen & Bolton, 1993; Volkmar et al., 1997b). Measures of joint attention are included in the current diagnostic instruments.

Categories of social behaviour

A study by Wing and Gould (1979) discussed earlier (sections 2.1.2 and 2.1.5), rated social behaviour observed during the Camberwell study under four distinct headings. These were social aloofness, passive interaction, active-but-odd interaction, and appropriate interaction (Wing & Gould, 1979; Wing, 1997a). These four distinct groupings of social interaction are now summarised.

Social aloofness

Wing and Gould (1979) found individuals placed within this group to have very severe impairment of social interaction; these children behaved as though other people did not exist. This is probably the most common type and most easily recognisable variant of autism seen in young children and is the category which fits most closely to the ICD-10 definition (Wing, 1996b; 1997a). Individuals who are considered to fit into this category have moderate to mild learning difficulties and some have higher levels of skill in specific areas; some individuals remain socially aloof, while others change as they mature (Wing, 1996b; 1997a).

Passive interaction

Children participating in the Camberwell study identified as passive did not make social contact spontaneously, but did accept approaches made by others (Wing & Gould, 1979). This was found to be the least common type of social interaction. Children who behaved in this way would be classified as having childhood autism or atypical autism, while others would fit the definition of Asperger's syndrome according to ICD-10 criteria (Wing 1996b; 1997a). Children classified under this heading are likely to have the least behaviour problems out of the four groups;

although it is believed that some might alter their behaviour in adolescence (Wing, 1996b). Impairment of communication and imagination are both likely for this group, whilst it is considered that ability is likely to be average or above average (Wing, 1997a).

'Active but odd' interaction

In the Camberwell study, children who did make social approaches of their own accord were categorised as 'active but odd'. Interaction by such individuals is usually made in a one-sided fashion and tends to be mostly with a person in authority (Wing, 1996b). It was observed in the Camberwell study that the behaviour of these children was generally inappropriate and was mainly perceived as taking place in order to indulge a repetitive preoccupation (Wing & Gould, 1979; Wing 1996b). Children who are categorised as 'active but odd' have no interest in others and do not feel anything regarding the needs of others; consequently, such individuals are likely to be less socially accepted (Wing & Gould, 1979). These individuals tend to fit Asperger's clinical description; speech may often be fluent, but repetitive and not reciprocal. A minority who fall into this category may have no history of delayed speech development and these individuals are generally classified as having Asperger's syndrome according to ICD-10 criteria (Wing, 1997a; 1997b). Individuals within this grouping may have special interests, which change from time to time. Also, there may be behaviour difficulties, which arise due to egocentricity and a resistance to doing something other than preferred activities (Wing, 1997b). Levels of cognitive ability appear to be higher for this group than for the aloof group (Wing, 1997b).

Appropriate interaction

Children rated under this category showed appropriate social interactions for their mental age and in addition used eye contact, facial expression, and gesture (Wing & Gould, 1979). As a rule this style of interaction is not seen until late adolescence or adulthood. It tends to be seen in those who are most able and who have a good level of language. Wing (1996b) describes how these individuals are inclined to be very polite and formal in their behaviour and try hard to stick firmly to the rules of social interaction. Wing (1997a) portrays such individuals as loners, people with average, high, or outstanding ability, and who have fluent speech and a preference for being alone. These individuals lack empathy and are mainly concerned with their own interests (Wing, 1997a).

2.2.1.2 Impairment of social communication

Jordan and Powell (1995) believe that for individuals with autism, the fundamental problem is with communication rather than language as such. Communication is a dynamic process, involving the transfer of information by verbal or non-verbal means (Hargie, Saunders, & Dickson, 1994). Dimensions of communication include the intention to communicate, as well as the accurate comprehension of a communication (Messer, 1994). Jordan (2001) states that there are four basic conditions necessary for communication to take place: something to communicate about (needs and desires), something to communicate with (speech or alternative means), a reason to communicate, and a communicative partner to receive and understand the message. Communication also involves some kind of signal which indicates the intention to communicate and this is something individuals with autism are often unable to provide (Jordan, 2001).

Qualitative impairments in both verbal and non-verbal communication are experienced by individuals with autism, regardless of their level of functioning (Noens & van Berckelaer-Onnes, 2005). Consequently, the normal pattern of development is disrupted in autism and the communication skills which normally precede language are absent. Jordan and Powell (1995) explain that this lack of development of communication ability makes it difficult for children with autism to acquire language, as communication is normally the prime means for learning language. Lord and Paul (1997) state:

> Knowledge about human communication is central to the theoretical principles and clinical practice in the field of autism. Milestones in language and communication play a major role in evaluating development and understanding autism (p. 195).

Language and communication ability varies greatly from individual to individual. Howlin (1997) states that certain individuals with autism may have well developed spoken language, but unfortunately may have considerable difficulty in understanding what is being said to them. Often it is very difficult for other people to appreciate the extent of the impairment of communication which individuals with autism experience and consequently, the behaviour of those with autism is frequently misunderstood (Howlin, 1997). For example, children with autism are often perceived as being deliberately uncooperative, rude, or even unintelligent, when in fact they may simply not have understood what has been said to them.

Essentially there are three specific areas where problems of communication arise for individuals with autism. These are a lack of preverbal communication, abnormalities of non-verbal communication, and abnormalities of speech and language.

Lack of preverbal communication

Lock (2004) describes how preverbal communication in the typically developing child goes through three specific stages during the first year of life. The first stage normally occurs at around 2 months of age, when the infant begins intentional communication with adults, through eye gaze (Lock, 2004). In the fifth month, infants normally lose interest in face-to-face interactions and instead become interested by objects which they can manipulate. The third transition stage of preverbal communication occurs at around 9 to 10 months and involves a connection between the infant’s interest in objects and their realisation that people can assist them in achieving their goals (Lock, 2004).

In infants with autism, there is a significant deficit in preverbal communication. As discussed earlier (section 2.2.1.1), reciprocal eye gaze and ‘joint attention’ are both lacking in infants with autism, which means that they are unable to achieve preverbal communication with their parents at this stage of development. Eye contact is a very important signalling mechanism, which is needed for adjusting the flow of communication (Davies, 1997; Hargie et al., 1994).

Abnormalities of non-verbal communication

Typically developing infants express non-verbal communication by means of simple gestures such as reaching toward someone or something (a request), or pushing away from someone or something (rejection), and in due course exhibit more complex gestures such as pointing a finger, or shaking the head (Camaioni, 2004; Lord & Paul, 1997; Ozonoff & South, 2004). Camaioni (2004) reports that when a child makes gestures such as these, eye contact or gaze alteration normally accompany the gestures.

Wing (1996b) describes how individuals with autism are impaired in using alternative methods of communication such as facial expressions, gestures, and bodily movements. Simple gestures such as a head shake or nod may develop, but more complex gestures are rare and individuals have as much trouble understanding non-verbal communication as they have in using it (Wing, 1996b). One significant difficulty with the lack of non-verbal communication by children with autism is that there is no feedback from the child. Consequently, parents and others have great difficulty in interpreting whether communication has been effective and also whether an interaction has been pleasing to the child or not (Davies, 1997). Another concern is that the lack of ability to point to objects by children with autism inhibits the learning of language, as a mother's normal response would be to name the object which the child has pointed to (Davies, 1997).

Abnormalities of speech and language

In typically developing children there are several reasons why speech and language may be disordered. For example, an individual may have a cognitive impairment, which has led to a delay in acquiring speech and language. Alternatively, there may be a specific language impairment which has no obvious cause. For individuals with autism impairments in the use of speech and language are characteristic features. Specific features of autism which are linked to speech and language abnormalities are rigidity of thought processes and a lack of social awareness (van der Gaag, 1996).

A significant feature of autism is an absence or delay in acquiring speech and language (Kent, 2004). It is very often this aspect which first raises parents' concerns about their child. Acquisition of language varies greatly among children with autism and a small minority (less than 20%) never develop language at all (Tager-Flusberg, Paul, & Lord, 2005). None of the children participating in this study fell into this category and so absence in acquiring language will not be considered further here.

Generally individuals with autism who do develop spoken language tend to begin later than the developmental milestone, which is normally around 12 months for the first spoken word (Lord & Paul, 1997) and develop speech at a slower rate than typically developing children (Tager-Flusberg et al., 2005). Difficulties with speech and language vary in severity (Wing, 1996b). A lack of comprehension as well as difficulties with expression, leads to problems occurring in the way in which individuals use the speech and language that they do have. In addition, Davies (1997) suggests that a lack of interest in speech by the child with autism has the effect of causing parents to become de-motivated in attempting to maintain conversation. There are reported to be two language profiles found in verbal children with autistic spectrum disorder (Tager-Flusberg et al., 2005):

- Children with autism and normal linguistic abilities (intact syntax, morphology, phonological skills, and vocabulary)
- Children with autism and impaired language, similar to the phenotype of specific language impairment (SLI)

Language has typically been thought of as having several domains, each of which develop in parallel in the typically developing child. These domains are now discussed in relation to children with autism.

Articulation

Articulation refers to the production of speech sounds (Messer, 1994). For verbal children with autism articulation is frequently normal, although some individuals sound precocious (Tager-Flusberg et al., 2005). For example, some individuals may have an odd sounding tone or inflection to their voice, with variations in quality and either normal or precocious articulation (Lord & Paul, 1997). In particular speech may sound monotonous or exaggerated (McCann & Peppé, 2003) and have a ‘robot’ like quality. In addition, volume control is an issue and speech is often very loud

(Klin & Volkmar, 1997; Lord & Paul, 1997; Noens & van Berckelaer-Onnes, 2005). In particular, those with Asperger's syndrome may have a constricted range of intonation and an unusual rate of speech, which may be too fast, jerky, or lacking in fluency (Klin & Volkmar, 1997; McCann & Peppé, 2003). Wing (1996b) reports that some individuals with autism have a 'special' voice and believes this may be as an attempt to rehearse different ways of speaking. McCann and Peppé (2003) discuss the relevance of prosodic reception in relation to theory of mind (ToM), suggesting that children with autism have difficulty understanding prosody of a second person, due to an inability to comprehend mental states. Although intonation problems may lessen as the child grows older, there may still be a quality to the speech which makes it difficult for the listener to understand or interpret (Howlin, 1997). This can cause problems in every day life and can also affect the way in which other people perceive the individual. For example, the speech style of the individual with autism may cause them to appear aggressive, boring, or unintelligent to others, even though this may not actually be the case. Differences in intonation of speech can lead to children with autism being regarded as different and may have unpleasant consequences, such as occasions of teasing and even bullying (Howlin, 1997).

Word use (semantics)

Semantics is the study of meaning in language and is concerned with the conventional interpretation of words (Messer, 1994). Camaioni (2004) states "acquiring language is an active process in which infants build their knowledge and construct meanings on the basis of experiences with objects and interaction with people" (p. 405). Impairments in social interaction and in communication mean that children with autism have less opportunity and less experience to build on than typically developing children. Consequently, semantic development is problematic, with immediate or delayed echolalia, pronoun reversal, and difficulties with figurative language continuing to be present (Kent, 2004; Lord & Paul, 1997). Individuals may continue to find it difficult to find the correct form of words for what they are trying to say, and so speech may continue to be odd and sound out of place, even when the child becomes an adolescent (Howlin, 1997). Also, a tendency to interpret whatever is said literally may lead to children with autism sounding rude or abrupt when responding to a comment. Some children with autism can develop a large vocabulary, particularly those with Asperger's syndrome. However, while some individuals may have a good range of vocabulary, they may actually speak very little. Others are noted to use old-fashioned words (Wing, 1996b). Howlin (1997) observes that use of vocabulary may be out of keeping with the child's age group, social group or family background, which can make fitting in even harder for the child with autism. Having a good range of vocabulary can also convey the wrong impression about the child and it is quite common for individuals with autism to be perceived as being at a higher level of intelligence than they actually are (Howlin, 1997).

Language use (pragmatics)

The actual use of language can be a considerable problem for those with autism. This is referred to as 'pragmatics' and is defined as "the study of language from the point of view of the users, especially of the choices they make, the constraints they encounter in using language in social interaction, and the effects their use of language has on the other participants in an act of communication" (Crystal, 2003, p.364). To be able to use language appropriately it is necessary to be able to take account of the communicative partner. However, due to difficulties with social interaction as discussed earlier (section 2.2.1.1) this is a significant problem for individuals with autism. Pragmatic difficulties are experienced in both non-verbal and verbal communication by individuals with autism, with higher-functioning individuals experiencing difficulties mainly with conversation (Noens & van Berckelaer-Onnes, 2005). Difficulties with pragmatic ability affect the way in which individuals with autism are able to organise language to enable a listener to understand what they are saying and similarly affect the individual's ability to comprehend a speaker's conversation (Volkmar et al., 1997b). As a result individuals may use inappropriate dialogue for the social context. As discussed earlier in section 2.2.1.1 and previously in this particular section, use of language by those with autism is affected by several factors:

- lack of awareness of others

- lack of ability to recognise the need to moderate output
- lack of recognition that others may not understand them
- a tendency to take things literally (i.e. not to understand the use of metaphors, idioms, humour, and sarcasm)

Three particular areas of difficulty with language use are now briefly outlined. These are echolalia, idiosyncratic use of words, and reversal of pronouns.

Echolalia

The occurrence of echolalia is one of the most prominent features of speech and language abnormality in autism and is considered a classic symptom (Howlin, 1997; Lord & Paul, 1997; Noens & van Berckelaer-Onnes, 2005). However, not all children with autism present echolalia and Lord and Paul (1997) report that this communication impairment is also seen in other disorders. Echolalia is essentially the repetition of words or phrases which someone else has just spoken and generally the child will use exactly the same intonation or accent as the original speaker (Kent, 2004; Wing, 1996b). Echolalia may be immediate, where a word or phrase may be repeated straight away, or delayed, where a phrase heard in the past may be repeated by the child (Howlin, 1997; Wing, 1996b).

While the words or phrase may have little actual meaning to the child, it is believed that echolalia does in fact serve a communicative function, although it is suggested this may only be the case if it is with a frequent communication partner (Prizant, Schuler, Wetherby, & Rydell, 1997). Functions suggested are turn-taking, making assertions, assenting to answers, making requests, enabling rehearsals, and self regulation (Prizant & Duchan 1981, cited in Lord & Paul, 1997). Howlin (1998) also suggests echolalia may serve to indicate a lack of comprehension. Wing (1996b) reports that some children remain at the stage of using echolalia indefinitely, while others move on to use spontaneous phrases. Howlin (1998) notes that echolalia tends to occur or increase when individuals are particularly stressed or anxious, or in situations where they may feel very constrained and recommends assessing the role of echolalia for each individual before making any attempt to modify this type of behaviour. Use of echolalia is of particular relevance for this study, where consideration of anxiety related behaviour was a concern during the evaluation stage.

Idiosyncratic use of words

Wing (1996b) explains how a child with autism may constantly use the same phrase or sentence in a particular situation because that was how it was first heard. Lord and Paul (1997) describe how children with autism may also modify ordinary word roots. For example, a child may use an odd sounding word which is still understandable, such as in 'cuts and bluesers' for cuts and bruises (Lord & Paul, 1997). Those with Asperger's syndrome and high-functioning autism may be noted to speak in a pedantic and very precise manner which may relate to rigidity of thought (Lord & Paul, 1997).

Reversal of pronouns

Confusion or interchanging of personal pronouns is frequently observed in children with autism and can occur in conjunction with echolalia (Lord & Paul, 1997; Wing, 1996b). When occurring with echolalia, this is generally believed to be as a result of the child copying the exact words of the speaker, saying for example, 'do you want a drink?' when in fact a child may be signalling that they want a drink themselves. An alternative theory suggests that the linguistic and informational demands of the communication process may be too great for the child, resulting in the misplacing of pronouns in this way (Lord & Paul, 1997). Frith (2003) argues that pronoun errors are related to the deictic function, with use of pronouns being moderated by who is speaking and who is listening during the communication. The concepts of 'you' and 'I' are very complex and can, therefore, be confusing for children with autism.

Syntax and morphology

Syntax refers to "the study of rules governing the way words are combined to form sentences in a language" (Crystal, 2003, p. 451). Morphology is the study of the internal structure of words. There have been relatively few studies in this area (Tager-Flusberg et al., 2005) and, therefore, little evidence to suggest grammatical aspects of language acquisition are a problem for children with autism. Lord and

Paul (1997) state “syntactic development in autistic children is very likely more similar than dissimilar to normal development. It proceeds at a slower pace and is related to developmental level more than to chronological age” (p. 207).

Comprehension

As mentioned previously, children with autism have difficulty understanding spoken language. This is because individuals lack the ability to integrate non-verbal cues which typically help in aiding comprehension (Tager-Flusberg et al., 2005). For example, a smile or the tone of a person’s voice would assist with situational understanding. Understanding language in varying contexts is challenging for the individual with autism because semantic and pragmatic aspects are closely linked to social communication (Tager-Flusberg et al., 2005). The researcher, therefore, believes that use of a computer-based timetable would be helpful for individuals with autism, with respect to comprehension. The computer has an asocial and context-free environment, discussed later (section 3.2.3.1), and so places no verbal demands on the user. Use of a computer for communication of timetable information for example, would possibly enable individuals with autism to focus on understanding the information presented, without the distraction of non-verbal and situational cues.

Literacy

It is reported that many children with autism develop an early interest in letters and numbers (Tager-Flusberg et al., 2005). Furthermore, written material has been found to be a useful medium for individuals with autism and can be used to increase social and communicative behaviour; for example, written lists, graphic organisers, and social stories have been reported to be beneficial (Tager-Flusberg et al., 2005). An example of use of social stories in a multimedia format is described later (section 3.2.4.1). Deficits in comprehension discussed previously, suggest it is necessary that care is taken to present individuals with texts which are not too complex (Tager-Flusberg et al., 2005).

2.2.1.3 Impairment of social imagination

Pretend play and imaginative activities occur in typically developing infants from around 18 months of age. However, this indication of the development of social imagination is rarely seen in children with autism and if present is very limited (Baron-Cohen & Bolton, 1993; Wing, 1996b). The autistic child 'plays' with toys in an unusual way, mouthing objects, spinning toys, or lining up a series of objects. Children with autism are also noted to have little curiosity about their environment.

The implications of this impairment are significant and children with autism lack the ability to associate past and present experiences in a way which they can conceptualise the future (Wing, 1996b). Jordan (2001) states "in solitary play the child explores the world, finding out about its properties but also finding out about him/herself" (p. 87). Pretend play can be divided into two subcategories: functional play and symbolic play. Functional play is noted to emerge before symbolic play in typically developing children and is where a child uses a toy in a conventional way to perform an act, for example, feeding a doll (Ozonoff & South, 2004). Symbolic play is noted to emerge in the typically developing child from around 20 months onwards (Ozonoff & South, 2004). This form of pretend play is defined as "play in which absent elements are represented through objects, gestures, and language in the play" (Rogers, Cook, & Meryl, 2005, p.391). Essentially, symbolic play concerns the child enacting behaviours in a different context from that which they are normally associated with (Ozonoff & South, 2004). For example, a toy figure may be animated by the child. Typically, it is symbolic play which has been found to be abnormal in children with autism and while there may be impairment in functional play, exactly what is unclear (Ozonoff & South, 2004). Thus the focus has mainly been on symbolic play abnormalities in autism. Marcus and Stone (1993) describe several studies which have investigated play skills of preschool children with autism. Generally it has been found that children with autism demonstrate less variety and less make believe elements in their play when compared with typically developing children; parental reports were found to be consistent with results of such studies (Marcus & Stone, 1993).

Restricted, repetitive and stereotyped behaviour patterns

Repetitive behaviours are perceived to be a consequence of the impairment of social imagination and a key feature of autism, although not all children with autism are found to display this behaviour (Baron-Cohen & Bolton, 1993; South, Ozonoff, & McMahon, 2005). Volkmar et al. (2004) note that repetitive behaviours have been found to be less common in very young children with autism and similarly less common in adolescents and adults with high functioning autism, than they are in school age children.

The category of restricted repetitive and stereotyped patterns of behaviour forms part of the diagnostic criteria for both autistic disorder (Appendix 1) and Asperger's disorder in DSM-IV-TR (APA, 2000) (Appendix 3), and for childhood autism (Appendix 2) and Asperger's syndrome in ICD-10 (WHO, 1993) (Appendix 4). South et al. (2005) illustrate how repetitive behaviours are set out in four sub-groups: stereotyped motor mannerisms, preoccupation with non-functional objects or parts of objects, patterns of interest which are unusual in the narrowness and/or intensity of their pursuit, extreme rigidity and insistence on sameness. These authors note that agreement exists between the two classification schemes and these symptom groups share the qualities of being unusual, persistent, and stereotyped. However, there is little else to suggest that such wide ranging activities could be classified meaningfully into a cohesive symptom group (South et al., 2005).

Despite repetitive behaviour being an important diagnostic criterion, it is suggested that difficulties relating to social imagination have been neglected in comparison with the areas of social interaction and communication impairments (Bodfish, Symons, Parker, & Lewis, 2000; South et al., 2005). "There is currently little understanding of even the most basic issues of causality, function, maintenance, and treatment of these behaviors" (South et al., 2005, p. 146). In addition, there is very little consensus on terminology regarding repetitive behaviours (Bodfish et al., 2000). For example, hand flapping has been described as stereotypic, self-stimulatory, ritualistic, gesturing, or posturing by various clinicians and may in fact serve any of these functions (Bodfish et al., 2000). Turner (1999) concurs, indicating that repetitive behaviour is an umbrella term for a class of behaviours which include repetition, rigidity, invariance, and inappropriateness.

Repetitive behaviours are also found to occur in other developmental disabilities and so it is important that behaviours seen in autism are clearly specified (Bodfish et al., 2000). It is suggested that an individual's level of cognitive ability may have an effect on the degree of repetitive behaviours exhibited and so it is considered important to evaluate specific abnormal repetitive behaviours in autism in relation to cognition, especially when assessing treatment effects (Bodfish et al., 2000).

Turner (1999) suggests that in general, repetitive behaviours can be broadly subdivided into two categories:

Lower-level behaviours (non-specific to autism)

- Repetition of movement
- Stereotyped movements
- Repetitive manipulation of objects
- Some forms of repetitive self-injurious behaviour

Complex/higher level behaviours (characteristic of autism)

- Attachment to objects
- Insistence on maintaining sameness
- Repetitive language
- Circumscribed interests
- Presenting as restricted or limited activities and actions

However, the categories are fairly broad and so key differences may be obscured (Turner, 1999).

Wing (1996b) considers that the action of repeating an activity provides reassurance and pleasure for the child and identifies the simplest forms of repetition as being repetitive sensations such as tasting, smelling, feeling, tapping, scratching, and staring at lights and other shiny objects. Sometimes repetitiveness involves self-biting and other forms of self-injury. This form of repetitive behaviour is mostly reported in young children and may be brought on by distress, frustration, or anger, but can sometimes be a habit (Wing, 1996b). Repetitive behaviours can be very debilitating (South et al., 2005). This is because the frequency of behaviours can interfere with everyday life causing considerable distress for both the individual and for their family. This has been found to be the case even for those with high-functioning autism and Asperger's syndrome.

The highest level of repetitive behaviour is regarded as being circumscribed interests (Turner, 1999). There have been conflicting findings between autism and Asperger's syndrome in this particular area. A study by Szatmari, Bartolucci, and Bremner (1989) (cited in Turner, 1999, p. 840) reported a higher level of circumscribed interests was found in individuals with autism compared to those with Asperger's syndrome, whilst a study by Kerbeshian, Burd, and Fisher (1990) found the opposite to be the case (cited in Turner, 1999, p.840). A study by South et al. (2005) showed that the category 'circumscribed interests' increased in severity over time. However, they caution that this could just be because 'circumscribed interests' become more noticeable if there has been an improvement in the areas of social interaction and communication, as there frequently is with maturity. These differences highlight the problem of quantifying and assessing higher-level behaviours, a factor of concern when conducting research. While principles of repetitive behaviour and the need for sameness underlie behaviour, characteristics demonstrated by individuals are widely variable (Turner, 1999).

An insistence on sameness and a resistance to change may be perceived as the child's attempt at trying to bring order to their confusing world. Every individual is different and so every situation needs to be approached differently. Wing (1996b) believes a balance between rigidity and order needs to be found. Stereotyped movements are sometimes referred to as 'stereotypies' and many children with autism display this type of movement. For example, over-activity, restlessness and hyperactivity symptoms are regularly reported by parents of children with autism (Marcus & Stone, 1993). Stereotypies which are useful to the child, for example, in reducing anxiety, or giving comfort and pleasure, and which do not interfere markedly with the lives of those around might be tolerated. However, many can become increasingly noticeable and dominate family life, in many cases causing unacceptable restrictions (Wing, 1980). For example, Wing (1980) cites the case of one family who were unable to invite guests for dinner as their child would scream violently if changes were made to seating arrangements at the dining table.

2.2.2 Psychological theories

Three cognitive theories mentioned previously (section 2.1.6.7) are now discussed.

2.2.2.1 'Theory of Mind'

Frith (2003) describes 'Theory of Mind' as a tool which enables human beings to "predict relationships between external states of affairs and internal states of mind" (p. 77). 'Theory of Mind' is essentially the ability to appreciate that other people have thoughts and feelings which result in actions (Baron-Cohen, 2000; Cumine et al., 1998; Wing, 1996b). It is suggested that a core abnormality of the autistic condition is impairment in the ability to understand the thoughts and feelings of others (Baron-Cohen, 2000). This impairment has been described as a form of 'mind-blindness' (Baron-Cohen, 1995). Frith (2003) believes that 'mind-blindness' explains many of the social and communication impairments of autism, whilst Wing (1996b) believes that the theory fits in with the social indifference which is observed in young children with autism and with the social naivety of older individuals. There is, however, some criticism of this theory and Trevarthen et al. (1998) point out that there is evidence that older children with autism may in fact develop these mentalising abilities as they develop communicative competence. Wing (1996b) also comments that the level of development of 'Theory of Mind' is related to the level of language comprehension in the individual.

An area of difficulty for those with Asperger's syndrome also relates to the 'Theory of Mind' impairment (Cumine et al., 1998). Individuals with a greater level of ability do eventually gain an understanding; however, this comprehension tends to develop much later than normal, possibly between ages of 9 and 14 years (Cumine et al., 1998). This basic cognitive deficit in autism is thought to restrict children to a disordered path of development, with the result that complex behaviours are manifest (Cumine et al., 1998). There are many implications of 'Theory of Mind' impairment for individuals with autism. Specific difficulties include:

- Difficulty predicting behaviour or intentions of others (this can lead to avoidance of other people because of the fear of uncertainty of how they might behave and can lead to a preference for solitary activities)
- Difficulty understanding emotions (their own and other people's), which can manifest as a lack of empathy with others
- Difficulty understanding how behaviour can affect how others think or feel (this can result in the individual with autism unintentionally upsetting someone)
- Difficulty explaining own behaviour
- Difficulties taking into account what other people know or can be expected to know (this can result in pedantic or incomprehensible language which the listener has difficulty understanding)
- Inability to read and react to a listener's level of interest in what is being said
- Inability to anticipate what others might think of one's actions
- Inability to understand deception
- Difficulty in understanding 'pretend' and being able to tell the difference between fact and fiction
- Inability to share attention
- Lack of understanding of social interaction and social convention (this can lead to difficulties with turn-taking and inappropriate use of eye contact)

(Cumine et al., 1998; Jordan & Powell, 1995)

Overall, these difficulties have an effect on the child's ability to interact and communicate socially and at the same time have a significant influence on the behaviour and thinking of the child (Cumine et al., 1998).

2.2.2.2 Executive function deficit

Essentially, executive functions are the abilities required to execute a change of plan from normal routine behaviour (Frith, 2003). "Executive abilities are crucial for keeping several tasks going at the same time and switching between them" (Frith, 2003, p. 177). A fault or malfunction of the frontal lobe of the brain is suggested as being responsible for executive function deficit in autism (Baron-Cohen & Swettenham, 1997; Frith, 2003; Trevarthen et al., 1998). Normal executive function behaviours include planning, self-monitoring, behavioural flexibility, organised search, and set maintenance and change (Cumine et al., 1998). These operations are often impaired in individuals with autism and consequently, behaviour may appear rigid and inflexible, with individuals having great difficulty in seeing the whole 'picture' (Cumine et al., 1998). Frith (2003) describes how individuals with autism display repetitive actions, which are triggered by stimuli, as a result of this lack of higher-level executive control. Other difficulties identified with executive function deficit include preoccupation of thoughts, a lack of ability to generate new ideas, difficulty with switching tasks, and perseveration, that is, a tendency to repeat the response to a previous experience in inappropriate situations (Frith, 2003). Cumine et al. (1998) identify the following difficulties arising from executive function deficit for individuals with autism:

- Difficulties in perceiving emotion
- Difficulties in imitation
- Difficulties in pretend play
- Difficulty in planning
- Difficulty in starting and stopping a task or activity

Baron-Cohen and Swettenham (1997) state that executive dysfunction is not exclusive to autism and occurs in a number of clinical disorders, suggesting that executive function impairment does not in itself lead to autism. Further, it is suggested that executive function impairments may co-occur with 'Theory of Mind' deficits and that this is likely to be related to the shared frontal origin in the brain (Baron-Cohen & Swettenham, 1997). As discussed later (sections 3.1.3 and 4.2.2), use of organisational aids and visual structure have been found to assist individuals with autism in organising behaviour, thus compensating for deficits with executive functioning. In particular use of a symbolic timetable in the classroom setting has been reported to assist with planning and enabling individuals to anticipate change (Mesibov et al., 1994). Whether this could be further aided by an interactive timetable is a key question of the current research.

2.2.2.3 Central coherence theory

Central coherence is essentially a natural tendency to see things as a whole. Frith (2003) describes central coherence as a force which pulls large amounts of information together. Individuals with autism lack the ability to make sense of situations or events based on the context (Cumine et al., 1998). Cumine et al. (1998) list several difficulties resulting from a weakness of central coherence:

- Idiosyncratic focus of attention
- Imposition of own perspective
- Preference for the known
- Inattentiveness to new tasks
- Difficulty in choosing and prioritising
- Difficulty in organising self, materials, experiences
- Difficulty seeing connections and generalising skills and knowledge
- Lack of compliance

Cumine et al. (1998) state that these difficulties affect a child's ability to cooperate with others and to notice the demands of others. Behaviour is affected and also thinking, so that for example, integration into a class group at school will be affected.

2.2.3 Other significant features

There are several other distinctive behaviours to be seen in individuals with autism, some of which can cause problems for the individual and some of which are noted to be significant features. However, not all of these behaviours are consistent across all individuals on the autistic spectrum and so the presence of these particular features is not necessary for diagnosis. These behaviours are considered to warrant reference here as some can be the cause of much distress for certain individuals, whilst some are very characteristic and so it was considered important to be aware of these, particularly with regards to the observation studies conducted during this research.

2.2.3.1 Significant movements

Three specific areas of movement which are commonly seen in individuals with autism are stereotyped movements, abnormalities of gait and posture, and imitation of other people's movements (Wing, 1996b). The reason why stereotyped movements occur in individuals with autism is not clear. Wing (1996b) suggests that the movements may be due to a general excitement of the body, or that they could be simple repetitive activities, conducted by the individual in order to obtain certain sensations. In typical development, such behaviours are seen in babies and toddlers when they become excited, but as a child grows older, he or she learns how to control such movements. In autism there is not this gradual control with age and if individuals have to stifle such movements they can become tense and distressed (Wing, 1996b).

Stereotyped movements which have been witnessed include finger flicking, flapping arms and hands, jumping up and down, head rolling, rocking whilst standing, facial grimaces, and walking on tip-toe with a springy gait (Marcus & Stone, 1993; Wing, 1996b). These types of movements tend to be most evident when the individual is excited, agitated or angry (Lewis, 2003; Wing, 1996b). Wing (1996b) states that sometimes stereotyped movements can occur when an individual is preoccupied and gazing at something, which has grabbed their attention. However, it has been noted that if an individual is engaged in a constructive activity, stereotyped movements are minimal or even absent (Wing, 1996b).

Abnormalities of gait and posture are exhibited by many individuals with autism, a characteristic more noticeable with age (Wing, 1996b). In particular, those fitting Asperger's description appear clumsy. Nearly all children with autism are immature in the way they move and have a characteristic way of standing, with head bowed forward and arms flexed at the elbow (Lewis, 2003; Wing, 1996b). Many children with autism walk on tip-toe. Physical education in school can be challenging for children with autism, particularly team games, as these involve not just coordination of movement, but organisational skills as well. Children with autism are impaired in imitating the movements of others and this has a significant impact on the development of social behaviour (Wing, 1996b).

2.2.3.2 Sensory stimulation

Many children with autism have unusual responses to certain sensory stimulation, such as sounds, visual stimuli, proximal sensations, and to appetite and thirst (Marcus & Stone, 1993; Wing, 1996b). Wing (1996b) describes how some children with autism find particular noises very distressing and may go so far as to cover their ears. Sometimes reactions to sensory experiences are bizarre (Lewis, 2003). For example, on some occasions a child may act as though surrounding noises have not been heard and may not respond to other sensory stimuli, while at other times the same child will react immediately to stimuli in either a normal or distressed way. This is referred to as selectivity of attention (Lewis, 2003).

Many children with autism are fascinated by bright lights, while others can become distressed, particularly by flashing lights (Wing, 1996b). It is suggested that children with autism make use of the peripheral part of the retina, paying more attention to movement and outline of objects, rather than using the central area of the retina which is normally used for seeing detail (Wing, 1996b).

Responses to sensations of touch, taste, smell, pain, and temperature can vary from individual to individual. Some children with autism like to be touched, while others find it distressing. Many are oblivious to pain and are apparently indifferent to extremes of temperature (Wing, 1996b). Wing (1996b) describes problems children with autism have with food and drink and suggests an insistence on eating a restricted range of food may indicate a resistance to change.

2.2.3.3 Anxiety and fears

Certain individuals with autism appear to have high levels of anxiety much of the time and frequently anxiety is related to situations which cause confusion for the individual (Wing, 1996b). Jordan (2001) suggests that fears and anxiety have a different quality in autism than for the general population, being more pervasive and being triggered by everyday stimuli such as those mentioned previously. It has been recognised that individuals with autism are unable to develop coping strategies to deal with stress and anxiety in the way which typically developing individuals can (Groden, Cautela, Prince, & Berryman, 1994; Jordan, 2001). Consequently, anxiety may be expressed in extreme and uninhibited ways (Jordan, 2001). Anxiety is a significant concern for children with autism and an issue of particular interest in this study. The implications of anxiety are considered in greater detail in the next section of this chapter (section 2.3).

2.2.4 Conclusion

Three specific areas of difficulty have been discussed in relation to social interaction, communication, and imagination. Many individuals with autism have little interest in social interaction and the social environment. Features which distinguish this particular impairment are unresponsiveness to people, lack of eye contact, lack of empathy, absence or oddness of attachment, and lack of joint attention. As a result of a study by Wing and Gould in 1979, a classification of sociability styles was developed, which identified individuals with autism as being aloof, passive, active but odd, or appropriate in their attempts at social interaction. The extent of the impairment in social interaction means that individuals with autism are unable to develop 'normal' social relationships and so are unable to learn through such experiences in the same way that typically developing children do. The implications of this are that children with autism are less socially accepted and have an egocentricity, which leads to behavioural problems and a tendency to resist doing something other than what they want to do.

Difficulties with communication also have considerable consequences for the child with autism. From the child's perspective, difficulties with speech and language use make it extremely difficult for effective communication to take place. Difficulty in understanding and using speech and language can lead to frustration, anxiety, distress, and anger, which can in turn result in behavioural problems. These difficulties can also increase the overall levels of stress and concern within the family group and again make effective communication a problem. Those outside the family unit who are unaware of the child's condition may perceive the child as being different and may have difficulty in understanding the individual. In many cases outsiders may find the child’s endeavours to communicate unsociable and even unacceptable. On the other hand, those individuals with autism who have a good range of vocabulary and who speak fluently and articulately may be perceived as being at a higher level of intelligence than they actually are. This can lead to misunderstandings and may result in a child being asked to do more than he or she is actually capable of.

The implications of impairment in social imagination are that children with autism are unable to learn through the experience of play and so are unable to associate past and present experiences with future expectations. A lack of curiosity about their environment can present a danger for these children, while impairment of imagination can compound the child’s solitary state.

Difficulties related to executive function deficits are particularly relevant to this study. Children with autism have little ability to cope with multiple tasks, to plan, to switch tasks, and generally to maintain their lives. Consequently, change is a major issue for these individuals and as a result, behaviour is commonly rigid and inflexible. Repetitive actions are frequently displayed as a result of this lack of higher-level executive control. Whilst these behaviours can become problematic if they interfere with daily functioning or lead to serious behaviour problems, the repetitive nature of the behaviours can in fact give reassurance and pleasure to the individual. A diverse range of approaches have been developed in order to assist those with autistic spectrum disorder in dealing with these areas of impairment and a selection of these approaches will be discussed in section 3.1.

2.3 Anxiety and stress in individuals with autism

The concepts and processes of anxiety and stress are now considered in relation to children with autism. An aim of this study was to evaluate the interactive timetable system to see if its use could in any way be associated with a reduction in uncertainty, discernible by lower levels of anxiety related behaviour for the participants. It was considered important, therefore, to gain an understanding of the concept of anxiety and of the specific implications which anxiety has for children with autism. Broad definitions of the concepts of anxiety and stress are set out and then these concepts are considered from the perspective of those with autism. Particular characteristics or traits of autism which make individuals particularly susceptible to anxiety and stress are described and the impact which these can have on children with autism is discussed. Strategies and techniques which have been developed to assist children with autism in coping with anxiety are briefly introduced and these will be discussed in greater detail in chapter three. It should be noted that research in the area of anxiety and autistic spectrum disorder has been fairly limited to date.

2.3.1 Definitions of anxiety and stress

Groden et al. (1994) state that the terms stress and anxiety tend to be used interchangeably, but caution that there is an important distinction between the two. Groden et al. (1994) state "the presence of stress indicates a disturbance of homeostasis in the individual, which may or may not be concurrent with the experience of anxiety. The presence of anxiety, however, always indicates that the individual is experiencing stress" (p. 178).

Anxiety is defined as "the tense anticipation of a threatening but vague event; a feeling of uneasy suspense. It is a negative affect so closely related to fear that in many circumstances the two terms are used interchangeably" (Rachman, 1998, p.2). For most people anxiety is a normal response when confronted with threatening or stressful situations (Wilkinson, Moore, & Moore, 2000; WHO, 1992). For many of the general population, some degree of anxiety can actually serve a useful purpose. However, when an individual's level of anxiety becomes so intense that it is out of proportion with the severity of the stressor, or when anxiety lasts for a prolonged period of time, then there is a serious risk to the health and wellbeing of the individual (Bernstein, Penner, Clarke-Stewart, & Roy, 2003; Hale, 1997; WHO, 1992). For individuals with autism this can be a significant concern, as a lack of self awareness, coupled with communication difficulties, indicate that anxiety issues might not be identified until well established. As a result complaints such as depression, paranoia, or increased obsessive compulsive disorder may develop (Attwood, 1998; Deudney, 2004).

Stress is defined as "the negative emotional and physiological process that occurs as individuals try to adjust to or deal with stressors" (Bernstein et al., 2003, p. 487). Stressors are generally background factors in an individual's life, which cause interference with daily functioning, either through actual disruption, or through the perceived threat of disruption. These can be chronic factors, continuing over a long period of time, or everyday stressors such as pressures or annoyances which can collectively cause an effect (Bernstein et al., 2003). It is suggested that stress can be caused by both pleasant and unhappy events (Bernstein et al., 2003; Groden et al., 1994). Physical responses to stress involve an increased heart rate and blood pressure, sweating, and hyperventilation. Psychological responses may also be manifest and these may occur as emotional changes, troubling thoughts, and unusual behaviours (Bernstein et al., 2003).

2.3.2 General characteristics and symptoms of anxiety

An individual with anxiety can present with a range of cognitive, perceptual, somatic, and behavioural symptoms as illustrated in table 2.3. Other features which have been noted are hyperventilation, restlessness, general fatigue, and poor sleep patterns. In addition, some individuals can appear inattentive, preoccupied, and unable to concentrate when anxious (Rachman, 1998). Inattentiveness and preoccupation are behaviours frequently observed in individuals with autism (Attwood, 1998; Deudney, 2001).

Table 2.3

Symptoms of anxiety

Cognitive symptoms	Confusion Urge to escape from a situation
Perceptual symptoms	De-realisation Depersonalization (losing sense of personal identity) Hyperesthesia (abnormal sensitivity of the skin)
Somatic symptoms	Shortness of breath Chest pressure or tightness Palpitations Muscle tension Sweating Chills Hot flushes Dry mouth Choking Nausea Diarrhoea Urge to pass water Numbness or tingling
Behavioural symptoms	Fearful facial expressions Pacing or immobility Irritability

Source: Sullivan, Kent, and Coplan, 2000, p.17

2.3.3 Anxiety and stress in autism

It is well documented that individuals with autism are particularly susceptible to stress and anxiety (Cumine et al., 1998; Deudney, 2004; Groden et al., 1994; Howlin, 1998; Jordan, 2001). However, Kim, Szatmari, Bryson, Streiner, and Wilson (2000) report that there have been relatively few studies regarding the prevalence of anxiety amongst children with autism. In particular Kim et al. (2000) note a lack of data relating to the correlation of early autistic symptoms with later anxiety problems (Kim et al*.,* 2000). In addition, Muris, Steerneman, Merckelbach, Holdrinet, and Meesters (1998) report that despite assertions by clinicians that anxiety symptoms are frequent in this population few studies have been conducted to examine the prevalence of symptoms of fear and anxiety. Kim et al. (2000) suggest that symptoms of anxiety are difficult to assess especially if verbal skills are limited and moreover, it is frequently difficult to differentiate whether symptoms are anxiety related or elements of the autistic disorder. Because of these difficulties, Kim et al. (2000) suggest that gathering qualitative information is important and that changes in behaviour should be assessed. A review of scales and instruments used to assess anxiety and behaviour was carried out early in this study and is presented in Appendix 5.

The exact cause of anxiety is not certain, but it is generally understood that biological, psychological, social, and environmental factors all have a part to play (Bernstein et al., 2003). It has also been reported that there is a hereditary disposition towards anxiety disorders. Abnormalities within the brain, such as in the neurotransmitter systems have also been suggested as causal in the development of anxiety disorders (Bernstein et al., 2003).

Anxiety is considered to be both a potential cause and a possible consequence of behavioural patterns displayed by children with autism (Gillott, Furniss, & Walter, 2001). Trevarthen et al. (1998) state "anxiety causes social withdrawal and consequent failure to learn and benefit from social interaction" (p. 54). Furthermore, Muris et al. (1998) suggest that symptoms of anxiety represent an additional impediment for individuals with autism. A clear reason why the concept and processes of anxiety should be taken seriously for such individuals is, therefore, indicated.

It has been suggested that specific traits common to individuals with autism are in many cases actually responsible for increasing vulnerability to stress and anxiety. Furthermore, individuals with autism do not necessarily have strategies for coping with stress in the same way as other people do. "Many of the behaviors that are typically labeled as *autistic* or *stereotypic* are functionally related to the experience of stress and anxiety by individuals who lack a repertoire of appropriate coping mechanisms" (Groden et al., 1994, p. 178) [italics original]. As a result, behavioural difficulties frequently present when individuals are in situations where they are unable to cope with the distress caused by anxiety (Cumine et al., 2000; Groden et al., 1994; Howlin, 1998).

2.3.3.1 Characteristics of autism: relationship with anxiety

Many traits have been found to occur in individuals with autism which generate and strengthen feelings of stress and anxiety. In addition, certain physiological and external elements have been found to contribute to stress in this population (Groden et al., 1994). These factors are now examined.

Deficits in social interaction

As discussed earlier (section 2.2.1.1), many individuals with autism show a marked lack of social awareness and consequently may behave inappropriately when attempting to socialise (Attwood, 1998; Groden et al., 1994; Howlin, 1998). Higher-functioning individuals may be aware that they are different from their peers in some way and those who have a desire for friendship may become unhappy and depressed when they are unable to establish a social relationship due to lack of social skills (Gillberg & Coleman, 1992). This inability to form friendships means that children with autism are unable to develop a coping mechanism commonly used by the general population, that of being able to talk to a friend and gain support in stressful situations (Groden et al., 1994).

As discussed previously (section 2.2.1.1) avoidance or lack of eye contact prevents individuals with autism from being able to read the intentions of others and to interpret other people's behaviour and emotions (Cumine et al., 2000; Groden et al., 1994). This can affect the individual's ability to predict the actions of others and can lead to uncertainty, which in turn can result in stress and anxiety. Lack of eye contact also has implications for communication deficits (Cumine et al., 2000) which again can result in anxiety and stress.

The naivety of children with autism with regards to a lack of awareness of social conventions, or of other people's feelings can have extremely distressing consequences for the child (Wing, 1980). Cumine et al. (1998) warn that many children with autism may become anxious in social situations, such as during school playtimes. This is most likely due to the unstructured nature of such situations and also because there is a likelihood of other children approaching; anticipation of social interaction can cause stress and anxiety. Stress caused by social situations can also be linked to an individual's need to maintain 'sameness' in order to be able to predict outcomes (Howlin, 1998).

As mentioned earlier, quite often a child with autism may form an odd attachment to a particular object and a dependence on the object may develop, proving problematic if the object is ever lost or destroyed. Such situations can lead to extreme distress, whilst excessive worrying and anxiety may also develop regarding the potential loss of such an object, to the extent that an individual is unable to eat or sleep (Asperger, 1944/1991).

Deficits in communication interaction

Deficits in communication were discussed in some detail previously (section 2.2.1.2). All human beings, especially young children, need to be able to communicate their requirements to others. If a child is unable to communicate either because they lack the ability to speak or because they are unable to use the speech and language which they do have effectively, then this can result in frustration, anxiety and distress (Cumine et al., 2000; Groden et al., 1994; Howlin, 1998).

A lack of eye contact, as mentioned earlier, has serious implications regarding communication. For example, eye gaze is an important signal, used to indicate the intention to communicate. This ability is commonly lacking in individuals with autism and so an important aspect of communication is absent (Carter, Davis, Klin, & Volkmar, 2005).

Being unable to use or to understand non-verbal communication can also cause considerable distress for individuals with autism. Non-verbal communication, such as facial expressions, gestures, and other forms of body language, are commonly used in addition to speech (Hargie et al., 1994). If a child with autism has difficulty in understanding both verbal and non-verbal communication, then the cognitive overload which this can produce may be too great to cope with. Consequently, communication may be ineffective (Howlin, 1998) and result in misunderstanding, which can lead to anxiety and distress.

As discussed earlier (section 2.2.1.2), use of language by the child with autism may be extremely problematic, so that not only are they unable to make others understand them, but they are also unable to understand other people. This can lead to frustration, anger, and distress (Howlin, 1998). Examples include:

- Difficulties with articulation and intonation make speech sound odd and difficult for others to interpret

- A relatively good range of expressive vocabulary can give the wrong impression of ability
- Use of sarcasm, humour, figurative, and literal speech by others may all present tremendous problems of understanding for children with autism

Williams (1995) describes how individuals with Asperger's syndrome are often unable to express their fears and worries and that this suppression of anxiety is eventually likely to surface as a temper tantrum or as another form of challenging behaviour.

Heightened sensitivity

The issue of sensory stimulation was discussed earlier (section 2.2.3.2). Hypersensitivity can occur in any or all of a person's senses. For individuals with autism, even low-level stimuli can lead to nervous system arousal, which in turn can lead to fear and anxiety (Groden et al., 1994). Individuals can be "overwhelmed by stimulation" (Jordan, 2001, p. 147), resulting in irritation and even withdrawal. Attwood (1998) provides examples, describing how certain sounds, such as dogs barking and the noise of a vacuum cleaner or hairdryer can be a cause of stress and anxiety for many children with autism.

Jordan (2001) also notes that in some cases, over sensitivity to stimuli can result in phobias. A phobia is described as "an intense, irrational fear of an object or situation that is not likely to be dangerous" (Bernstein et al., 2003, p. 566). Children with autism frequently develop specific fears of harmless, everyday objects. "Fears and fascinations often become inextricably linked, so that children who have an obsession with a particular object at one stage can develop a great fear of it later" (Howlin, 2004, p.145). For these children the fear and anxiety related to the object may last for many years and encountering such objects can be very problematic not just for the individual, but for the family as well.

Need to maintain sameness

As discussed earlier (section 2.2.1.3), the child with autism has a strong need to maintain sameness. Groden et al. (1994) state "minor changes in routine or environment that would not be anxiety producing for a typical child can produce anxiety and intense behaviour responses in individuals with autism" (p. 181). Such rigidity often leads to behavioural difficulties and children have been known to become extremely distressed or to behave violently as a result of minor changes in their home environment (Cumine et al., 2000; Wing, 1980).

Ritualistic behaviour

An anxiety disorder which involves a person having repetitive thoughts as well as urges to perform certain rituals is obsessive-compulsive disorder (Bernstein et al., 2003). Repetitive and unwanted thoughts frequently centre on the person doing harm to themselves or others, although it is rare that any carry out such harmful acts (Bernstein et al., 2003). The presence of obsessive thoughts leads in many cases, to individuals developing impulses to perform ritualistic and repetitive behaviours (WHO, 1992). Okocha (1998) suggests that such compulsions are believed by sufferers to ward off some feared outcome, or in some way to reduce the feelings of anxiety brought on by the obsessions.

Some rituals and obsessions have been found to help individuals with autism make sense of the world and assist in maintaining a degree of predictability (Jordan, 2001). Jordan (2001) suggests that a display of ritualistic behaviour by the child with autism can sometimes be a warning of challenging behaviour to come, especially if the behaviour increases in intensity or speed. It is suggested that individuals with autism use rituals and obsessions as a way of coping with stress (Attwood, 1998; Jordan, 2001). Furthermore, it has been found that anxiety can increase if ritualistic behaviours are interrupted or prevented (Groden et al., 1994).

2.3.3.2 External stressors in autism

Kim et al. (2000) believe "that mood and anxiety problems in this population are normal manifestations of environmental stressors" (p. 119-120). Certain external factors and events may cause stress for the child with autism, interfering with the child's ability to function effectively and ultimately may result in maladaptive behaviours. For example, Groden et al. (1994) identify specific factors which have been found to produce stress in the classroom setting. These include noise or disruption from other children in the classroom, the use of punishments such as time out, and overcorrection by adults. Changes in daily routine are also recognised to arouse stress and anxiety in individuals with autism (Deudney, 2001, 2004; Groden et al., 1994).

2.3.3.3 Manifestations of anxiety and stress in autism

No two individuals are the same and so anxiety and stress in individuals with autism may be discernible in many ways. Groden et al. (1994) highlight certain behaviours which individuals with autism are frequently noted to exhibit following a stressful event. These include tantrums, aggression, self-injury, and avoidance. It is suggested that children with autism may well use such behaviours as a maladaptive coping strategy and this response may to some degree reduce the nervous system arousal (Groden et al., 1994). Groden et al. (1994) suggest using functional analysis to assess the relationship between stress, anxiety, and the occurrence of maladaptive behaviour.

Several studies have linked the frequency of self-injurious behaviour in individuals with autism, with the occurrence of stress producing conditions or pain (Groden et al., 1994). Maladaptive behaviours, such as self-injury, were also found to occur in situations where there were high levels of demand, such as in the classroom, whilst lower rates were found in less demanding situations, such as in free play settings. Free play settings are typically those where individuals are able to choose a play activity from available items. These differ from unstructured play settings such as the school playground. Likely presentations of anxiety in individuals with autism include:

- Retreating into special interest
- Increased preoccupation
- Increase in rigidity of thought processes
- Increased insistence on routines

(Attwood, 1998; Deudney, 2001, 2004)

2.3.4 Management of anxiety and stress

Deudney (2001) suggests children with autism and their parents should be educated to identify signs, symptoms, and potential triggers of stress. Ability to identify potentially stressful situations would enable a timely action plan, or coping strategies to be introduced, such as relaxation techniques, distraction, or physical activity. Groden et al. (1994) suggest the following areas for assisting children with autism in learning strategies for coping with stress and anxiety:

- Social skills training
- The use of positive programmes
- Teaching self control
- Relaxation techniques
- Use of cognitive and imagery based procedures
- Introducing environmental changes

If children with autism are helped to learn social skills then they will be better prepared and more likely to have more positive interaction with others, which in turn can reduce stress (Groden et al., 1994). Deudney (2001) provides examples of relaxation techniques and these include watching a favourite programme or video, listening to music, having access to a quiet place, having no social demands, taking part in a physical activity, having a massage, or having drug therapy. A structured environment which is predictable and which has consistent routines has been found to alleviate anxiety, whilst a concrete display of events and times also assists (Groden et al., 1994). Chapter three examines the educational environment and considers methods used to alleviate anxiety in more detail.

2.3.5 Conclusion

Despite a general awareness that individuals with autism are particularly susceptible to stress and anxiety, research in this area has been found to be limited. This is possibly due to difficulties associated with the nature of autism itself. For example, it has been suggested that a lack of verbal skills in many individuals with autism makes assessing actual levels of anxiety very difficult. Furthermore, it has also been noted to be difficult to differentiate between traits of the autistic disorder and anxiety symptoms, a factor which could hinder research in this area.

It has been shown that children with autism have little or no self-initiated strategies for coping with stress in the way that typically developing children do. This is principally seen to be a consequence of the impairments in the areas of social interaction, communication, and imagination. This suggests that the characteristics of autism encourage feelings of stress and anxiety in individuals and because of the difficulties caused by the ‘triad of impairments’, individuals with autism are unable to develop coping strategies like typically developing children do. Individuals with autism commonly develop phobias and general anxiety problems, both of which can be very debilitating for the child and their family. Whilst many children with autism carry out repetitive actions, it is unclear whether these actually cause distress for the individual and there is controversy regarding the issue of obsessive compulsive disorder as an anxiety state with regards to autistic spectrum disorder. Therefore, individuals with autism need assistance to learn how to cope with stress and anxiety. Chapter three proceeds to consider the educational environment and strategies employed to assist individuals with autism in coping with anxiety and stress.

Chapter 3: The user environment

In-depth knowledge of the environment in which the prospective user population of a proposed system will be functioning in is a key requirement of systems development (Faulkner, 1998; Preece et al., 1994). Section 3.1 examines the educational context and environment in which children with autism are placed in the United Kingdom (UK). Approaches and strategies employed in the classroom to assist children with autism in coping with the daily school routine are also considered. Section 3.2 considers the computing environment and its relevance for individuals with autism.

3.1 The educational environment for children with autism

This section considers the type of educational setting in which children with autism are likely to be placed in the United Kingdom (UK). The section begins by looking at the educational context and provides details of the assessment process which children with special needs undergo. Placements vary according to several factors, such as individual needs, parental wishes, and available resources. No two individuals are affected by the autistic condition in the same way and so allowances have to be made for individuality in any educational approach that is practised. Consequently, settings vary greatly. A brief overview of the range of current educational opportunities for children with autism in the UK is, therefore, set out. Many therapies, interventions and educational approaches have been developed to assist children with autism both at home and at school; the approaches considered most relevant to this study are discussed. Specific strategies employed in the classroom are also reviewed.

3.1.1 Educational context

A brief outline of the history and legislative framework of the educational context is set out in Appendix 6. Although there are noted to be differences between the Scottish and English education systems, provision for children with autism is found to be very similar within these systems. Generally, it is acknowledged that early intervention is beneficial for children with autism and the involvement of parents in the educational process is regarded as being equally important (Shields, 2000). As discussed previously (section 2.1.4), diagnosis of autism is being made much earlier, with the benefit of enabling appropriate educational management to begin at an earlier age in the UK. Local Education Authorities (LEAs) endeavour to provide for the Special Educational Needs (SENs) of children with autism by placing individuals according to individual requirements.

3.1.1.1 Educational assessment

The educational process in the UK requires that a consultation, known as a statutory assessment, should take place between the parents of the child and the professionals involved in the particular case. The assessment is a detailed investigation intended to determine the special educational needs of a child, with the main outcome being a document setting out special educational requirements, non-educational needs, and assistance which a child is entitled to receive (Department for Education and Employment, 1997a; Department for Education and Skills, n.d.). There is a slight variation in the terminology and process as carried out in England and in Scotland. In England the assessment may result in “a Statement of Special Educational Needs” being drawn up for the child (DfES, n.d.). In Scotland, the assessment may result in a “Record of Special Educational Needs”. In either case, reviews are conducted annually, to ensure that needs are being met and to ascertain whether a placement continues to be appropriate. Essentially, the aim of the assessment process is to give parents a chance to express personal views regarding their child’s educational future.

Once a child is established in an educational setting, an Individual Education Plan (IEP) is created. This is basically a plan of actions regarding the teaching approach and progress reviews. The IEP generally records short-term targets which are different or additional to the targets applying to the rest of the class (M. Farrell, 2003). The Department for Education and Skills (n.d.) suggest the IEP should state:

- What special help is being given
- How often the child will receive the help
- Who will provide the help
- What the targets for the child are
- How and when the child’s progress will be checked
- What help parents can give their child at home

The important point to consider throughout this whole process is that the child is placed according to their level and pattern of functioning (Aarons & Gittens, 1999).

3.1.1.2 Educational settings in the UK

There are many options regarding the educational settings available for children with autism in the UK, ranging from mainstream schools to autism specific schools. The range of settings varies greatly from region to region (Nye, 2000). Examples of educational settings in which children on the autistic spectrum may be placed in the UK are illustrated in table 3.1.

Table 3.1

Educational settings for children with ASD (UK)

Special needs nursery
Mainstream nursery
Mainstream class with no special help
Mainstream class with support
Division of time between mainstream class and special class
Full time special class
Mainstream school with specialist unit attached
Speech and language unit
School providing for children with moderate learning difficulties (MLD)
School providing for children with severe learning difficulties (SLD)
School for emotional and behavioural difficulties
School providing for children with learning difficulties, physical disabilities and/or medical conditions
Specialist school providing solely for pupils on the autistic spectrum
Specialist school providing for pupils with a particular part of the spectrum
Residential schools
Independent / voluntary schools
Home education programme

Sources: Loynes (2001, p. 9); Nye (2000, p. 14); Organisation for Economic Co-operation and Development (1994, p. 7)

It can be seen that there is a wide range of potential placements. However, the philosophy of education is such that children should always be placed to meet individual needs within the resources available. There is much debate in the literature regarding mainstream settings versus specialist education settings. However, this issue was not a focus of this study and, therefore, is not discussed in depth here.

3.1.2 Educational approaches

The individual needs of children with autism vary greatly, so that no one overall educational approach which would suit all needs is possible and there continues to be little agreement regarding what is the ‘best’ approach to follow (Cumine et al., 2000; Jordan, 2001). As mentioned earlier, the approach to education for children on the autistic spectrum in the UK is varied and each child's programme should be set out in the individual's statement and in the IEP. Jordan (2001) comments that the needs of children with autism are often specified imprecisely, so that guidance regarding which educational approach to adopt relies mainly on general educational principles as set out by law. However, pressure from parents, together with an increased awareness of responsibility by LEAs, is providing motivation for a gradual change in this situation.

It is acknowledged that parents of children with autism have a right to be involved in decisions regarding their child's educational provision. However, many therapies, interventions and approaches professing a 'cure' have emerged, particularly from the United States of America (USA). Many have been developed in response to the variations in attitudes, cultures, professional interest, and to differing characteristics of children with autism. A survey of 200 LEAs in England, Wales and Northern Ireland conducted by the All Party Parliamentary Group on Autism (Loynes, 2001) found the following therapies or interventions were being used to some extent:

- Treatment and Education of Autistic and related Communication handicapped Children (TEACCH)
- Lovaas therapy
- Applied Behavioural Approaches (ABA)
- Son-Rise/Option approach
- Daily Life Therapy (Higashi)
- Auditory Integration Therapy (AIT)
- Autism Specific Speech and Language Therapy (SLT)
- Picture Exchange Communication System (PECS)
- Social skills training
- Art therapy
- Musical interaction therapy
- SPELL (an acronym for the National Autistic Society's approach to autism - Structure, Positive, Empathy, Low arousal, Links)
- The Earlybird project (a National Autistic Society initiative)

It can be seen that parents face difficult decisions when it comes to selecting appropriate educational provision for their child. In addition, shortages in local funding may restrict the range of choices available to parents (Siddles, Mills, & Collins, 1997), whilst media hype and overstated claims for effectiveness can influence parents' judgements on the most suitable approach. Consequently, professional guidance may be required to select the most appropriate approach for each child. Whichever approach is followed, it is important that consideration be given to the extent to which learning and quality of life is supported. Furthermore, any approach which is adopted should aim to reduce stress, while at the same time promote learning and development (Jordan, 2001). An early intervention approach reported to be widely used within UK schools is now briefly described. This is the treatment and education of autistic and related communication handicapped children (TEACCH) approach.

Treatment and education of autistic and related communication handicapped children (TEACCH)

TEACCH is a program which provides services, training, and research on behalf of autism and associated developmental disabilities in the state of North Carolina, USA (Schopler, 1997). This structured teaching approach was developed in the 1960s at the University of North Carolina School of Medicine (Schopler, 1976). The TEACCH philosophy includes nine key principles which are described in detail by Schopler (1997). The principle of structured teaching is central to the approach (Cumine et al., 2000), with the element of structure being provided through directions given by the teachers, parents, and other care givers, with regard to the daily routine of the child (Mesibov et al., 2001). The topic of daily timetables is discussed in greater detail later (section 4.2.1).

The central idea behind the TEACCH approach is that the school day should be highly structured, with continuity of the people involved with the child; this structure should also extend to the general environment and overall routine (Gillberg & Coleman, 2000). This approach takes into consideration the differences between each child and can be very much an individualised approach. The main teaching aspects of the TEACCH approach include intervention programmes, which are focused on language and behaviour processes (Baron-Cohen & Bolton, 1993). Methods employed tend to be very visual and concrete in nature. Strategic checks of the child's development are conducted at regular intervals and an educational assessment is also carried out; the family is encouraged to be strongly involved throughout.

The TEACCH approach has been widely adopted by many specialist schools in the UK (Cumine et al., 2000; Potter & Whittaker, 2001). In particular, it was found that this approach was adopted in 77% of participating LEAs (Loynes, 2001). Essentially, the TEACCH approach is viewed as being flexible and, therefore, more user friendly in differing contexts. The main elements adopted in the UK have tended to be the overall physical organisation of the classroom space, the use of timetables, emphasis on independent work, and the implementation of certain predictable routines (Cumine et al., 2000; Potter & Whittaker, 2001).

Benefits of the TEACCH approach

Several benefits of this approach have been noted. Essentially the approach has been found to enable children with autism to make sense of their surroundings in a way which facilitates understanding of what is expected of them; this greatly reduces frustration for the individual and can lessen anxiety (Cumine et al., 2000). The approach is also relatively inexpensive to adopt (Loynes, 2001). Other advantages which have been distinguished include:

- Effective organisation of the curriculum and environment
- A comprehensible classroom environment, with clear visible boundaries, which minimise distractions and facilitate independent working (Cumine et al., 2000; Potter & Whittaker, 2001)
- Improvement in behaviour and communication, leading to an improvement in quality of life (Cumine et al., 2000; Gillberg & Coleman, 2000)
- Flexible, content free approach, which leaves the teacher free to decide on which activities to include in the timetable (Potter & Whittaker, 2001)
- Aids predictability, which can help reduce anxiety (Cumine et al., 2000)

Limitations of the TEACCH approach

Cumine et al. (2000) believe that this approach "provides what might be called a 'prosthetic environment' whereby many of the difficulties can be circumvented and people with autism can be enabled to live and learn without undue stress and anxiety" (p. 42). Jordan and Powell (1997) suggest that the TEACCH approach can provide a good starting point for schools, by providing useful techniques and strategies:

> It offers ways of structuring the curriculum and the environment to reduce stress and to promote cued learning. It will do much for the majority of pupils with autism who need that kind of structure, at least in the early years, but it can never go beyond that structure to give the child internally cued strategies and so enable remediation of thinking and independence from the structure (p.19-20)

Essentially, the use of structure in this way attempts to address difficulties related to executive function deficits discussed earlier (section 2.2.2.2). However, Cumine et al. (2000) and Jordan and Powell (1997) both raise concerns that the approach can be too structured, limiting opportunities for children to make their own decisions and to be creative. Specific concerns are listed below:

- Individuals can become too dependent on the structure (Jordan & Powell, 1997)
- Does not allow individuals to develop their own ways of coping with things (Cumine et al., 2000; Jordan & Powell, 1997)
- Too strict an adherence to the class timetable may intensify the rigid behaviour patterns of the individual (Potter & Whittaker, 2001)

In particular, Potter and Whittaker (2001) raise concern regarding spontaneous communication of children with autism in classes where the TEACCH approach is adopted. Potter and Whittaker (2001) discuss research conducted by Svavarsdottir in 1992, which showed that opportunities for spontaneous communication in class were limited to transition periods. The timetable, which is a key factor of this educational approach, was seen as a 'powerful instrument' but, "it often formed the only subject for communication….most of the interactions occurring around the timetable in changeover periods" (Svavarsdottir, 1992, cited in Potter & Whittaker, 2001, p. 156).

3.1.3 Classroom strategies

The ultimate aim of education is to "instruct or guide children, through age-appropriate steps, towards levels of understanding, knowledge, forms of behaviour and habits of work that are deemed to be desirable and useful in adult society" (Trevarthen et al.*,* 1998, p. 216). Practices in mainstream education are, therefore, dictated to some degree by social norms and to some extent by the child's own motives and sense of achievement (Trevarthen et al.*,* 1998). The current study is concerned with evaluating the use of an interactive timetable in an educational setting specifically aimed at assisting children with conditions such as autism. The strategies most commonly adopted in such classrooms to assist children with autism will now be discussed. These include organisation of environment and space, establishing routine and organisation during the school day, use of visual structure, timetables, prompts and reinforcement, collaboration between school and home, and training in areas relating to daily functioning, such as social skills.

3.1.3.1 Organisation of environment and space

As discussed earlier (section 2.2.2), children with autism tend to experience bewilderment as a consequence of psychological deficits relating to areas of executive functioning and central coherence. A predictable and clearly structured environment is advocated, to help moderate difficulties (Peeters & Gillberg, 1999). Mesibov et al. (1994) assert that the physical layout of the classroom is particularly important for children with autism and this is noted to be a key principle of the TEACCH philosophy. It is suggested that the layout of the classroom space should be consistent, with obvious boundaries and clearly defined areas, so that children can develop an understanding of the environment and the events which take place there (Cumine et al., 1998; Mesibov et al.*,* 1994). It is also suggested that there should be a specific area for each major activity as this will assist the child in distinguishing between unrelated events, something individuals with autism find hard to do

(Mesibov et al., 1994). A structured layout of physical space can also support the individual in focusing attention on the task at hand; children with autism are easily distracted. A structured environment, with for example, book cases to provide obvious physical boundaries, can assist in concealing distracting sights and can also minimise noise interference. A transition area is also believed to be beneficial as it can serve to maintain consistency for the child during the day (Mesibov et al., 1994). A transition area is generally an area where timetables are displayed and where pupils assemble between activities.

3.1.3.2 Routine and organisation

Structure in the form of routine and organisation is considered an important support for children with autism, who struggle to understand the requirements of different situations and who have great difficulty in understanding and organising their daily lives (Marcus, Kunce, & Schopler, 1997; Mesibov et al., 1994). Predictability is, therefore, an essential basis for the educational environment of children with autism (Peeters & Gillberg, 1999). A routine is a procedural support, as it identifies the order of an activity (Dalrymple, 1995). Both visual cues and environmental cues are an important feature of routine. Any routine which is established needs to be consistent, but also flexible, so that it can be applied in a variety of situations (Mesibov et al., 1994). It is suggested that in helping the child with autism to see a task or event as a whole, rather than as fragmented parts (how they would normally function), would enable the child to be more organised in thought processes and it is hoped ultimately more adaptable (Maddock, 1997). There is, however, a concern that structure in the form of routine could strengthen the dependency of the individual with autism and encourage a compulsion to maintain sameness (Marcus et al., 1997). It is, therefore, recommended that some form of self-control is introduced into any routine (Powell & Jordan, 1997).

Mesibov et al. (1994) provide an example of a specific routine established in the classroom. Teaching individuals to work from left-to-right and from top-to-bottom is an approach which can be applied in many situations, from tasks such as reading and writing, to practical tasks such as washing dishes. However, it should be noted that this approach is only appropriate for cultures where written language follows this format. Eastern countries, such as Saudi Arabia, China and Japan use a different form of written language and so the TEACCH approach would need to be adapted to be of relevance.

3.1.3.3 Visual structure

Children with autism are generally found to function more ably when tasks are presented in a more concrete and visual form, and so the use of visual structure is seen as being an indispensable support (Mesibov et al., 1994). Visual support can be referred back to, unlike auditory commands, which are transient. Fundamentally, visual support assists children with autism in two directions. Firstly, visual structure can facilitate communication from the environment to the child with autism and secondly, communication by the child with autism can be supported through use of visual structure (Peeters & Gillberg, 1999). Visual organisation of materials assists the child with autism in processing information more efficiently, which in turn can facilitate learning (Mesibov et al., 1994). For example, specific areas of the classroom, as well as individual belongings, can be marked with visual cues such as name cards or colour coding, in order to facilitate identification (Mesibov et al., 1994). Providing visual instructions for a task can also aid the child, by enabling steps to be seen clearly and in the correct sequence (Mesibov et al., 1994).

3.1.3.4 Timetables

Mesibov et al. (1994) describe timetable use as an essential form of communication between teacher and pupils. The main purpose of a timetable is to explain which activities will occur and in what sequence (Cumine et al., 1998). This assists the child with autism greatly, by providing a concrete perspective of daily activities, ensuring predictability and assisting the individual in maintaining some form of control over their life (Peeters & Gillberg, 1999). Generally, timetables can be in the form of written materials, picture symbols, or a mixture of both text and pictures (Cumine et al., 1998; Mesibov et al., 1994). Mesibov et al. (1994) suggest that a timetable offers many beneficial qualities, such as communicating information to enable children to anticipate upcoming activities, enhancing predictability, and assisting with understanding and memory difficulties. There are two types of timetable used in the TEACCH approach: a general classroom timetable and an individual pupil timetable (Mesibov et al., 1994). Timetables are discussed in greater detail later (section 4.2).

3.1.3.5 Prompts

Mesibov et al. (1994) suggest that use of prompts in the classroom can be a useful motivator, particularly when teaching pupils new tasks. The type of prompt used varies according to the situation and task. Carr (1998) describes three types of prompt which can be used: physical prompts, verbal prompts, and gestures. A physical prompt, with an adult directing a child's hands, head or whole body, can assist in guiding a child with autism to complete a task (Carr, 1998; Mesibov et al., 1994). Facilitated communication is an example of such a physical prompt which has been used in the past to communicate support and encouragement to individuals with autism (Delfos, 2005). However, achieving success with this form of support is reported to be difficult (Delfos, 2005). A verbal prompt can be used with a child who has sufficient verbal understanding, to act as a reminder. A gesture can include movements which generally accompany speech, such as pointing, moving the head, and even glancing, in order to convey a meaning and to reinforce a verbal statement (Carr, 1998).

Mesibov et al. (1994) stress that it is important to gain the child's attention before making use of any prompt and in order to be effective, prompts must be delivered clearly and consistently. Many children with autism are known to be prompt dependent and so teachers need to be aware of unintentional prompting; by positioning themselves behind or beside a child, unintentional cues could be avoided (Mesibov et al., 1994). To assist in reducing dependence, prompts can be faded gradually (Carr, 1998).

3.1.3.6 Reinforcement

Reinforcement is defined as "anything which, when it follows a behaviour, makes that behaviour more likely to happen again" (Carr, 1998, p. 80). The terms reinforcement and reward are frequently used interchangeably and refer to anything which can be used to motivate a child to repeat a particular behaviour (Carr, 1998). Children with autism are not generally motivated by praise, remuneration or innate satisfaction in the same way as typically developing children are (Mesibov et al., 1994; Peeters & Gillberg, 1999). It can be difficult, therefore, for the teacher to establish factors which act as a motivator for the child with autism. However, once motivators have been identified the teacher can then introduce meaningful rewards which motivate the child. Food, toys and preferred activities are all examples of reinforcers which can be used to motivate individuals (Carr, 1998; Mesibov et al., 1994).

Another form of reinforcement which has been found to be effective is the use of token programmes. “Tokens are secondary reinforcers that acquire their reinforcing properties through association with backup (primary) reinforcers” (Charlop-Christy & Haymes, 1998, p. 189). Token systems are considered easy and convenient to use and examples include ‘happy faces’ (Charlop-Christy & Haymes, 1998) and star charts (Carr, 1998). However, children with learning disabilities such as autism are not always motivated by the achievement of earning a ‘star’ or a ‘happy face’ and it is possible to set up a system where the tokens are exchangeable for something which does motivate the child, such as a ‘back-up’ reinforcer (Carr, 1998).

A study by Charlop-Christy and Haymes (1998) considered the use of objects of obsession as token reinforcers and found outcomes were generally favourable. There was an overall increase in correct responses on tasks and criterion for success was met rapidly by the participating children when objects of obsession were used as token reinforcers (Charlop-Christy & Haymes, 1998). Carr (1998) recommends that in order for the child to connect the behaviour with the reinforcer, “The reinforcement should be given immediately after the behaviour” (p. 81). To maintain the effect of the reinforcer it should only be given in the circumstances of reinforcement (Carr, 1998).

3.1.3.7 Home and school

Good communication between parents and teachers is extremely important and should be a continuous and two-way process (Wing, 1971). Jordan and Powell

(1995) advocate a 24 hour curriculum; the nature of the learning needs of the child with autism is such that education should be continued at home, hence parental involvement is paramount. It is suggested that involving parents is extremely important for a number of reasons:

- Interest and support from parents is of great value
- Home and cultural values must be taken into account
- Those who know the child best are best able to assist with learning
- Parents have a unique interest in their child
- Problems are not exclusively academic and all areas of a child's development are affected
- Parents need and seek guidance from professionals

(Jordan & Powell, 1995, p. 146)

3.1.3.8 Social skills training

This is the name given to a "broad range of techniques used to help teach children and adults with autism how to interact socially" (Baron-Cohen & Bolton, 1993, p. 68). Harris and Handleman (1997) suggest that a competency in social skills is necessary if children with autism are to be effectively integrated in mainstream classes. As discussed earlier (section 2.2.1.1), difficulties which children with autism face with regard to social interaction can have serious implications, leading to difficulties with 'fitting in' and rejection by others (Harris & Handleman, 1997).

For individuals with autism the difficulties in social situations are more likely to arise from problems with social conventions rather than with the physical aspects of a task. So for example, social skills training for children with autism could involve helping them to learn how to behave in the school dining area, by teaching social conventions such as the concept of queuing. Attwood (1998) reports on the success of social skills groups for adolescents with Asperger's syndrome, stating that such groups allow individuals an opportunity to practise and learn a variety of social skills. Groups may be organised by schools or by specialists and Attwood (1998) advises that it is important for the groups to be small enough to allow individual tuition to take place. There is concern, however, that although some social skills can be taught, it is often a problem for the person with autism to generalise the skill to a new or alternative situation, or indeed to remember the newly learnt skill (Baron-Cohen & Bolton, 1993).

Harris and Handleman (1997) report on research in the areas of teacher, peer and child-focused intervention to teach social skills and suggest that an optimal setting is one which, “would combine adult mediation, responsive peers, and a well-prepared child with autism” (Harris & Handleman, 1997, p.666). Research in the area of social skills is currently looking at the use of social stories as a means of teaching social skills to this population. The approach of ‘social stories’ was developed by Carol Gray, in America, in the early 1990s. Essentially, the principle is that parents or professionals write stories in a child appropriate format, to describe difficult or confusing social situations (Gray, 1995; Kuttler, Smith Myles, & Carlson, 1998). Social stories have been noted to be particularly compatible with a visual learning style (Kuttler et al., 1998). Examples of studies which have specifically looked at the use of social stories include Bledsoe, Smith Myles, and Simpson (2003), Kuttler et al. (1998), Rowe (1999), and Scattone, Wilczynski, Edwards, and Rabian (2002). An example of a multimedia program developed to teach appropriate social behaviours using social stories is described later (section 3.2.4.1).

3.1.4 Conclusion

This section of the chapter has considered the educational environment in which children with autism are situated in the UK. It was demonstrated that a wide range of educational settings exist. However, placement is crucially dependent on individual needs, as well as availability of options. The process of assessment provides parents with an opportunity to express preferences regarding placement choices.

A range of approaches to the education of children with autism was identified and it is recognised that deciding on the most appropriate approach for an individual can be a difficult task. There is no one ‘best’ approach which is suitable for all children with autism. Professionals and parents, therefore, need to be open-minded and undertake an approach which suits individual needs, rather than trying to ‘fit’ an individual into one standard approach. The overall intention should be to consider the extent to which the quality of life of an individual is supported and the degree to which learning is facilitated by the chosen approach. An example of an approach commonly used in UK school settings was discussed. Strategies aimed at assisting children with autism in overcoming difficulties and in facilitating education were highlighted and an essential element was found to be structure. Providing structure in the environment, in routines and in 'time', was found to be a key feature which could assist children in the classroom. Support was also noted to be provided through the use of prompts and reinforcers, useful motivators for children with autism. In addition, it was noted that collaboration between school and home was considered very important for supporting continuous education. A further strategy, social skills training, was found to assist children with autism in developing basic skills to facilitate daily functioning. A range of techniques is employed in this area and a popular method currently used in schools is that of 'social stories'. Social stories integrate well with the visual learning style associated with children with autism.

Overall it can be seen that the educational environment is varied and is likely to differ greatly from one setting to another. This is due essentially to the requirement to accommodate individual needs as well as because of the varying level of experiences brought to the situation by the professionals operating there. The following section now proceeds by considering the computing environment.

3.2 The computing environment: computer use by children with autism

The focus of this section is on the use of computers by children with autism. The section begins with an overview of information and communication technology (ICT). A brief summary of the history of computing in schools generally since the 1960s is presented, in order to set the context for examining the use of computers by children with autism. The use of the computer by children with autism is discussed and in particular, reasons why computers are believed to be appropriate for this particular population are examined. Potential benefits which computer technology has to offer this user group are highlighted and areas of concern are considered. Lastly, examples are given of research studies, illustrating specific areas where computers have been used to assist children with autism in some way.

3.2.1 Information and communication technology

The term information and communication technology (ICT) is used to indicate a whole range of technologies involved in electronic communications, including the World Wide Web (WWW), electronic mail, video conferencing, and fax (Scottish Office Education and Industry Department, 1998). The pervasiveness of ICT is now such that it is present in most lifestyles, from classrooms to the workplace, and with ever-increasing numbers of homes acquiring personal computers and establishing an Internet connection. Advances in this technology have also led to the development of smaller, more mobile devices, creating a significant increase in the potential of ICT.

The use of computer technology has become increasingly more important in society as a whole, due to several key factors. Zorkoczy (1991) described how the emergence of the ‘information society’, with the application of computer technology to information handling, led to changes in the way we communicate and in the type of occupation which the working population now perform. Alexander (1999) and Selwyn (2003) note that together with this social impetus there also appeared to be a political motivation, aimed particularly at encouraging the use of ICT in schools, as successive governments strove to maintain a competitive balance with other nations. Kerawalla and Crook (2002) maintain that “most children in Britain have access to computers in school" (p.751). A report by The Office for National Statistics (ONS) (2004, online) states:

> In autumn 2002, 98 per cent of young people aged 5 to 18 used computers at home, at school or elsewhere - with 22 per cent saying they used computers at school but not at home. For children aged between 11 and 18, the main activities undertaken on a computer at home were school or college work (90 per cent), playing games (70 per cent), and using the Internet (67 per cent). For younger children, 40 per cent of those aged between 7 and 11 who used a computer at home said they did their homework on the computer.

Livingstone (2002) found that use of the Internet has increased rapidly in just a matter of a few years and that this "is evident by the speed with which access figures become out of date" (p. 11).

3.2.2 Historical review of information and communication technology use in schools

Since the late 1960s, various governments have considered the issue of educational technology. Specific organisations such as the National Council for Educational Technology (1967) and the Council for Educational Technology (1973) were created in order to investigate technology issues in more depth (Office for Official Publications of the European Communities, 1993).

The significance of ICT use and instruction was acknowledged with the revision of the National Curriculum (England and Wales) in 1994. As a result, greater emphasis was given to the use of information technology within the curriculum, making it an integral part of all subject areas (Central Office of Information, 1996). Towards the end of the 1990s, a significant growth was noted to be occurring in schools, both in the quantity of information technology equipment available and in the use of information technology across the curriculum (Herring, 1999). Selwyn (1999) describes how in 1995 the Department for Trade and Industry developed the 'Schools Online Scheme'. This scheme linked 50 secondary schools to the Internet and was believed to be motivated by both economics and politics; the scheme was partly funded by industry, whilst the need for a computer literate workforce was acknowledged by the government (Selwyn, 1999). In 1997, the Education Department introduced the Superhighways Initiative (EDSI), which involved around 1,000 schools across the UK in a variety of projects; examples include the Superhighways Teams Across Rural Schools (STARS), Students Across Europe, and the Bristol Education On-line Project (Department for Education and Employment, 1997b). In 1998 the government's initiative, the National Grid for Learning was introduced, and was portrayed as "a mosaic of inter-connecting networks and education services based on the Internet, which will support teaching, learning, training and administration in schools, colleges, universities, libraries, the workplace and homes" (DfEE, 1997b, p.3).

3.2.3 Computer use and children with autism

It has been suggested that computer technology has the potential to present new and innovative ways of learning and teaching for children with autism (Powell, 1996). The appropriateness of computer technology for children with autism is now discussed, and this will be followed by a discussion of the beneficial features and concerns.

3.2.3.1 Why are computers considered appropriate for children with autism?

It has been generally acknowledged that many children with autism are not only very comfortable, but also frequently very skilled at using computers and in addition, that they find the experience enjoyable (Attwood, 1998; Bell & Potter, 1999; Murray, 1997). It is suggested that computer use has the potential to provide both educational and therapeutic benefits and additionally, that use of a computer can actually address some of the difficulties faced by children with autism (D. Moore, McGrath, & Thorpe, 2000; Murray, 1997; Murray & Lesser, 1999). For example, use of a computer can provide an ideal environment for encouraging communication, creativeness, sociability, and relaxation; features which can help ease the difficulties relating to the 'triad of impairments'. It has been suggested that computers have several attributes which make them potentially appropriate for children with autism and these are now discussed in detail.

A contained and context-free environment

Murray (1997) suggests that computers are very suitable for individuals with autism, as the computer offers a context-free environment and present users with clearly defined boundaries. Murray and Lesser (1999) state “computers afford an easy way of joining attention tunnels with minimum mutual discomfort, so circumventing some of the most disabling features of autistic spectrum disorders” (p.1). Murray (1997) describes how the single-channelled style of absorption seen in those with autism results in attention being focused in one direction, with objects being seen in isolation, devoid of context. This concentration of attention can have the effect of making the world appear frightening and disorganised for children with autism. In contrast, the contained, context-free environment presented by the computer can be reassuring for the individual and at the same time may provide an opportunity for the individual to become relaxed enough for their level of awareness to become less absorbed (Murray, 1997).

A safe, predictable and asocial environment

The computing environment is typically deemed a safe and predictable setting, which places no verbal demands on the user. For children with autism, a computer offers a predictable environment where experimentation can be made safely (D. Moore, et al., 2000). This can encourage exploration and creativity, whilst ensuring freedom from fear of misunderstandings or verbal repercussions for mistakes which are made; a fear which often inhibits children with autism in social situations (Bell & Potter, 1999; Lee, McGee, & Ungar, 2001; Murray, 1997; Powell, 1996). Powell (1996) states those with autism commonly find the “social mediation of learning a difficulty so the asocial nature of the computer is amenable to their particular way of learning” (p.129). Nimmo (1994) suggests that the lack of human interaction together with the fact that a computer allows the ‘world’ to be repeated, makes the computer an attractive option for children with autism, who do not take readily to change. The predictability of a computer adds to the controllability of its environment, a feature which makes the computer appealing for individuals with autism (Murray, 1997).

Instant, unambiguous and asocial feedback

A computer is commonly acknowledged to provide unambiguous and non-social feedback, a feature which is particularly appropriate for children with autism, who find social situations difficult, confusing and even threatening (Powell, 1996). Non-social and instantly recognisable feedback would not only be an aid to effective learning, but would also suit the needs of individuals with autism, whose attention span may be short and who, as discussed earlier (section 2.2.1.2), characteristically take verbal communication literally.

Constant patience

Individuals with autism commonly need time to work at their own pace and it is suggested that the computer has the potential to offer users continual patience, enabling progress to occur at the individual's own pace (D. Moore, 1998; M. Moore & Calvert, 2000; Powell, 1996). For example, a teacher may require a child to respond swiftly to a request due to time constraints of the school day, but the computer on the other hand has no such time constraints and so the child is able to take his time, possibly even saving his work so that he can continue with it later.

Visual presentation

It is commonly recognised that children with autism respond well to visual information. A computer has the potential to present highly visual information, through use of multimedia channels, making it possible for information to be presented in a way which is appropriate for the needs of each individual (D. Moore, 1998; Powell, 1996). Multimedia can be used to introduce interactivity, as well as enabling displays to be paused or repeated (D. Moore, et al., 2000). Furthermore, use of multimedia can enable visual presentations to be adapted to suit the user's style of learning and assist in retaining the user's attention (Lee et al., 2001).

3.2.3.2 Beneficial features of computer use for children with autism

Therapeutic benefits

Murray (1997) suggests that use of a computer can in fact offer therapeutic benefits to children with autism. Many of the attributes of the computer outlined previously (section 3.2.3.1), such as predictability, controllability and patience can actually aid individuals, by creating a general feeling of ease. Murray (1997) believes that once at ease, children with autism may then find an opportunity to learn a new skill, such as learning to take turns, or to communicate in a mutual way if someone else is joining in.

Motivational benefits

Murray (1997) suggests that when using a computer, a child with autism may become motivated to show other persons nearby items being viewed on the computer screen and that this may actually lead to the sharing of activities with another person. For example, joint attention may be encouraged. Murray (1997) proposes that interacting with a computer programme could motivate a child to speak, either to the computer or to persons nearby. Additionally, use of a computer programme could provide the motivation a child needs to read (Murray, 1997).

New ways of learning and teaching

Children with autism frequently find learning difficult in social situations. The fact that a computer is a logical, rational instrument, with no social dimensions could actually assist individuals with autism, by enabling concentration on learning, instead of distraction from the difficulties associated with verbal and social interaction (Jordan & Powell, 1995; Powell, 1996). Powell (1996) suggests that traditional teaching methods may often be inappropriate for certain children with autism, particularly where there are problems with social interaction or communication; in such cases, use of computer technology may be a favourable alternative. Computer Aided Learning (CAL) is perceived to be a useful tool for introducing new skills or a new area of knowledge to a child (Jordan & Powell, 1995). For example, computer-learning environments offer encouraging possibilities where "levels can be built into a computer program which become progressively more complex, thus allowing for different degrees of ability" (Lee et al., 2001, p.66). The computer, therefore, has the potential to be used within the curriculum in a supportive role and outside the normal curriculum as a tool to increase the learning environment (Powell, 1996).

Allows individual needs to be taken into account

Children with autism have variable and often complex learning problems and frequently require individualised instructional programmes (Higgins & Boone, 1996). There is a plethora of needs which should be accounted for when developing individual programmes, such as the child's language needs, academic needs, ability to retain information over time, ability to generalise, motivation levels, social skills, behaviours, and any idiosyncratic learning habits the child may have (Higgins & Boone, 1996). There is "no single teaching method to suit every student" (Higgins & Boone, 1996, p. 69) and so frequently it is becoming the task of teaching staff to create appropriate and individual materials. Higgins and Boone (1996) see the potential of the computer as being "an effective tool for re-enforcing or practicing skills" (p. 70). Use of a computer offers the possibility of both non-verbal and verbal expression (Bell & Potter, 1999). For example, sounds can be used in computer programs to augment visual cues where necessary (Powell, 1996). The computer, therefore, has great potential as an additional tool with which teachers can work, provided the instruction delivered by computer is as effective as that delivered by the teacher.

3.2.3.3 Concerns with computer use

There are concerns that use of a computer in the classroom could present particular risks for children with autism. For example, it has been suggested that certain individuals may begin to prefer interacting with the machine rather than participating in social interaction, reinforcing difficulties which already exist (D. Moore, 1998; Murray, 1997; Powell, 1996). It is suggested that regular use of a computer could lead to more rigidity of thought in children with autism, as well as an increase in obsessiveness (Powell, 1996). There is also concern that the computer offers too many distracters and too much complexity, particularly if there has been overuse of graphics, animation and sound (Powell, 1996). However, Murray (1997) asserts that it is unlikely that any child would be allowed to monopolise the computer in the classroom situation. It would appear, therefore, that caution is advised and that teachers should be guided by their knowledge of individual needs and characteristics when introducing computer programs.

3.2.4 Examples of research into software development

Examples of computer software programs which have been developed to assist specific areas of difficulty faced by children with autism, such as those associated with the 'triad of impairments', are now discussed.

3.2.4.1 Social skills

As discussed previously (section 2.2.1.1), one of the key difficulties faced by many children with autism, is an inability to develop 'normal' social relationships. Individuals with autism find social situations confusing and frightening. Social skills training, a strategy discussed earlier (section 3.1.3.8), aims to assist children with autism in learning how to interact socially, with a view to helping them to attain valuable life skills. Examples of studies where computer programs have been developed to address this particular area are now discussed.

A multimedia social story program

Hagiwara and Smith Myles (1999) describe a study in which a multimedia software program was used to teach appropriate social behaviours to individuals with autism and to introduce situations which were new and potentially threatening. The aim of the study was to investigate further the use of social stories and at the same time to introduce computer-based multimedia as a new medium of presentation (Hagiwara & Smith Myles, 1999). "A social story describes social situations in terms of relevant social cues and identifies appropriate responses for individual students" (Gray, 1994, cited in Hagiwara & Smith Myles, 1999, p. 82). By using pictures along with small amounts of text, it was hoped to reduce the confusion frequently caused for those with autism when verbal instructions and social interaction take place together. The study found that overall, the use of a multimedia social story programme was effective and that "many students with autism are visual learners" (Hagiwara & Smith Myles, 1999, p. 83).

Virtual environments (VEs)

An investigation into the potential of virtual environments for teaching social skills to individuals with Asperger's syndrome was conducted in collaboration between researchers at the University of Nottingham and the National Autistic Society. The study known as the 'AS interactive project' took place over a period of three years and aimed to assess "the potential feasibility and acceptability of VEs for adults with AS" (Parsons, et al., 2000, p. 166). Parsons et al. (2000) suggest that virtual environments have the potential to provide an opportunity for social skills training as "many of the confusing inputs in 'real world' interactions can be removed" (p.163) and that virtual environments can provide "less threatening situations in which skills can be practiced and learned" (p. 164). Parsons et al. (2000) state, "virtual reality offers a stable and predictable environment in which interactions can take place without the anxiety-inducing plethora of non-verbal and verbal information that characterise social interactions" (p. 169). Neale, Cobb, and Wilson (2002) and Strickland (1997) concur, suggesting that VEs are a suitable training channel as they offer many features, which match the needs of social skills training for individuals with autism.

Social engagement and understanding

A study by Pino (2003) investigated "the use of computers as an environment to teach and practise social understanding. The computer provided a 'real life' environment and a shared interest, as well as a motivational and safe tool around which to construct a relationship" (p. 133). An experimental study was conducted with 28 children, comparing interaction patterns when playing a paper-based game of noughts and crosses with an adult, and a computer-based version of the game. There were reported to be no strong conclusions for this study, however, the children were found to be more engaged when using the computer (B. Pino, conference presentation, November 15, 2003).

3.2.4.2 Literacy skills

Computer programs aimed at addressing literacy skills have been developed to help overcome difficulties associated with the impairment of social communication.

Multimedia: literacy skills programme

An example of a multimedia program developed specifically for a group of children with autism with the aim of advancing literacy skills, is ‘DeltaMessages’ (Tjus, Heimann, & Nelson, 1998). The program was developed for use on a Macintosh machine and allowed children to create a sentence, which the program then responded to by providing multi-channel feedback (Tjus et al., 1998). The authors reported that results were encouraging, with significant gains noted in reading and phonological awareness, whilst it was also found that the multimedia had a general motivating effect on the children.

A further study by Tjus, Heinemann, and Lundälv (2003) employed a specific strategy for literacy and communication development, using multimedia. This consisted of three ‘building blocks’ referred to as Multimedia Interaction Recasting (MIR):

- **M**ultimedia program: Omega-Interactive Sentences
- **I**nteraction: adult support/dialogue
- **R**ecasting: adult expands child’s words, or multimedia material explored

The multimedia program Omega-Interactive Sentences was developed specially and was found to be more adaptable than previous programs (Tjus et al., 2003). The authors reported positive findings, with gains being noted in reading skills, phonological awareness, communicative skills, and in processing skills. The following were also reported:

- Positive interaction findings
- More talk (about relevant things)
- More enjoyment - laughing, smiling
- Asking about language materials

- Less teacher directives
  (Tjus et al., 2003)

Computer-animated speech and language tutor

Bosseler and Massaro (2003) describe a computer-animated tutor program called ‘Baldi’, which was developed for children with autism in order to teach vocabulary and grammar. The rationale for this program was to investigate an alternative delivery method, which it was hoped would overcome some of the difficulties faced by speech and language therapists when working with children with autism, such as a lack of cooperation and a lack of motivation to communicate (Bosseler & Massaro, 2003). The study involved nine children aged between 7 and 12 years and took place in California. The researchers conducted a series of training sessions before beginning the formal investigation in order to introduce the children to the researcher, the program, and the format of lessons. The program provided feedback in the form of ‘smiley’ or ‘sad’ faces for happy or incorrect answers. All but one participant was found to enjoy the experience.

The researchers highlighted the fact that “effective programs for this population share the following elements: curriculum addressing the ability to use and comprehend language and interact socially, highly supportive teaching environments and generalization strategies, and learning environments that are predictable and routine” (Bosseler & Massaro, 2003, p.655). The following advantages of this particular research program were identified:

- Ability to control and manipulate the visual and auditory components
- Use of visual images and text - providing additional cues for word and concept learning
- Variation in the learning environment (at a reasonable level) to facilitate generalisation of what is learned
- One-to-one format between child and computer
- Can diminish social difficulties experienced when interacting with teacher or others
  (Bosseler & Massaro, 2003.)

3.2.4.3 Executive function

As discussed earlier (section 2.2.2.2), executive function behaviours normally enable an individual to plan and organise, self-monitor, behave flexibly, and cope with changes. A deficit in executive function causes rigidity and inflexibility and as a result, individuals with autism struggle to see the whole 'picture' (Cumine et al., 1998). Various strategies aimed at assisting children with autism in coping with these difficulties were discussed earlier (section 3.1.3). Examples of research involving computer programs developed to address impairments in this area are now presented.

Computer-mediated role taking: the Bubble Dialogue

Rajendran and Mitchell (2000) used a multimedia application, Bubble Dialogue, to assess "the experience of computer-mediated role-taking on the interpersonal understanding, executive abilities and verbal abilities of two young male adults with Asperger's Syndrome" (p.189). The aim of this study was to assess and where possible, improve interpersonal understanding in those with Asperger's syndrome. Scenarios based on 'Theory of Mind' social situations were developed for use with the Bubble Dialogue application. "The application creates the experience of role-play in a comic strip world, in which two users each role-play a character" (Rajendran & Mitchell, 2000, p.190). The study was carried out with the researcher and participants assuming the character roles of the scenarios. The role-play was not found to induce a detectable change in interpersonal understanding; however, it was observed that participants did comment on how much they had enjoyed using the application (Rajendran & Mitchell, 2000). Overall, Bubble Dialogue was seen to provide an interactive and socially non-threatening environment for role-play in social situations (Rajendran & Mitchell, 2000).

Multimedia for personal safety skills

A study conducted by Lee et al. (2001) at Glasgow Caledonian University, used a multimedia program to teach personal safety skills to children with severe learning difficulties. Scenarios were presented on the computer screen and participants had to make a choice from three options, which then resulted in a follow-on scenario. It was found that this method of presenting personal safety issues was effective; participants demonstrated knowledge of the concepts and were noted to retain this knowledge over a reasonable period of time (Lee et al., 2001).

Learning to recognise and predict emotions in others

A study conducted by Silver and Oakes (2001) evaluated a computer intervention designed to teach individuals with autism to recognise and predict emotions in others. The study employed a randomised controlled trial, with two groups of 11 children participating from two special schools. One group was experimental and used the computer program, whilst the other group was a control group and had only normal lessons. The group which used the computer program was assessed pre and post intervention and gains were noted to be made relative to the control group on all three measures, suggesting positive effects of computer program use (Silver & Oakes, 2001).

3.2.5 Conclusion

This section has provided a background context to the use of computer technology in schools and it can be seen that this use is expanding at a rapid pace. It has been demonstrated that computers are generally seen as being appropriate for use by those with autism, offering a contained and context-free environment, predictability and an asocial setting. The instant and unambiguous feedback of a computer is thought to be very appropriate for children with autism, who generally have a short attention span and a lack of imagination. Additionally, the infinite patience of the computer enables users to work at their own pace without fear of constraint, whilst the potential for visual presentation on a computer screen can accommodate a wide range of users' needs. Advantageous features presented by computer technology include therapeutic benefits, motivational gains, and pedagogic support. In addition, computer technology enables individual needs to be accommodated, for example, presenting opportunities for both verbal and non-verbal expression to be included in programs. However, computer use by children with autism is not without concerns. Examples of computer programs developed to assist children with autism with difficulties relating to the 'triad of impairments' have been illustrated here and these have been found to be used successfully in several areas.

Chapter 4: The task

An understanding of the task a system is required to perform is essential if a useful and usable system is to be developed (Shneiderman & Plaisant, 2005). This chapter considers the task of communicating the daily routine in the classroom setting. Section 4.1 considers communication approaches generally, while section 4.2 considers use of visual support such as a symbolic timetable.

4.1 Communication approaches

This section discusses communication approaches. It begins by providing basic definitions and then proceeds to examine specific forms of alternative and augmentative communication (AAC) approaches.

4.1.1 Communication

Communication is broadly defined as “a two-way process by which information is passed from one person to another” (Brown & O’Regan, 2001, p.1). As discussed earlier (section 2.2.1.2), communication processes include the intention to communicate, together with the correct understanding of a communication (Messer, 1994). Four basic conditions necessary for communication to take place were also outlined earlier (section 2.2.1.2), and include something to communicate about, something to communicate with, a reason to communicate, and a communicative partner to receive and understand the message (Jordan, 2001).

As discussed earlier (section 2.2.1.2) individuals with autism have considerable difficulties with social communication and vary greatly in their communicative ability. For example, an intention to communicate is normally signalled by eye gaze; however, many individuals with autism lack this ability. Also mentioned earlier, was the difficulty individuals may have in comprehending what is said to them, as well as difficulty in being understood. Because individuals with autism differ in their ability in this way, approaches to assist communication tend to be individualised, with a style being advocated which begins with the form of communication which the child is best able to cope with independently (Peeters & Gillberg, 1999). Ways of assisting children with autism in overcoming communication difficulties include augmentative and alternative forms of communication and these are now discussed.

4.1.2 Augmentative and alternative communication (AAC)

“*Alternative communication* is used when the individual communicates in face-to-face communication in ways other than through speech” (von Tetzchner & Martinsen, 2000, p.7) [italics original]. Examples of alternative communication methods which can replace speech include writing, manual and graphic signs, and Morse code (von Tetzchner & Martinsen, 2000). "*Augmentative* communication refers to the use of aids or techniques that supplement existing vocal or verbal communication skills" (Mustonen, Locke, Reichle, Solbrack, & Lindgren, 1991, p. 1) [italics original].

Jordan and Powell (1995) report that there is mixed opinion regarding the use of AAC with children with autism. Some educationalists suggest children with autism should not be taught alternative forms of communication alongside speech, as coping with information from more than one channel at a time can be very difficult for these children; other educationalists, however, suggest that use of an alternative form of communication accompanying speech can have beneficial effects on the development of spoken language and on levels of understanding (Jordan & Powell, 1995).

> The very essence of communication is that it is a shared system and, while there can be some individual variation within a class or family group, there must be a system that is understood and used by all the adult members of the communicating group at least (Jordan & Powell, 1995, p. 64)

Choice of which form of AAC to employ is, therefore, very much dependent on the individual and on the context in which the approach will be taught (Jordan & Powell, 1995). AAC could be divided into static and dynamic forms; these are now discussed.

4.1.2.1 Static forms of augmentative and alternative communication

Graphic symbols or objects which are permanent and remain fixed, yet still convey meaning, are referred to as being static forms of AAC (Mustonen et al., 1991). Examples include written communications and symbols such as Rebus, Blissymbols and Picture Communication Symbols (PCS). Static forms of AAC are typically associated with aids such as communication boards (Beukelman & Mirenda, 1998; Mustonen et al., 1991).

Rebus symbols are a pictorial system which use line drawings and provide a wide range of vocabulary appropriate for varying levels of cognitive ability (MacDonald, 2003). Rebus symbols are the vocabulary resource used in Widget software ‘writing with symbols’ (MacDonald, 2003). Blissymbols are a form of ideographic writing (von Tetzchner & Martinsen, 2000). This is described as being a versatile system with the “ability to represent multi-meaning concepts and to generate syntax” (MacDonald, 2003, p. 4). However, Blissymbols tend to be very abstract, placing high cognitive demands on users and, therefore, are less suited to those with more severe forms of learning difficulty (MacDonald, 2003). PCS, a library of pictorial symbols, are particularly suitable for individuals with severe learning difficulties and are used extensively for communication displays and for teaching activities (MacDonald, 2003). PCS are used in Boardmaker™ software.

As discussed earlier (section 3.1.3.3), visual structure is acknowledged to be an important support for individuals with autism. Johnston, Nelson, Evans, and Palazolo (2003) describe how visual supports such as graphic symbols can facilitate communication for children with autism, by presenting information in a form which enables the child to encode the information in their own time. The term ‘symbol’ is defined as “a graphic representation of meaning other than the written word” (Clarke, Price, & Jolleff, 2001, p. 269). Symbols are only effective as a form of communication if they are understood by those using them and so should be “visually clear and unambiguous” (MacDonald, 2003, p.6). Symbols can be pictorial or iconic and tend to be categorised as symbol sets (a vocabulary of symbols) or as symbol systems (having its own phonology and grammar) (Clarke et al., 2001). Generally this form of AAC is referred to as being “low tech” (Bondy & Frost, 1994). Examples of symbol sets include Picture Communication Symbols (PCS) such as Mayer-Johnson’s Boardmaker™ (mentioned earlier) and the Picture Exchange Communication System (PECS) (Clarke et al., 2001). The basic principle of PECS is to enable a child with social-communication difficulties to communicate with a partner, such as a teacher or parent, in order to make a request (Bondy & Frost, 1994; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002). Suggested benefits of PECS are that it can be learnt very quickly, is reasonably inexpensive and is easily transportable, facilitating use in various settings (Bondy & Frost, 1994; Charlop-Christy et al., 2002). Examples of symbol systems include Rebus symbols and Makaton symbols (Hazell & Cockerill, 2001).

Howlin (1998) suggests that pictorially based systems, which use images reflecting an individual's needs or interests, may provide greater motivation for use. Hazell and Cockerill (2001) caution that "in new environments or when changes are made to an individual's communication system, professionals should never remove what the user already knows" (p. 165). It is important that the choice of graphic system should not rule out the ability to use symbols from another system, as it may sometimes be necessary to supplement unavailable symbols; incompatibility between systems would equate to the user having to learn a new language (Hazell & Cockerill, 2001). The main advantage of using a symbol set is that it places less cognitive demand on the individual, as there is less need to memorise symbols (Hazell & Cockerill, 2001; Howlin, 1998).

4.1.2.2 Dynamic forms of augmentative and alternative communication

As the name suggests, dynamic forms of AAC convey meaning by movement and transition and are, therefore, not permanent or enduring (Mustonen et al., 1991). Dynamic forms of AAC are typically associated with gestural mode systems (Mustonen et al., 1991). Examples include British sign language, gesture, and other forms of non-verbal communication.

There has been a move in recent years towards the introduction of keyword signs to assist children who are failing to develop spoken language, to enable individuals to find a way to express themselves (G. Powell, 2001). For children with autism, where a lack of eye contact is commonly observed, use of signing may actually motivate communication; it is difficult to focus on making signs and maintaining eye contact at the same time (Clibbens & G. Powell, 2003). Benefits of signing for children with autism include:

- An alterative means for learning to communicate
- A more readily comprehended means of communication, thereby assisting in understanding of communication and of the spoken language
- Teachers generally slow down their use of accompanying spoken language when signing and this can limit the communication to key concepts only, thus reducing the cognitive load for the 'listener'

- use of signing forces the ‘speaker’ to think about the ‘listener’s’ needs during conversation

(Jordan & Powell, 1995, p. 64)

An example of a specific sign system is the Makaton vocabulary, which was developed in the early 1970s (Hazell & Cockerill, 2001). The Makaton sign system aims to:

> …provide a controlled method of teaching British Sign Language to mentally handicapped children and adults and other language-handicapped people, in order to provide a basic means of communication; to encourage expressive speech wherever possible; to develop an understanding of language through the visual medium of the signs and the logical structure of the sign language (Walker, online, n.d.)

Whilst a key advantage of signing is that it can be more easily shaped and prompted than speech there is, however, little evidence so far that it can actually enhance communication for the child with autism (Howlin, 1998). Furthermore, a significant limitation of signing with regards to this population is that there is a tendency for signing to mirror spoken language difficulties in autism. In addition, there are frequently noted to be problems associated with motor dyspraxia in people with autism, which limit imitation ability (Nulens, Breesch, & Steyaert, 2003). Dyspraxia is a motor disability which causes difficulty for individuals when performing voluntary actions (von Tetzchner & Martinsen, 2000).

Another significant limitation of signing is that the majority of people will not know how to sign. This limits the communication environment, as those unfamiliar with signing will be unable to understand attempts at communication in this form and will also be unable to respond (Howlin, 1998; Jordan & Powell, 1995). While some parents may be willing to learn to use manual signs others may find this difficult, or be reluctant, fearing that the introduction of another form of communication may further delay the development of spoken language (Granlund, Björck-Åkesson, Olsson, & Rydeman, 2001).

Millar (2003) asserts that for those with autism, “presentation of information through a permanent visual medium is shown to be much more effective than through a transient, verbal route" (p. 63). Therefore, it would appear that static forms of AAC would be more suitable for the needs of those with autism.

4.1.3 Computerised communication devices

MacDonald (2003) describes how recent technological advances have provided innovative ways of communicating and that this has led to an increase in options available. For example, computer keyboards have been adapted for symbol based communication, increasing the possibilities of use (MacDonald, 2003). Howlin (1998) describes how the sophistication of computerised communication devices has developed in recent years, with some now being specifically designed for children with autism. For example, devices now focus on reciprocal interaction and turn-taking (Howlin, 1998). Vanbiervliet and Parette (2002) describe how advances in computer technology have provided opportunities for the "development of powerful assistive devices using synthesized or digitally recorded speech and dynamic visual displays" (p. 143). It is suggested that such development will continue (Vanbiervliet & Parette, 2002).

Hazell and Cockerill (2001) discuss the use of computer software in the field of AAC and indicate that there is now a growth in the number of programs developed specifically for use in this area. Detheridge (2003) reports on how development of software tools such as 'writing with symbols' has facilitated communication with symbols. Hazell and Cockerill (2001) and MacDonald (2003) report that emailing options for symbol communication are being explored.

4.1.4 Conclusion

This section has considered communicative approaches with respect to children with autism. It has been suggested that due to the range of abilities observed in individuals with autism, approaches to assist communication need to be individualised. Forms of static and dynamic AAC have been considered and whilst dynamic forms such as signing have been useful in some cases this option is generally considered less suitable. Overall it is acknowledged that a permanent, visual medium of communication is much more effective for individuals with autism than a transient, verbal route; therefore, communication in the form of symbol sets and symbol systems is favoured as a form of augmentative and alternative communication for children with autism. These ‘low tech’ forms of communication alleviate the need for recall and can be individualised to reflect needs and interests, providing added motivation for use. Advances in ICT have led to interesting developments in the field and computerised communication devices are becoming more readily available.

4.2 Communication of the daily class routine

The task of communicating information about the daily class routine is considered in greater detail in this section. A description of the form of timetable commonly used in the educational context is given and different styles of timetable are identified. The overall purpose of a daily timetable is then discussed in relation to children with autism. The key benefits of using a timetable as a visual aid for communicating daily activity plans to children with autism are established, together with acknowledged limitations. Finally, examples of timetable use are highlighted. It should be mentioned that there are several terms which are found to be used interchangeably to refer to this form of communication tool, i.e. schedule, timetable and activity plan. For the purpose of this thesis the term ‘timetable’ will be used.

4.2.1 The timetable

A timetable is used as a visual structure for informing and communicating the overall sequence of events for the day (Mesibov et al., 1994). Dalrymple (1995) classifies the timetable as a temporal environmental support used to organise time sequences. The timetable can take a daily or weekly form and can be on view permanently in the classroom or can be used as a portable system, such as in a workbook (Peeters & Gillberg, 1999). Generally, a timetable can be made up in any style which suits the needs of those who are intended to use it. It can consist of objects, drawings, a combination of objects and drawings, photographs, a combination of photographs, drawings and words, words only: there are many possibilities.

Mesibov et al. (1994) suggest using two main types of timetable in an educational context: a general classroom timetable and an individual pupil timetable. A general class timetable is one which is available for everyone in the class to see and use, and as a rule this would be reviewed first thing in the morning, once all the children had arrived in the classroom (Mesibov et al., 1994). Generally, the class timetable is arranged either from left to right, or from top to bottom. As mentioned earlier (section 3.1.3.2), there is a cultural bias regarding this arrangement. However, the participants of this study were of a Western cultural background and so for the purpose of this study this issue was not a concern. An individual pupil timetable serves to facilitate the child with autism in understanding what they are to do during activities listed on the general class timetable and can be made up by the teacher or by the pupil themselves (Mesibov et al., 1994). Individual timetables can be displayed adjacent to the general timetable or at the individual's work desk. Mesibov et al. (1994) stress that it is important that timetables are meaningful and balanced, with pleasurable activities alternating with less enjoyable ones.

Advances in ICT mentioned briefly earlier (section 1.2.2) offer potential for individuals with autism. For example, Personal Digital Assistants (PDAs) and other organisational tools provide individuals with facilities for organising tasks (Klin, McPartland, & Volkmar, 2005). In addition, such tools are frequently capable of being handheld and portable, thus creating ideal opportunities for assisting individuals with autism in a variety of settings in areas relating to executive dysfunction.

Figure 4.1 demonstrates an example of a visual timetable in a classroom setting. The main timetable runs along the bottom of the photograph and displays symbols representing activities that will take place during the day. The timetable is read moving from left to right in this example. Above the main timetable are coloured strips on which information relating to individual variations is displayed.

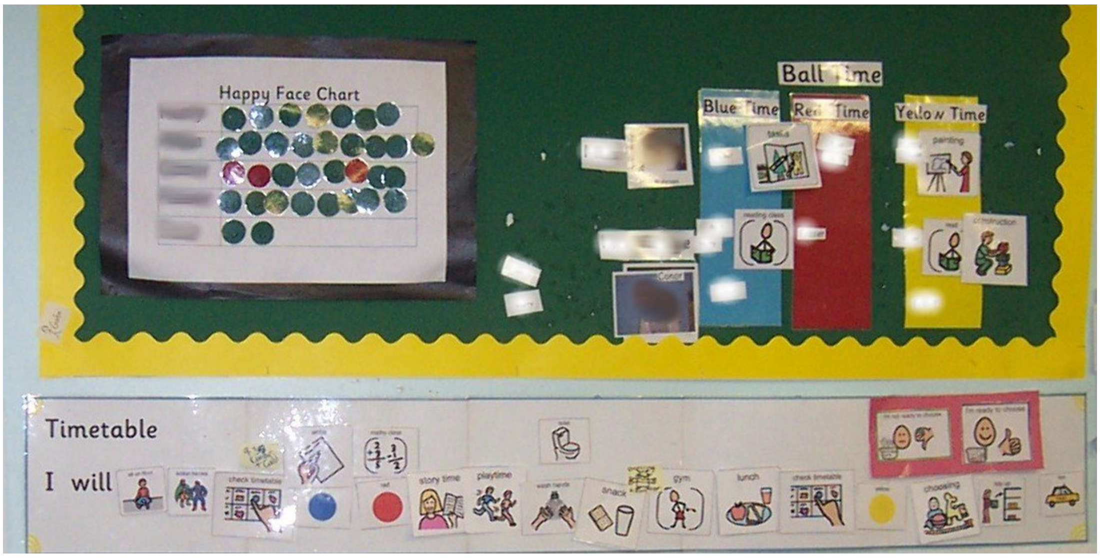


Figure 4.1: Example of a symbolic timetable in a classroom setting

4.2.2 Rationale for timetable use by children with autism

The purpose of a timetable is essentially to provide predictability, to aid the development of communication and to assist children with autism to acquire a level of independence (Peeters & Gillberg, 1999). Peeters and Gillberg (1999) hold the view that individuals with autism lack the ability to build internal scenarios of events and that this ability is something, which assists typically developing children in organising behaviour. This difficulty can be related to the deficits which individuals with autism suffer in the areas of executive function and central coherence (sections 2.2.2.2 and 2.2.2.3). A visual timetable can provide a concrete example of an external scenario and can, therefore, help an individual with autism to compensate for deficiencies in these specific areas. In particular, Quill (1995) discusses strengths which children with autism and pervasive developmental disorder possess in areas of concrete thinking, rote memory, and in understanding of visuo-spatial relationships, suggesting that use of pictographic and written cues can provide concrete forms of support for such individuals by facilitating learning and communication.

As discussed earlier, some individuals have difficulty in retaining transient and abstract information, such as time concepts. A visual support such as a timetable can assist by providing concrete support with this. Some individuals with autism compensate for such difficulties by developing routines and rituals (Peeters & Gillberg, 1999). It is common for children with autism to have their day organised so that they do things in the same order each day; this helps them feel in control and makes life more predictable for them. If there are unexpected changes to the daily routine the child with autism may suffer extreme confusion and also distress, and consequently may demonstrate behavioural problems. Mesibov et al. (2002) suggest that a timetable is a form of predictor strategy and can be used to reduce the stress of transitions for children with autism. It is suggested that prior warning of a change in activity, or of a move from one activity to another, would enable a child with autism to cope more ably with the stress associated with such a change. The purpose of a timetable is characterised as being:

- To assist with transitions between activities, reducing problem behaviour
- To enable a child to perform a series of tasks or activities independently
- To enable an individual to follow a sequence of activities in a school or work setting
- To make it possible for an individual to take charge of managing their own leisure time

(Mesibov et al., 2002, p. 74)

4.2.3 Beneficial aspects of timetable use

As discussed earlier (section 2.2.1.2), children with autism have serious communication difficulties both in understanding verbal communication and in expressing themselves. In addition, as mentioned previously (section 2.2.2), children with autism have immense difficulty with executive function skills such as planning, organising and managing changes, as well as a weakness of central coherence, which manifests as a preference for the known, an individual focus of attention, and difficulties with choosing, prioritising, organising and generalising skills (Cumine et al., 1998). All these factors have implications with regards to how children with autism function daily, as well as implications with regards to patterns of learning. It is generally acknowledged that use of a daily timetable can assist children with autism to engage successfully in daily school activities, by providing a clear and predictable visual support (Mesibov et al., 1994; Mesibov et al., 2001). There are many benefits proposed in support of timetable use and these are now discussed.

Communication of information

A timetable is essentially a communication tool, with the specific function of communicating information. The timetable assists the teacher in communicating information to the pupils regarding what will occur during the school day, the sequence of events and the relationship of events to one another (Mesibov et al., 1994; Quirk Hodgdon, 1995). For many children with autism, the ability to process and understand visual information is much stronger than their ability to understand verbal information (Mesibov et al., 1994; Quill, 1995).

Predictability and anticipation

By providing clear visual information regarding future activities and events, a timetable can offer predictability on a daily and weekly level for children with autism (Mesibov et al., 1994; Quill, 1995). A clearly displayed, visual timetable can facilitate anticipation of forthcoming events, as the children can see which specific activities are coming ahead (Mesibov et al., 1994). The benefit of being able to anticipate activities and events in the near future, is that worry and anxiety can be lessened and that behavioural problems brought about through anxiety and stress can also be reduced. O'Reilly, Sigafoos, Lancioni, Edrisinha, and Andrews (2005) suggest that "individualized schedules may act as a form of antecedent intervention to reduce challenging behavior as they may limit the impact of various setting events (e.g., stressful activities, unpredictable transitions) on such behaviors" (p. 305).

Consistency

Consistency in the use of a timetable is important, whilst reliability can enhance the learning process and encourage positive behaviour (Quirk Hodgdon, 1995). A consistent timetable format can be maintained for the children to follow even if there were to be a change of staff members, for example.

Relationship between events

Sequencing of activities in a specific time frame can help a child with autism gain a perspective as to the order of events and so understanding of how activities interrelate with one another can develop (Dalrymple, 1995; Mesibov et al., 1994).

Memory aid

Children with autism have particular difficulties with sequential memory and organisation skills; a timetable can help alleviate such problems, by providing a constant reminder of the day's events (Mesibov et al., 1994). Quill (1995) asserts that "graphic language serves as a concrete retrieval cue" (p. 11). Many children with autism have difficulty with stopping and starting activities. If a facility for 'crossing off' or 'taking down' a symbol of an activity was available for use in a visual timetable, then the child could be aided in understanding concepts such as stopping and starting and become more adaptable at transferring between activities (Quirk Hodgdon, 1995).

Understanding

Children with autism have great difficulty in understanding spoken instructions and are able to focus attention on visual materials much more easily (Mesibov et al., 1994; Quill, 1995; Quirk Hodgdon, 1995). As mentioned earlier this is partly due to the transient nature of the spoken word. Use of a pictographic timetable, therefore, increases the likelihood that meaning will be extracted from the information presented (Quill, 1995). Concrete, visual information, concerning daily activities can assist the child with autism in understanding the world of the classroom (Dalrymple, 1995). Twachtman (1995) describes the timetable as "a tool that enables the child to keep track of the day's events and activities and at the same time helps him or her to develop an understanding of time frames and an appreciation of environmental sequences" (p. 145). Graphic augmentative systems (such as visual timetable schedules) are universally understood (Quill, 1995).

Attention

A visual timetable can be used to help redirect attention (Mesibov et al., 1994; Quirk Hodgdon, 1995). For example, a child may become distracted and leave a particular task to begin another activity. The teacher can use the timetable to redirect the child's attention and remind the child of the current activity. The fact that the timetable is continuously on view indicates that it can be seen and used at any time; problems associated with attention can, therefore, be moderated.

Motivation

If a child can see that a favourite activity is due to take place after a difficult or unpleasant activity, then this visual information may provide the motivation which the child might need to get through the difficult or unpleasant task (Mesibov et al., 1994).

Independence

It has been suggested that use of a timetable can assist a child in gaining independence (Dalrymple, 1995; Quill, 1995). For example, by enabling a child to see the concept of time in relation to daily activities, a degree of self-organisation can be developed. It is also suggested that the experience of learning how to use a timetable can assist a child in becoming skilled at following directions and this can increase independence, while at the same time reduce reliance on the teacher's guidance (MacDuff, Krantz, & McClannahan, 1993; Quill, 1995).

Control over environment

Essentially, use of a timetable can assist in increasing the level of control which an individual has over their environment and many of the factors already mentioned (such as predictability, consistency, communication, aiding memory, understanding, and anticipation) can contribute to this control.

4.2.4 Limitations of timetable use

There are considered to be certain limitations to the use of a timetable by individuals with autism and these are now discussed. One major concern is that the rigid behaviour patterns of those with autism could be intensified if a timetable is applied too rigidly (Potter & Whittaker, 2001). It is regarded as important to introduce flexibility into the structuring of a timetable, as a rigidly ordered timetable with a requirement to adhere strictly to exact time schedules could result in distress for individuals, especially if an activity is unavoidably delayed. It is, therefore, prudent for timetables to be flexible and to present a range of times when an activity might start between (Dalrymple, 1995).

Peeters and Gillberg (1999) caution that deciding upon the amount of scheduling to offer individuals can present a problem. Too little information can result in not enough predictability and lead to behavioural problems, whilst too much information can result in processing difficulties for the individual, which could result in confusion. It is suggested that timetables should be individualised as this can facilitate clarity and predictability (Degrieck, 2003; Peeters & Gillberg, 1999).

Degrieck (2003) suggests that there is a danger of communication becoming one-sided in timetable use and that whilst predictability is important for individuals with autism, it is also important to include some degree of choice. However, choice is a difficult concept for individuals with autism and is a skill which may need to be taught (Degrieck, 2003). It is anticipated that some individuals will need a great deal of support to learn how to use a visual timetable (Mesibov et al., 2002). In addition, it is acknowledged that the need for this form of support varies greatly between individuals and whilst some may require less support as they mature, others will always need to use this form of support (Mesibov et al., 2001).

4.2.5 Considerations for timetable design

To be effective, visual information presented in a timetable should be accurate, consistent and in a concrete form (Dalrymple, 1995). As mentioned earlier, the method of organisation is important and generally it is advised that timetable information should be arranged from left to right or from top to bottom (Mesibov et al., 2002). It is important not to over-estimate the child's symbol skills and if new symbols are introduced then this should be performed clearly.

Dalrymple (1995) suggests that events which normally occur in a child's day should be considered carefully, as these activities can act as a guideline for the development of a timetable. Quirk Hodgdon (1995) recommends that a timetable should be reviewed first thing in the morning, as well as at transition times and that time should be taken to talk about the activities which are represented, in order to increase understanding. Children should be encouraged to participate in the preparation of the timetable as this will increase understanding, as well as encourage use. Similarly, incorporating choice into the timetable where possible will encourage participation and self-determination (Mesibov et al., 2002). Degrieck (2003) suggests the timetable can be individualised by the form of communication (objects, pictures, written language), by use (presentational or representational) and by duration of time (immediate time span, up to a time span of several weeks/months) (Degrieck, 2003). These factors were taken into consideration during the development of the interactive timetable and are discussed later (chapter 6). For example, familiar symbols were used and information was presented in a way which was consistent with the symbolic timetable, such as left to right and top to bottom.

4.2.6 Examples of research into timetable use

Examples of research studies which considered specific areas of use of visual timetables by individuals on the autistic spectrum are now put forward in order to demonstrate interest in this area.

An early study by MacDuff et al. (1993) used photographic activity schedules to assess acquisition, maintenance, and generalisation of complex response chains in children with autism. It was found that through use of the photographic activity schedules, participants remained on-task and were able to move to different settings in transition periods without prompts (MacDuff et al., 1993). Generally, “the photographic schedules enabled the boys to display lengthy and complex chains of previously mastered, functional behaviour” (MacDuff et al., 1993 p. 96).

A study by Dooley, Wilczenski, and Torem (2001) examined the use of an activity schedule to smooth transitions between classes. The participant, a 3 year old boy, had exhibited aggressive and disruptive behaviours. A PECs based schedule board was used as part of a behaviour support plan and the study found “dramatic decrease in problem behaviours and increase in compliance during transitions were readily apparent following intervention” (Dooley et al., 2001, p. 59). In addition it was reported that staff members found the PECs easy to use and to implement.

A study by O’Reilly et al. (2005) examined the use of an individualised schedule by a 12 year old boy with severe autism, to see whether any effects on levels of engagement and self-injury could be observed. The individual schedule was determined following use of an analogue functional analysis and then the schedule was evaluated to assess effectiveness on engagement levels and on self-injurious behaviour. The study found that levels of engagement were increased and that self-injurious behaviour was reduced (O’Reilly et al., 2005).

Although small scale in terms of participant numbers, these three studies demonstrate in these particular cases that the use of a visual timetable can assist children with autism greatly. A timetable can be used to ease transitions from one activity to another, can be used to assist a child with autism in remaining on task, and can in time assist in reducing problem behaviours.

4.2.7 Conclusion

A timetable, as used within the context of special education, is considered to be a visual structure, employed for the purpose of communicating information regarding daily class routine. Such a timetable can be on permanent display in the classroom, or can be of a portable style. A timetable has been acknowledged to serve many functions. For the child with autism, a timetable provides predictability and consistency, and can communicate specific information in a more easily accessible form. Depending on the nature of the timetable which is used, and the needs and abilities of the individual, it may be possible to facilitate a certain level of independence for the individual.

Children with autism are known to have difficulty with abstract concepts and sequential memory, whilst having a strong understanding of visuo-spatial relationships. This suggests that use of pictographic and written cues, such as those used in a timetable, can provide clear and permanent visual support for children with autism. The specific beneficial features of timetable use include the timely communication of information, predictability, and reduction of uncertainty; a timetable can act as an aid for memory, attention, motivation, and independence. Overall, use of a timetable can assist the individual in gaining control of their environment.

Certain limitations of timetable use by children with autism were highlighted. For example, a danger of too much rigidity in the structuring of a timetable could exacerbate the already rigid nature of individuals with autism. Flexibility, therefore, should be encouraged when developing a timetable. Another concern was with the amount of information that a timetable is used to present. There is a worry that too much information can make processing difficult, whilst too little information can reduce predictability. It is, therefore, important for the teacher to be clear as to the amount of information which specific pupils can cope with when using a timetable. A further concern was that use of a timetable could result in communication becoming one-sided to a marked degree.

When constructing a visual support such as a timetable for individuals with autism, it is important to include information which is accurate, consistent, timely, and of a highly visual and concrete nature. It is recommended that the timetable be based on events which the child is familiar with and that the timetable should be reviewed regularly and talked through, in order to encourage understanding. It is suggested that individual timetables could be appropriate for particular children in order to facilitate clarity and understanding. Overall it is accepted, that for certain individuals, this form of visual support will always be required.

Chapter 5: Research methodology

5.1 Introduction

This chapter sets out in detail the research methodology for this study. It begins by discussing the theoretical and methodological framework of this study and then proceeds by presenting the research aims. The research design is then set out, followed by a discussion of the research methods and data analysis procedures. Finally, ethical considerations are discussed.

5.2 Overview

A subject of concern motivating this study and illustrated in the literature review, was that children with autism demonstrate difficulty coping with change (Cumine et al., 1998; Frith, 2003). During the school day children can be involved in activities which entail moving to a different location, often with a different educationalist. Changes such as these can lead to anxiety for many children with autism and can result in disruptive behaviour and loss of learning opportunities for the individual (Loveland & Tunali-Kotoski, 2005), as well as for others in the class. It has been suggested that advanced knowledge of the day's activities can considerably lessen anxiety for children with autism, especially if information is highly visual in presentation (Mesibov et al., 1994; Peeters & Gillberg, 1999). As established in the literature, teaching of children with autism frequently follows a model known as TEACCH, which encourages a highly structured approach and advocates the use of visual planning aids in the classroom, such as daily symbolic timetables (Gillberg & Coleman, 2000; Mesibov et al., 2002). This model is reported to be widely adopted in educational settings in the UK (Loynes, 2001).

A theme illustrated in the literature which highlights great potential, is that children with autism are noted to be skilled at using a computer and furthermore, that use of a computer presents an ideal resource for both educational and recreational use for children with autism (Attwood, 1998; Bell & Potter, 1999; Higgins & Boone, 1996; D. Moore, 1998; Murray, 1997; Powell, 1996). The possibility of utilising computer technology as a strategy for reducing children's anxiety as related to the uncertainty caused by changes in the daily routine was, therefore, considered. The research questions at the outset of this study were, "can timetable information be communicated to children with autism in an interactive and computer-based form?" and if so, "can an interactive timetable assist children with autism in coping with changes in their daily school routine?"

5.3 Theoretical framework

Ways of understanding and making sense of the world are addressed through ontological assumptions and involve addressing questions regarding "the very nature and essence of things in the social world" (Mason, 1996, p. 11). As mentioned in the introductory chapter (section 1.6.2), an understanding of the different forms of knowledge which exist and of the reliability of sources of knowledge is essential if authoritative and justifiable research is to be conducted. Ultimately, epistemological assumptions provide a theoretical foundation for understanding knowledge, for recognising that different forms of knowledge exist and for facilitating an understanding of the context of research (Flyvbjerg, 2001). Epistemological assumptions concern the beliefs and conventions by which researchers decide the ways in which social phenomena can be known, as well as how this knowledge can be demonstrated to others (Mason, 1996). Epistemology is "a way of understanding and explaining how we know what we know" (Crotty, 1998, p. 3).

It is important to be able to understand and appreciate alternative epistemological views so that the position of a particular study can be justified and explained. Four contrasting paradigms traditionally informing qualitative enquiry in the social sciences were discussed earlier (section 1.6.2): positivism, postpositivism, critical theory, and constructionism. As discussed earlier (section 1.6.2), this study expresses a constructivist position. The researcher's belief is that knowledge is constructed rather than discovered. The ontological stance of interpretivism is traditionally associated with the constructivist position. Interpretivism is an approach which emphasises human action as being meaningful constructs of social reality (Greene, 2000; Schwandt, 2000). This position views reality as being subjective; reality is "a social product constructed and interpreted by humans as social actors according to their beliefs and value systems" (Darke et al., 1998, p. 276). The interpretivist position acknowledges multiple realities, which are socially and individually constructed and as such are considered meaningful elements of social reality

(Greene, 2000; Mason, 1996; Williamson et al., 2002). As discussed earlier, an interpretivist position is traditionally associated with qualitative methods of inquiry and an inductive method of data analysis (Williamson et al., 2002).

Principally, the focus of this study concerned the use, by children with autism, of information relating to daily class activities as set out in a symbolic timetable; in essence the phenomenon of a symbolic timetable was central to this study. Use of a symbolic timetable was acknowledged to be an existing and established practice within the field of special needs education. As demonstrated in the literature review (chapter 3), there exists some literature relating to this particular subject matter and this provided general background knowledge in this area. However, questions such as "how does use of a symbolic timetable fit into the daily routine of a particular class?" or "what actions and interactions take place regarding use of a symbolic timetable in the 'real life' setting of a classroom?" and "what type of behaviour do the children exhibit when engaging with a symbolic timetable?" were considered central to this study. The researcher's personal philosophical stance is that knowledge of this kind is constructed, not discovered, and only through witnessing and experiencing people's actions and interactions at first-hand could knowledge of these elements be gained. To acquire knowledge of these elements, the researcher considered it necessary to interact with persons working with and caring for the children participating in this study, in order to gain access to their views and understandings. The researcher's intention was therefore, to describe "reality as experienced by the respondents" (Sarantakos, 1998, p. 6).

5.4 Methodological framework

A systems development methodology was employed for this study. The symbolic timetable used by the children participating in this study was considered by the researcher to be an information system. An information system is defined as being "a linked and related system of entities (including one or more information devices) that provides access to one or more bodies of knowledge and acts as a mechanism through which individuals can inform other people or become informed" (B.L. Allen, 1996, p.5). The symbolic timetable was considered to be a device used to communicate information regarding daily class activities in an organised form and was, therefore, perceived to be an information system.

Systems development methodology "denotes a way to perform research through exploration and integration of available technologies to produce an artefact, system or system prototype" (Burstein, 2002, p.151). Nunamaker, Chen, and Purdin (1990-91) state that when used as a research methodology, systems development should meet the following criteria:

> (1) the purpose is to study an important phenomenon in areas of information systems through system building, (2) the results make a significant contribution to the domain, (3) the system is testable against all the stated objectives and requirements, (4) the new system can provide better solutions to IS problems than existing systems, and (5) experience and design expertise gained from building the system can be generalized for future use (p. 101).

This study endeavoured to meet these criteria. A prototype, interactive, computer-based timetable system was developed in order to explore the potential of such a system. It was considered necessary to create a tailor-made timetable system, as it was recognised that finding an appropriate system in the open market which would meet the needs of such a specific user group would have been a difficult undertaking. It was anticipated that studying the phenomenon of the timetable in this way could enable a contribution to be made to knowledge in this area. The system that was developed was testable as far as possible within the limitations of the study against the stated aims.

The field of information systems development is understood to derive theory from a wide range of disciplines, however, not all were considered transferable to this particular study. Typically, those conducting research in the field of information systems have adopted a positivist position, asserting that data and information exist independently of their creators, reflecting real world structures in an objective manner (Mingers, 1997). More recently a contrasting approach has been adopted, which maintains that "information is essentially *subjectivist,* created by people and reflecting their particular expectations, values and beliefs" (Mingers, 1997, p. 73) [italics original]. Research methodologies applied in the field of information systems have tended to vary according to the application domain and the researcher's philosophical position; there is no one recognised methodological framework for information systems research (Burstein, 2002). It is acknowledged that the values and intentions of the researcher as well as the nature of the topic will have a major influence on the philosophical position adopted and, therefore, on the choice of methodology (Benbasat, Goldstein, & Mead, 1987; Petheram, 1997). Avison and Shah (1997) suggest that the fundamental differences between methodologies relate to the emphasis placed by information systems analysts themselves, with some choosing methodologies which emphasise the humanistic aspects of developing information systems, whilst others follow a scientific approach. This particular study placed emphasis on the humanistic approach, by recognising the importance of the user at all stages of the systems development process and as will be discussed in the System Design Methodology (chapter 6), a user-centred approach was followed for the development of the interactive timetable system. The importance of involving potential users of information systems in the design process is widely acknowledged (B.L. Allen, 1996; Avison & Shah, 1997; Maguire, 1997, Preece et al., 1994).

User-centred design is “an approach which views knowledge about users and their involvement in the design process as a central concern” (Preece et al., 1994, p. 722). From the researcher’s perspective, the nature of the user was an important consideration in this study. The main user group for this study were young children, and moreover, they were children with autism. There was uncertainty regarding how the children would react to the researcher, as well as concerns regarding the extent to which it would be possible to actively involve the children in the design process. For example, due to the nature of the autistic disorder it was possible that any interaction the researcher had with the children might be problematic. These particular children would have a different perception of the researcher from what might normally be expected and there was a concern that the researcher’s presence might cause distress or anxiety for the children. On the other hand, it was also possible that the children might simply ignore the researcher. It was acknowledged, therefore, that those most closely involved with the children would have an important role to play in the study on behalf of the children.

The system development methodology employed in this study was primarily qualitative and as discussed earlier (section 1.2), of an ethnographic nature.

However, some quantitative techniques were employed. Use of multiple methods is sometimes referred to as triangulation and is where data are gathered using different techniques, in relation to the same object of study (Brannen, 1992). For example, in this particular study, both observation studies and questionnaires were used during the later stages to assess the usability of the interactive timetable. In addition, use of both qualitative and quantitative methods enabled multiple data sets to be derived, assisting in providing a more holistic picture of certain aspects of the study (Brannen, 1992).

The nature of qualitative research is a much debated concept and is notoriously difficult to define (Glazier, 1992; Strauss & Corbin, 1998). One definition suggests qualitative research is “a situated activity that locates the observer in the world” (Denzin & Lincoln, 2000, p. 3). This implies that qualitative research takes place in a ‘natural’ setting, relative to the object of study. For this particular study, the researcher spent considerable time in the ‘natural’ setting, firstly to try and understand the processes involved in the use of a symbolic timetable system, and then later to evaluate use of the interactive timetable. There is no one distinctive theory which distinguishes qualitative research and no prescriptive set of methods applicable to this practice (Denzin & Lincoln, 1998; Mason, 1996). Qualitative research is recognised to be multidisciplinary and to be situated within a complex historical field (Denzin & Lincoln, 1998; Mason, 1996). The practice of qualitative research has been closely associated with interpretivist sociological traditions, ethnomethodology, and symbolic interactionism, and has traditionally been used in anthropological studies (Mason, 1996). Qualitative research is essentially recognised to be an interpretive process (Mason, 1996; Janesick, 2000). Furthermore, qualitative research has the strength of generating rich data and enabling contextualisation of the data (Glazier, 1992). It was, therefore, considered to be the appropriate approach for the current study.

5.5 Research aims

Maxwell (2005) states that in addition to personal goals, there are both practical and intellectual goals of a research study. The motivation for this study was to develop a computer-based, interactive timetable, to consider the actual use of the interactive timetable by children with autism and to assess whether the needs of this particular user group could be effectively met through use of such a system. The area of computer-based timetabling with regards to children with autism has been researched very little to date. By conducting research into the processes of design, development and evaluation of an interactive timetable, the researcher anticipated that a contribution could be made to knowledge in this particular area. Furthermore, the outcomes of such research could enable recommendations for a future and more general, interactive timetabling system to be proposed.

As mentioned earlier (section 1.5), the study set out to address the questions, “can timetable information be communicated to children with autism in an interactive and computer-based form?” and if so, “can an interactive timetable assist children with autism in coping with changes in their daily school routine?” The aims of the study were set out earlier (section 1.5) and are repeated here for ease of reference:

1. To develop a computer-based, interactive timetable system for a class of children diagnosed as having an autistic spectrum disorder (ASD), allowing individual children to personalise their own timetable

2. To evaluate the effectiveness of the interactive timetable system by considering whether its use in any way assisted the participating children in overcoming anxiety related to changes in daily class routine

3. To evaluate the effectiveness of the interactive timetable system as a management and communication tool for the teacher and parents

4. To examine the feasibility of building a general, interactive timetabling system, capable of widespread implementation

5.6 Research design

Research design is “the logical sequence that connects the empirical data to a study’s initial research questions and, ultimately, to its conclusions” (Yin, 2003, p. 20). The focus of the study was on a contemporary phenomenon – the development and evaluation of an interactive, computer-based timetable, in a real-life context – the classroom setting. A case study approach was, therefore, considered appropriate for this study.

5.6.1 A case study approach

The case study is an empirical inquiry, employed to investigate contextual conditions in relation to a contemporary phenomenon and in some circumstances forms a comprehensive research strategy with an all-encompassing method (Yin, 2003). Stake (2000a) asserts that "case study is not a methodological choice but a choice of what is to be studied" (Stake, 2000a, p. 435). As discussed earlier (section 1.2), the case being considered at the early stage of the study was the class of children as a whole. This is what Stake (2000a) refers to as an instrumental case study. At the later stages individual children were studied as a collective case study.

Stake (2000a) describes three specific forms of case study research: intrinsic, instrumental and collective. When a researcher wishes to gain a better understanding of a particular case, then the intrinsic case study is employed (Stake, 2000a). In an intrinsic case study it is the case and its particularity which is of interest to the researcher, not the fact that it represents other cases (Stake, 2005). Gomm, Hammerseley, and Foster (2000) argue that whilst some case studies may have intrinsic value, perhaps being of interest to a target audience, there are limitations concerning the justification for such studies, particularly with regards to transferability to other cases. A second form of case study is an instrumental case study. This is used to provide insight into a particular phenomenon or event and is sometimes used to illustrate generalisations; the case is of secondary interest and aids the understanding of something in particular (Stake, 2005). The third type of case study is referred to as a collective case study and this is where a number of cases may be studied, in order to investigate a specific phenomenon, population, or general condition (Stake, 2000a). Collective case study is an extension of the instrumental case study, whereby several cases are included "because it is believed that understanding them will lead to better understanding, perhaps better theorizing, about a still larger collection of cases" (Stake, 2000a, p.437).

As mentioned earlier, an instrumental case study was employed during the early stage of the study. As Stake (2005) suggests, this form of case study is useful for affording insight into a particular phenomenon and in such situations the case provides a supportive role in facilitating understanding. In this study the researcher wished to explore in depth the use and functionality of a symbolic timetable, so as to develop a greater understanding of this phenomenon. The class of children was chosen as it was considered useful, or 'instrumental' in advancing this understanding. In this particular study, the concern was not just whether an interactive timetable would be of value to the children participating in the study, but whether it would also be of value to other children with autism. In other words, as Nunamaker et al. (1990-91) suggest, would the experience gained from creating the system be generalisable to other situations and uses? Findings from the instrumental case study informed the design and development of a prototype interactive, computer-based timetable. Later, during stage 4 of the study, a collective case study was employed, where four of the participating children were studied as single cases. Detheridge (2000) recommends that small scale studies of an interpretive nature are more appropriate for conducting research involving children with learning difficulties. Through studying in greater depth the children's use of the interactive timetable, the researcher was able to highlight specific benefits and limitations of the timetable in relation to each child through the process of evaluation. By comparing findings across all four children, it was intended to increase the understanding of each child's interactions with the interactive timetable and to create a possibility for theorising how an interactive timetable could be of value to a wider population.

It was believed that by employing a case study approach, the researcher would be able to witness the symbolic timetable being used in its 'natural' setting, which would enable the role and functionality of this phenomenon to be studied in greater depth. The researcher had no previous experience of symbolic timetable use and believed that the most appropriate way of achieving an understanding of this phenomenon was through witnessing and experiencing its use. The researcher believed that only through studying in-depth the processes involved in using a symbolic timetable, by witnessing the interactions which occurred with and around the timetable, and by identifying the information which was essential to the use of such a timetable, could an interactive version of the timetable be created. Case study is considered a framework within which other methods can be used for the collection and analysis of data (Bryman, 2001; N. Moore, 2000). As mentioned earlier, this study employed multiple methods of data collection, a common characteristic of systems development methodology (Williamson et al., 2002) and of case study research (Benbasat et al., 1987).

Darke et al. (1998) suggest that case study is an appropriate method for information systems research as it is "well suited to understanding the interactions between information technology (IT)-related innovations and organizational contexts" (p. 274). Benbasat et al. (1987) identify three reasons for the suitability of case study as an information systems research method. Firstly, by studying information systems in a natural setting the researcher can "generate theories from practice" (Benbasat et al., 1987, p. 370). Secondly, case study allows the researcher to "understand the nature and complexity of the processes taking place" (Benbasat et al., 1987, p. 370). Thirdly, case study is a suitable approach for exploring an area in which few previous studies have been conducted (Benbasat et al., 1987).

5.6.2 The research setting

The setting for this study was a language and communication classroom attached to a mainstream primary school in central Scotland.

5.6.2.1 Selection of setting

The setting was selected purposively. Purposive sampling is a form of non-probability sampling and "allows us to choose a case because it illustrates some feature or process in which we are interested" (Silverman, 2005, p.129). A setting, which demonstrated the phenomena of interest, use of a symbolic timetable by pupils with autistic spectrum disorders, was chosen. The setting was, therefore, meaningful theoretically, as characteristics which were central to this study were present: an example of a symbolic timetable and a group of children with autism. For this particular study the case study approach was used to facilitate naturalistic inquiry. Stake (2000a) suggests that qualitative fieldwork facilitates variety and intensive study and that it is sometimes more important to choose a case from which most can be learnt. The setting chosen for this study was selected because it provided a location from which knowledge of the use of a symbolic timetable could be gained.

It seemed practical to observe the use of the symbolic timetable in its natural surroundings, in order to understand *how* and *why* it was being used. A setting which was situated relatively locally to the researcher was chosen, so that field visits could take place as frequently as possible and whenever permitted, without the limitation caused by travelling great distances. It was considered very important to spend as much time in the setting as possible. This was so that the children would become used to the researcher's presence, which it was hoped would go some way to reducing the potential for changes in behaviour being due to the presence of a stranger. By selecting one particular classroom as a setting, it was considered that less disruption to other children in the school would be likely to occur. A further consideration when selecting a setting was that there should be access to a computer in the classroom, to enable piloting of the interactive timetable to be carried out in the 'natural' setting.

5.6.2.2 Access

Access to the field was negotiated initially through a teacher, who became both gatekeeper and a key informant for the duration of the study. The teacher held a position of seniority within the school through which a gatekeeper role emerged, facilitating sponsorship of the researcher within this setting. The teacher was able to recommend appropriate times to conduct field visits and was able to introduce the researcher to potential participants. Access was renegotiated as a continuous activity (Denscombe, 1998). Written consent to conduct the research in principle in this setting was obtained from the Director of Education for the appropriate region (Appendix 7). Access was also agreed by the head teacher of the school and by the class teacher. Informed, written consent was obtained from parents and members of the educational team who agreed to participate and from parents of participating children on the child's behalf (example consent forms and information sheets Appendix 8). Ethical approval to conduct this study was obtained from the Queen Margaret University College Research Ethics Sub-Committee. Although at the time it was not a legal requirement, disclosure of the researcher was carried out via a statutory police check as a good will gesture. This was in order to satisfy the education authority that the researcher was not a risk to the children or the school. Entry to the field was eventually gained in week 29 and withdrawal from the field was achieved by week 146. A timeline of research activities which occurred during the course of this study can be found in Appendix 9.

5.6.2.3 Description of setting

The classroom setting for this study was part of a language and communication unit, which was set apart from the main building of the primary school. At the beginning of the study, the unit consisted of one classroom (classroom 1), a speech and language therapy room, kitchen amenities and cloakroom facilities. During the first year of the study the unit was reorganised over the school summer holiday period, so that an extra classroom and a further speech and language therapy (SLT) room were added. Preliminary investigations were carried out when the children were in the setting of classroom 1. However, the participating children were moved to classroom 2 during the second year of the study and so further investigations were carried out there. Figure 5.1 demonstrates the layout of the unit as it appeared at the later stages of the study.

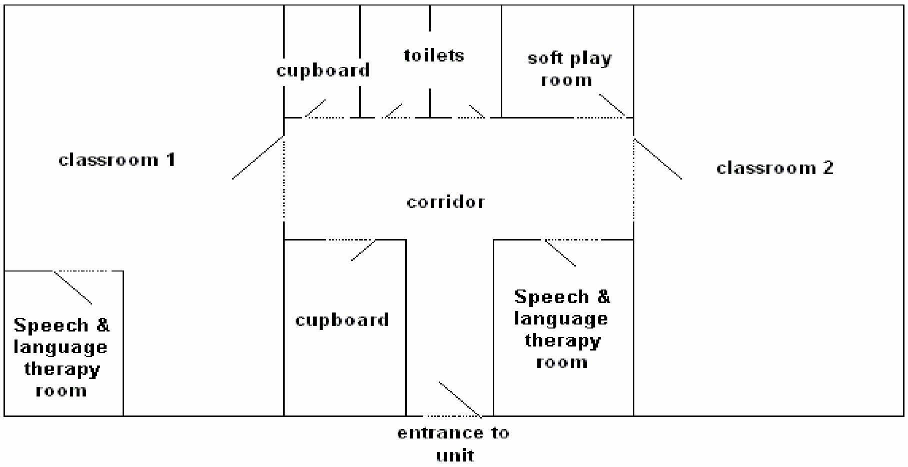


Figure 5.1: Layout of the language and communication unit

5.6.3 The participants

A total of 21 participants were involved during the course of this study. These comprised seven children, all male, aged between six and nine years, seven members of the education team, all female, and seven of the children’s parents (five mothers and two fathers). Although seven children were involved over the course of the study, only four were able to participate in the final evaluations. This particular group of children with autism were selected as it was anticipated that they would have certain characteristics representative of a wider population of children with autism. However, it is acknowledged that the condition of autism varies greatly from individual to individual.

5.6.3.1 Selection of participating children

Sampling “enables the researcher to study a relatively small number of units in place of the target population and to obtain data that are representative of the whole target population.” (Sarantakos, 1998, p. 139). The criteria for participation were as follows:

- Participating children should have a diagnosis of autism, autistic spectrum disorder, or Asperger’s syndrome
- Children should be cognitively relatively able
- Located within the context of mainstream education
- Primary school age range
- Parents and children willing to be involved
- Educational staff and school willing to be involved

As stated earlier (section 1.2), diagnostic information was initially gained from the class teacher and later confirmed by the educational psychologist involved in this setting. The demographic details of the children participating in the study are demonstrated in table 5.1. It can be seen that four of the children had a diagnosis of autistic spectrum disorder.

Table 5.1

Child participants

	Child						
	1	*2*	*3*	*4*	*5*	*6*	*7*
Gender	Male	Male	Male	Male	Male	Male	Male
Age	8	7	8	6	8	9	8
Diagnosis	ASD	ASD	Autism	ASD	ASD	AS	AS
Age diagnosed	4½	-	2½ - 3	4	-	7	5½

Note. ASD = autistic spectrum disorder. AS = Asperger's syndrome.

5.6.3.2 Recruitment

It was anticipated that it would not be easy to gain access to a list of such a specific population. As the literature review indicates (section 3.1.1.2) children with autism may be educated within a wide range of educational scenarios. Lists of special schools and mainstream schools with special units were available for specific regions of Scotland, but these would not have given precise details regarding the status of the pupils attending these schools. Further enquiry would have been necessary to ascertain whether any of the pupils met the criteria for the study and this would have been a time-consuming process, whilst there was no guarantee that the schools identified would have been agreeable to participating in the study. Therefore, the participants were selected due to meeting the criteria discussed previously (section 5.6.3.1). Table 5.2 demonstrates the recruitment of children to this study, the stages during which they participated and reasons for attrition. It can be seen from table 5.2 that the main reason for attrition was movement of children from this particular class to other classes or schools. However, other children did join the class and two of these were able to participate in the study at the later stages.

Table 5.2

Recruitment and attrition of child participants

	Child						
	1	*2*	*3*	*4*	*5*	*6*	*7*
Recruited	May 02	May 02	May 02	May 02	Sept 03	Sept 03	Sept 03
Stages of participation	O/B O/ST O/U O/IT	O/B O/ST	O/B O/ST	O/B O/ST O/U O/IT	None	O/B O/ST O/U O/IT	O/B O/ST O/U O/IT
Participation period (wks)	119	60	60	119	2	48	48
Reason for leaving study	-	Moved out of the area	Moved out of the area	-	Moved to another class	-	-

Note: O/B = observation study / behaviour. O/ST = observation study / symbolic timetable use. O/U = observation study / usability. O/IT = observation study / interactive timetable use.

5.6.3.3 Selection of adult participants

The criteria for adult participants being included in the study were that they were either a member of the education team working with the children, or a parent of a participating child. The researcher considered that those working with and caring for the participating children would be able to provide information and useful insights regarding the use of the symbolic timetable.

Three members of the educational team agreed to participate in the study at the beginning and were also keen to play a part in the design of an interactive timetable. Each had a different role in the classroom setting and so it seemed likely that each would regard the role and use of the symbolic timetable from a different perspective. Generating data regarding different perspectives was considered important as it would enable a more holistic view of the use of the symbolic timetable to emerge, strengthening the study and enabling triangulation by source (Brannen, 1992; Mason, 1996). Four new members joined the education team during the course of the study and all agreed to participate in the study.

Parents of all participating children were invited to take part in the study. It was recognised that the children's parents would be able to offer information regarding their child which could be useful for this study. In particular, it was anticipated that parents as well as teachers, would be able to provide detailed information regarding the anxiety related behaviour of the children (this relates to aim 2). In addition, it was believed that parents would have views regarding the benefits and limitations of using an interactive timetable which would be of interest for this research. Seven of the children's parents (five mothers and two fathers) accepted the invitation to be involved in the research and participated in the study. Tables 5.3 and 5.4 illustrate recruitment details of adults participating in the study.

Table 5.3

Educationalist participants

	Educationalist						
	T1	*T2*	*NN1*	*NN2*	*NN3*	*SLT1*	*SLT2*
Gender	Female	Female	Female	Female	Female	Female	Female
Recruited	Nov 01	Sept 02	Nov 01	Sept 02	Oct 03	Nov 01	Sept 02
Participation period (wks)	146	99	146	32	67	146	99
Period of service with unit (at end of study)	4 yrs	2 yrs	4 yrs	8 mths	1 yr	4 yrs	2 yrs

Note. T = teacher. NN = nursery nurse. SLT = speech and language therapist.

Table 5.4

Parent participants

	Parent						
	P1A	*P1B*	*P2A*	*P3A*	*P6A*	*P6B*	*P7A*
Gender	Female	Male	Female	Female	Female	Male	Female
Recruited	May 02	May 02	June 02	May 02	Sept 03	Sept 03	Sept 03
Participation period (wks)	119	119	60	60	48	48	48

Note. P = parent. A = mother. B = father.

5.6.4 Research plan

The study took place over five stages (research plan - Appendix 10). Preliminary investigations were carried out in stage 1. These involved visits to different educational settings so that the researcher could become familiar with forms of symbolic timetable and with different educational environments. Software and systems used by children with special needs such as autism were also considered during this preliminary phase. As discussed earlier (section 5.6.1), stage 2 comprised an instrumental case study to investigate the role and use of the symbolic timetable in the selected setting. This consisted of a task analysis and a requirements analysis. Development of the interactive timetable took place during stage 3 of the study and formative evaluations were undertaken during this phase. Stage 4 of the study was concerned with conducting evaluations of the interactive timetable in order to address research aims 2 and 3. Lastly, the feasibility of building a general, interactive timetabling system, capable of widespread implementation was to be considered during stage 5, with consideration being given to recommendations. Whilst the research plan follows a chronological order, it should be noted that the actual execution of data collection was not in fact as straightforward as this. Some data collection activities had to be repeated, as for example, when new participants were recruited. Furthermore, data collection was highly dependent on access and there were considerable difficulties with access at the later stages of the study. For example, at one stage the children were only attending school for two days of the week due to industrial action by members of the education team and so data collection was suspended at this time.

5.7 Overview of data generation methods and analysis procedures

As demonstrated in the research plan (Appendix 10), a variety of methods, both qualitative and quantitative, were employed to gather data at each stage of this study. Methods included non-participant observation, participant observation and structured observation studies, semi-structured interview technique, visual recordings in the form of photographs, and administration of self-completion questionnaires. In addition, documents were consulted to provide background knowledge, whilst materials which supported the symbolic timetable were examined in order to determine content and relevance for an interactive timetable. Analysis of data was generally carried out as soon as data was gathered and this is discussed further in relation to each specific activity. A brief summary of the different methods of data collection employed is set out here, whilst precise details of procedures are provided later in the relevant sub-sections of section 5.8.

5.7.1 Observation studies

Observation studies were a key method used throughout this study. Adler and Adler (1998) assert, "Observational research can vary considerably in its character among different practitioners, through the stages of a research project, in various settings, and depending on the relationship of researcher to their subjects" (p. 83). The observation studies conducted during this study varied according to the focus at different stages of the study.

Non-participant observations

It is suggested that informal observation is an appropriate method for early stages of a study, when gathering background information is essential for informing the development of questions (Sommer & Sommer, 1991). At the beginning of the study informal, non-participant observations were carried out, in order to obtain a general feel for the classroom setting and to witness at first hand how the daily symbolic timetable was used.

Participant observation

Participant observation enables the researcher to learn about a situation at first hand, facilitating the collection of rich detailed data (Burgess, 1984). A form of participant observation, known as cooperative user evaluation, was employed to gain a deeper understanding of the participants' experience of interacting with the interactive timetable and to assess usability of the timetable. This is a technique commonly used in the fields of human-computer interaction and systems design, which enables the user and designer to evaluate a prototype together, in order to identify problem areas (Monk, Wright, Haber, & Davenport, 1993). This form of observation involved the researcher sitting alongside a participant, in front of the classroom computer. Each participant was requested to use the interactive timetable and the researcher then observed the interactions which took place. The researcher took notes during each observation session.

Structured observation

A structured style of observation was carried out at the later stages of the study, to observe and record behaviours displayed by the participating children. Bryman (2001) reports that structured observations are frequently used in school settings where behaviour and interaction is a major concern of the research.

5.7.2 Visual recordings

Digital photographs were taken of the symbolic timetable on various occasions throughout the study. These photographs assisted in creating a visual record of the way in which the timetable was used and of changes which were made.

5.7.3 Semi-structured interviews

Semi-structured interviews were conducted to gather data at different stages of the study, from various participants and for different purposes. For example, interviews were conducted with members of the educational team during stage 2 of the study, in order to gain an insight into participants' views regarding the purpose and functionality of the symbolic timetable. Mason (1996) indicates that the qualitative interview can vary, "for some researchers, a qualitative interview is always and necessarily semi-structured or loosely structured, whereas for others a qualitative interview can be based on open ended questions in an otherwise structured interview schedule" (p. 39). Interviews conducted during this study were semi-structured. The researcher used a script as a guide for each set of interviews, ensuring that the same topics were introduced (Preece, 2000), while allowing a degree of flexibility to accommodate individual perspectives (interview scripts are included in the appendices and are signposted in the relevant sub-sections of section 5.8).

5.7.4 Questionnaires

Self-completion questionnaires were used on four occasions, to gather a range of data. Mason (1996) suggests questionnaires can be used in a complementary fashion to enhance and verify the understanding gained through qualitative data. In this particular study questionnaires were used to gather information regarding specific characteristics of the participants. For example: the 'user checklist questionnaire' administered in stage 2 assisted in highlighting levels of computer literacy amongst participants; questionnaires administered as a system development tool during stage 3 enabled usability of the interactive timetable to be assessed; the anxiety related behaviour questionnaires administered during stage 4 provided an additional point of reference with which observed behaviours of the children could be compared.

5.8 Data collection and analysis

The methods of data collection and analysis employed in relation to the first four stages illustrated in the research plan (Appendix 10) are now discussed.

5.8.1 Stage 1: Preliminary investigations

This section briefly sets out details of preliminary investigations which were conducted at the beginning of this study in order that the researcher should become familiar with the subject matter (Fidel, 1992).

5.8.1.1 Gathering background information

An informal visit was made to a language and communication class attached to a mainstream primary school in central Scotland. This was in order to experience a general sense of a classroom environment and to enable the researcher to gain an impression of what the study might involve. Denscombe (1998) suggests that it is important to gain an overall feel for a study by carrying out non-selective observations at an early stage. The focus of this informal visit was on acquiring an idea of the activities which took place in the classroom and in becoming acquainted with the pupils and staff, in order to establish a rapport. An informal meeting with the class teacher confirmed the teacher's interest in the proposed study and willingness to participate. Also, it enabled relevant information sources within the classroom to be identified. As part of this preliminary investigation, the teacher provided basic information, such as the number of children attending the class and details regarding use of computers in the classroom. Information, gathered in the form of field notes at this initial stage, assisted with formatting topics for future in-depth discussion.

A visit was also made to a special school in Scotland, for children with autism. This was to allow the researcher to observe the use of a symbolic timetable by a class of individuals with more severe presentations of autism.

5.8.1.2 Investigating software and systems

When developing any product it is important to look at similar products which exist (Preece et al., 1994), to establish typical conventions and to identify examples of good practice which might be utilised. An investigation of the different types of software available for children with special educational needs such as autism was carried out (Appendix 11). Essentially, available software was sought in one of three ways: through consultation of information held by recognised organisations supporting children with special needs (e.g. National Autistic Society), through informal enquiry of educationalists and parents, and by keyword searching via the Internet. Whilst there were found to be many examples of multimedia software produced for special needs, these were generally aimed at meeting pedagogic needs in the areas of literacy and numeracy, as well as for recreational use. No products were found which addressed the area of class timetabling in an interactive, computer-based form. This confirmed the need to develop a timetable specifically for this study. Investigating examples of multimedia software did assist in demonstrating to the researcher the styles of symbols used in this area, which was useful for the design stage.

A review of the literature regarding research into the development of information systems and multimedia systems for individuals with autism was also carried out at this stage. This was so that similar studies could be identified and so that the researcher could gain knowledge of others' experience in this area. Several studies were reported earlier in the literature review (section 3.2.4).

5.8.2 Stage 2: Investigating the role and use of a symbolic timetable

An investigation of the existing symbolic timetable system was conducted in the setting, using an instrumental case study approach as discussed earlier (section 5.6.1). A systems analysis was carried out. This involved a task analysis to examine the role and functionality of the symbolic timetable and a requirements analysis, to identify the requirements and information needs of the users of the proposed interactive timetable.

5.8.2.1 Task analysis

A task analysis refers to a collection of formal and informal techniques, used to identify the goals of a system (Nickerson & Landauer, 1997). It is suggested that "In order to design a system, it is necessary first to understand what it is that the system should be doing" (Faulkner, 1998, p. 95). The research questions which were being considered at this stage were:

- How is a symbolic timetable used in the classroom setting?
- When is the timetable used?
- Who uses the timetable?
- What information is communicated via the symbolic timetable?

In order to answer these questions a series of 'naturalistic' observations were conducted, to observe the actual use of the symbolic timetable in the classroom setting. Visual recordings of the symbolic timetable in the form of digital photographs were taken, to provide a clear record of information content at specific times.

The reasons why a symbolic timetable was being used for children with autism in school settings had become apparent from a review of the literature (section 4.2). However, the researcher considered it important to clarify this issue and to identify both beneficial and negative aspects of using such a timetable, in order to inform the design of a computer-based version. Further questions which were considered comprised:

- Why is a symbolic timetable used in the classroom context for these particular children with autism?
- What are the benefits of using a symbolic timetable?
- What are the limitations of a symbolic timetable?

It was decided that knowledge of these particular issues could best be gained from those working closely with the children and with the timetable, and so semi-structured interviews with members of the educational team were carried out.

The methods of investigation conducted at this stage of the study were, therefore, observation studies, visual recordings in the form of photographs, and semi-structured interviews. Each of these methods is now discussed in greater detail, together with analysis procedures.

1) Observation studies

Informal, non-participant observations were carried out in week 31, during the exploratory stage of the study. Adler and Adler (1998) assert that "researchers must actively witness the phenomena they are studying in action" (p. 80). The reason for conducting observation studies at the early stages was to witness use of the timetable at first hand, to form an understanding of how the timetable was used, to see which persons actually used the timetable, and to note the occasions when the timetable was used. It was hoped that through direct observation the following questions could be answered:

- What does the symbolic timetable look like? What form does it take? Why does it take this form? What size is the timetable?
- What information is communicated? How is information displayed?
- How often during the day is the timetable used?
- Is reference made to the timetable by staff members? How is reference made?
- Do the children read the timetable?
- Do the children make reference to the timetable? How is reference made?
- Do the children interact with the timetable? Do they ever go up to the timetable? Do they ever touch the timetable?
- Are any changes made to the timetable? If so, when and how are changes made? Who makes changes to the timetable?

Observation studies were conducted openly; the researcher was introduced to the children as a visitor who was interested in their timetable and to the staff members as a researcher. However, the researcher tried to conduct observations as unobtrusively as possible, to try and gain a natural and realistic picture of the normal pattern of timetable use. The researcher tried to keep interaction with participants to a minimum, to avoid causing changes to events. Specific precautions are discussed later under the heading of ethics (section 5.9.1). Field notes were taken and were written up fully in a descriptive and reflective style as soon after the event as possible, to aid recall. Events needing clarification were discussed with the class teacher at a convenient time.

The children were considered to be a vulnerable group, by virtue of their age. In addition, a diagnosis of autism suggested the children would potentially have difficulty in coping with social interaction. A decision was taken not to interview the children, as it was considered that such an interaction might be stressful. Therefore, it was considered important to observe the participating children using the symbolic timetable as an alternative means of gathering information regarding use.

Data were analysed manually by the researcher, with each transcript of field notes being examined for recurrent themes and in particular in relation to the questions posed above. Findings are reported later (section 7.3.1.1). Findings were incorporated into a systems analysis report at this stage of the study, which informed the system design. The recommendations section of the systems analysis report is presented in Appendix 12. It was found that through the process of observing use of the timetable, the researcher was able to identify issues which needed further explanation. Observation, therefore, assisted in the development of further questions.

2) Visual records

Photographs were taken at this stage, which helped the researcher to identify specific symbols for use in the development of the prototype timetable. Essentially, photographs created a visual record of the type of information displayed in the timetable and provided a record of how the symbolic timetable changed and evolved from one school year to next. In addition, the photographs acted as a point of reference and memory aid for the researcher. Yin (2003) suggests that photographs can be used to share important characteristics of a case with those persons unable to enter the setting. The researcher believed that in addition to using the photographs as a memory aid, that selected pictures might be used to illustrate particular examples of timetable use in the presentation of the findings of this study and so facilitate understanding.

Care was taken to ensure that the symbolic timetable was only photographed when the pupils were absent from the classroom, for ethical considerations, to ensure no child could be identified. Information regarding the taking and use of photographs was included in the information sheet for parents (Appendix 8). The digital photographs were labelled and stored on the researcher's computer and were only available to the researcher.

3) Semi-structured interviews

Interview was considered a useful method for generating data relating to the issues of timetable role and use during this exploratory stage. It was observed that members of the educational team engaged with the symbolic timetable on a daily basis and so it was anticipated that they would be knowledgeable about the purpose and functionality of a symbolic timetable. The researcher considered that members of the educational team would be able to give an account based on knowledge and practical experience of using the symbolic timetable. Members of the educational team were interviewed, therefore, to explore in greater depth *why* and *how* the symbolic timetable was used. In addition, opinions regarding the benefits and limitations of a symbolic timetable were sought and views regarding the proposed use of an interactive, computer-based version of such a timetable were also sought at this time.

Interviews with the education team members were conducted during weeks 31 and 47, at a convenient time and in a quiet location within the school. Informed and written consent was obtained prior to interview (Appendix 8). A list of open-ended questions was drawn up to guide the researcher (Appendix 13). However, as members of the educational team had different roles within the setting there was a degree of flexibility regarding areas of questioning. All interviews were audio-tape recorded with permission of the interviewee and recordings were transcribed by the researcher. The audio-tapes were stored securely and will be destroyed on completion of the study. New members who joined the education team later in the study also participated in interview investigations relating to these issues and the same protocols were followed.

Once transcribed in word document format, interview data were converted to text files and imported into QSR N5, software for qualitative data analysis. Analysis provided a rich description of the role and use of the symbolic timetable and enabled inferences to be drawn, from which a model for an interactive timetable began to emerge. Findings are reported later (section 7.3.1.2). These were incorporated into a system analysis report at this stage of the study which assisted in informing the design of the system. Recommendations established in the report are set out in Appendix 12.

5.8.2.2 Requirements analysis

Requirements analysis is a term for the process whereby the user's requirements of a proposed software system are determined in order to clarify specific needs (Cox & Walker, 1993; Dix, Finlay, Abowd, and Beale, 1998; Preece et al., 1994). This process is discussed further in the System Design Methodology (chapter 6). A requirements analysis was conducted at this stage of the study in order to seek answers to the following questions:

- Do the potential users of the interactive timetable have any special requirements?
- What information is needed for inclusion in an interactive timetable?

Techniques typically used to gather this information include interviewing, observation and document analysis (Preece et al., 1994). An outcome of the requirements analysis was an initial requirements specification report (Appendix 14). The methods employed for this investigation are now discussed in detail.

1) Self-completion questionnaires

A questionnaire referred to in this study as a 'user analysis checklist' was developed, to gather information relating to computer literacy (Appendix 15). The purpose of this particular questionnaire was to identify the level of experience potential users had in using a computer and in using the Internet, and to highlight any potential problem areas (for example, any difficulties with colour differentiation). It is important to appreciate the differences which exist between users with regards to physical abilities, intellectual abilities and personalities (Preece et al., 1994; Shneiderman, 1992). In addition, a user's level of experience will be influential in their ability to learn and perform a particular task (Shneiderman & Plaisant, 2005). Faulkner (1998) suggests there are three levels of user: novices, knowledgeable intermittent users, and expert or frequent users. Establishing the level of experience of potential users of the interactive timetable assisted with certain design decisions. For example, an indication of the level of training required was established.

The ‘user analysis checklist’ questionnaire was piloted informally by colleagues at QMUC. Three versions of the questionnaire were created to assess the three main user groups: children, parents and members of the educational team (Appendix 15). Basic demographic information, details regarding physical capabilities, home computer use, previous experience and knowledge relating to computer use, ability in using a computer, and memory and learning ability was sought. This was administered to adult participants. In addition, parents were asked to complete this questionnaire on behalf of their child.

A questionnaire was considered the most appropriate method for gathering this type of mostly straightforward and factual data. It was considered that to have conducted an interview solely to gather this information would have been a poor use of time resources. Parents were administered the questionnaire following on from an interview, so that assistance could be given by the researcher if required. This also ensured that this data was collected. Members of the educational team completed the questionnaires in their own time. However, there was a low response rate for these.

2) Semi-structured interviews

Two members of staff and four parents were interviewed in order to identify information needs for the proposed interactive timetable. Whilst observation and study of the symbolic timetable had highlighted the information content of the current timetable, the researcher considered that the information requirements for an interactive timetable might differ in some ways from those of a symbolic timetable. In addition, it was proposed that the interactive timetable should be accessible at home via the Internet and so it was possible that there was the potential for new information needs. For example, parents might have information needs as yet unaddressed.

Semi-structured interviews were, therefore, conducted with the purpose of gathering data relating to the information needs of the three main user groups: the pupils, members of the education team, and parents. Scripts were drawn up to guide the interviews, but were flexible to reflect the different perspectives these groups might have (Appendix 16). Opinions were also sought at this time, regarding benefits and limitations of the proposed interactive timetable.

Two members of the educational team were unable to take part in an interview at this time and so information was collected from them in a questionnaire format. In addition, data relating to information requirements were also collected from these two members via email communication.

As before, interviews were conducted at a convenient time and place for participants. Parents were interviewed at home, whilst members of the educational team were interviewed at school. All interviews were audio-tape recorded with interviewees' consent and recordings were transcribed by the researcher. Transcribed data were imported into QSR N5 software as before and analysed with the aid of this software.

3) Document examination

An examination of all paper materials used to support the symbolic timetable was carried out in order to identify those materials which might be needed for inclusion in the interactive timetable. Additionally, documents used within the classroom for communicating information were also examined. These included 'passport' booklets, home-school diaries, social story booklets, and the visual diaries which were introduced during the study. An information-communication map (Appendix 17) was drawn up by the researcher. This highlighted the purpose of certain information resources and enabled the researcher, in discussion with educationalists, to consider the appropriateness of including these resources within the structure of the interactive timetable. Where possible photocopies of supporting materials were obtained and some were also photographed in order to illustrate their location within the context of the symbolic timetable.

Documents such as the home-school diary were examined in order to gain an understanding of their content and purpose, but due to the personal and sensitive nature of the content it was considered unethical to make copies of any part of these. A visual diary sheet (Appendix 18) was introduced by the teacher during the course of the study and this sheet was completed by each child at the end of the day.

5.8.3 Stage 3: Developing a prototype interactive timetable

Data gathered through the observation studies, photographs, semi-structured interviews, self-completion questionnaires, and document examination were analysed and the findings from these investigations were used to inform the design and development of a prototype interactive timetable. As indicated earlier (section 5.4), development of the interactive timetable followed a user-centred design approach. This was an iterative process and involved various stages of activity, which are discussed in detail in the System Development Methodology (chapter 6). Techniques such as paper models, storyboards and prototyping were used to present conceptual models of the proposed interactive timetable to potential users; these are discussed in chapter 6. This section now sets out the methods used to conduct formative evaluations of the prototype interactive timetable.

5.8.3.1 Formative evaluations

Formative evaluation is "an evaluation that takes place before actual implementation and which influences the development of the product" (Preece et al., 1994, p. 713). These evaluations were conducted during the design stage, when it was important to gain feedback on how usable or useful the system was and whether it was actually fulfilling the users' needs. These also address research aims 2 and 3 (section 5.5) to some extent. The research issues considered during this stage of the study were:

- Is the prototype interactive timetable useable?
- Does the interactive timetable system meet the users' needs?

Two methods of data collection were employed to assess the usability of the prototype timetable at this stage. Cooperative user evaluation observations were conducted with children and with members of the education team, whilst self-completion questionnaires were filled out by members of the education team to assess usability anonymously. The methods of data collection used at this stage of the study are now set out.

1) Cooperative user evaluation observations

As indicated previously (section 5.7.1), cooperative evaluation is a technique used in the fields of human-computer interaction and systems design to obtain feedback from users, and assists designers in identifying key problems with prototype products (Monk et al., 1993). "Users are encouraged to ask the evaluator questions about interacting with the system and the evaluator asks them questions about their understanding of the system" (Monk et al., 1993, p.21). A benefit of this technique is that it can be conducted in the 'natural' setting. Cooperative observations are discussed further in the System Development Methodology (chapter 6).

Members of the education team were observed using the interactive timetable on seven occasions (during weeks 65, 72, 73, 81 and 124). When conducting these observations the researcher sat beside the adult participant at the computer in the classroom and directed the participant to explore the timetable. Participants were asked to comment as they were using the timetable. Notes were taken by the researcher during each observation session. Data were analysed as soon as possible after each evaluation and involved studying the field notes in detail. This enabled the researcher to identify areas of the prototype timetable which were satisfactory and to distinguish areas which were problematic. An account of each cooperative evaluation was documented and a report was drawn up from the findings. Following analysis, changes were made to the interactive timetable where necessary.

Participating children were observed using this technique on seven occasions (during weeks 82 and 124). The researcher sat beside the child at the computer in the classroom to conduct these observations. Little instruction was given, as the researcher was interested in observing how intuitive the timetable interface was at this stage. Also, as discussed later (section 5.9.1), the researcher was careful to keep interaction with each child to a minimum, to avoid causing additional stress. Therefore, more emphasis was placed on observing each child's interaction with the interactive timetable than in asking the child questions about the system. Prompts were given to the children by the researcher if needed (such as how to enter a password, or how to print a page). Notes were taken during each observation and were transcribed as soon after the event as possible. Data were analysed and changes implemented where necessary. An account of each cooperative evaluation was documented and a report drawn up of the findings (Appendix 19).

2) Usability questionnaires

A self-completion questionnaire (Appendix 20) was designed to evaluate the usability of the prototype interactive timetable. The format was influenced by guidelines presented in the literature (see Nielsen, 1993 and Shneiderman, 1992) and questionnaires were piloted by colleagues at QMUC. The objectives of the usability investigation were:

- To ascertain opinions relating to the general layout and design of the interactive timetable web pages
- To establish views regarding the ease of navigation of the timetable web pages
- To identify additional material which could be included in the content
- To assess the functionality of the prototype, by asking participants to complete a series of tasks

Six members of the educational team were invited to take part in this procedure during week 81, five were able to comply. The procedure involved answering 10 questions while using the prototype interactive timetable. The questions related to general layout, navigation, and content of the interactive timetable. The questionnaire asked six closed questions. Five questions had a two-point scale of ‘yes’ and ‘no’ and for these a space was also provided for comments. A further closed question asked for a four-point semantic differential response, rating navigation of the interactive timetable on a scale of ‘very quickly and easily’ to ‘very slowly and with great difficulty’. Four open-ended questions were included in the questionnaire, to explore the users’ views regarding information needs. A series of seven usability tasks were also included for participants to complete whilst using the web pages and participants were asked to write comments regarding their ability to complete these tasks on the sheet provided. All questionnaires were completed anonymously. In addition, the researcher was not present when these evaluations took place, to reduce the chance of the researcher having an effect on the outcome and to maintain anonymity, which it was hoped would encourage more honest answers to be given.

Five questionnaires were returned completed and as this was a small sample, the data were collated and analysed manually. As each questionnaire was anonymous, a number from 1 to 5 was allocated to each as an identifier. Where 'yes' or 'no' answers were given, tables were drawn up to aid evaluation. Additional comments, suggestions and responses to open-ended questions were collated according to individual questions. These were set out to aid comparison and to evaluate for emerging themes. Generally, the objectives of the usability study, which were set out previously, were met and useful data was gathered regarding layout, navigation, content, and functionality. Findings of this investigation are reported in section 7.4.1.2.

5.8.4 Stage 4: Evaluating the interactive timetable

Once the prototype interactive timetable had been developed as far as was feasible within the timescale of the study, it was implemented for use in the classroom and by those able to access it from home. Only one family had access to the Internet at home at this time and so only one child was able to access the interactive timetable at home at this point in the study. In addition, due to technical difficulties, it was not possible at this stage for the educational team to make changes to the timetable as had been intended and this limited the degree to which the interactive timetable could be evaluated. Evaluations were carried out with regards to aim 2 and aim 3 (section 5.5) of this study as far as was possible within these limitations and a range of data collection methods were used to address these aims. Methods included semi-structured interviews, self-completion questionnaires, structured observation studies, cooperative evaluation observations, and 'expert' user evaluation questionnaires. This section now considers the data collection methods employed during this stage of the study with regards to aim 2 and aim 3.

5.8.4.1 Uncertainty and anxiety related behaviour

At the beginning of this study it had been determined that the interactive timetable would be assessed to see whether its use could in any way reduce uncertainty for the participating children. A review of the relevant literature had been conducted to consider the concepts of anxiety and stress (section 2.3) and from this it had been determined that:

- Individuals with autistic spectrum disorder are predisposed to suffering from stress and anxiety (Attwood, 1998; Cumine et al., 1998; Deudney, 2001; Groden et al., 1994; Howlin, 1998; Jordan, 2001)
- Anxiety leads to social withdrawal for those with autism, resulting in failure to learn and benefit from social interaction (Trevarthen et al., 1998)
- Anxiety is a potential cause and consequence of behavioural patterns in ASD (Gillott et al., 2001)
- Autistic traits may be responsible for increasing vulnerability to stress and anxiety (Groden et al., 1994)
- Symptoms of anxiety are difficult to assess in individuals with autism, especially if verbal skills are poor (Kim et al., 2000)
- It is difficult to differentiate whether symptoms are anxiety related or part of the autistic condition (Kim et al., 2000)

These assumptions strengthened the researcher’s belief that interviewing the participating children would not be possible, as it was considered that the interview process could prove stressful for many of the children. An alternative means of assessing whether there was an association between use of the interactive timetable and lower levels of anxiety was, therefore, sought. It was decided to observe the children’s behaviour patterns prior to use of the interactive timetable (a baseline study) and to observe behaviour patterns again during use of the interactive timetable. This was so that comparisons could be made between the two observation studies in order to see if any similarities or differences in the children’s behaviour patterns emerged, and to see whether it would be possible to relate these findings to use of the interactive timetable in any way.

At first it was considered that a standardised test might be administered for each child immediately before and after use of the interactive timetable in order to assess anxiety levels (a review of standardised tests is set out in Appendix 5). However, standardised tests intended specifically to assess anxiety levels in children with autism were found to be scarce and this method was rejected for several reasons. Tests which were reviewed were found to be unsuitable for this particular context. This was because they were considered too broad in focus and included elements not relevant for this particular aim. Other tests were considered difficult and time-consuming to administer as they required care-givers to complete them and this would have involved the teacher considerably, detracting from teaching time which would affect both teacher and children. Moreover, some instruments relied on self-assessment and were, therefore, considered inappropriate for use with the children participating in this particular study. Tests of this nature are usually administered as part of an experiment, where changes in behaviour are assessed in relation to use of an intervention and where a hypothesis is being tested. This was inconsistent with the methodological approach of this study; the study began with no prior theory from which deductions could be made or a hypothesis tested. Furthermore, it would not have been possible to isolate all relevant variables in the ‘natural’ setting of the classroom, or for the researcher to control these.

It was decided, therefore, that it would not be possible to measure any reduction in anxiety, but alternatively, that by observing and recording each child’s behaviour before and after use of the interactive timetable a picture of behaviour patterns could be constructed, from which inferences could be drawn. This would enable comparisons to be made both within and between participants, so that similarities and differences could be identified. The researcher recognised that structured observation of the participating children would be likely to generate considerable data and in addition that it would be difficult to differentiate between behaviours considered to be autistic traits and behaviours which could be anxiety related. Therefore, it was considered important to establish prior to the observation studies what actually constituted anxiety-related behaviour for each child. To do this, the researcher gathered data from the people considered most knowledgeable about this issue, the children’s parents and the class teacher. It was initially the researcher’s intention to gather information regarding anxiety related behaviour by semi-structured interview with parents, as this was considered a sensitive issue. Two parents were interviewed regarding anxiety related behaviour at the early stages of the study. However, it was recognised that interviewing the class teacher to gather this information for seven children would take up a considerable amount of the teacher's valuable time and so a self-completion questionnaire was developed for this purpose. Parents joining later in the study were also asked to complete a questionnaire. The methods of data collection are now discussed in greater detail with regards to aim 2: evaluating the effectiveness of the interactive timetable by considering whether its use assisted the children in overcoming anxiety related to change.

1) Semi-structured interviews

Semi-structured interviews were conducted with two parents, P1A and P2A, during weeks 34 and 74. A list of open-ended questions was drawn up to guide the researcher during each interview (Appendix 21). In addition, three structured questions were asked, which involved parents in identifying specific behaviours which might apply to their child. Three prompt cards (A, B, and C) were drawn up to assist with these structured questions (Appendix 22). Prompt card A presented a list of 22 stereotyped behaviours and these had been drawn from stereotyped behaviours documented in the literature (see American Psychiatric Association, 2000; Luteijn, Luteijn, Jackson, Volkmar, & Minderaa, 2000; Rojahn, Matson, Lott, Esbensen, & Smalls*,* 2001; WHO, 1993). Stereotyped behaviours are considered to be repetitive actions and thoughts, and are distinguishing diagnostic criteria for autistic spectrum disorder (Frith, 2003; South et al., 2005). In typically developing individuals a display of stereotyped behaviour would very likely signify boredom or inattentiveness and would normally decrease when other people were present; for individuals with autism, presentation of stereotyped behaviour is associated with anxiety and stress and does not necessarily decrease when others are present (Frith, 2003). It was considered important to identify any stereotypical behaviour which the children commonly presented, and in particular whether these were considered to be anxiety related or habitual, so that the researcher would be able to differentiate between behaviours observed later during structured observation studies.

Prompt card B presented a list of 25 potential environmental stressors and these were drawn from those suggested by Groden, Diller, Bausman, Velicer, Norman, & Cautela (2001) in the “Stress Survey Schedule”. Categories included in this schedule were discussed with the class teacher and those considered most appropriate to the classroom setting were drawn out to be used in the prompt card. For example, questions relating to pleasant events such as ‘being allowed to attend a party’ were not considered situationally appropriate for this study. It was suggested in the literature that certain environmental events can provoke feelings of stress and anxiety for individuals with autism. The researcher anticipated that each child would have experience of being stressed as a result of certain environmental events and that both the parent and the teacher would be knowledgeable of these. This would enable triangulation within sources to be made following the observation studies.

Prompt card C listed 15 physical signs of anxiety and these were developed with guidance from the literature. In addition, assessment scales such the “Children’s Manifest Anxiety Scale” (Reynolds & Richmond, 1997) and the “Children’s Social Behaviour Questionnaire” (Luteijn et al., 2000) provided examples of physical signs of anxiety (review in Appendix 5). Advice was sought from the teacher regarding the items to include in each of the prompt card lists.

Interviews were tape recorded and were transcribed by the researcher as soon after each interview as possible, to aid recall. Transcripts were converted to text files and stored in QSR N5 software where they were examined to see whether any similarities were apparent between the parent and teacher assessments. The information gathered from parent interviews was collated together with the information received from the teacher and was used to create a profile for each child, which it was hoped could be used to assist in the analysis of data gathered during the observation studies.

2) Self-completion questionnaires

A self-completion questionnaire (Appendix 23) was used to gather information from the class teacher regarding anxiety related behaviour for each child participating in the study. It was recognised that the teacher had limited time to spare and so completing a questionnaire was considered a less time consuming process for this particular information. A pilot version of the questionnaire was developed and was completed by the teacher in week 48. Final versions of the questionnaires were completed for four of the children by the teacher in week 111.

The questionnaire which the teacher was asked to complete followed the same line of questioning as had been asked of the parents during interview. That is, six open-ended questions were asked to enable the teacher to describe aspects of each child's behaviour in general terms and three lists based on the three prompt cards used during the parent interviews were also included. From each list the teacher was asked to select the relevant behaviours or factors which applied to each child. A space was also provided for the teacher to note any factors not accommodated for in each list.

The parents of child 6 and child 7, who joined the study in week 98, were asked to complete a questionnaire regarding anxiety related behaviour (Appendix 24). Completed questionnaires were received from these parents in week 111. A questionnaire was utilised at this time rather than interviewing the parents, as it was considered a more convenient method of gathering this particular information at this late stage of the study. The mothers of child 1 and child 4 were also asked to complete a questionnaire relating to their child's anxiety related behaviour at this time, in order to verify data previously collected via interview (in the case of child 1) and in an attempt to gather data from the parent of child 4. However, these questionnaires were not returned.

3) Structured observations

A pilot observation study was carried out in week 116. A basic observation chart (Appendix 25 – example 1) was used at this time. However, this was refined and a more comprehensive chart (Appendix 25 – example 2) was eventually used during the final two observation studies (which will be referred to as study 1 and study 2). This second observation chart was based to some extent on the 'star recording chart' developed by Zarkowska and Clements (1994).

In order to establish a baseline of anxiety related behaviour for each of the four children participating at this stage of the study, a series of structured observations were conducted in week 134 (study 1). The interactive timetable was then implemented in week 135 and structured observations (study 2) of the children were conducted during weeks 135 to 137.

It was recognised that the participating children were highly reliant on the symbolic timetable used in the classroom setting and it was, therefore, considered inappropriate to cease use of the symbolic timetable in order to evaluate use of the interactive timetable alone. Furthermore, to do so would have been introducing further change into the situation, making it difficult to determine whether participants' behaviours were associated with the lack of this particular support or with changes in class routines. Therefore, the symbolic timetable continued to be used as normal during observation study 1 and study 2.

The procedure for the structured observation studies was as follows. Each child was observed during a range of structured activities and observation sessions lasted between ten and twenty minutes depending on the activity. An observation chart was used to note behaviours which were observed, recording the time these commenced and any environmental factors which had preceded the behaviour. Any impact the behaviour had on the child or on others was noted, any interactions which occurred between the child and others were also noted. Any use of the symbolic timetable by the children or staff members was also recorded. In addition field notes were taken. Photographs were taken of the symbolic timetable each day and of the accompanying materials. These photographs were used to create a record of the timetable and aided recall of events for the researcher. In addition, the researcher drew diagrams of seating positions during the various activities to aid recall.

The notes recorded on the observation charts were entered verbatim into a word processed table as soon as possible after the observation in order to aid recall of events. These charts were then studied and behaviours and environmental events were drawn out and placed in separate lists for further examination. These were then categorised; stereotyped behaviours, physical signs of anxiety, and environmental events were singled out on the word processed charts using colour coded highlighter pens and the number corresponding to each category was written beside the highlighted text. This enabled the frequency of each item to be counted and tables to be drawn up charting frequencies of stereotyped behaviours, physical signs of anxiety and environmental events for each observation period for all participants. A document reporting the findings of structured observation study 1 was then created. This presented the data relating to frequency of behaviours and environmental events in table form, whilst qualitative data were reported in descriptive form. Comparisons were also made between these findings and the parent and teacher assessments to see if there was any corroboration between the assessments and the observation studies. The class teacher was shown the three categorisation schemes at the end of the final set of observation studies and was asked to review these to see if there was agreement regarding groupings. An example of a categorisation document for stereotyped behaviours is demonstrated in Appendix 26. Generally the classification process was iterative and with each new set of observations some revision of the classification was made.

5.8.4.2 A management and communication tool

A third aim of this study was to evaluate the interactive timetable to see whether it was effective as a management and communication tool. Questions at this stage considered:

- Is the interactive timetable usable?
- What benefits might an interactive timetable offer?
- What are the limitations of an interactive timetable?

Three forms of investigation were carried out in order to address this aim: cooperative user evaluation observations, semi-structured interviews, and expert evaluations. These are now discussed.

1) Cooperative user evaluation observations

These observations were conducted with four participating children and one teacher as part of the summative evaluations in order to:

- Observe use of the interactive timetable in the ‘natural’ setting of the classroom

- Observe users performing specific tasks
- Identify any problems with the prototype
- Record comments which could assist with future development

The protocol for these observations was as described previously (section 5.8.3.1), with the researcher sitting alongside the participant in front of the class computer. The children were instructed to complete two tasks during this second series of cooperative evaluations. At the beginning of each session the researcher asked the child to check the class timetable on the computer for that day and then asked the child to make up their own timetable for the day using the interactive timetable. As stated previously (section 5.8.3.1), prompts were given to the children if required (e.g. how to enter a password, or how to print a page). Length of sessions varied slightly for each child. Field notes were recorded and were transcribed verbatim as soon after the event as possible. Data were analysed manually and comparisons made with previous observations.

The format for the observation with the teacher was similar. A computer in the SLT room was used for this observation and the researcher sat beside the teacher at the computer. This particular session was audio-tape recorded with the teacher's permission. The recording was transcribed as soon after the event as possible and data were analysed manually.

2) Semi-structured interviews

Interviews were conducted with two parents and two members of the education team. Interview protocols were followed as set out earlier (section 5.8.2.1). The focus for these interviews was on:

- Assessing the actual use of the interactive timetable
- Identifying benefits of use
- Identifying limitations

One parent had been able to access the interactive timetable at home. The other parent had no Internet access at this time and so the interactive timetable was demonstrated at the parent's home with use of a lap-top computer. As before, a script (Appendix 27) was used to guide the researcher and interviews were audio-tape recorded with consent. Recordings were transcribed by the researcher. Data were analysed using QRS N5 software, to allow comparative analysis to be made with earlier data.

3) Expert evaluations

Expert evaluations can be carried out at any point during the design phase (Shneiderman & Plaisant, 2005). These evaluations were conducted as part of the summative evaluation stage, simply because this was the most convenient time to organise this assessment for this particular study. On reflection, however, it would have been more useful to have conducted these evaluations during the formative stage. Expert evaluations were conducted in order to assess the interactive timetable according to principles of interface design and to assist with the identification of any technical problems. Self-completion questionnaires were created (Appendix 28). The format was influenced by guidelines presented in the literature (see Nielsen, 1993 and Shneiderman, 1992) and questionnaires were piloted by a colleague at QMUC. The questionnaire required respondents to assess general layout, consistency and navigation features of the interactive timetable. Revised questionnaires were administered via email to five people with experience of computer systems design. Two respondents were colleagues, one respondent was a passing acquaintance, and this person recruited two further respondents who were unknown to the researcher. Four questionnaires were completed and returned via email. Responses were allocated a code, to maintain anonymity. Data were analysed manually.

5.8.5 Stage 5: Developing protocols

It was the intention of this research to examine the feasibility of building a general, interactive timetabling system, capable of widespread implementation. It was considered that protocols and recommendations would be developed to assist with this and that experience gained from creating a prototype interactive timetable system might be applicable to other situations and uses. However, due to limitations discussed later (chapter 8), the study took much longer than anticipated and this stage has not yet been attained.

5.9 Ethical considerations

Researchers have a responsibility to their participants, to themselves and to their profession, to ensure that research is conducted as ethically as possible. “Ethical research involves and uses humans respectfully and equitably without trying to change them or their surroundings” (Johanson, 2002, p. 68). Codes and principles have evolved to provide guidelines for researchers and to support ethical research processes. In addition, many professional associations have a code of ethics. Moreover, research conducted within higher education is generally subject to approval of an ethics committee before proceeding (Blaikie, 2000). The nature of qualitative research is such that it entails researchers conducting in-depth studies and spending a good deal of time in close contact with participants. Consequently, qualitative researchers frequently engage with issues of an ethical nature (Gorman & Clayton, 1997; Janesick, 2000; Mason, 1996).

The involvement of children in research is also likely to increase the possibility of ethical issues arising. Morrow and Richards (1996) acknowledge that research involving children is likely to be methodologically and ethically challenging, and that in addition to the ethical considerations which should apply to all research activities, research with children should also consider competencies regarding consent, data collection, interpretation of data, and the potential vulnerability of the participant. The onus is clearly on the researcher to safeguard children participating in research by incorporating precautions into the design and ensuring evidence of protection throughout the study (Helseth & Slettebø, 2004). Ethical considerations, in addition to being situational and context specific, should be continuous throughout the research process (Morrow & Richards, 1996).

The children participating in this study were young, aged between six and ten years, and were diagnosed with autism. Furthermore, their developmental ages were lower than their chronological ages. These factors suggest that the children could be considered vulnerable and the researcher was conscious throughout the study of a need to safeguard these children, minimising any risks encountered through the research process.

There are recognised to be four key areas of ethical concern for participants generally and these relate to the issues of risk and harm, privacy, informed consent, and deception (Bryman, 2001). Other issues of ethical concern involve trust (Gorman & Clayton, 1997; Mason, 1996; Ryen, 2004), and accuracy (Christians, 2000). There tends to be a degree of overlap between these areas and in particular, consent, confidentiality, and trust are all ethical issues which are closely linked (Ryen, 2004). The issues of informed consent and protection of participants are likely to be problematic in research involving children (Morrow & Richards, 1996).

5.9.1 Harm

There are many variations regarding the concept of harm as it relates to research. Harm can refer to a physical action, to interference with a participant's natural development, to affecting self-esteem, and to causing a participant undue stress (Bryman, 2001). With regards to this particular study and the issue of harm, it is possible that the very presence of the researcher in the classroom may have caused stress for some, or all of the participating children. The researcher considered this issue from the very beginning and one of the reasons for maintaining a constant presence in the classroom for prolonged periods was so that the children could become used to the researcher. It was hoped that this would lessen the threat of stress for the children. Morrow and Richards (1996) suggest that developing a relationship between the researcher and participants is important and that studies should be designed to allow time for familiarity between researcher and respondents to develop. To reduce the potential for stress at the early stages of this study, the researcher took care not to initiate interaction with the children. On occasions when interaction was initiated by the child, the researcher responded in an appropriate, friendly and professional manner.

Another concern regarding the issue of harm related to one child who was not participating in the study. The child was clearly keen to investigate the interactive timetable along with the other children, but his parents had declined the invitation for him to participate in the research study. The researcher was concerned that excluding the child from engaging with the interactive timetable would cause him to feel 'left out' and that he might even feel he was being punished in some way. To overcome this potential difficulty the child was allowed to join in on the 'fringe' as it were, by engaging with the interactive timetable on occasions, but with no records being made of his interactions.

5.9.2 Confidentiality and privacy

Maintaining confidentiality requires that participants' identities, the location of a setting and any subsequent records are all treated with care. If there are any published findings, then care should be taken that participants are unidentifiable in these (Bryman, 2001). It is suggested that protecting the identity of participants is much more difficult in qualitative studies, due to the smaller numbers involved and to the use of rich descriptive field notes (Bryman, 2001; Mason, 1996).

For this particular study, all participants were assured of confidentiality in the information sheet and at various points during the study, such as at the beginning of an interview. The researcher allocated a code to all participants and this was used when referring to participants in written reports, to maintain anonymity. In addition the location of the research setting was anonymised. All data were stored securely in a locked cabinet and the researcher took great care not to disclose information regarding the location of the setting or details of the participants to anyone.

Ryen (2004) suggests that guidelines of confidentiality should also apply to the use of photographic evidence, "Using photographs from fieldwork can make a story more vivid and act as proof of the fieldwork" (p.233), but use of photographs could lead to identification. Care was taken during this study when taking photographs, to only do so when the children were absent from the classroom. Any form of identification which appeared in the photographs, such as names, was later edited from the photograph.

5.9.3 Informed consent

Agreement to participate in any research must be voluntary, without physical or psychological coercion, whilst consent to participation must be based on full and open information (Christians, 2000). Research participants must be given as much information as is needed in order to make an informed decision whether to participate. However, it is often difficult to inform participants of absolutely everything about a study at the beginning and sometimes digressions from the original research plan may occur (Bryman, 2001). Participants have the right to know when they are being researched and the right to be informed about the nature of the research, they also have the right to withdraw from a study at any time (Ryen, 2004). Informed consent is complex and may be culturally or contextually problematic (Ryen, 2004). In addition, informed consent may need to be renegotiated throughout a study, particularly as relationships change and develop (British Psychological Society, 2004; Mason, 1996). Further problems can arise when participants are unable to comprehend the implications of participating in a study (Ryen, 2004). For example, this could apply to the children participating in this particular study. Sometimes researchers do not want their participants to know too much about the nature of a study, to avoid potential bias. Sometimes it is not always clear at the start of a study exactly what is being researched, so the extent of informed consent may be called in to question (Ryen, 2004).

There was no intention to mislead in this study and the researcher was open about all aspects of the research at all times, judging the adult participants to be fully aware of the nature of study. An information booklet was provided for the parents and for members of the educational team at the beginning of the study (Appendix 8). In addition, the researcher attended a meeting with parents and educational team members, to explain the nature of the study. Observation studies were conducted overtly and the researcher introduced herself as a researcher in the classroom setting. Informed consent was obtained from all adult participants. Consent for each child's participation was gained from the child's parent. An emphasis on informed consent moves to oppose the occurrence of deception (Christians, 2000). Parents were informed in the information sheet of the extent of the study as far as possible and in addition specific guidelines regarding the researcher's presence in the classroom were stipulated. These were that the researcher undertook to have no contact with the children unless a member of staff was present and to only work with a child if they assented at that time. A second consent was obtained from the parents later in the study when it became clear that access to documents such as IQ test scores and IEPs would be beneficial. Participating parents and members of the educational team were provided with reports on the progress of the study at various stages (example Appendix 29).

5.10 Conclusion

This chapter has presented the research methodology for this study. The theoretical framework has been established as being constructionist; the researcher holds the view that knowledge is constructed through engagement with the individually interpreted realities of the world (Crotty, 1998; Greene, 2000). The methodological framework was demonstrated to follow a systems development approach. A web-based timetable system was developed so that the usefulness and usability of such a system by children with autism could be investigated. The stages of the study were set out clearly, to clarify this approach. The selection of the setting was theoretically based, with a setting that reflected the characteristics central to the study being chosen. Criteria for the selection of participants were established. A case study approach facilitated gathering of mainly qualitative data and the procedures for collection and analysis of data were described. The system design stage was assisted by a user-centred approach. Finally, ethical issues were discussed and it was noted that these were considered throughout the study. Chapter six now proceeds to set out the system development methodology.

Chapter 6: System development methodology

6.1 Introduction

This chapter sets out the approach employed during the creation of an interactive timetable system. The chapter begins by providing a rationale for the development of a computer-based, interactive timetable. The framework within which the design process took place is set out and the design architecture is described and discussed.

6.2 Rationale for a computer-based, interactive timetable

As discussed previously (section 1.2), the rationale for this study was that an interactive, computer-based timetable system was considered to be an alternative and complementary way of presenting timetable information for children with autism. It was anticipated that a commercially available timetable system which met the specific needs of the case study class would be difficult to find and so an initial consideration of the study was that it would be necessary to develop a tailor-made system.

6.2.1 A computer-based system

It was demonstrated in the literature (section 3.2.3.1) that children with autism are comfortable and frequently skilled at using computers and indeed, it is suggested that computers offer many beneficial features for individuals with autism (Attwood, 1998; Bell & Potter, 1999; Murray, 1997). Consideration of these factors suggested that computer-based technology offered a feasible option for communicating timetable information as an alternative form of presentation. Furthermore, it was anticipated that a computer-based timetable might facilitate access from different locations, particularly if the system was to be web-based.

The rationale for creating a computer-based timetable was founded on three factors. Firstly, information communicated by means of a symbolic timetable is seen to be dynamic in nature, reflecting the range of activities that occur during the school day. As discussed later (section 6.2.2), interactive systems offer great potential in the way that information can be displayed and communicated. Secondly, it was recognised that computer-based systems offer the potential to facilitate the organisation and management of timetable information. For example, timetable information could be organised in such a way so as to allow collaboration, or to be adapted for individual needs. Thirdly, findings from investigations carried out during stage one and stage two of the current study highlighted a need for an application which could be accessed both at home and at school, and which could be easily maintained and frequently updated by teaching staff. A web-based, hypertext application was, therefore, considered to be a feasible option. The terms ‘the Web’, ‘HyperText Markup Language’ and ‘hypertext’ are now briefly explained.

6.2.1.1 The Web

The Web is a term used to refer to the World Wide Web (WWW), or W3 (Vora & Helander, 1997). Essentially, the Web is “a collection of protocols and standards used to access the information available on the Internet” (Vora & Helander, 1997, p. 899). There are three standards which assist the functioning of the Web: Uniform Resource Identifiers (URIs), which provide a mechanism for locating information, HyperText Transfer Protocol (HTTP), which provides a mechanism for transferring information, and HyperText Markup Language (HTML), which is a language for displaying information (Vora & Helander, 1997).

6.2.1.2 HyperText Markup Language (HTML)

As mentioned earlier, HTML is a language for displaying information on the Web. It does this by describing the logical structure of a hypertext document in such a way that it is understood by the web browser, which then processes the information and presents the document on the Web (Vora & Helander, 1997). HTML is based on Standard Generalized Markup Language (SGML), an international standard “for defining markup languages. Authors *mark up* their documents by representing structural, presentational, and semantic information alongside content. HTML is one example of a markup language” (W3C, 1995-2006a) [italics original]. HTML can be created using a variety of tools. For example, a plain text editor such as Notepad can be used to write HTML from scratch, while more sophisticated authoring tools such as Microsoft FrontPage and

Macromedia Dreamweaver offer a 'What You See Is What You Get' (WYSIWYG) environment (W3C, 1995-2006b). Authoring tools are discussed briefly later in section 6.4.

6.2.1.3 Hypertext

There is no clear definition of the term 'hypertext' (Horton, 1990; Rada, 1991; Vora & Helander, 1997). Typically, hypertext may refer to one or all of the following processes: information creation, information storage and management, and information presentation and access (Vora & Helander, 1997). In order to understand the meaning of hypertext, a comparison to traditional text should be made (Nielsen, 1995). Traditional text follows a sequential structure, with a linear sequence determining the order in which the reader looks at the text; hypertext on the other hand has a non-sequential structure, that is, there is no specified order in which the text should be read (Nielsen, 1995).

> Hypertext presents several different options to the readers, and the *individual* reader determines which of them to follow *at the time* of reading the text. This means that the author of the text has set up a number of alternatives for readers to explore rather than a single stream of information (Nielsen, 1995, p. 2) [italics original]

Hypertext applications have many beneficial features. For example, large collections of materials in varying media can be assembled and linked using hypertext (Vora & Helander, 1997). In addition, hypertext facilitates the organisation of information in multiple ways, making cross-referencing of information easier and allowing multiple authors to combine information, promoting collaboration (Horton, 1990). These factors were considered relevant for this particular study where various forms of information were required to be organised and presented, and where several people might be responsible for authoring materials. Other benefits of hypertext include the fact that it can be controlled by the user and it has the potential for savings to be made on physical storage space and also on updating information (Nielsen, 1995), features which were important considerations for this study.

There are, however, several arguments against the use of hypertext. The principal drawback is that users frequently suffer disorientation and experience a feeling of being 'lost in hyperspace' (Dix et al., 2004; Horton, 1990; Vora & Helander, 1997). This is primarily due to the non-linear nature of hypertext and the fact that the user is free to control his movement through a hypertext document (Dix et al*.,* 1998). A second area of concern is that use of hypertext systems can result in cognitive overload for the user (Vora & Helander, 1997). Information may be hard to find and as previously mentioned, the user is able to choose his route, with the result that the sequence in which a document is read may be unpredictable (Horton, 1990). Uncertainty may arise if information is presented in a complex structure and because the user is able to miss out pages when navigating hypertext documents confusion can arise (Dix et al., 2004). Furthermore, hypertext documents are frequently of a transient nature (Horton, 1990). For example, a web-based document may be short-lived depending on the circumstances in which it has been created and the purpose it serves. Whilst these limitations were given great consideration during the design process, it was believed that the beneficial features of interactivity and user control outweighed these concerns.

6.2.2 An interactive system

It is commonly acknowledged that the nature of education is such that a range of activities take place during the school day, creating an environment of constant change. An interactive timetable was considered to be a feasible option for coping with the dynamic nature of the information which might be required in communicating daily timetable details.

Interactivity is an elusive concept, but primarily entails "reciprocal communication exchanges that involve some form of *media*, or information and communication technology" (Bucy, 2004, p. 375) [italics original]. The term 'interactivity' is typically used to refer to "the combination of different types of media into a digital presentation that allows the user some degree of interaction" (Graham, 1999, p.2). Interactive design "implies an exciting involvement in the way the information is presented and retrieved" (Gillham & Buckner, 1997, p. 79). A variety of different media formats are combined to present information and to facilitate communication between the user and the computer system. For example, interactive systems may include a mixture of graphics, text, sound and other media formats, which contribute to making the interaction an interesting and pleasant experience for the user. The aim of an interactive system is essentially, "to aid a user in accomplishing *goals* from some application *domain*. A domain defines an area of expertise and knowledge in some real-world activity" (Dix et al., 1998, p. 104) [italics original]. An interactive design was proposed for this particular system, to enable users to achieve the goals of engaging with information and communicating information, not to be just passive recipients of information.

In order for interaction and communication to take place there needs to be an interface to mediate between the user and the computer system; this is commonly referred to as the 'Human-Computer Interface' (Faulkner, 1998). The interface is, therefore, an essential element in the interaction process, as it operates as a translator for both the user and the computer system. For a successful interaction to occur the interface must be able to facilitate an adequate translation.

6.3 The development framework

A framework was required within which to develop the interactive timetable. A framework commonly used in the field of information systems design is the information systems development life cycle (Avgerou & Cornford, 1993; Avison & Shah, 1997; Rowley, 1998). "The life cycle is a model used to structure the development process as a sequence of phases each containing a number of specific activities or stages." (Avgerou & Cornford, 1993, p. 120). Typically the stages include: a feasibility study, system investigation, systems analysis, systems design, implementation, and review and maintenance (Avison & Shah, 1997). There have been many variations of this basic framework, indicating its adaptability. For example, Vora (1998) proposes a methodology for designing web sites based on human factors and usability engineering principles, which uses "steps similar to those required for any system development: *planning, analysis, design and development, testing, implementation,* and *maintenance*" (p. 154) [italics original]. Similarly, December (online, n.d.) outlines a framework of six processes which assist in web site development: planning, design, analysis, implementation, promotion, and innovation. These approaches are very similar, in that they follow a series of prescribed stages. However, there are slight variations in the focus of evaluation in these approaches, as well as in the terminology used.

The framework employed for the current study was an adaptation of the life cycle model and is illustrated in figure 6.1. The process was highly iterative, with several cycles being made between design and evaluation. In addition, it can be seen that this framework integrates the first four stages set out in the research methodology discussed earlier (chapter 5): preliminary investigations, investigating the role and use of a symbolic timetable through system analysis, development of a prototype system, and evaluating the interactive timetable.

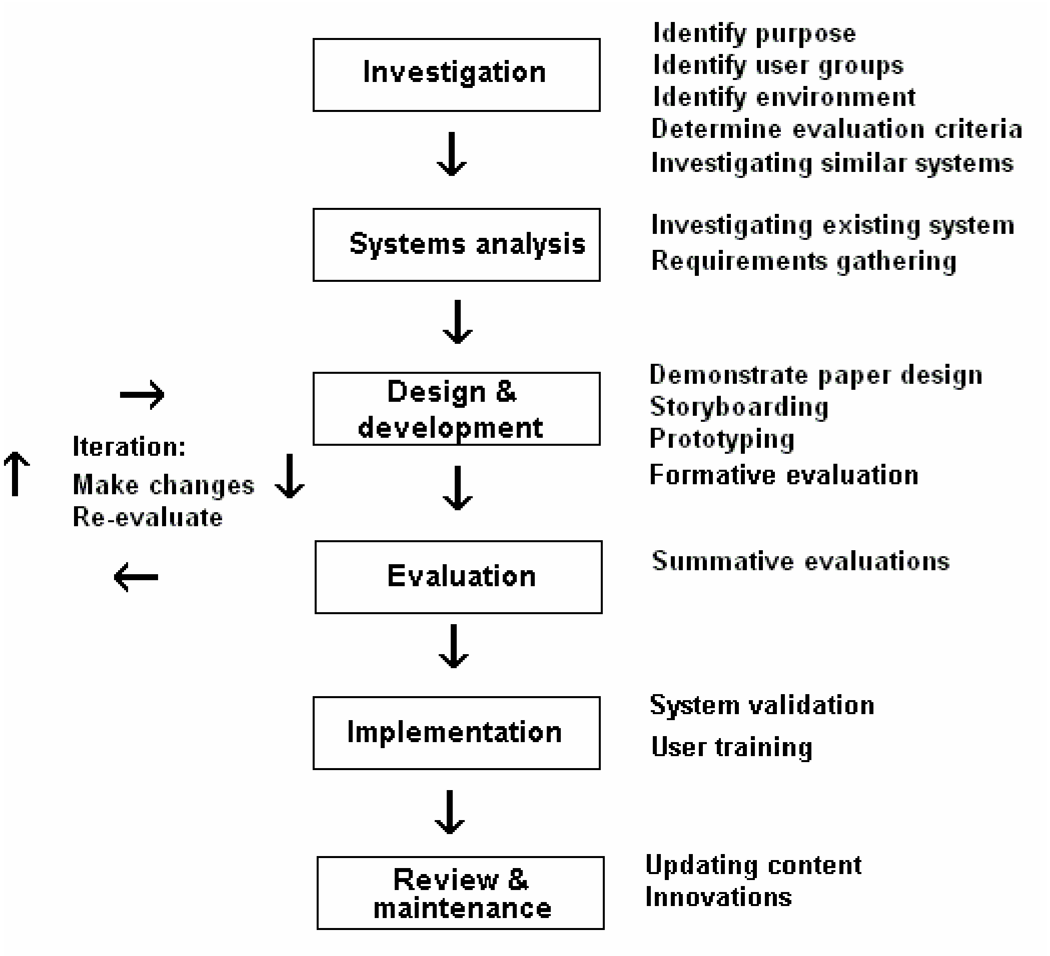


Figure 6.1: The development framework for the interactive timetable system

6.3.1 Investigation

As discussed earlier (section 5.8.1), preliminary investigations assisted the researcher in identifying the purpose of the proposed system, the user groups and a use environment. Determining who the users will be is an important step, as it will influence subsequent design decisions (Gould, Boies, & Ukelson, 1997). For example, by establishing that the users of the proposed interactive timetable consisted of three specific groups (children, educationalists, and parents), it could be seen that a wide range of needs and abilities would need to be accommodated. Also, by recognising that the participating children were potentially vulnerable it was established that it would be necessary to exclude outsiders from accessing the timetable. Furthermore, by identifying the environments of use to be the classroom and the children's homes, a web-based system was recommended to facilitate access from any location. As mentioned earlier (section 5.8.1.2), a review of software and systems available for those with autism was carried out during the preliminary investigation stage (Appendix 11).

Evaluation criteria were also determined at this stage, with criteria and tools for both formative and summative evaluations being decided upon. Continual evaluation is important in order to improve design and achieve the aim of designing a system which is usable. Evaluation is discussed in greater detail later (section 6.3.4).

6.3.2 Systems analysis

The systems analysis stage involved an investigation of the existing system and user requirements modelling.

6.3.2.1 Investigating the existing system

As discussed earlier (section 5.8.2.1), a task analysis was conducted to identify the goals of the proposed interactive timetable system. The methods of data collection for this investigation were discussed in the Research Methodology (section 5.8.2.1), and the findings from the investigation are presented in the Research Findings (section 7.3.1).

6.3.2.2 User requirements modelling

User requirements' modelling is concerned with establishing the needs of the user and, therefore, forms an important role in the design process (Cox & Walker, 1993; Dix et al., 1998). Methods of data collection for this investigation are set out in the Research Methodology (section 5.8.2.2), and the findings of this investigation are presented in Research Findings (section 7.3.2). An outcome of this activity was a requirements specification (Appendix 14) and this was the starting point for the user interface design process. Requirements specification is an ongoing process as the users' requirements typically change as their understanding of the system changes (Cox & Walker, 1993).

User-centred design

The principal aim of user-centred design is "to produce systems that are easy to learn and use by their intended users, and that are safe and effective in facilitating the activities that people want to undertake" (Preece et al., 1994, p.360). To achieve this aim it is essential "to make user issues central in the design process, to carry out early testing and evaluation with users and to design iteratively" (Preece et al., 1994, p. 372). As mentioned earlier (section 5.4), the importance of involving users in the design of the interactive timetable was recognised and consequently, the system design methodology followed a user-centred approach. Three user-centred approaches which are relevant to HCI design principles are now briefly discussed: participative design, socio-technical design, and soft systems methodology.

Participative design

This approach to systems design originated in Scandinavia and recognises the importance of involving users in the design process, asserting that users have a right to be involved in designing systems which they will be using (Ehn & Löwgren, 1997; Muller, Haslwanter, & Dayton, 1997; Shneiderman, 1992). The approach acknowledges that participants are important sources of information, as they have specific knowledge of the environment (Avgerou & Cornford, 1993). For this particular study, it was recognised that the adult participants were likely to have valuable knowledge regarding the children's needs with respect to an interactive timetable and so their contribution to the design process was considered invaluable. It is also suggested that user involvement is more likely to increase acceptance of the end product (Dix et al., 2004; Muller et al., 1997; Shneiderman, 1992; Shneiderman & Plaisant, 2005). This is generally because a participative approach enables users to learn about a new system while it is being developed, reducing fear of the unknown, and causing the user to feel less threatened. It was hoped that by involving the users of this particular system throughout the design process that they would feel a sense of ownership of the interactive timetable.

Participation can be in the form of consultative decisions about the proposed system, or involvement in the analysis and design stages (Avgerou & Cornford, 1993). The current study set out to involve users in all areas, wherever possible. For example, all adult participants were consulted regarding requirements, whilst members of the educational team were actively involved in design decisions through discourse processes such as face-to-face meetings. Adult participants were also kept informed of the progress of the study through written communication. Moreover, many of the participants, including children, were involved to some extent in evaluation processes.

There are, however, limitations to this participative approach. For example, it can be a time-consuming and expensive process (Avgerou & Cornford, 1993). Furthermore, it has been found that the implementation period can become lengthy and there may be compromise regarding the ultimate design (Dix et al*.,* 1998; Shneiderman & Plaisant, 2005). Integrating participatory activities into the software lifecycle is frequently difficult (Muller et al., 1997). For example, in relation to the current study, involvement was frequently constrained by time factors for adult participants, whilst the nature of the participating children precluded their involvement to a greater extent.

Techniques commonly employed in participative design include brainstorming, where participants are encouraged to share ideas in an informal context, storyboarding (a method for demonstrating designs), and pencil and paper walkthroughs, which allow early demonstration and assessment of a design (Dix et al., 2004). Techniques used during this study are discussed briefly later in this chapter.

Socio-technical design

Socio-technical design is “a form of cooperative design that focuses on developing complete and coherent human-machine systems” (Preece et al., 1994, p. 375). Faulkner (1998) states the aim of this approach is:

> … to fit the process of design into the framework of the needs of the organization. Socio-technical design takes the idea of designing for the user and the task a stage further and endeavours to design within the structure of the organization and the way in which it operates (p. 134).

Socio-technical design encourages the end-user to contribute to the system development process. However, this approach is ultimately more concerned with the structure and needs of an organisation than with the individual (Faulkner, 1998). The outcome generally, is a product which is more likely to be suited to the needs of an organisation; with a system being developed which enables those involved in the organisation to perform their role more effectively (Avgerou & Cornford, 1993). Essentially, this approach is likely to lead to the implementation of change within an organisation. This particular approach was considered to be not wholly appropriate for this particular study, which was concerned primarily with the individual at this stage and not the organisation per se. However, this approach could possibly be of use in future research, particularly if an action research approach were taken.

Soft systems methodology

Soft systems methodology (SSM) is an established method, developed in the 1970s, which aims to improve problem situations by taking a holistic view of the human-computer system (Checkland & Scholes, 1990). SSM “is an organized way of tackling messy situations in the real world. It is based on systems thinking, which enables it to be highly defined and described, but is flexible in use and broad in scope” (Checkland & Scholes, 1990, p. 1). Systems philosophy holds the view that the organisation is a system “of which the technology and people are components” (Dix et al., 1998, p. 227). The emphasis is on understanding the situation in which a perceived problem is thought to exist, rather than devising a solution to a specific problem (Dix et al., 2004; Preece et al., 1994).

The role of the system analyst in this approach is that of a participant in a team, with the SSM approach recognising the importance of the different perspectives which people have (Rowley, 1996). The outcomes of this approach are conceptual models of an ideal system (Preece et al., 1994). SSM was considered not wholly appropriate for this study, which was concerned with considering an alternative means of communicating an information system. Nonetheless, certain aspects of this approach were applicable; for example, SSM enables a holistic view of a situation to emerge and focuses on people and constraints, both important considerations in this study.

6.3.3 Design and development

Following analysis of data gathered during the first two phases, the design and development stage commenced. This involved presenting models of the proposed timetable system to the users, to help them develop an understanding of how the system might look and function. Users' expectations of a system are commonly difficult to establish in written format and so conceptual models are typically used to demonstrate a particular system structure and to facilitate discussion between users and the system designer (Dix et al., 2004). Three specific techniques were used during this study to demonstrate the proposed timetable system: a paper model of the proposed system was created, screen shots of various stages of interface development were presented as a storyboard, and prototype models of the system were developed for the users to try out. This section begins by briefly clarifying the concepts of 'mental models' and 'conceptual models', before discussing the techniques of paper models, storyboarding, and prototyping.

Formative evaluations were also carried out during this stage, in order to assess areas of the design, to ensure that user requirements were being met, and that the developing system was usable. The investigation methods employed were cooperative user evaluation and usability questionnaires. These procedures were discussed in the Research Methodology (section 5.8.3.1), and findings from these investigations are set out in the Research Findings (section 7.4.1).

6.3.3.1 Mental models

A user generally has certain expectations about the behaviour of a computer system and this is typically referred to as the user's mental model (Allen, 1997; Faulkner, 1998). This type of model exists in a person's head and so obviously it is not possible to see such a model (Allen, 1997). People form their mental models of systems through experience and training (Norman, 1988). In complex situations people tend to make inferences based on prior experience, developing mental models dynamically to help them cope with a new or difficult situation (Preece et al., 1994). Therefore, "the user's mental model of an information system has a critical impact on the user's ability to use systems effectively" (Chen & Sharma, 2002, p. 51). Unfortunately, mental models formed by users are frequently vague and incomplete and it is, therefore, important that the interface of a computer system is designed in such a way that it facilitates the attainment of an accurate model of the system by the user (Faulkner, 1998; Preece et al., 1994). A means of assisting a system designer to demonstrate a potential system and facilitate discussion of a user's mental model is through development of conceptual models.

6.3.3.2 Conceptual models

A conceptual model such as a paper model enables users to predict the effect an action has (Norman, 1988). There are several forms of conceptual models. Two examples are mappings and metaphors.

Mappings

Mappings are a form of conceptual model which can be used as a starting point in the design process and which can be used to describe "the links between the task the users must complete and the actions required to complete those tasks" (Allen, 1997, p. 50). Examples of mappings include the system design techniques of paper and pencil walkthroughs and storyboards (movable mock-ups of the interface). These techniques were used in this study and are discussed later in this section.

Metaphors

The term 'metaphor' is a linguistic expression for a figure of speech, which is used to describe a concept in a familiar and accessible form (Preece et al., 1994). Using a metaphor as a conceptual model is essentially where a similar and familiar process is used to teach a person about a new or different process (Allen, 1997; Dix et al., 2004). For example, within the field of computing the typewriter metaphor was used when word processors were first introduced because of the similarities between the keyboard of a computer and that of a typewriter (Dix et al., 1998). Furthermore, the user interface metaphor is an example of a framework of familiar concepts that are used to assist users in understanding the actions, tasks and goals which they hope to achieve through interaction with the interface of a computer system (D.C. Neale & Carroll, 1997).

> Metaphors allow the transference or *mapping* of knowledge from a *source domain* (familiar area of knowledge) to a *target domain* (unfamiliar area or situation), enabling humans to use specific prior knowledge and experience for understanding and behaving in situations that are novel or unfamiliar (D.C. Neale & Carroll, 1997, p. 441) [italics original]

The use of a metaphor as a conceptual model benefits the user in two ways. Firstly, a metaphor can enable the expectations of a user to be visualised, and secondly, it facilitates the prediction of system behaviour (D.C. Neale & Carroll, 1997). However, it has been suggested that use of metaphors may be counterproductive, particularly if the metaphor which is used is not an appropriate fit (Berg, 2000). For example, metaphors are commonly used in the design phase of web-based environments, in order to facilitate understanding of website structure and information retrieval (Vora, 1998). However, if a metaphor is not universally understood by users, then confusion can occur. There was a concern in this study that children with autism would have difficulty in understanding use of metaphors as a conceptual model, due to difficulties relating to social communication (section 2.2.1.2). Therefore, care was taken to use a structure that was familiar to the children.

6.3.3.3 Techniques for demonstrating the interface design

Three techniques used in this study to demonstrate the timetable system interface design to the users are now discussed. These are paper models, storyboarding, and prototyping.

Paper models

A paper model is a form of conceptual model and is a technique frequently used by system designers to assist with demonstration and discussion of a user's mental model of a system. A paper model (Appendix 30) of the proposed timetable system was created at an early point in the system development stage and presented to members of the educational team, in order to enable them to visualise the form an interactive timetable might take and to encourage discussion.

Storyboarding

Storyboarding is the "graphical depiction of the outward appearance of the intended system" (Dix et al., 1998, p. 208). Storyboarding is a technique for presenting design ideas at an early stage of the system design process (Faulkner, 1998). Storyboarding has several functions: it can be used to present screen mock ups, where elements can be moved around until the user is satisfied with the layout, it can be used to outline navigational progression, and it can enable the designer to check the users' understanding of command dialogues (Faulkner, 1998). During this study, storyboarding was used several times to demonstrate the proposed system (Appendix 31). For example, at an early stage, scale drawings of potential page layouts using A4 paper, were set out on a table in the classroom to demonstrate page layout and navigation steps to participants from the education team. Participants were able to physically move the drawings around the table and this assisted in their understanding of the overall structure of the system. Later, screen shots of the interface were presented in a similar fashion to participants from the education team and these allowed a more realistic view of the timetable to be demonstrated. Storyboarding has the following advantages:

- Easy to move drawings around until happy with layout
- Appears less intimidating than screen versions
- Encourages user involvement
- User more likely to suggest changes
- Low costs
- Effective way of checking early stages of design
- Facilitates discussion between designer and user

(Faulkner, 1998, p.103)

However, storyboarding is not sufficient for demonstrating the functionality of interactive features of a system (Dix et al., 2004). A technique for demonstrating functionality of a system is prototyping.

Prototyping

“A prototype is a preliminary onscreen model of the interactive document … it is a critical developmental tool that translates the storyboard into a partially or fully functional digital document” (Graham, 1999, p. 188). A prototype may be used “to get feedback on the general look and operation of the design as early as possible during development” (England & Finney, 1999, p.349). The purpose of prototyping is to identify the strengths and weaknesses of a system and it can be used to test:

- Content organisation and presentation
- Functionality and usability of interactive controls and navigation
- Media integration into the interface
- How well the layout design works on multiple screens with different elements

(Graham, 1999)

Prototyping is essentially an iterative process and can involve the development of several prototypes in order to see how much time is needed to produce the final version, as well as the technologies required (Graham, 1999). During this study for example, three prototypes were developed. The first was developed using Hypertext Markup Language (HTML) and was used generally to demonstrate interface design features and to facilitate usability testing by users. The second prototype was developed using Extensible HyperText Markup Language (XHTML), a successor of HTML, also used for publishing hypertext on the World Wide Web (Cowell, 2003). XHTML was considered to offer increased compatibility with different web browsers and allow support for new technologies such as wireless devices (Cowell, 2003). The third prototype was developed using Active Server Pages (ASP), so that dynamic features and a database could be introduced. Generally, "a prototype should include a representative sample of every interface element that will eventually be used in the final interactive document" (Graham, 1999, p. 189). Prototypes developed for this study provided examples of elements including images, icons, navigation bars, text, and graphics. In addition, examples of interactive features such as forms were included. This allowed users to evaluate these elements and to identify potential problems with any of these, as demonstrated in the findings (section 7.4.1.2).

It is important that the same authoring tools and delivery platforms which will be used for the final version of a system should be used for prototype development, as this will enable problems with these to be identified at an early stage (Graham, 1999). Once a prototype is ready, then usability testing can take place.

6.3.4 Evaluation

"Evaluation is concerned with gathering data about the usability of a design or product by a specified group of users for a particular activity within a specified environment or work context" (Preece et al., 1994, p.602). Evaluation involves the testing of a system, a piece of software, or interface, in order to assess the relationship between the design and the use of the system. This is to make sure that it is behaving as expected, that it is usable and that ultimately it meets the users' requirements (Benyon, 1990; Dix et al., 2004; Faulkner, 1998; Preece et al., 1994). Without evaluation a system is untried and, therefore, does not reflect the true relationship between a design and its use (Benyon, 1990). Usability is considered to be associated with five attributes: learnability, efficiency, memorability, error making, and satisfaction (Nielsen, 1993). There are generally two objectives to evaluation of an interface; one is to determine the effectiveness or potential effectiveness of an interface in use and the other to provide a means for suggesting improvements (Benyon, 1990). Evaluation occurs within a context which considers and includes:

- The experience level of users
- The types of task being undertaken
- The system being used
- The environment in which the study takes place

(Benyon, 1990; Preece et al., 1994)

These factors are important for designers to consider, as knowledge of these will assist the designer in understanding how the system will be used and so aid design. These were in fact areas which were reviewed in-depth in the literature.

The focus of software evaluation methodologies has changed from validating and measuring systems in order to assess how good or bad something is (Karat, 1997). The focus is now aimed at trying to improve designs and employs an information gathering role to “inform iterative design” (Karat, 1997, p. 689). Generally, there has been a move from a summative to a formative evaluation focus. However, regardless of the type of evaluation, all have some common features: an object, a process and a purpose (Karat, 1997). The purpose of conducting evaluations is to assist the designer in understanding what it is that users want from a product and also to identify any problems the user encounters. Fundamentally, evaluation aids the designer’s understanding of the user’s needs and hopefully results in an improved design (Preece et al., 1994). Evaluations can be used to inform the design of a product, as well as provide indications of how effective the final product is.

> Evaluation should not be thought of as a single phase in the design process (still less as an activity tacked on at the end of the process if time permits). Ideally, evaluation should occur throughout the design life cycle, with the results of the evaluation feeding back into modifications to the design. Clearly it is not usually possible to perform extensive experimental testing continuously throughout the design, but analytic and informal techniques can and should be used (Dix et al., 1998, p. 406).

As mentioned earlier, (sections 5.8.3.1 and 5.8.4) in this current study evaluations were carried out in the setting of the classroom throughout the study and involved both formative and summative evaluation.

6.3.4.1 Styles of evaluation

"The type of evaluation which is appropriate depends on the time at which the evaluation is conducted and the use that is to be made of the information collected" Karat, 1997, p. 695). As mentioned earlier, evaluations conducted during the development stage are referred to as being formative and tend to assess specific details of the interface design, so that improvements can be made (Karat, 1997). For example, early evaluations in the current study led to changes being made to the design of navigation icons.

Evaluations conducted at the end of development are concerned with more general aspects (Karat, 1997). These evaluations are typically focused on highlighting difficulties users have (Preece et al., 1994). Assessments can be analytical, for example evaluating tasks and goals through a formal pencil and paper walkthrough technique, or empirical, "assessing user performance in relation to the proposed system" (Faulkner, 1998, p.113). For example, in the current study an assessment was carried out at the later stages to see if there was any association between the children's use of the interactive timetable and a reduction in uncertainty as manifest by lower levels of anxiety related behaviour.

6.3.4.2 Evaluation methods

There are several categories of evaluation methods and these include the following:

- Observing and monitoring usage
- Collecting users' opinions
- Experiments and benchmarking
- Interpretive evaluation
- Predictive evaluation

(Preece et al., 1994, p.609)

Observing and monitoring usage

Observations and monitoring may be formal and take place in a laboratory, or informal and take place in the field (Benyon, 1990; Karat, 1997). Frequently this form of evaluation is carried out from an ethnographical perspective to try to understand "how users themselves interact with technology in natural settings" (Preece et al., 1994, p.610). Techniques employed for this approach include direct observation, video observation, keystroke logging, and interaction logging (Benyon, 1990; Preece et al., 1994). Software logging has the advantage of being an unobtrusive technique, having no affect on the user's performance, although there are privacy concerns and users should be informed if this method is to be used (Nielsen, 1993). Data obtained from logging are more easily quantified and so are typically used for quantitative analysis (Karat, 1997). For this current study direct observation techniques were employed to observe users interacting with the timetable system and whilst analysis was mostly qualitative, some quantitative data were obtained.

Collecting users' opinions

Techniques for collecting opinions include surveys, questionnaires, focus groups, and interviews. These are considered useful ways to gather opinions and views on what users like and dislike about a system (Benyon, 1990; Karat, 1997; Nielsen, 1993; Preece et al., 1994). These are indirect methods of studying usability, as they do not assess the interface directly; rather these gather subjective data relating to users' opinions (Nielsen, 1993). However, these methods are useful for measuring user satisfaction (Nielsen, 1993). Questionnaire and interview techniques were used in this current study and were discussed in detail previously (sections 5.7.3 and 5.7.4).

Experiments

Two approaches to experimentation on a new system are comparative experiments in relation to an existing system and absolute experiments, where the new system is tested in isolation (Faulkner, 1998). Experimental evaluation is a controlled evaluation, "usually, the number of factors studied is deliberately limited so that causal relationships can be clearly established" (Benyon, 1990, p.117). This is acknowledged to be a difficult method of evaluation, requiring all but the variables of interest to be controlled. Generally, experiments provide "empirical evidence to support a particular claim or hypothesis" (Dix et al., 1998, p. 416). Experiments are a more formal approach to evaluation and have a tendency to be more costly, requiring experienced administrators and controlled environments (Faulkner, 1998). This form of evaluation was considered to be not suitable for the current study, where it was not possible to control the environment.

Interpretive evaluation

Interpretive evaluation approaches enable designers to "understand better how users use systems in their natural environments and how the use of these systems integrates with other activities" (Preece et al., 1994, p.610). Naturalistic and informal methods are used to collect data, in order to cause as little disturbance to the user as possible and it is quite common for some form of user participation to take place (Preece et al., 1994). Methods include participative evaluation and contextual evaluation, methods devised particularly for HCI and ethnography (Preece et al., 1994). The current study used participative evaluation methods at several stages of the study (sections 5.8.3.1 and 5.8.4.2).

Predictive evaluation

This is concerned with predicting user performance through help of formal or semi-formal interface descriptions. “The aim of this kind of evaluation is to predict the kind of problems that users will encounter when using a system without actually testing the system with the users” (Preece et al., 1994, p.611). Experts may be invited to review a user interface, with a task analysis and a user interface definition, in order to identify usability problems (Virzi, 1997). For example, expert evaluations were carried out in later stages of this study. Predictive evaluations can be carried out at an early stage. This type of evaluation can be time-consuming and may require a specialist psychological knowledge to perform (Benyon, 1990).

6.3.5 Implementation

Implementation is the stage when the physical system is constructed (Avison & Shah, 1997) and becomes operational. In some instances it is the stage where a system is filled with a complete set of data, which can be a very labour intensive and time consuming phase (Avgerou & Cornford, 1993). For web-based systems, it is the stage where content is moved to the web server and where programs and links are checked to ensure everything is working as expected (Vora, 1998). Implementation is seen as a phase when change will occur and where users come to terms with the changes a system will bring (Avgerou & Cornford, 1993; Eason, 1997). User involvement during earlier stages of the system design will have assisted in making this stage easier by encouraging acceptance and reducing resistance to change. User training is important at this stage, particularly for those who will be running and administering the system (Avgerou & Cornford, 1993). During the current study, implementation of the interactive timetable was limited. Although the system was operational, there were technical difficulties and the ability to update and upload materials was not possible for anyone other than the researcher.

6.3.6 Review and maintenance

Review of a system typically takes place some time after a system has been operational, once users have become familiar with the system (Avison & Shah, 1997). This form of review may involve monitoring usage of the system by looking at the busiest times of use and numbers of user requests, and is important for identifying problems related to usage (Vora, 1998). A review of this nature was not carried out in the current study, as the timetable system was only used for the duration of the study. However, a concern in the current study was that this form of review was not likely to be something which the members of the education team would be able to undertake. Therefore, it was considered that it would be necessary to identify a person within the education environment, such as an information technology (IT) specialist, who would be prepared to undertake this future role.

It was recognised that maintenance of content would need to be carried out daily for the timetable system and this was perceived to be a task which the teacher would be most likely to fulfil. Maintenance is necessary to ensure a system continues to run smoothly and efficiently. In addition to maintaining and updating content, three types of maintenance may be required: corrective, adaptive, and perfective maintenance (Avgerou & Cornford, 1993).

Corrective maintenance

Corrective maintenance is concerned with dealing with errors. Whilst every effort should be made to check for errors during development, errors may appear once a system becomes operational (Avgerou & Cornford, 1993; Vora, 1998). Users may report errors, but it would usually be the system designer’s role to rectify these, unless of course errors related to content which was maintained by the system users.

Adaptive maintenance

This form of maintenance considers system changes, which might be necessary to meet user needs or organisational requirements as changes occur (Avgerou & Cornford, 1993; Vora, 1998). For example, in the current study, the system might need to be adapted if curricular changes were introduced.

Perfective maintenance

Once users have been working with a system for a while, new features or functions which would enhance the system may be requested (Avgerou & Cornford, 1993). For example, new technologies may become available (Vora, 1998). This type of maintenance would most likely be carried out by the system developer, or by a user who had the technical ability to carry out this task. For example, in the current study an IT specialist within the school might be happy to take on the role of such maintenance.

6.4 The system architecture

This section sets out the design structure for the interactive timetable.

6.4.1 System development environment

As mentioned earlier (section 6.3.3.3), the prototype, interactive timetable was developed using Extensible HyperText Markup Language (XHTML). The dynamic nature of the application was produced through the use of Active Server Pages (ASP) and connection to a back-end Microsoft Access database. Several authoring tools were considered for the development environment. These included Notepad, where HTML could be written from basics, as well as Microsoft FrontPage and Macromedia Dreamweaver, which are commercially available HTML editors for designing, coding, and developing web applications. These tools enable code to be generated in a WYSIWYG environment, facilitating ease of use. Macromedia Dreamweaver was chosen as a development environment, due to the researcher’s familiarity with this tool and the concern of time constraints should a new authoring environment be required to be learnt.

Temporary web space (Jimmy server, QMUC) was set up and prototype version 1 was uploaded in week 58. Server space was later set up in a more permanent area and prototype version 2 was uploaded in week 67 (CT server, QMUC). Prototype version 3 was later uploaded to this web space also. A disk with an HTML version of the prototype, interactive timetable application accompanies this thesis.

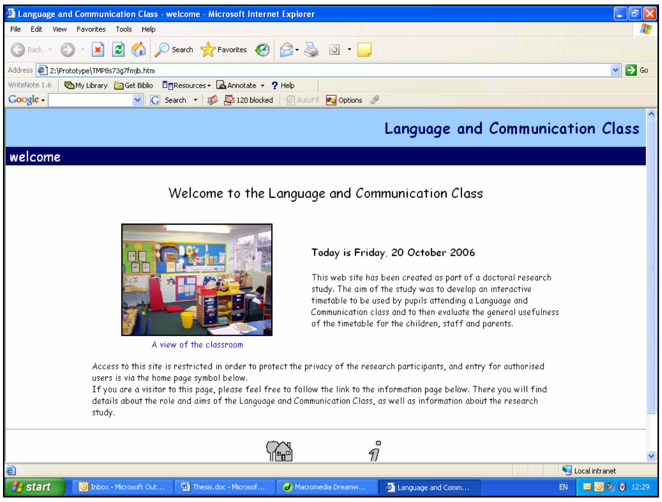
6.4.2 System structure

The structure of the system progressed as shown in Appendix 32. The structure which was finally implemented consisted of the following areas: an entry page (‘welcome’ page), a security login page, a ‘home’ page, individual timetable pages, a class timetable area, a speech and language therapy area, a parents’ area, and a visitors’ page. These areas are now discussed.

6.4.2.1 Entry page

The entry page was to be the main entry point to the interactive timetable system on the web. It was recognised that access would need to be restricted to participants and so a security login was set up. Originally the entry page was developed to include a photograph of the members of the educational team standing outside the entrance to the language unit. This was so that the children would be presented with a familiar image. However, it was recognised that anonymity needed to be maintained for the purpose of this study and so the photograph was, therefore, changed to an internal view of the classroom, something which the children would still recognise as being familiar. The original designs also had the name of the school on the entry page, but these were later removed to protect the location of the school and a general page header was used instead. These earlier screen shots can not, therefore, be demonstrated due to the inclusion of names.

The entry page later became known as the ‘welcome page’. A brief statement outlining the purpose of the timetable application was included on this page and there were two navigational links at the bottom of the page; one link was to the home page and the other to a page for visitors. A piece of JavaScript code was set up on this page to enable the day and date to display automatically. Figure 6.2 illustrates the final version of the entry page interface.



Language and Communication Class

welcome

Welcome to the Language and Communication Class

A view of the classroom

Today is Friday, 20 October 2006

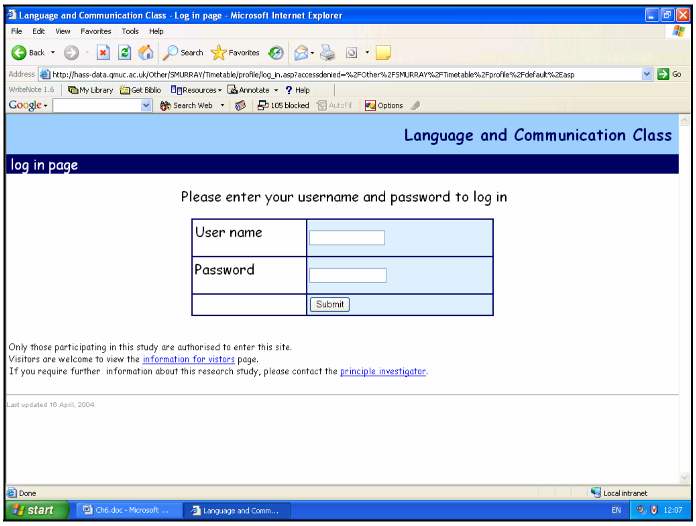
This web site has been created as part of a doctoral research study. The aim of the study was to develop an interactive timetable to be used by pupils attending a Language and Communication class and to then evaluate the general usefulness of the timetable for the children, staff and parents.

Access to this site is restricted in order to protect the privacy of the research participants, and entry for authorised users is via the home page symbol below.
If you are a visitor to this page, please feel free to follow the link to the information page below. There you will find details about the role and aims of the Language and Communication Class, as well as information about the research study.

Figure 6.2: Final version of the timetable entry page interface

6.4.2.2 Login page

A login page was introduced in order to deter anyone other than participants from accessing the timetable application. Parents and staff members were provided with written details of the structure of the timetable application and were also issued with usernames, passwords, and instructions of how to login (Appendix 33). The process of setting up the user login page was complicated and protracted. Server permissions that were in place on the QMUC server meant that several options needed to be reviewed (Appendix 34). Eventually a script was created using ASP and server behaviours were added to the login page. To enable the process to function a Data Source Name (DSN) was required to be set up on the server by the server administrator so that Open DataBase Connectivity (ODBC) could be used to connect with the Access database, where user profiles were stored. Figure 6.3 illustrates the login page interface.



Language and Communication Class

log in page

Please enter your username and password to log in

User name

Password

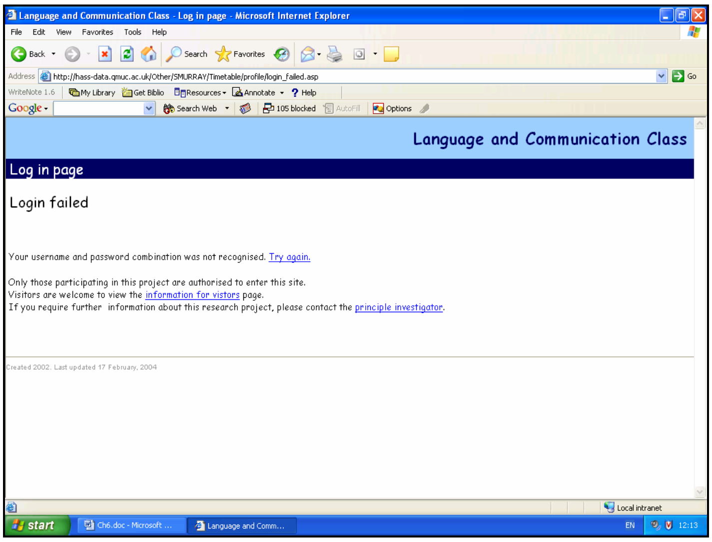
Submit

Only those participating in this study are authorised to enter this site.
Visitors are welcome to view the information for vistors page.
If you require further information about this research study, please contact the principle investigator.

Last updated 16 April, 2004

Figure 6.3: The user login interface

A login failed page was created in event of users' mistyping or making an error. This page offered an option for the user to retry, for those unauthorised to view a visitors' page, and for those requiring assistance an email address for the administrator was provided. Figure 6.4 demonstrates the login failed interface.



Language and Communication Class

Log in page

Login failed

Your username and password combination was not recognised. Try again.

Only those participating in this project are authorised to enter this site.
Visitors are welcome to view the information for vistors page.
If you require further information about this research project, please contact the principle investigator.

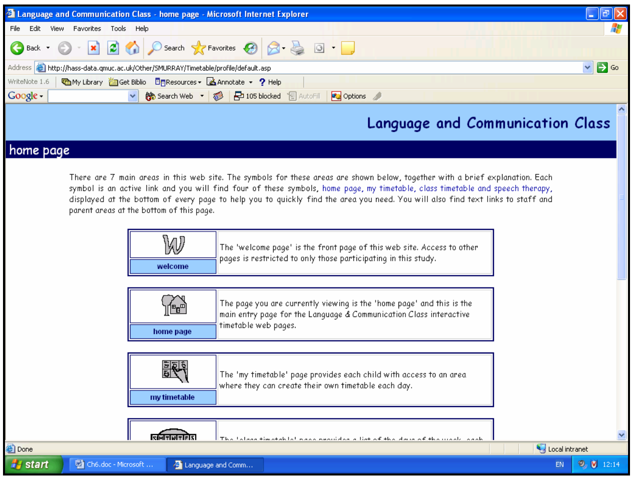
Created 2002. Last updated 17 February, 2004

Figure 6.4: The login failed interface

It was decided to restrict the children's access to four main areas in order to try and keep them focused on their tasks and to lessen distractions. These areas were the home page, 'my timetable' area, class timetable area, and the speech and language therapy area. Restrictions were set up using the login script.

6.4.2.3 Home page

The home page provided an introduction to each of the main areas of the timetable site, so was seen to have a purely functional purpose. The areas were set out in list format moving from top to bottom in order of hierarchy. A hypertext link with an image for each area was set out to the left side of the page. A text description was provided beneath the image and alternative text was included in the page code, to enable a description of the purpose of the image to appear when the cursor was held over it. A brief description of the purpose of each area was included beside the image. Four of the images (home page, 'my timetable', class timetable, and speech and language therapy) were used as navigation icons at the foot of every page. Other areas described on the home page included a parents' page and a visitors' page. Figure 6.5 illustrates the home page interface.



Language and Communication Class

home page

There are 7 main areas in this web site. The symbols for these areas are shown below, together with a brief explanation. Each symbol is an active link and you will find four of these symbols, home page, my timetable, class timetable and speech therapy, displayed at the bottom of every page to help you to quickly find the area you need. You will also find text links to staff and parent areas at the bottom of this page.

welcome	The 'welcome page' is the front page of this web site. Access to other pages is restricted to only those participating in this study.
home page	The page you are currently viewing is the 'home page' and this is the main entry page for the Language & Communication Class interactive timetable web pages.
my timetable	The 'my timetable' page provides each child with access to an area where they can create their own timetable each day.

Figure 6.5: The home page interface

6.4.2.4 'My timetable' entry page

The entry page to the 'my timetable' area was set up very simply. It had a favourite symbol for each of the four children participating at this stage and the child's name set beside the symbol. These were arranged in list format moving down the page as illustrated in figure 6.6 (the names have been airbrushed out of the coloured images in figure 6.6).

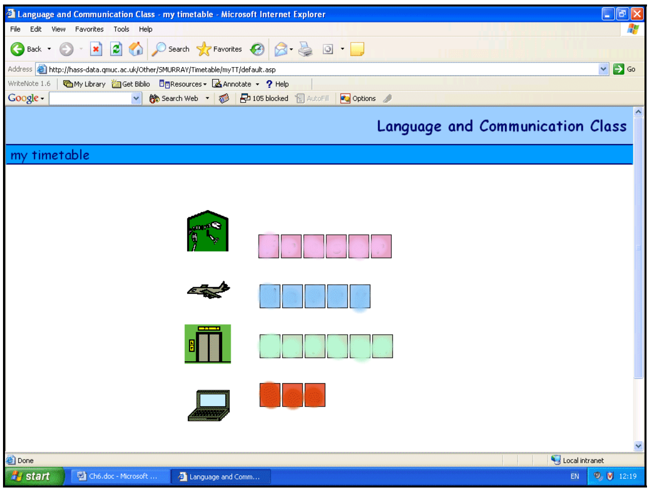
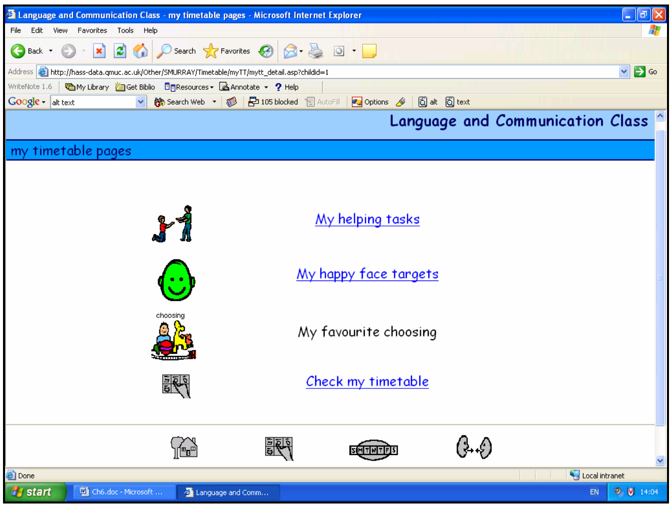


Figure 6.6: 'my timetable' entry page interface

Both the symbols and the name images were hypertext links and either could be used to take the child to their own area, referred to as 'my timetable pages'. This area is demonstrated in figure 6.7. At this stage all the links were directed to the same area, but it would be possible to set up different areas for different children, to reflect varying needs. It was also possible for a child to select another child's name and follow this link, although only one child was noted to do this during the observation studies. In practice, restrictions would be set up to prevent a child from accessing another child's area. The 'my timetable pages' interface was intended to provide links to specific activities; similar to those which took place in the classroom each day. Three areas were active on implementation: 'my helping tasks', 'my happy face targets' and 'check my timetable'. These are now briefly reviewed.



Language and Communication Class

my timetable pages

My helping tasks

My happy face targets

choosing

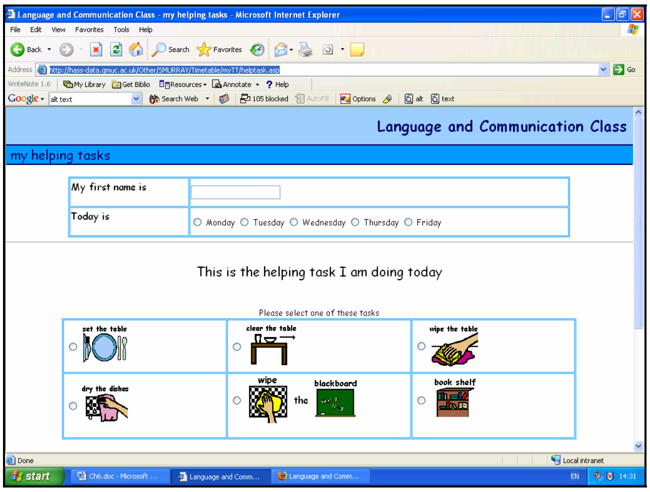
My favourite choosing

Check my timetable

Figure 6.7: ‘my timetable pages’ interface

‘My helping tasks’

This page was set up using a form and invited the child to type in their name, to select the correct day from the days listed, and to then select the task which they had been allocated for that particular day from those illustrated. Figures 6.8 and 6.9 demonstrate the top and lower parts of the page. The child was then required to select a button labelled ‘go to next page’ (figure 6.9), in order to send the form and to view the response. At the bottom of the page symbols for ‘tidy up’ and ‘happy faces’ were included to provide reminders for the child.



Language and Communication Class

my helping tasks

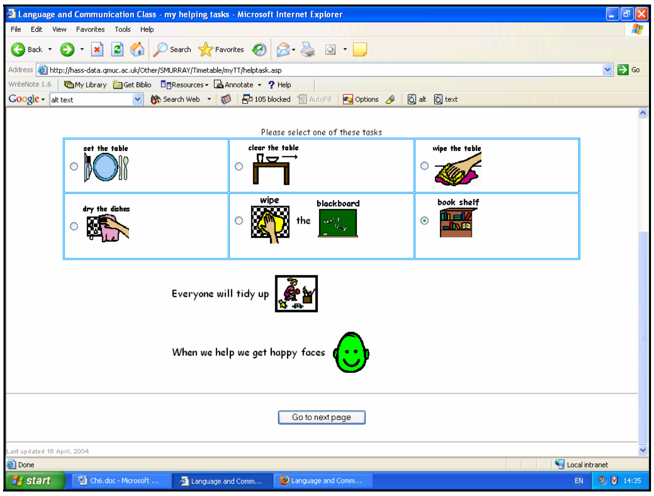
My first name is	
Today is	○ Monday ○ Tuesday ○ Wednesday ○ Thursday ○ Friday

This is the helping task I am doing today

Please select one of these tasks

○ set the table	○ clear the table	○ wipe the table
○ dry the dishes	○ wipe the blackboard	○ book shelf

Figure 6.8: Top part of 'my helping tasks' form



Please select one of these tasks

○ set the table	○ clear the table	○ wipe the table
○ dry the dishes	○ wipe the blackboard	● book shelf

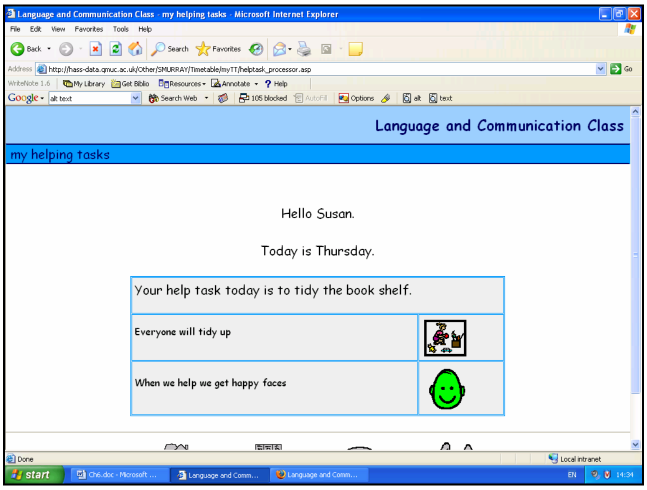
Everyone will tidy up

When we help we get happy faces

Last updated 16 April, 2004

Figure 6.9: Lower part of 'my helping tasks' form

Selecting the 'go to next page' button caused the form to be sent and the child was then taken to a response page. Figure 6.10 illustrates an example response. During participant observation sessions the children were encouraged to print a copy of the response page, illustrating their selections.



Language and Communication Class

my helping tasks

Hello Susan.

Today is Thursday.

Your help task today is to tidy the book shelf.

Everyone will tidy up

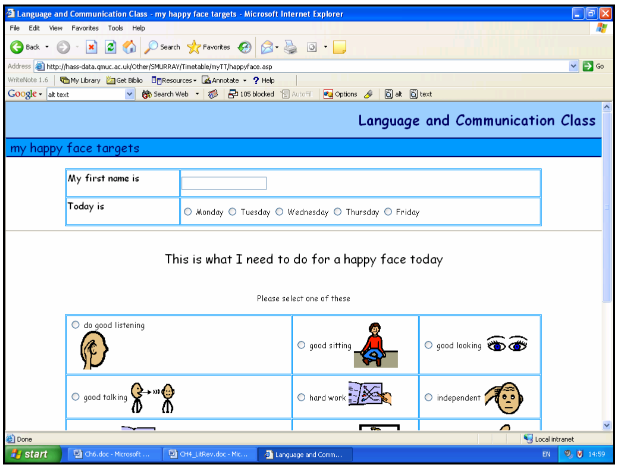
When we help we get happy faces

Figure 6.10: Example response for ‘my helping tasks’ form

Forms are a method of interaction used mainly for data entry, when several different categories of data are required to be inputted by the keyboard (Preece et al., 1994). A form was chosen as a method of interaction for this task as it was considered a style which was easy to learn and to use, and suitable for all user types (Dix et al., 2004; Sutcliffe, 1988). A form can be designed to take up a full computer screen, or appear as a pop-up (Faulkner, 1998). In this case it took up the whole screen, to encourage the children to remain focused on the task. Essentially a form is a means of allowing the user to enter the same type of data repeatedly, as well as enabling the user to enter the data in the correct position on the page. As a rule, the order the task is carried out in is unimportant when using forms (Faulkner, 1998). Using this style of interaction can help the user to feel in control, as all the information is visible and resembles paper-filling tasks, which many users are familiar with (Shneiderman, 1992; Shneiderman & Plaisant, 2005). In this example, the form used symbols from Boardmaker™ which the children were familiar with.

‘My happy face targets’

This task was also set up using a form and invited the child to complete the form in the same way as the previous page, beginning with typing in their name and selecting the correct day (figure 6.11).



Language and Communication Class

my happy face targets

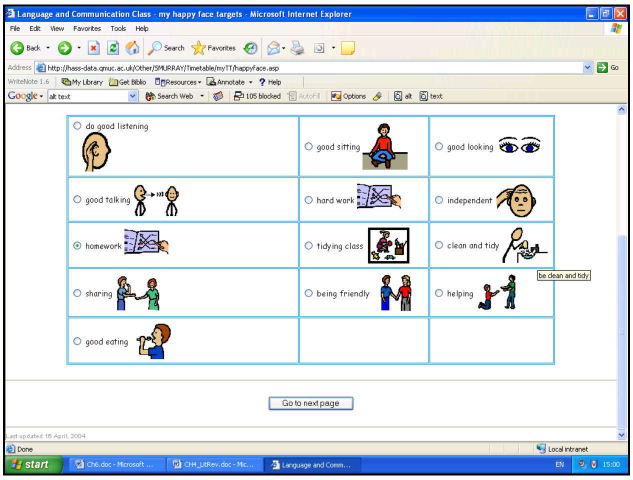
My first name is	
Today is	○ Monday ○ Tuesday ○ Wednesday ○ Thursday ○ Friday

This is what I need to do for a happy face today

Please select one of these

○ do good listening	○ good sitting	○ good looking
○ good talking	○ hard work	○ independent

Figure 6.11: Top part of 'my happy face targets' form

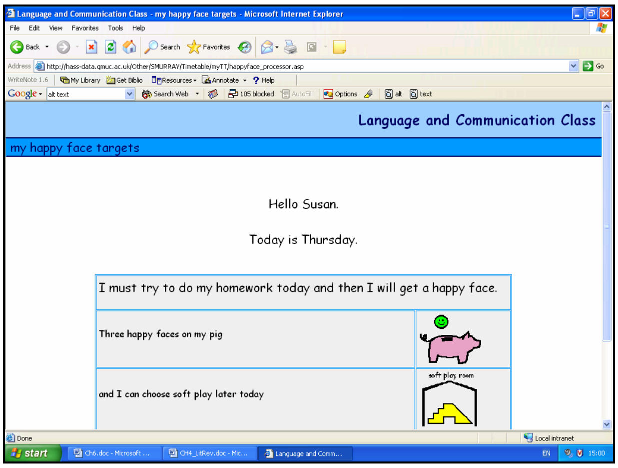


○ do good listening	○ good sitting	○ good looking
○ good talking	○ hard work	○ independent
● homework	○ tidying class	○ clean and tidy
○ sharing	○ being friendly	○ helping
○ good eating		

Last updated 16 April, 2004

Figure 6.12: Lower part of 'my happy face targets' form

The child was invited to select one of the target behaviours which they had been advised by the teacher to fulfil that day (figure 6.12). The child was again required to select the 'go to next page' button in order to send the form and to view the response (figure 6.13).



Language and Communication Class

my happy face targets

Hello Susan.

Today is Thursday.

I must try to do my homework today and then I will get a happy face.

Three happy faces on my pig

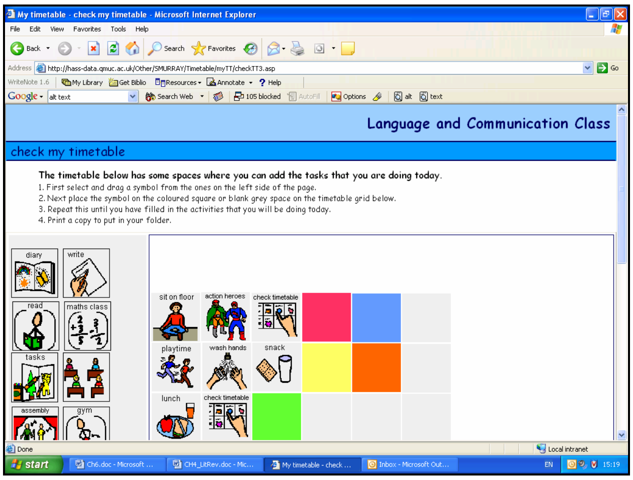
and I can choose soft play later today

Figure 6.13: Example response for 'my happy face targets' form

Several problems became apparent with these two pages. One issue was that only one item could be selected from the tasks and one from the behaviours. This was a problem; on some days a child might be allocated two helping tasks and might also have two or three behaviour targets to meet. A second issue was that it was not possible at this stage of development to save the settings of the page. This meant that the child's responses would have been reset to the default if he returned during another session later in the day; there would be no record of the responses selected earlier to act as a reminder. It was, however, possible to print the pages (on most occasions) and so this was used as an alternative method for keeping a copy for the child at this time.

'Check my timetable' page

This page was set up to allow the children to create their own individual timetable. A grid format was used on the middle section of the page and the children were to click and drag symbols from those stored on the left of the page. Colour squares were created to indicate 'coloured ball' session times, to assist the child in recognising the structure of the day. Coloured ball sessions were periods when the timetable varied for each individual so that, for example, one child might have reading and another maths. To develop this page the Boardmaker symbols had to be reduced in size and a technique known as layering was used to enable images to be moved around the screen. There were problems noted with using this interface during observation sessions with the children. To begin with, the effect of clicking and dragging was only possible if the browser Internet Explorer was used. In addition, it was observed that when this activity was performed using the classroom iMac, a series of lines appeared on the screen as the image was being dragged. This caused a distraction for several of the children and one in particular spent several minutes playing with the images to create this effect. Figure 6.14 demonstrates this interface, whilst figure 6.15 illustrates an example of a completed timetable.



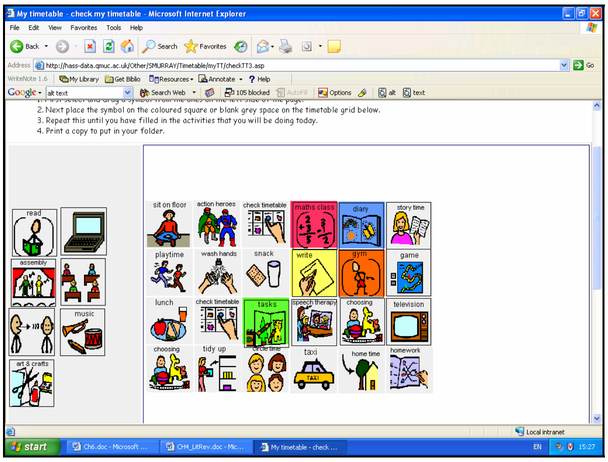
Language and Communication Class

check my timetable

The timetable below has some spaces where you can add the tasks that you are doing today.

1. First select and drag a symbol from the ones on the left side of the page.
2. Next place the symbol on the coloured square or blank grey space on the timetable grid below.
3. Repeat this until you have filled in the activities that you will be doing today.
4. Print a copy to put in your folder.

Figure 6.14: Top part of 'check my timetable' interface

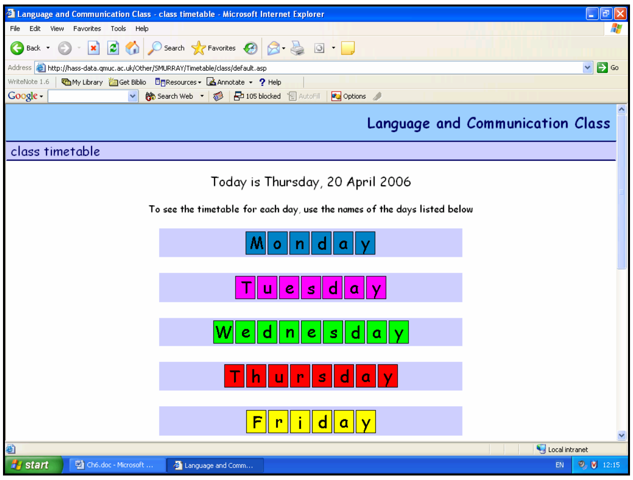


2. Next place the symbol on the coloured square or blank grey space on the timetable grid below.
3. Repeat this until you have filled in the activities that you will be doing today.
4. Print a copy to put in your folder.

Figure 6.15: Example of a completed timetable

6.4.2.5 Class timetable entry page

The interface for the class timetable area presented the days of the week in list format, moving from top to bottom in hierarchical order. Images were created for the names of the days. Originally these had been created using capital letters, but discussion with the educational team had stressed the importance of presenting the names of the days as they would normally be written, in order to maintain familiarity and to continue to teach literacy skills. Images had originally been created using a single colour, but there had been a request to enable the names to be differentiated by using different colours. Finding colours which did not clash and which displayed well on the screen was a difficult task. Figures 6.16 and 6.17 demonstrate the class timetable entry page interface. Each image was a hypertext link, which the user could use to move to the appropriate day. This page also included the day and date at the top of the page, which changed automatically due to a piece of JavaScript in the page code. Saturday and Sunday were included in the list of days and it was intended to provide an area on these pages where the children could write about what they had done on those days, although this was not accomplished during the study.



Language and Communication Class - class timetable - Microsoft Internet Explorer

Address http://hass-data.qmuc.ac.uk/Other/SMURRAY/Timetable/class/default.asp

Language and Communication Class

class timetable

Today is Thursday, 20 April 2006

To see the timetable for each day, use the names of the days listed below

Monday

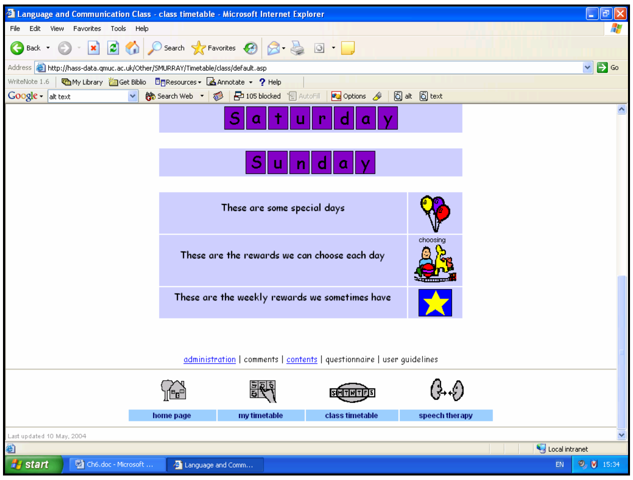
Tuesday

Wednesday

Thursday

Friday

Figure 6.16: Top part of ‘class timetable’ entry page interface



Saturday

Sunday

These are some special days

These are the rewards we can choose each day

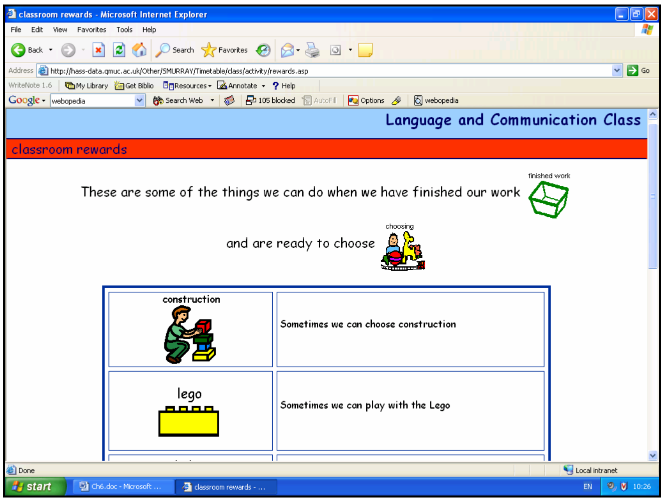
These are the weekly rewards we sometimes have

administration | comments | contents | questionnaire | user guidelines

Last updated 10 May, 2004

Figure 6.17: Lower part of ‘class timetable’ entry page interface

At the foot of the class timetable entry page there were also symbols for special days, choosing rewards, and weekly rewards. These were hypertext links to pages which set out information about these items. Figure 6.18 illustrates an example of what was set out on the classroom rewards page.



Language and Communication Class

classroom rewards

These are some of the things we can do when we have finished our work

and are ready to choose

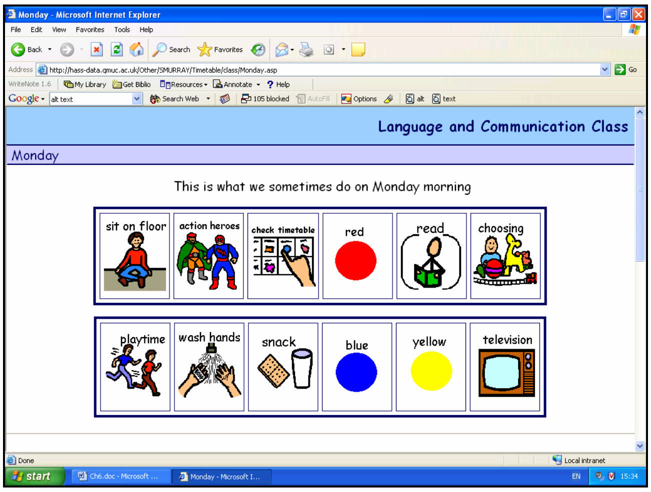
Sometimes we can choose construction

Sometimes we can play with the Lego

Figure 6.18: Classroom rewards (choosing) examples

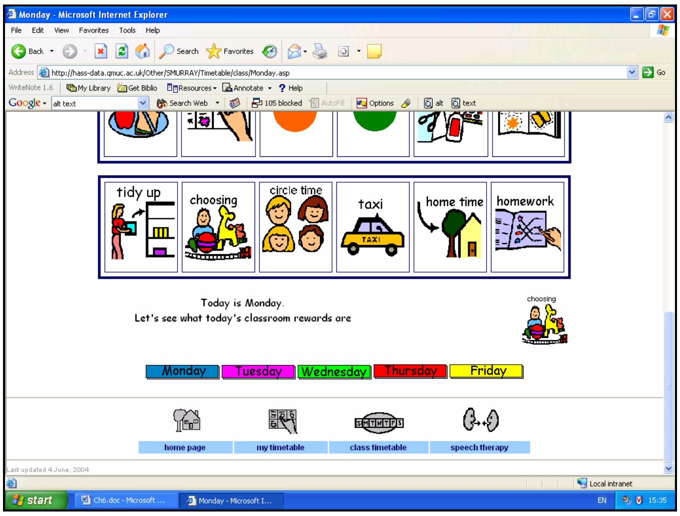
‘Monday’ page

An example of a day of the week is illustrated in figures 6.19 and 6.20. This demonstrates the ‘Monday’ page. It was a difficult task to accommodate the daily timetable on the screen. In the classroom situation the timetable is set out in one long row, moving from left to right as is the cultural convention in the UK. To display the timetable in this way on the computer screen would have required the symbols to have been very small, or for the user to scroll considerably from left to right. Both of these options were considered impractical and so as a compromise it can be seen that the timetable was set out in four rows. The page was developed so that the symbols were of a reasonable size, but would fit in an average size screen without scrolling from left to right.



This is what we sometimes do on Monday morning

Figure 6.19: Top part of 'Monday' page

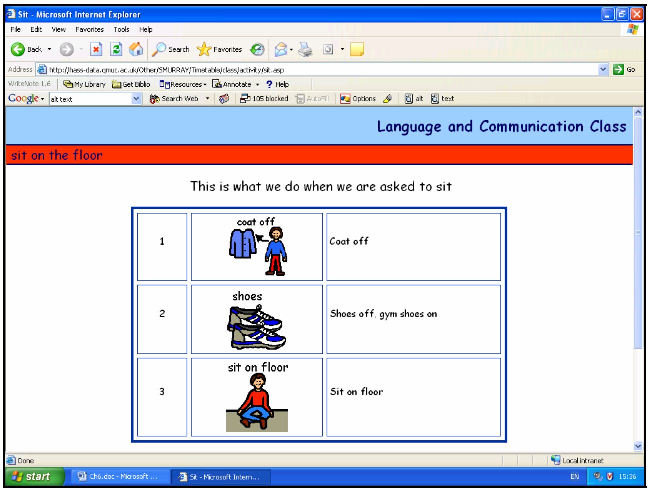


Today is Monday.
Let's see what today's classroom rewards are

Last updated 4 June, 2004

Figure 6.20: Lower part of 'Monday' page

At the foot of the page were two sets of navigation links and these are discussed later (section 6.4.3). Several of the symbols on the timetable pages were set up to be hypertext links to further pages where a breakdown of a particular activity was presented. For example, figure 6.21 illustrates a breakdown of the activity, which a child would be able to see if he followed the link from the ‘sit on floor’ symbol (top row, first on left in figure 6.19). The teacher had provided details of how to set these breakdowns out, including numbering the steps involved and using familiar symbols, as well as simple text. There were ten activity pages set up in this way: sit on floor, action heroes, red ball time, blue ball time, yellow ball time, green ball time, orange ball time, lunch time, playtime, and trips.



Language and Communication Class

sit on the floor

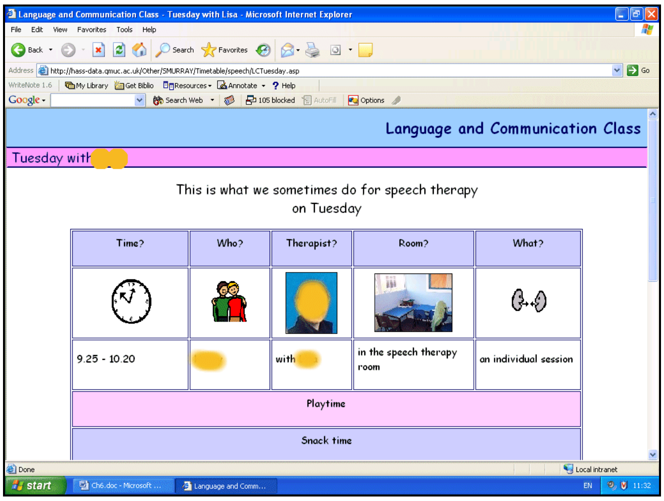
This is what we do when we are asked to sit

1	coat off	Coat off
2	shoes	Shoes off, gym shoes on
3	sit on floor	Sit on floor

Figure 6.21: Example of a breakdown of ‘sit on floor’ activity

6.4.2.6 Speech and language therapy area

An area was set up within the application for speech and language therapy (SLT) information. The entry page contained general information about the SLT provision within the unit and presented photographs of the two therapists. Unfortunately this page cannot be demonstrated here because of this fact. However, figures 6.22 and 6.23 illustrate an area reached via the entry page, which sets out sessions for one of the therapists (names and a photograph have been airbrushed to protect identities). Information presented here was very basic and included details of session times, the children involved, the therapist taking the session, the room the session was to take place in, and the format the session was to take.



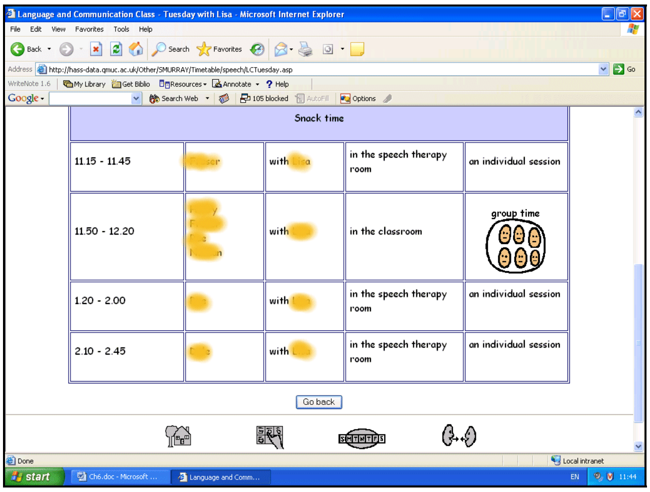
Language and Communication Class

Tuesday with [redacted]

This is what we sometimes do for speech therapy on Tuesday

Time?	Who?	Therapist?	Room?	What?
9.25 - 10.20	[redacted]	with [redacted]	in the speech therapy room	an individual session
Playtime				
Snack time				

Figure 6.22: Top part of Tuesday page for SLT information

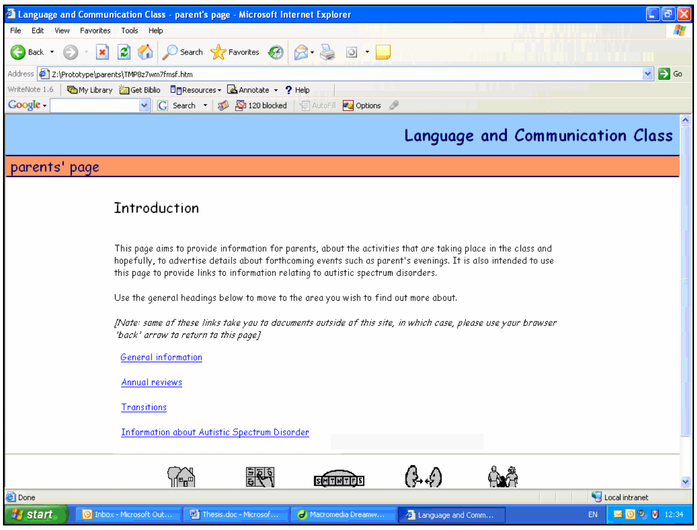


Snack time				
11.15 - 11.45	[redacted]	with [redacted]	in the speech therapy room	an individual session
11.50 - 12.20	[redacted]	with [redacted]	in the classroom	group time
1.20 - 2.00	[redacted]	with [redacted]	in the speech therapy room	an individual session
2.10 - 2.45	[redacted]	with [redacted]	in the speech therapy room	an individual session

Figure 6.23: Lower part of Tuesday page for SLT information

6.4.2.7 Parents' area

An area was included within the application where information could be presented for parents. During the current study this area included links to general information about the language unit and school, processes which took place such as annual reviews, and links to web sites where parents could go to find information about autistic spectrum disorder.



Language and Communication Class

parents' page

Introduction

This page aims to provide information for parents, about the activities that are taking place in the class and hopefully, to advertise details about forthcoming events such as parent's evenings. It is also intended to use this page to provide links to information relating to autistic spectrum disorders.

Use the general headings below to move to the area you wish to find out more about.

[Note: some of these links take you to documents outside of this site, in which case, please use your browser 'back' arrow to return to this page]

General information

Annual reviews

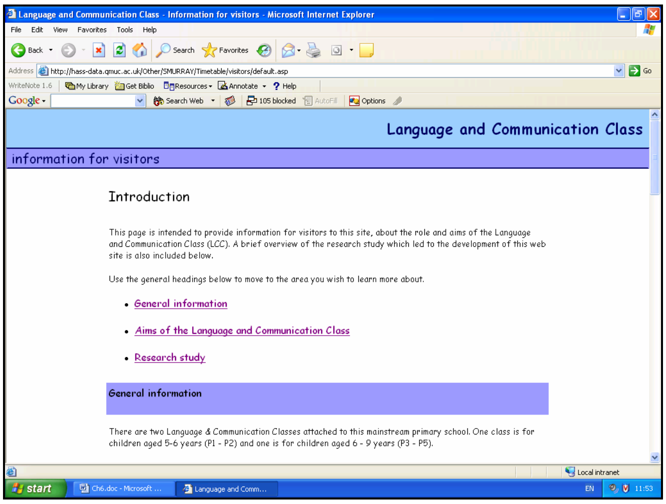
Transitions

Information about Autistic Spectrum Disorder

Figure 6.24: The parents' area interface

6.4.2.8 Information for visitors

An area which could be accessed by any visitors to the site was set up in order to provide general information about the aims of a language unit and to give details of the research study. No personal information or contact details were given out on this page. Figure 6.25 demonstrates the information for visitors interface.



Language and Communication Class

information for visitors

Introduction

This page is intended to provide information for visitors to this site, about the role and aims of the Language and Communication Class (LCC). A brief overview of the research study which led to the development of this web site is also included below.

Use the general headings below to move to the area you wish to learn more about.

- General information
- Aims of the Language and Communication Class
- Research study

General information

There are two Language & Communication Classes attached to this mainstream primary school. One class is for children aged 5-6 years (P1 - P2) and one is for children aged 6 - 9 years (P3 - P5).

Figure 6.25: Information for visitors interface

6.4.3 Navigation

Positioning

Navigation differed from what was the normal standard for web design. Instead of presenting navigation aids in a sidebar at the left hand side of the page, or at the top of a page, navigation aids were located at the foot of the page. This was because this was essentially not a web site, but a web-based application and as such had a specialist set of users. The main reason for choosing to locate navigation features at the foot of the page was related to the presentation of the class timetable. As mentioned earlier, the timetable had been difficult to accommodate and it was recognised that it was important to display the timetable prominently. If navigation features had been incorporated at the left side of the page, then the timetable would have been forced over to the right side, giving it less prominence on the page and making the task of displaying it effectively more difficult. Likewise, if navigation aids had been located at the top of the page, the timetable would have been displayed further down the page, when it was important for it to be the most prominent feature on the page. Therefore, a decision was taken to locate navigation features at the foot of the page, so as not to detract from the importance of the timetable's position on the page. In order to maintain consistency, navigation features were displayed at the foot of the page throughout.

Icons

Selecting navigation aids was a difficult task. Initially text images were designed, but members of the education team preferred that text and symbols be used. A range of images and Boardmaker™ symbols were tried out, but some presented difficulty of understanding for the adult participants and so it was unlikely these would be understood by the children. As discussed earlier (sections 2.2.1.2 and 6.3.3.2), it was unclear whether the children would be able to understand the metaphors implied in many of the symbols investigated. Eventually familiar Boardmaker™ symbols used daily in the classroom environment were identified and used for the navigation icons. The navigation icons were displayed in grey, as there was already an abundance of colour used throughout the application. A text description of the navigation icon was displayed below and alternative text was included in the page source code, to describe the purpose of the navigation image (should images be turned off in the browser).

Additional navigation features

On the class timetable pages, links to the days of the week were also included at the foot of the page above the navigation links. In addition, certain pages (for example, ‘red ball time’, ‘lunchtime’, SLT session pages etc.) had a ‘go back’ button at the foot of the page. This was to enable the user to return to the page which they had just arrived from. Several children were observed to make use of these internal navigation aids during the study.

6.5 Conclusion

This chapter has set out the rationale for a computer-based, interactive timetable. It was determined that such an application might in some way assist children with autism in coping with changes in daily school routine, particularly as such children are reported to be comfortable and skilled at using computers. The framework for the development of the interactive timetable was set out and discussed and it was demonstrated that a framework based on the life cycle approach was followed. The importance of involving users in the design process was highlighted as part of the development framework and it was shown that a user-centred, participative approach was employed during this current study. Techniques used to demonstrate the conceptual design of the interface were discussed and in particular it was shown that paper models, storyboards, and prototypes of the interface were all used within this study. Finally, the system architecture was discussed in some detail and various aspects of the system structure were illustrated. The following chapter now sets out the research findings.

Chapter 7: Research findings

7.1 Introduction

This chapter presents the findings of the various investigations conducted throughout this study. These are set out according to the stages of the research plan as illustrated earlier (section 5.6.4) and are presented mainly as a narrative, reflecting the qualitative context of this study.

7. 2 Stage 1: Preliminary investigations

A brief summary of the findings of the preliminary investigation stage of the study is presented. Findings relate to visits made to educational settings and to preliminary investigations regarding software and systems available for children with autism.

7.2.1 Gathering background information

7.2.1.1 Mainstream setting

An informal visit was made to a language and communication class, which was attached to a mainstream primary school in Scotland. This became the setting for the study. The unit had been operating for two years and there were plans for another class to be added to accommodate older children. The class teacher demonstrated the symbolic timetable, which was made up using Picture Communication Symbols (PCS) from Boardmaker™, attached to a coloured strip of card on the wall (figure.7.1).

Figure 7.1: Example of a symbolic timetable in a mainstream school setting

The teacher illustrated an example of an information resource. This was a ‘passport’ booklet, which was passed on to people who had contact with the children such as transport staff. These booklets provided an overview of each child’s character as well as important points to be aware of regarding the child’s likes, dislikes and behaviour. From this visit the following details were noted:

- Seven children in the class
- All male
- Ages ranged from 5 to 7 years of age
- Diagnosed as being on the autistic spectrum
- Three members of staff (teacher, nursery nurse, speech and language therapist)
- Speech and language therapy room within the unit
- The class followed a TEACCH approach
- The room was set out in clearly structured areas (timetable area, work area, play area)
- Only one computer in the classroom (iMac)
- Computer not used as part of the curricular timetable at this time (the children used it in free choice periods and interacted with educational software)

7.2.1.2 Special education setting

An informal visit was made to a special school, in Scotland, for children with autistic spectrum disorders. This particular school offered both day and residential educational facilities for children aged between 5 and 17 years of age. Children from any location in Scotland could attend this school and boarding facilities were provided during the week, with children returning home at weekends. Class sizes were small; the class visited by the researcher was made up of five children, all male, and ages ranged from 8 to 14 years of age. It was noted that the school worked on the principles of the TEACCH approach. Figure 7.2 demonstrates the timetable used in this particular class. The timetable filled most of one wall and was made up of different sections. These included information relating to tasks, class members and teaching staff, calendar information, weather information, and the events for the day. One feature of particular interest was the use of clock symbols displayed above the daily timetable at various points to indicate time periods of specific activities. This differed from the mainstream setting, where no indication of time periods was given possibly because the children were of a younger age group. Another feature of interest was the use of a black cross, which was placed over an activity if for some reason it was not going to take place.

Figure 7.2: Example of a symbolic timetable in a special school setting

The teacher also demonstrated individual timetables which the children made up each morning. These were plastic cards, approximately A4 size, which could be written on and wiped clean as required. An example is illustrated in figure 7.3. This timetable included space for the individual to insert their name, the day and the date. Symbols or text could be used depending on each individual's ability. At the bottom of the timetable was space for individuals to demonstrate "what I did well in" and "what I need help in". These timetables were pinned to the wall to the right side of the daily timetable. The teacher reported that these were photocopied at the end of the day and the photocopies taken home to the children's parents to provide feedback.

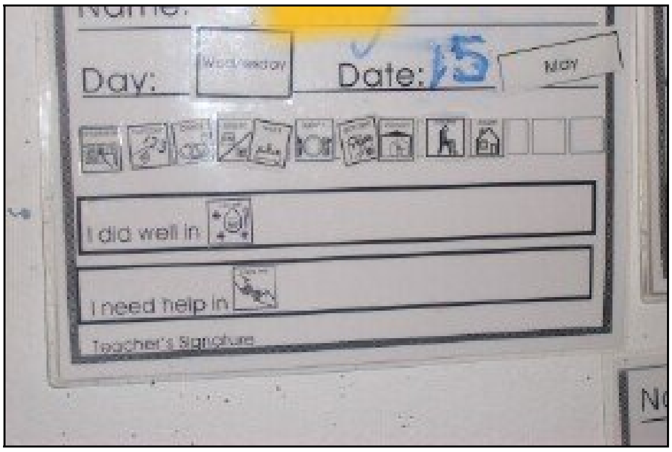


Figure 7.3: Example of an individual timetable in a special school setting

7.2.1.3 Summary

Many similarities were noted between these two settings. In particular both displayed the timetable prominently, used PCS, and communicated information relating to class activities. In both settings class sizes were found to be small. Differences were noted in ways in which the symbolic timetable was used. For example, the specialist setting encouraged pupils to create their own individual timetable to display alongside the class timetable. However, the age group was noted to be older in this class.

7.2.2 Investigating software and systems

A review of software availability for special needs conditions such as autism (Appendix 11) found that although there were many commercially available packages these addressed areas relating to social skills, emotions, literacy, and numeric skills. Only one example of activity scheduling software was identified at this time. This was referred to as Make-A-Schedule and was commercially available from a company known as Do2Learn. This product was essentially a database of picture communication symbols and was available online or could be downloaded, to either a PC or Macintosh computer. The resource provided picture cards and templates for parents and teachers to create story strips and schedules which could be printed out for use at home and in school. This product differed from the interactive timetable developed for this study; the Make-A-Schedule product provided only static symbols and offered no interactive features at this time.

Research in the area of computer-based timetabling was found to be scarce and it was anticipated that software would need to be created for this study. It was considered important to look at software designed specifically for children with special needs in order to gain an idea of particular techniques or issues, as this could prove helpful for the development of the interactive timetable. Examples of research using multimedia software investigated at this time were discussed earlier (section 3.2.4) and a review is presented in Appendix 11.

7.3 Stage 2: Investigating the role and use of a symbolic timetable

This section of the chapter sets out the findings of investigations which were carried out in the mainstream setting during stage two of the study, to examine the existing symbolic timetable. These investigations involved a task analysis and a requirements analysis.

7.3.1 Task analysis findings

The findings of the task analysis are now presented. Investigation methods were discussed earlier (section 5.8.2.1), and comprised non-participant observation studies and semi-structured interviews. As discussed earlier (sections 5.4, 5.6.3.3 and 5.8.2.1) these two methods of data collection were employed so that use of the symbolic timetable could be considered from different perspectives, allowing a more holistic picture of this phenomenon to be gained.

7.3.1.1 Observation studies

This section provides a commentary on the presentation format of the symbolic timetable and sets out key findings of the observation studies.

Presentation format

The symbolic timetable was observed to be displayed very prominently on a wall at the back of the classroom. A coloured card was attached to the wall at approximately child height and activity symbols were secured to the card by the use of Velcro™ or blue tack, in a sequence determined by the class teacher. The timetable appeared to be part of a larger display on the wall, which included the following items:

- Ordered list of the days of the week
- Calendar, with numbers for each day of the month
- Chart for each day of the week with stickers of happy or sad faces
- A picture of a clown juggling three coloured balls, signifying task time
- Silver star, which was used to show who the 'star person' was for each day
- Breakdown of "ball time" on yellow, blue and red cards (orange and green cards introduced in the following school year)
- Additional/occasional items e.g. photographs of visitors to class

Figures 7.4 and 7.5 demonstrate photographs of the symbolic timetable and supporting information at different stages of the study.

Figure 7.4: The daily symbolic timetable and supporting information (week 31)

Figure 7.5: The daily symbolic timetable and supporting information (week 112)

The symbolic timetable consisted of a series of symbols acquired from Boardmaker™, a commercial software product created by Mayer Johnson Company and consisting of Picture Communication Symbols. The class teacher reported that these symbols were widely used at a national level for children with special educational needs, such as autism, and that most of the children in this class (and their families) were familiar with the symbols. Most had been introduced to the symbols from an early age in the context of home and nursery school.

Symbols for use in the classroom were made by the educational team. Appropriate symbols were selected from the software package stored on the class computer. These were printed in colour in a standard size (approximately 2 x 2 inch) and laminated to prolong life. A collection of symbols was stored in a container close to the timetable to be accessible when required.

Times of use

The children arrived at school at around 09:10 a.m., and once they had assembled in front of the timetable, the teacher talked the children through the daily routine using the timetable as a reference. It was noted that on a Monday morning, the children spent approximately 45 minutes sitting in front of the timetable during this first session. This was because the children were encouraged to take turns to report on their weekend activities, prior to writing about these in their diaries. On other days of the week the time spent in front of the timetable at the beginning of the day was generally around 20 to 25 minutes.

The activity known as ‘balloon time’ took place during the first period and was when the ‘star person’ for the day was chosen. The selection of a ‘star person’ appeared to serve two main functions. Firstly, it was seen to be a form of reward, as one of the children was chosen to be a ‘special person’ with certain privileges for that particular day. Secondly, it provided the child with an opportunity to demonstrate his abilities to the teacher and for the teacher to assess progress. The child was required to perform certain tasks as the ‘star person’, one of which involved making up the calendar for the day (figure 7.6). Through carrying out this particular task the child was encouraged to reflect and to demonstrate his knowledge of the days of the week, the numbers of the month and year, and also to be able to decide on what he considered the weather for that day to be.

Figure 7.6: Example of the calendar made up daily by the ‘star person’

The children next assembled beside the timetable as a group immediately after snack time, generally sometime between 11:00 a.m. and 11:15 a.m. This was noted to be for a shorter period of time, around 10 to 15 minutes, and involved the children listening to the teacher reading them a story. After the story, the teacher would refer to the timetable to remind the children of the next activity.

The children assembled beside the timetable as a group again after lunchtime, at around 13:15 p.m. This appeared to be another opportunity to remind the children of the structure of the day, as well as a way of settling down and regrouping the children after their period of unstructured play outside the classroom.

Who uses the symbolic timetable?

Use by members of the educational team

The class teacher and the nursery nurse were both observed to refer to the symbolic timetable on many occasions during the day. References were made verbally by directing the children to look at the timetable. Physical references were also made, with members of the educational team pointing to the timetable, or attaching new symbols and special notes to the timetable. It was noted that the staff members referred to the timetable from any location in the classroom, not just when they were standing beside it. Some examples of references to the symbolic timetable are set out below:

Referring a child to the timetable

When a child became distracted during an activity (story time), the teacher asked him to look at the timetable and to remember what it was he should be doing.

> *Teacher asks child to look at the timetable on the wall and to remember what he is supposed to be doing just now*
> (FV3 lines 132-133)

Information provision

The teacher wrote on a small piece of notepaper additions to the timetable which were not available in the collection of symbols. For example, during a visit to the classroom it was observed that the teacher wrote the researcher’s name on a piece of paper and placed it above the activity nearest to the time of the researcher’s visit.

Improvised symbol for individual child

One child had an obsession with drawing trucks during this particular week of the study. In this instance the teacher wrote "makes book" on a piece of notepaper and added this to the timetable at an appropriate time when the child could indulge in his obsession. This was done to accommodate the child's obsession and to help keep the child focused on the other activities which he was to take part in. The child became upset and began crying when he was not allowed to do his drawings, but once he understood that he would be allowed time later to do this and could see this visually on the timetable, he began to settle down. It was observed that the note for "makes book" was used as an addition to the timetable all week and it was also noted that both the class teacher and the nursery nurse were responsible for moving this symbol along the daily timetable.

> *Child went to the craft table to do drawings of trucks in his book. He was asked to go to the sitting corner, but wanted to continue drawing trucks, so became upset and started crying. Teacher told him that he would have time to do drawing after coloured ball time. She said that she would talk about his book at story time and put it on the timetable to do after coloured ball time. Teacher took a small piece of paper and wrote, "**** makes book" and put it on the timetable after coloured ball time.*
> (FV4 lines 10 -17)

Use by children

The children's reference to the timetable was not as obvious as that of the staff members. It is possible that the researcher was not attuned enough to the children's behaviour to be aware of when they were referencing the timetable discreetly. Examples of occasions when the children were observed to be using the symbolic timetable are illustrated below.

Approaching the timetable

One child went over to the timetable and was noted to be using it to check how to spell the word 'timetable' for his diary.

> *Child goes over to the timetable to check the spelling of the word 'timetable' ...*
> *he was writing in his diary about the Edinburgh tour bus timetable.*
> (FV3 lines 67–69)

Verbally referencing the timetable

The teacher had forgotten to change the timetable from the previous day and all of the children noticed this fact as soon as they came into the room. Some of the comments made by the children were:

> *"We don't have gym on a Friday"*
> *"We don't do tasks on a Friday"*
> *"Are we going on another trip today?"*
> (FV7 lines 5–7)

Reading the timetable

The children were observed to be reading the timetable on the occasions when they were gathered in front of it. This was most noticeable when individual children were referred to the timetable by the teacher.

Touching the timetable

Only one child was seen to touch the timetable during these observation studies and this occurred one morning when the children were assembled in front of the timetable. On this particular day, the teacher had forgotten to change the timetable from the previous day before the children arrived and consequently, made the changes in front of the children. The symbols were not quite as straight as they normally were and one child appeared to be unhappy with this arrangement. The child moved the last symbol further along, so that there was less of a gap between the symbols.

> *Child moves the last symbol on the timetable back a space, so that it is now next to the last activity before they go home.*
> (FV7 lines 14-15)

Changes to the symbolic timetable

Both the teacher and the nursery nurse made changes to the timetable. This was generally done by creating an improvised note, consisting of text, and placing this on the timetable at the appropriate place. Changes were observed to be made as and when they were needed, depending on the circumstances. Three specific types of changes were observed:

Informative changes

A change was made to the timetable to inform the children if something different was happening. For example, if there was to be a visitor to the classroom.

Supporting individual needs

Changes were made to the timetable to accommodate the needs of an individual child who was having difficulties coping with the timetable as a whole. For example, by adding a special activity related to a particular obsession.

Prompts and reminders

Changes were made specifically at task time, in order to remind the whole class when one task had finished and another task was due to start. For example, by removing the coloured balls above the clown picture and putting them away again to signify the end of a task period.

7.3.1.2 Interview findings

This section sets out the main findings of the interviews conducted with members of the educational team during week 31 and week 47. The findings are set out according to themes which emerged following analysis of data. Quotations from the interview transcripts are included to illustrate specific points.

What is the purpose of a symbolic timetable?

It was generally agreed that use of a symbolic timetable assisted in preparing the children for the activities of the day, by enabling the children to see the overall structure of the day, the order activities were to take place in, and the times when activities began and ended. It was considered that the timetable assisted the children in preparing for what was about to happen next and prepared them for changes in activities throughout the day. It was suggested by members of the educational team that a symbolic timetable assisted in averting behaviour problems which might arise if a child was uncertain of what was to occur during the school day. The following examples of responses illustrate these points.

> *"So it's really to give them some kind of outline of the day ahead and to give them a chance to… become prepared themselves for change. One of the main reasons that we actually use it is because the children with autism need a certain amount of routine to their days and if we have the same ... similar things happening each day then their anxiety is actually at a minimum. It helps behaviour ...with this in mind ... and also independence as well"*
> (IT1/1 lines 17–23)

> *"It prepares the children for what is about to happen next, it allows them to see the order of activities. This tends to prevent them from misbehaving or having difficulties with coping with change or if there's a break in the daily routine, we can show that visually and then we can go over that with them, rather than just springing it upon them."*
> (IT2/1 lines 9–13)

> *"I think research has shown that children with autism respond well to visual... they're very visual learners, so like I said before, sometimes you can say something verbally and they might be...they tend to be quite single channelled so they might be picking up on one tiny thing on the table that you haven't even noticed and so there they're not listening to you, but then if you can kind of draw their eyes towards something like for speech therapy and a picture of me for example, the understanding and everything clicks. It's like a backup I guess."*
> (ISLT2/1 lines 50–57)

Why does the symbolic timetable take this particular form?

It was considered important to understand the reasons why the symbolic timetable was displayed in the way that it was, so that the most appropriate style of presentation could be created for the interactive timetable. The observation studies had found that the timetable was displayed prominently on the wall and interview findings suggested this was so the timetable was easily visible and accessible. The timetable was considered to be a focal point for the children, much in the same way that a blackboard is the focal point of many classrooms. Also, it was considered important for the children to be aware that they were all sharing a common timetable. The following responses illustrate these points:

> *"Well, it's on the classroom wall so that all the children can see it as soon as they come in and sit on the carpet. And it's quite large, so that if they were sitting at a table they'd be able to see it from distance, if they were to ask me a question about what we were doing next"*
> (IT2/1 lines 40–43)

> *"It's really so that they are aware that all the children are doing the same thing and sometimes that they'll be split into smaller groups. Again it's something that's shared, because the nature of autism as well, they're not very aware of what other people are doing and it's to try and make them a little bit more aware."*
> (IT1/1 lines 128–132)

It was remarked earlier (ISLT2/1 lines 50–57) that children with autism are generally found to be visual learners and that having a visual prompt in the form of a symbolic timetable could assist in focusing attention. It was reported by the teacher and the speech and language therapist that these particular children had varying degrees of literacy ability. For example, several of the children were reported to have good listening skills in a one-to-one situation, but required prompting in group situations. Some of the children were prone to taking things literally, which could lead to them becoming upset if there was misunderstanding. Several of the children were reported to have demonstrated echolalia when younger and some still continued with this. The non-verbal abilities of one child were reported to be better than his verbal abilities, whilst for others non-verbal abilities were poor. It was, therefore, considered important to have symbols and text presented together, to promote literacy and visual skills and to aid comprehension. It was mentioned that the timetable also assisted the adults involved in the class, by reminding them of what was expected each day.

Are other forms or variations of the symbolic timetable used?

It was considered important to identify any possible variations of the timetable, in case these were required to be integrated into the interactive timetable. For example, if a child had a smaller, individual copy of the timetable for some reason, then it might be necessary for a daily printout to be made from the interactive timetable.

Both teachers explained that it was possible to develop variations of the symbolic timetable if a child required assistance in a specific area. Examples of timetable variations are now illustrated.

Alternative visual formats

It was indicated that it was possible to use alternative forms of visual prompts, such as photographs, to support a child's needs.

> *"It's generally Boardmaker images that are used, but some children who are less confident with the symbols often use photographs and some children who are not very good with photographs can use objects, or object signifiers, which are like miniature versions of objects"*
> (IT2/1 lines 23–26)

Home use

Examples of ways in which the timetable could be extended to be used at home were identified and included use of miniature versions.

> *"…when the children are here at first, so that the parents can get to know what the children's… routine is, we actually send them a miniature timetable, so that the children can actually share it with the adults, with their parents"*
> (IT1/1 lines 73–76)

> *"What we quite often do, is if the children are having difficulty with a certain thing, like having a bath, or doing their homework, we actually send an extended timetable home and try to encourage the parents to actually put that on their wall at night and you know, each time they've arrived home they've said hello and they can remove that picture, that's done and kind of work their way up, right the way through the evening to bed time."*
> (IT1/1 lines 89–95)

> *"And it's good, because it also helps at home; the style of timetable is so versatile, that a program like that can be taken on at home."*
> (INN1/1 lines 164–166)

Supporting new children

An example was given of a smaller, individual timetable being used to support the needs of new children joining the class.

> *"Where there's maybe new children coming in, we would maybe have a workstation, which is essentially a table of their own in a very quiet area of the classroom and they would actually have their own timetable in front of them, so that they can see what happens next...... Actually on the wall in front of them."*
> (IT1/1 lines 113–120)

Supporting individual activities

It was reported that sometimes a child could experience difficulty when being required to leave the classroom, for example, to attend speech and language therapy sessions. The symbolic timetable was commonly extended to assist with these occasions.

> *"I suppose if I wanted to work with a particular child. It's almost like I'm working in parallel to the main timetable. So in the morning the children are doing their tasks and I will take children out and for a while we actually had a child who couldn't cope with that, so we had to have like… a parallel timetable for him where he had a specific speech therapy symbol."*
> (IST1/1 lines 47–52)

What role do members of the educational team play in the use of the timetable?

It was considered important to identify those involved in the creation of the timetable and in the key decisions regarding its use. This was so that persons requiring administration access for the interactive timetable would be identified. Roles were found to vary significantly regarding involvement with planning of timetable use, and appeared to be linked to the overall roles within the classroom. It was also noted that to a certain extent, involvement with the timetable appeared to be influenced by the length of time a member of the educational team had been working within the setting. For example, the interviews conducted in week 31 showed a more cohesive and group decision making approach to timetable planning than the interviews of the new members of the education team in week 47. It is possible that the new members needed time to become accustomed to working together with the timetable.

Responsibility for setting up the timetable

A new timetable was displayed each day and this was normally set up first thing in the morning, before the children arrived. Interviews conducted in week 31 identified the nursery nurse (NN1) as carrying out this duty, whilst interviews conducted in week 47 identified the teacher (T2) as performing this task. (It should be noted that the teacher (T2) was newly appointed to the class shortly before this interview).

> *"It was me for the first couple of months, or weeks. And now the nursery nurse tends to be the person that sets up the next day, because she very much knows what's happening."*
> (IT1/1 lines 137–140)

> *"Mostly it's me, because I'm the one that decides what we're going to do every day and it generally corresponds with my own weekly timetable."*
> (IT2/1 lines 80–81)

Responsibility for decisions regarding daily activities

When asked who decided on the activities for the day, there were some differences of opinion. The teachers stated that they made this decision in consultation with the curriculum. The nursery nurses implied they were involved in this decision making process through consultation with the teachers. Both teachers indicated their responsibilities as demonstrated below.

> *"Myself and again it's trying to have a balance of the curriculum as well, because it's making sure you've got your P.E. and also that you have all got a chance to take the children, both as a class, individually as a group and trying to fit in the mainstream timetable as well."*
> (IT1/1 lines 159–162)

> *"I tend to be the one that plans the day, plans the timetable, but yes, there's nothing to stop the nursery nurse at some point in the future having some control for doing that…"*
> (IT2/1 lines 74–76)

The nursery nurses indicated they were consulted about the planning of the day's activities.

> *"It's sort of a group decision; we see where the children….what their interests have been. I can give my opinions and observations."*
> (INN1/1 lines 17–18)

> *"Usually it would be the class teacher, so that would be *** that decides that. Obviously she goes over the plan with me in the morning, so that we both know what we're doing throughout the rest of the day and then once she's decided and we've discussed that we then go on and she'll start to use the appropriate symbols to then go through the process of the timetable."*
> (INN2/1 lines 8–13)

The speech and language therapist reported she had an input with the forward planning of activities, but that mainly the class teacher made the day-to-day decisions in relation to the curriculum.

> *"Well, within the framework of the timetable, the general class activities are usually determined by the teacher, but I suppose at the beginning of the term they're planned collaboratively with myself and the nursery nurse."*
> (IST1/1 lines 8–11)

Organisation of symbols

The Boardmaker™ symbols were expected to form a large part of the content of the interactive timetable. It was considered important to understand how symbols were used to represent specific activities and whether the sequencing of activities was important. To establish an overall picture of the operation of the activities displayed on the timetable, members of the educational team were asked questions relating to the sequence and timing of the activities.

Sequence of activities

The main points noted concerning the sequencing of activities, were that it appeared to be important for the timetable to be consistent and predictable and also that it should reflect a familiar routine. It was generally remarked that task based work tended to be done earlier in the day, when the children were more alert.

> *"I think it's important for the children that the order of activities is consistent, so that they learn to predict and they're comfortable with that routine, because if they're comfortable in that routine, then you can start to introduce new things, but you can only really if you're wanting to teach them say a new skill, or a new task, you have to do that within a familiar, predictable routine."*
> (ST1/1 lines 118–123)

Timing of activities

It was found that generally the task activities lasted for short periods of time, usually around 20 minutes and this was because the children could really only cope with concentrating on one specific activity for this length of time. Other activities which required less concentration tended to vary in length depending on the activity and the circumstances.

> *"We do try to make it 20 minutes. Today was slightly more rushed than usual, but we find that 20 minutes is the length of time that they can concentrate. Any longer than that, sometimes it's just too much. And moving on to a completely different place in the room is enough to kind of refresh them, sort of variety. It's also a good amount of time for speech therapy. Also when they're on the computer, 20 minutes is quite a good amount of time, for them both to have 10 minutes each."*
> (IT1/1 lines 241–248)

Changes to the timetable

It was considered important to establish an understanding of the type of changes which were made to the timetable, so that the interactive timetable could be developed in such a way as to accommodate changes easily and efficiently. Members of the educational team were asked questions relating to when, how and why changes were made, as well as who had responsibility for making changes.

When and why are changes made?

It was reported that changes were made as and when they were needed, and were carried out as soon as possible. It was suggested that changes were made to the symbolic timetable for various reasons and depended greatly on circumstances. For example, a change might be necessary if a particular activity could not go ahead as planned. In addition, it was suggested that sometimes important changes occurred in a particular child's life, such as joining a new class or having a new baby in the family, and these events would be incorporated in some way within the symbolic timetable, offering additional support for the child.

> *"There are things, if a child is finding change particularly difficult, for instance, children that were going to go to a new class, to visit schools near them, we would make a book up, a social storybook up. In a way that is the timetable extended and very much personalised. It would also go on the calendar, we actually write particular events, so that children can actually see that event coming closer and that they've got some idea of time scale, because that's one thing that the children find quite difficult."*
> (IT1/1 lines 264–271)

How are changes made?

Teacher 2 explained that she would draw the children's attention to the timetable and physically make the necessary change on the timetable in front of the children, with either a new symbol, or an improvised message. The teacher also stated that any changes made were reinforced verbally.

Who makes changes?

Both teachers acknowledged that they would physically make changes to the timetable. In addition, one of the nursery nurses stated she would make changes, but that these were within the structure of an activity and so not necessarily made to the symbolic timetable itself.

> *"Only around the bits that involve my group on a Monday and a Thursday. If there's something that I said that we'd do and I think the children are not ready for it, it's changed, but the symbol on the timetable still stays the same."*
> (INN1/1 lines 43–46)

Use of the timetable by the children

By considering the children's overall use of the timetable it was hoped it would be possible to establish an idea of the amount of usage an interactive computer-based timetable could be expected to receive. Questions were asked relating to how the members of staff could tell if a child was using the timetable.

Do all the children use the timetable?

It was generally agreed among the staff that the children did all use the timetable and on the whole were keen to look at it quite often.

> *"... the children do look at it, but it's less obvious ..."*
> (INN1/1 lines 72–76)
>
> *"They don't tend to go up to it, but they kind of look at it more."*
> (IST2/1 line 83)
>
> *"They look at it in the morning and then I think they remember and because things aren't new or surprising they just think, "Right that's fine", but when there is something new we will draw their attention to it."*
> (INN1/1 line 122–125)
>
> *"They all use it because…well they all start off in the morning by coming in and they're all shown exactly what they are going to do."*
> (IT2/1 lines 171–172)

How can you tell if a child is using the symbolic timetable?

It was reported that members of the educational team knew from experience when the children had been using the timetable, and that the children tended to make comments about the timetable, or to ask questions about it. Also, the children were seen to be looking at the timetable in situations where they were asked questions by the teacher regarding the timetable.

> *"They also comment on it. Like once they've finished a piece of work they then say "what was the next thing I was to do?" and then either we suggest, or a lot of them do it independently, either look from the table, or walk over to the timetable, look at it and then see what they've got to do next. So it is a big part of their day to be looking at it."*
> (INN2/1 lines 66–71)
>
> *"Some of them reference it indirectly, like for instance *** will ask questions about it. Some of them, probably *** would go and check it. Again, by now they're quite comfortable with it. I would say they probably referenced it more initially. I think they're quite aware of what's up there and of the fact that it might be slightly different on different days."*
> (IST1/1 lines 204–209)

> *"... when you ask them a question, the reason that you know they're using the timetable is because you just have to look at their faces. They're looking at the timetable to answer your questions."*
> (IT2/1 lines 178–180)

How useful is the symbolic timetable?

It was considered important to identify the beneficial and effective aspects of the existing symbolic timetable system, so that these features could be incorporated in the new interactive timetable. The symbolic timetable was considered with regards to benefits for the children and for the staff.

Advantages for the children

Generally it was agreed that the main advantage for the children was that the timetable helped to prepare them for the day ahead, assisting in allaying anxiety by reducing the uncertainty of their day. Other key advantages suggested were that the timetable reminded the children what they had achieved and showed them what remained to be done.

> *"The advantages are that you can actually make it quite a progressive means of preparing the children. It gives them an enormous amount of focus…"*
> (IT1/1 lines 303–304)

> *"The children can concentrate on what is happening as opposed to how long is this going to be happening for. It definitely reduces their anxiety and they can see an end to the day."*
> (IT1/I lines 312–314)

> *"...they find it a very difficult to move on from certain activities and the timetable is extremely good because you can say "we've done this, this is finished and look what we're going to do next and after this we're going to do…" and it almost prompts them to see what they are supposed to be focusing on at that moment in time."*
> (IT1/1 lines 282–286)

Another advantage suggested was that the timetable provided clear signals for what was expected of the children.

> *"I think it compensates for their lack of comprehension and because autistic children have difficulties with interpreting things like gesture, visual symbols are a very clear way of showing to them what we are going to do."*
> (IT2/1 lines 201–204)

> *"So the children know exactly where they are, they have no… there's no surprises, no real surprises. It's kind of like they're aware of what's going on, again what's expected, the expectation that they need to meet"*
> (INN1/1 lines 162–164)

> *"I feel that if they weren't to have this system up, like they have just now, I think the children, in my opinion, would be lost. I think they need that so that they know what's expected of them and what's to be done throughout the rest of the day, because I think that if you were just to say it verbally, then they would be lost, they wouldn't remember it all."*
> (INN2/1 lines 139–144)

The speech and language therapists both agreed the timetable helped provide a clear structure of the children's day and the fact that the timetable was so visual, aided the children's comprehension of the day's events.

> *"It aids comprehension, comprehension of tasks…gives them structure, a kind of structure to the day, so that they don't have to be anxious about what's coming next."*
> (IST2/1 lines 103–105)

> *"A visual timetable…it helps them to structure their day, it provides a predictable structure to their routine…it needs to be visual and ideally pictorial and written for the non-readers…and just because it's a lot more…even for the children who can read, I think that having the pictures, it's a more powerful prompt. It helps to reduce their stress and their anxiety."*
> (IST1/1 lines 218–223)

Advantages for members of the educational team

It was generally agreed that the symbolic timetable was an important aid for organisation and reinforcement of the day's activities. The presence of the timetable relieved the teacher from repeating information continually throughout the day.

> *"For me, its organisation, I like to know what I'm doing first thing with the children in the morning."*
> (INN1/1 lines 174–175)

> *"Again it's reinforcement ..... so it's another strategy that we can use for them, so that it can calm them down a bit, so that they're not worrying about "what's happening next" you can say "well look at the timetable, see what you've got to do". And it makes them more independent too, because they can look at that without having to ask all the time."*
> (INN2/1 lines 153–158)

> *"I think that the advantage again is I don't have to be there to keep telling people what's coming next."*
> (IT1/1 lines 311–312)

> *"I suppose it means that staff have to kind of stick to what's up there, they can't kind of decide to wander up and do something completely different, you know, it's quite good... and like I said, with me coming into the class, sometimes if I haven't had a chance to speak to the teacher, just to see what's happening straight after snack or whatever."*
> (IST2/1 lines 111–115)

Are there any limitations to the use of the symbolic timetable?

It was considered important to identify any negative and unsuccessful features of the symbolic timetable to avoid repeating these in the interactive timetable. The disadvantages of the symbolic timetable were considered from the point of view of the children and members of the educational team.

Disadvantages for the children

It was generally agreed that a main disadvantage of the symbolic timetable was that the children could become too dependent on it. More specifically, there was a tendency for some of the children to become over-reliant on using exact symbols, which could lead to confusion in other situations outside the classroom. A further concern was that the children could interfere physically with the timetable symbols.

> "*I suppose another drawback is the children are…they are very used to it, so to go to into somewhere else that doesn't use those exact labels and symbols could be quite confusing for them."*
> (INN1/1 lines 187–189)

> *"I think the disadvantages would probably be…that the children can probably become too dependent on the timetable and not be able to actually think clearly for themselves and be able to learn about predicting."*
> (IT1/1 lines 315–318)

> *"It is up quite high at the moment, but they can still reach it, so they could come and take things off. I suppose if something doesn't, for example, something doesn't happen, quite as it's on the board, they'll not pull you up on it, but they'll be quite anxious that didn't happen, we didn't do that."*
> (IST2/1 lines 120–123)

Disadvantages for members of the educational team

It was generally agreed that the planning of the timetable was quite time consuming and furthermore that the timetable was limited to an extent by the availability of symbols.

> *"It's time consuming I suppose. Having to constantly think ahead, what's coming?"*
> (IST2/1 line 132)

> *"It has its limitation in the number of symbols we have available"*
> (IST1/1 line 239)

> *"I think that perhaps that we could do with some more precise symbols."*
> (INN1/1 line 185)

Members of the educational team were also asked for opinions and views regarding use of an interactive timetable during these interviews. These findings are presented later in section 7.5.2.2.

7.3.1.3 Summary

By observing how the symbolic timetable was used in the classroom setting and by questioning educationalists regarding the use of the symbolic timetable, the researcher was able to develop a more complete picture of this particular phenomenon. In particular, findings from these investigations identified the purpose of the symbolic timetable as being to provide structure and to prepare the children for the day ahead. In addition, it was found that the timetable was displayed very prominently, was highly visible and was a focal point in the room, with the children assembling in the timetable area between activities. Much supporting information was found to be incorporated into the timetable display. Whilst it was reported that the children used the timetable, it was noted that use was often not explicit.

Advantages of a symbolic timetable were identified and suggested that it provided a clear structure and clear signals for the children, and that it aided comprehension. The timetable was found to assist the staff members by providing an organisation tool and in addition was reported to reduce the need for constant verbal repetition of certain information by the teacher. Disadvantages were found to be that there was a certain dependency on the timetable structure by the children and that some were over reliant on specific symbols. Planning of the daily timetable was noted to be time-consuming for the teacher.

7.3.2 Requirements analysis findings

Three methods of investigation were carried out for the requirements analysis. These were self-completion questionnaires, semi-structured interviews, and examination of documents and other materials. As discussed earlier (section 5.4) multiple methods of data collection were employed in order to facilitate a more complete understanding of the users' requirements for the proposed interactive timetable application and to enable different perspectives to be considered. The findings of these investigations are now set out.

7.3.2.1 Self-completion questionnaires

As discussed earlier (section 5.8.2.2), an assessment of user characteristics and ability was carried out during this stage of this study. Home computer use and anticipated use of the interactive timetable at home were also examined. The findings of these assessments are now presented in order of children, parents and educational team members.

Children

Four completed questionnaires were returned. These were for child 1, child 3, child 6 and child 7. These particular questionnaires were all completed by parents in the presence of the investigator (which may have been a factor in their completion). Questionnaire checklists were also forwarded to the parents of child 2 and child 4, but these were not returned. No data was collected for child 5. The findings relating to the four completed questionnaires are now presented.

Demographic information

Demographic information for all seven of the participating children was set out previously in table 5.1 (section 5.6.3.1). The participating children were all male and ages at time of recruitment ranged from 6 years to 9 years. Four of the seven children had a diagnosis of ASD, two a diagnosis of Asperger's syndrome, and one a diagnosis of autism.

Physical capabilities

Child 7 was noted to need to wear glasses at all times. None of the four children investigated through use of these questionnaires were found to have colour blindness, hearing problems, or coordination difficulties. All four of these children were identified as being right-handed.

Home computer use

All four of the children were found to have a home computer and these were all of the PC variety. Two of the children had the home computer in their own bedroom, while in one family the computer was situated in the sitting room and in another family the computer was to be found in a home office. Three of the children's families were found to have Internet access at the time these data were collected. One family hoped to have access in the near future (child 1). In all four cases it was acknowledged that all of the family used the home computer and in two instances it was found that the individual child used the computer most out of the family (child 1 and child 6).

Previous experience and knowledge

Responses varied in this section. All four of the children were found to have experience of using multimedia in the form of CD ROMs, games and educational software. Three of the children were found to have experience of using the Internet. Child 1 was found to have no experience of using the Internet, e-mail, web browsers or search engines, and this was most likely due to there being no Internet access in his home.

Ability in using a computer

The four children were considered by parents to be of reasonable ability in using a computer and one child was noted to be very competent (child 3). All four of the children were considered capable of starting up and shutting down a computer, although one parent commented that her child (child 1) would need assistance with setting up new programs on the computer. Three of the four children were considered by parents to be able to access the Internet unaided. There was no Internet access at the home of child 1, but his parent believed he would easily be able to learn to carry out this task. All four of the children were noted to know how to use hyperlinks. Three of the four children were considered by parents to be reasonably able at coping with problems by themselves when using the computer, but it was noted that all four would ask for help if needed. One child was considered by his parents to be unable to cope with problems by himself when using the computer (child 1).

Memory and learning

All four of the children were reported to be able to remember how to use computer programs which they had used on previous occasions. All four of the children were happy to try out new computer programs, although one child (child 7) did sometimes like to use a familiar programme over and over again. All four of the children were reported to be competent at learning to use new programs, although one parent commented that her child (child 1) could become frustrated at first. Three of the parents reported that they had difficulty when it came to getting their child to finish using the computer at home (child 3, child 6 and child 7). The parent of child 1 commented that this used to be a problem, but as long as the child was given plenty of warning he was happy to finish using the computer when asked.

Parents

All of the parents of children participating in this study were invited to complete a user analysis checklist. Five checklists were returned completed and these were from the mother (P1A) and father (P1B) of child 1, the mother (P3A) of child 3, the father (P6B) of child 6 and the mother (P7A) of child 7. The findings relating to these are now presented.

Demographic information

Recruitment details of participating parents were presented earlier in table 5.4 (section 5.6.3.3). From the information gathered from five parents through the user analysis checklist, the age of the parents was found to range from 30 to 39 years.

Physical capabilities

Two of the parents were found to wear spectacles or contact lenses (P1B and P6B). None of the parents were found to suffer from colour blindness, hearing difficulties or to have any problems with hand coordination. All five of the parents were noted to be right handed. It was anticipated that parents would support their child in using the interactive timetable at home. Therefore, it was regarded important to ascertain any difficulties parents might have when using a computer.

Ability in using a computer

Four of the five parents acknowledged knowing how to access the Internet, but one parent had no access to the Internet at home, so was unsure of this. Three of the parents were confident they knew how to use hyperlinks (P3A, P6B and P7A); while two of the parents indicated they did not. Three of the five parents confirmed they would know how to sort out a problem with their computer themselves, but one parent (P1A) qualified this by adding *"it depends on what the problems is"*. One parent admitted to not being able to sort out problems on the computer alone, while one parent left this question blank. Generally, the parents selected the categories of "reasonably able" and "very competent" regarding ability at using a computer.

Previous experience and knowledge

Four of the five parents indicated they had previous experience and knowledge of using the Internet, with three of these four indicating familiarity with e-mail, web browsers and search engines. All five of the parents affirmed they had experience of using CD ROMs, multimedia games and educational software on a computer.

Home computer use

All five of the parents acknowledged having a home computer and these were all of the PC variety. Three parents (P1A, P1B and P6B) indicated the computer was situated in the child's bedroom. One parent (P3A) indicated the computer was situated in the office area of this family home. One parent (P7A) indicated the computer was located in the sitting room of this home. Three of the five parents acknowledged they had Internet access (P3A, P6A and P7A). One parent noted she had Broadband connection to the Internet (P7A). All five parents confirmed that the computer was used by all members of the family. The parents of child 1 and child 6 indicated that these children made most use of the computer in their households.

Memory and learning

All five of the parents indicated they were able to remember how to use programs they had used before. Three noted they did not need constant reminders to help them in using familiar programs. However, one parent indicated that he did require reminding how to use familiar programs. It is possible this parent used the programs infrequently. Whilst all five of the parents acknowledged that they liked to try out new computer programs, two of the five parents also admitted to having a preference with repeatedly using familiar programs. All five of the parents agreed that they were good at learning how to use new programs and that they tended to do this quickly. However, one parent (P7A) qualified this by adding that she was proficient at learning how to use new programs *"most of the time"*. One of the parents (P6B) stated that he also learnt how to use new programs slowly, possibly indicating that some programs the parent could pick up quickly while others required more time to learn.

Use of an interactive timetable

The parents were asked to indicate whether they would be likely to use an interactive version of the timetable at home and if so, which specific tasks would they use it for.

All five of the parents indicated that they would at some point look at an interactive timetable if they were able to access it from home.

> *"It would be helpful to see what *** does with his time at school"*
> (P1A)
>
> *"It would be useful, I could find out what *** was doing at school"*
> (P7A)

All five of the parents indicated they would access the timetable for information, to see what their child had done at school that day, and to see what was to happen on the next day at school. Four of the five parents also indicated they would use the timetable to communicate with the teacher. None of the five parents gave any additional reasons for accessing the timetable at home.

Educationalists

Two completed checklist questionnaires were returned from staff members. These were from the class teacher (T2) and from the nursery nurse (NN2).

Demographic information

Recruitment information relating to educationalists was presented earlier in table 5.3 (section 5.6.3.3).

Physical capabilities

The nursery nurse confirmed that she wore spectacles and contact lenses. Neither member of staff reported having any colour blindness, deafness, or trouble with hand coordination. Both were right handed. It was anticipated that staff members would support the children in using the interactive timetable in the classroom. Therefore, it was regarded important to ascertain any potential difficulties.

Ability in using a computer

When asked about ability in using a computer the teacher indicated she was unsure how to start up and shut down the computer and that she was also unable to word process documents on the computer. The nursery nurse, however, indicated that she felt confident in her ability to perform each of these tasks. Both the teacher and nursery nurse indicated that they knew the procedure for accessing the Internet on the class computer, but both indicated that they were unaware of how to use hypertext links. It is possible they were unfamiliar with the word ‘hypertext’ and so had responded negatively to this particular question. The teacher acknowledged that she would feel confident sorting out problems she encountered using the computer, while the nursery nurse felt she would not be able to sort out problems by herself. Both rated their abilities as “reasonably able”.

Previous experience and knowledge

Both the teacher and the nursery nurse acknowledged having used the Internet, email, web browsers, CD ROMs, multimedia games, and educational software. However, the nursery nurse reported that she had not used search engines.

Home computer use

The nursery nurse indicated having access to a PC with an Internet connection at home. The teacher reported that she had no home computer and only accessed the Internet whilst at school. The class computer was an iMac.

Memory and learning

Both the teacher and the nursery nurse indicated that they found it easy to remember how to use programs they had used before. The teacher noted that she liked to try out new programs, but the nursery nurse indicated that she did not. Both stated that they preferred to use a familiar programme. The nursery nurse indicated that she preferred to be shown how to use a new programme by somebody else, while the teacher stated that she found she could *“learn by doing”*.

Use of an interactive timetable

When asked if they would view the interactive timetable if able to access it from home, both members of staff affirmed they would. When asked to indicate reasons for viewing the timetable at home, both members of staff acknowledged they would do so for information, to see what had been happening at school that day, to see what was to happen on the next day, and possibly to make changes to the timetable. The nursery nurse also indicated that she would use the timetable to communicate with parents of the children, but the teacher left this option blank. Neither the teacher nor the nursery nurse offered any alternative reasons for accessing the timetable from home.

7.3.2.2 Summary

Findings of the user ability investigations identified that four of the children had home computers and that these children were all familiar with using multimedia software on the computer, such as games and educational software. Three of the four children were rated as being reasonably competent by their parents and a fourth was rated as being very competent. One concern which three of the parents reported was a difficulty in getting their child to finish using the computer.

Five of the participating parents were found to be computer literate, rating themselves as reasonably able to very competent. These five parents professed to be familiar with using multimedia software. When asked to consider why they might access an interactive timetable at home, these parents reported that they would use it to see what their child had being doing at school and to see what was happening the next day. Four of the five parents also indicated that an interactive timetable could be used as a way to communicate with the class teacher.

Two staff members completed these questionnaires and both rated ability in using a computer as reasonably able. Both acknowledged to having previous experience of the Internet and multimedia software.

7.3.2.3 Interview findings

As discussed in the research methodology (section 5.8.2.2), four parents and two members of the educational team were interviewed regarding information requirements. As discussed earlier (5.8.2.2) this was so that the information needs of the three main user groups might be investigated. The findings of these interviews are now set out. The findings were incorporated into a report following analysis, to facilitate further development of the timetable system.

Parent interviews

Four parents were interviewed regarding requirements and information needs for the proposed interactive timetable (interview schedule Appendix 16). These were P2A, P3A, P6A and P7A. Parents were asked to consider requirements from their child's perspective as well as from their own point of view.

Children's requirements

Themes which emerged regarding the children's needs were mainly related to the content and format of information, and to concerns with use of the timetable. The findings are set out here in relation to these themes.

1) Content

Generally it was suggested that the interactive timetable should present the following types of information for the children:

- Homework task information
- Reminders (for example, to wear casual clothes for a forthcoming trip, to bring a specified amount of money for a visit to the local shops)
- A countdown to special days, such as birthdays
- Information about class rewards

One parent believed that displaying homework tasks on the timetable pages would be helpful as it could encourage independence.

> *"At the moment the way its set up, they go over the homework with them at school, but we still have to read the diary to find out what the homework is. And ultimately I think he needs that independence of being able to find out what his homework is himself."*
> (IP2A/2, lines 244–247)

2) Format

Generally, it was agreed that a format which the children were used to should be maintained and that Boardmaker™ symbols should continue to be used along with words where appropriate. Several suggestions were made regarding personalisation of individual timetables and these included:

- Use of the child's name on the page
- Using the child's favourite colour
- Incorporating special interest topics in some way (for example, Thomas the tank engine, buses etc.)
- Details of special projects (for example, construction projects)

3) Concerns

Some concerns were raised. For example, one parent was concerned that her child would use the interactive timetable to choose only the activities which he wanted to do and which would probably not include 'work' type activities. Two parents were concerned that being able to see the next day's activities in advance could cause an upset if it was an activity the child did not like. However, one of these parents also believed this could be turned to an advantage, as the teacher could then be warned of the child's feelings concerning a particular activity.

> *"a child could look at the following day and if there's something there they don't want to do on it, then that could cause problems ... but by the same token I think it's an advantage because you can prepare them for it, so you could even put a note in to the teachers saying they're not very happy about this or that activity, so it can just prepare her"*
> (IP3A/2 lines 55–61)

Other concerns were raised about use of an interactive timetable in general. One parent was concerned that access to a computer-based timetable would be problematic, both from the point of view of screen size and due to the fact of there being limited resources in the classroom.

> *"I think the current board will be easier than the PC to see. The screen size could be a problem. Access could be a problem if there is only one machine"*
> (IP2A/2 lines 196–198)

One parent suggested that those without computer access at home could be disadvantaged. Another parent was concerned that the children would lose out on valuable group time together.

> *"Well there's one disadvantage, the group time when they're learning to communicate with each other ..."*
> (IP7A/1 lines 106–107)

Concerns were also raised regarding children's interaction with the timetable. For example, one parent was concerned that her child would have difficulty with manipulating scroll bars and navigation buttons using the mouse as an input device. This parent was also worried that her child might not understand how to use hyperlinks. One general concern which parents raised was whether the teacher would be able to update the timetable regularly.

4) Miscellaneous suggestions for content

Additional ideas for inclusion in the timetable web pages were suggested. The ideas are listed below:

- A games page – this could have educational games such as word searches and could be changed on a weekly basis
- Stages for reading and maths, showing whether the children have completed a stage, or where they are with the stages each term
- A click and colour chart could be used for activities, such as spelling
- A photo gallery of the children playing when on class trips – photographs could form part of a reward system (one parent suggested that photographs help the children remember events)

Parents' requirements

Themes which emerged regarding the parents' needs were related to the communication of information. The findings are set out here in relation to this theme.

1) Information for parents

Generally, it was felt that a parents' page within the timetable web pages would be useful, to display information similar to the type written in the home-school diary. Suggestions included:

- Details about parents' evenings and reminders about similar events
- Suggestions from staff members about helpful activities which parents could be using with the children
- Information about forthcoming trips
- Reminders of when to send in money and details of amounts (e.g. for outings to shops)
- Details about school uniform orders
- Dates of in-service days and holidays
- Details about special visitors (e.g. who visitors are and when they are likely to be visiting the classroom)

2) Two-way communication

It was suggested by two parents that a method of communication, such as email, between parents and teachers would be useful. This would enable parents to discuss any problem issues or concerns with the teacher. One parent suggested that there could perhaps be an area where parents could receive feedback in private about their child. However, two parents were concerned that nothing of a personal nature should be displayed on the timetable pages.

Beneficial features of an interactive timetable

Opinions regarding beneficial aspects were considered from the perspectives of child, parent and teaching staff and are set out in relation to these areas.

1) Benefits for the child

The following were perceived by the parents as being benefits for the child if an interactive timetable were to be introduced:

- Enable the child to prepare for the day ahead or for the next day (e.g. perhaps go to school more eagerly knowing what to expect)
- Encourage the child to make choices
- Provide reminders (e.g. homework tasks)
- Provide reinforcement regarding the day's activities
- Increase independence (e.g. using the timetable alone)
- Assist with turn-taking in class setting
- Increase computer skills

2) Benefits for the parent

The following beneficial features of an interactive timetable were identified by the parents:

- Assist parents in preparing the child for the next day at school
- Enable parents to see what the child has been doing at school that day
- Facilitate discussion between parent and child regarding the activities the child has participated in at school
- Provide useful information

3) Benefits for the teacher

Generally the parents believed that use of an interactive timetable would in some way assist in reducing the teacher's workload. One parent believed that an interactive timetable might be easier for the teacher to change and manipulate than the current timetable.

Speech and language therapist interviews

Earlier investigations had found that information relating to speech and language therapy (SLT) was an integral part of the timetable and so it was considered important to include this information within the structure of the interactive timetable. This section sets out the findings of interviews conducted with the two speech and language therapists (interview schedule Appendix 16). It begins by illustrating opinions regarding the role of SLT within the structure of the interactive timetable.

Role and purpose of SLT related information

The therapists identified several ways in which SLT information could be usefully integrated as part of the interactive timetable. These included being used to communicate basic information about SLT sessions, to provide feedback to parents, and to assist the children in understanding the SLT tasks.

1) Communication role

It was suggested that basic information about the SLT sessions could be communicated to the children. Three important characteristics of such information were identified as providing details of whom, when, and where for each session.

> *"To let the children be aware of when their speech therapy slot is, who they're having it with, because they know there's both myself and ****...probably where…because we've now got two speech therapy rooms …very much…to inform, and keep the children informed"*
> (IST1/2, 18–27)

> *"My kids know that its group time, but sometimes we're in here and sometimes we're in the classroom and they never know, but they seem to cope quite well with that, whereas I know the wee ones mightn't if they were somewhere different."*
> (IST2/2, 149–153)

It was suggested that in addition to the children, members of the educational team might make use of the SLT information displayed within the interactive timetable web pages.

> *"Also for the staff I suppose……so that everyone is aware of who's doing what and when and where."*
> (IST1/2, 27–30)

Both therapists identified a further function of SLT information within the interactive timetable, as being to support communication between school and home.

> *"And possibly as a way of communicating to parents a bit more what we're doing"*
> (IST1/2, 112–114)

> *"I suppose telling them [the parents] like I said what particular thing you've worked on that day and how long you might carry it over for. Maybe they would have more of an idea, if they saw your aims and could then feed into it, but again that might be better done face to face."*
> (IST2/2, 73–78)

One therapist also believed that there was the potential for communicating with parents in a more immediate way through the use of an interactive timetable.

> *"I think to have the facility of contacting parents almost immediately just to say this is what we were doing today ... did very well at this, or even any anxieties, I suppose like instead of just writing it down, typing it so that parents can access it."*
> (IST2/2, 61–65)

2) Assisting understanding

One therapist felt that displaying the SLT information as part of an interactive timetable could assist the children in understanding the activities involved in the SLT sessions. The therapist described how one child particularly needed visual aids for completing tasks and that displaying a more detailed breakdown of SLT activities might assist this particular child in understanding what was involved.

Information format

Generally, both therapists were of the opinion that the format of SLT information should be similar to the information displayed on the current symbolic timetable. The information should be visual in nature, with symbols, photographs, and words being used. One therapist suggested that photographs of the two therapists should be displayed, with their names beside them, much like those currently displayed on the symbolic timetable. It was also suggested that presenting either symbols or photographs of the rooms which were used for SLT sessions would be a good idea.

Information content

One therapist believed that it would not be appropriate to display information about the content of SLT sessions, but that it might be useful to inform the children whether it would be a one-to-one session or a group session. She also thought it might be helpful to have different symbols for each of the different types of group session. For example, indicating whether the session was to be for social skills, language skills, music, or general interaction sessions. The therapist thought that it would be advisable to avoid being tied down to specific activities.

One therapist believed it might be useful at some stage to provide parents with access to relevant social stories. The therapist explained how this technique was used to help prepare the children for events such as outings and suggested storing this information in the form of an attachment for parents to access at home.

> *"Like add an attachment for the parents, so you could just send them home a social story. Because that's something I think would be quite good ...It would be good if then parents could go over it at home."*
> (IST2/2, 185–193)

Information storage

It was considered important to identify where SLT information was currently stored and in what form. Boardmaker™ symbols which the children were familiar with were currently used to present SLT information. These symbols were reported to be stored on the computer within the Boardmaker™ programme, as well as in card form beside the symbolic timetable. One of the therapists reported having files on the computer containing activities such as social stories, and print copies of these were also available.

Changes

It was considered important to assess the amount of changes which were likely to be made to SLT information, in order to understand the level of maintenance which would be required by the therapists for this particular section of the interactive timetable. One therapist implied that as long as the information was kept at the level discussed earlier (i.e. whom, when and where), then it was likely that the information would remain constant for a reasonable period of time. It was reported that the timetable generally remained stable for the term. However, the area most likely to change was the content of each session.

7.3.2.4 Summary

These interviews identified some useful findings and there was much agreement between interviewees. It was generally suggested that the format of information should remain as in the symbolic timetable, using Boardmaker™ symbols and words. Suggestions for content included reminders for the children and communicating information generally. Suggestions for personalisation of timetables included use of names, favourite colours, and special interests. Concerns were raised by the parents and included worries that the children might follow their own agenda when using a computer-based timetable. Also it was suggested that prior knowledge of activities for the week ahead might cause anxiety for some individuals. Concerns were also raised regarding resources and hardware. For example, having only one computer in the classroom would limit access, whilst the size of the computer screen might be a problem for viewing the timetable. Other concerns included children being disadvantaged if there was no computer or Internet access at home, difficulties with motor skills ability might cause problems for some children and a further concern was that the teaching staff might not have the necessary skills to maintain an interactive timetable. These concerns are discussed further in chapter eight. Generally the parents saw an interactive timetable as being a useful way to extend communication between school and home. It would allow parents to see what their child had done at school and hopefully facilitate discussion between child and parent. Speech and language therapists viewed the use of an interactive timetable as a way to enhance communication for the child in the classroom setting and to extend communication of timetable activities to the home environment.

7.3.2.5 Document findings

Several documents were examined, which provided background knowledge regarding the language unit, routines and activities, facilitating the researcher's understanding of the participants and setting. However, due to the sensitive nature of certain documents, details are not reported here. These documents were:

- Individual 'passports' – documents provided for people who had contact with the children, such as transport drivers

- Home-school diaries
- Individual educational plans (IEPs)
- Intelligence quotient scores

Other documents which were examined in order to identify potential content for the interactive timetable pages included:

- General information leaflets (normally distributed to parents of new children)
- Materials supporting the symbolic timetable i.e. help task chart, reward chart, star chart
- Term timetable
- Daily SLT plan
- Visual diary chart
- Examples and guidelines for social stories

An example of a visual diary chart can be found in Appendix 18. An information-communication map (Appendix 17) was developed to highlight the purpose of certain information resources and to consider appropriateness of including these within the structure of the interactive timetable.

7.4 Stage 3: Developing a prototype interactive timetable

The findings presented here relate to investigations conducted during the development of the interactive timetable and relate to formative evaluations as discussed in the research methodology (section 5.8.3.1).

7.4.1 Formative evaluation findings

Two forms of investigation were conducted in order to assess the usability of the interactive timetable by different user groups. Cooperative user evaluation observations were carried out to enable the researcher to witness the children interacting with the prototype timetable application, whilst a usability assessment enabled adult users to report anonymously their opinions regarding the prototype interactive timetable.

7.4.1.1 Cooperative evaluation observations

Findings from these observations were analysed and a report of the findings was created (Appendix 19), which assisted with furthering the development of the interactive timetable.

7.4.1.2 Usability assessment

The findings of the usability study conducted with five members of the educational team were documented in a report. A summary of these findings is set out here. The questionnaire (Appendix 20) considered three specific themes: general layout, navigation, and content. A usability task was completed by participants to assess functionality.

General layout

Colour use

Four of the five participants reported that colours used in the prototype were suitable. One participant reported that colours used were unsuitable. In particular, it was suggested that one particular image had a poor choice of colour, which made it appear grey on the screen. An alternative colour was suggested.

Suitability of font

Three of the five participants reported that the font (Comic Sans MS) used on the timetable pages was suitable, whilst two participants disagreed and suggested that an alternative font (Sassoon infant CR) should be used instead. Sassoon infant CR is the font used in the classroom for documentation. Other suggestions were that lower case should be used for the names of the days of the week. To address the need to maintain use of a font which was consistent with the font used in the classroom setting, the font Sassoon infant CR was included in the style sheets which were set up for the timetable pages. However, the font Comic Sans MS was also included in the font families set up in the style sheets as it was recognised that not all web browsers would be able to interpret and display the font Sassoon infant CR. Comic Sans MS was acknowledged to be an appropriate alternative by the teachers following discussion of this restriction.

Readability of text

Generally all of the participants agreed that the size of the text on the interactive timetable pages was appropriate and readable. However, some suggestions were made and included:

- Navigation buttons could be bigger
- Text on ‘days of the week’ should not be in upper case
- Text could be larger in lunchtime section

Screen layout

Responses to an open-ended question regarding screen layout included:

- Very good and clear
- Excellent, extremely pleasing
- I found the layout quite clear
- It would be useful to have a facility to have an overview of the whole day
- Laid out fine

Navigation

Appropriateness of navigation icons

The navigation icons used at this stage were adapted from Boardmaker™ symbols as illustrated in figure 7.7.

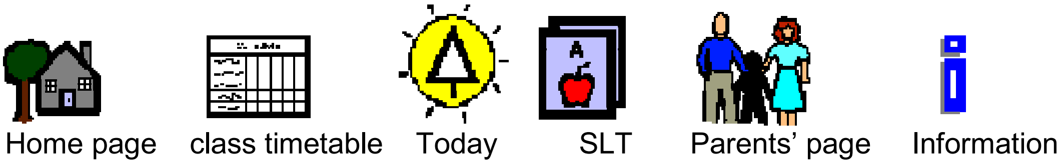


Figure 7.7: Example of navigation icons at an early stage of development

All five of the participants responded negatively and provided comments and suggestions.

> *"Maybe a better symbol to use" (respondent 1)*
> (Referring to the Boardmaker™ symbol for today which had been used – a yellow arrow in a circle)
>
> *"This is unclear" (respondent 2)*
> (Referring to the Boardmaker™ symbol for today)
>
> *"Calendar - unsure of what will be on it / what it's for, yellow circle - not obvious enough for timetable of week, A – apple book - not sure what it will involve" (respondent 3)*
>
> *"Navigation buttons 1, 2 and 3 – I'm unsure of – not certain what they mean" (respondent 4)*
>
> *"The 'today' navigation button on the home page isn't as easy to understand as the other ones" (respondent 5)*

The main problems appeared to be with the 'today' page symbol, the 'class' timetable symbol and the 'speech therapy' symbol. The meaning of these was not easily understood, possibly because these particular Boardmaker™ symbols were not commonly used in this class setting.

Appropriateness of page headers

Four of the five participants agreed that page headers were appropriate and that these gave a clear indication of which page they were viewing. One participant disagreed, commenting that the page headers were not clear enough for the children to follow.

Ease of use

Four of the five participants reported finding their way around the timetable reasonably quickly and easily when first trying the web pages. One participant reported finding her way around very quickly and easily.

Content

Participants were invited to make suggestions regarding content for three areas of the timetable web pages.

Information page

Suggestions for content of an information page included:

- Information about the language unit
- Information about class trips
- Information regarding transport to and from school
- Photographs

Parents' page

Suggestions for content of a page for parents included:

- Information about diagnosis, stress, siblings etc.
- Links to useful websites
- Information about child friendly organisations
- Social events
- Reminders (e.g. when child to bring gym kit to school)

Individual timetables

Suggestions for content to display on individual timetables included:

- Photograph of child
- 'Smiley face' reward for when task completed

- Personal symbol
- Details of child's 'choosing' reward
- Information about SLT time

7.4.1.3 Summary

Generally these findings were encouraging. The fact that questionnaires were completed anonymously enabled members of the education team to report opinions regarding the usability of specific features of the prototype openly. Important issues regarding use of specific fonts and unsuitability of navigation icons were raised and this allowed consideration of alternative options to be made.

7.5 Stage 4: Evaluating the interactive timetable

This section of the chapter sets out the findings of the evaluations carried out in relation to aim 2: evaluating the effectiveness of the interactive timetable by considering whether its use in any way assisted the participating children in overcoming anxiety related to changes in daily class routine; and in relation to aim 3: to evaluate the effectiveness of the interactive timetable as a management and communication tool for the teacher and parents.

7.5.1 Findings relating to Aim 2

This section reports the findings relating to the second aim of this study. As discussed earlier (section 5.8.4.1), multiple methods of data collection were employed in order to facilitate triangulation. Methods used at this stage included semi-structured interview, self-completion questionnaires, and structured observations. In addition to enabling different perspectives of this particular aspect of the study to be examined, using different methods of data collection facilitated comparison of findings. For example, comparisons were made between data gathered from the parents and the teacher and in addition, comparisons were also made between these data and the data gathered through the observation studies. Information was gathered from parents and the class teacher to establish a baseline checklist of typical anxiety-related behaviours for each child. This was to assist the researcher in establishing whether behaviours observed during the observation studies were typical anxiety-related behaviours or more likely to be typical of autistic spectrum disorder. It was established in the literature that it is difficult to assess symptoms of anxiety in individuals with autism (Kim et al., 2000). This is because anxiety related behaviours can be very similar to certain characteristics of autistic spectrum disorder

Child 2, child 3 and child 5 had withdrawn from the study by this stage, so only four children (child 1, child 4, child 6, and child 7) were observed during the two observation studies. Study 1 (week 134) involved observing the children using just the symbolic timetable, whilst study 2 (weeks 135–137) involved observing the children after the introduction of the interactive timetable. The intention was to see if introduction of the interactive timetable had resulted in less anxiety related behaviour being observed. Findings are presented for each child in turn and begin with consideration of parent and teacher assessments, followed by findings from studies 1 and 2.

7.5.1.1 Child 1

The findings of the assessments conducted in relation to child 1 are now set out, beginning with the parent and teacher assessments. The findings of structured observation studies 1 and 2 are then presented.

Parent and teacher assessments

The findings presented here concerning child 1 are drawn from data gathered from two sources: a semi-structured interview was conducted with the child’s mother (Appendix 21) during week 34 and a self-completion questionnaire (Appendix 23) was filled out by the class teacher during week 111. The findings are set out in relation to question themes.

General behaviour

The child’s mother reported that the child was generally happy, but liked a routine.

> *"He's a happy, outgoing little boy, but he does like a routine. He's happy with a routine in his life and if you disrupt that, he can get quite upset by it."*
> (IP1A/1 lines 19–20)

The teacher stated that the child was:

> *Placid, passive, gentle, developing assertive skills gradually*
> (AQ1:Q1)

Anxiety and stress related behaviour

The child's mother stated that the child would commonly cry when he was presented with a stressful situation and that he frequently folded his arms. The mother also noted that the child often spoke in a high-pitched voice tone when he was excited and that he would frequently ask to go to the toilet if in a stressful situation.

> *"But we can see when he's not happy, either crying, or going in a huff."*
> (IP1A/1 line 55)
>
> *"When he gets excited, he has this high-pitched tone to his voice."*
> (IP1A/1 line 84)
>
> *"If he finds it tough going he asks to go to the toilet."*
> (IP1A/1 line 118)

The teacher stated that when stressed, the child was

> *Jumpy, overly forgetful, difficulty carrying out simple tasks when nervous or under pressure*
> (AQ1: Q2)

Recognised stereotyped behaviour

The mother selected only one from the 22 stereotyped behaviours listed on card A (Appendix 22):

- Hand movements (from habit)

In addition, the mother commented that the child frequently picked at his fingers and lips.

The teacher selected the following behaviours from the list:

- Sniffing objects or self (from habit)
- Hand movements (from habit and when anxious)
- Finger movements (from habit and when anxious)
- Gazing (from habit)

Anxiety provoking events

The child's mother reported that a change in routine was stressful for the child.

> *"Changing a routine. Any routine. He loves to have a routine, "what's happening, what do we do?", but if you change it, he gets anxious."*
> (IP1A/1 lines 136–137)

The mother also noted that the child did not like to wear new or different clothes, preferring to wear the same clothes all the time. The mother commented that her child did not like to be shouted at and found it very stressful if he did anything wrong. In particular, he could become very anxious if he made mistakes in his schoolwork.

> *"He gets upset if you shout at him. He can. If he does something bad. You always feel like he's quite fragile... He's a bit more sensitive. He doesn't like doing anything wrong. I think he's like that in the classroom as well, with his work he doesn't like getting anything wrong. He has to get it right or else..."*
> (IP1A/1 lines 112–117)

The teacher reported that the child could become anxious in the following situations:

> *Visiting professionals sitting very close to him, watching doing tasks - won't reveal all skills – becomes dependent, forgetful. Sudden noises, movement.*
> (AQ1: Q4)

Potential stressors

When shown a list of 25 potential environmental stressors (card B, Appendix 22) the child's mother selected the following 10 as applying to her child:

- Changes in environment from familiar to unfamiliar
- Changes in task to a new task with new directions
- Waiting for transportation
- Receiving a reprimand
- Being told "no"
- Personal objects out of order
- Personal objects touched by others
- Personal objects missing
- Being prevented from carrying out a ritual
- Being prevented from completing a ritual

In addition the mother commented that she thought her child was unperturbed by any changes in teacher or supervisor.

> *"I think he's okay with changes in teacher or supervisor; he doesn't seem to be bothered about that"*
> (IP1A/1 lines 263–265)

The mother also commented that her child had no worries about being touched,

> *"He likes being touched, he's very tactile."*
> (IP1A/1 line 266)

The teacher selected the following eight behaviours from the list of potential environmental stressors:

- Loud noises
- Noise or disruption from others

- Changes in schedule or plans
- Changes in task to a new task with new directions (*“becomes dependent”*)
- Changes in environment from familiar to unfamiliar
- Being unable to communicate needs
- Needing to ask for help
- Receiving a reprimand (“*becomes nervous”*)

The teacher also reported that the child frequently lost personal items, but noted that this did not appear to cause particular stress.

Stress related environments

The child’s mother reported that unfamiliar environments could cause anxiety for the child, but when questioned was unable to provide specific examples.

> *“School seems to be okay. He loves school. He feels relaxed at school. I suppose out, if it’s not familiar. He likes to go and see his grandmother. Maybe other places.”*
> (IP1A/1 lines 306–307)

The teacher reported that playtimes were stressful for child 1, particularly when the class was getting ready to go outdoors. The teacher also noted that class trips were stressful events and that the child needed one-to-one supervision at these times.

Recognised physical signs of anxiety and stress

The mother reported that the child would complain of having nightmares from time to time.

> *“He talks about nightmares actually. Sort of ghosts and monsters. He’s never woken up, he’s never had us up, but he has mentioned it.”*
> (IP1A/1 lines 314–315)

The mother selected the following five physical signs of anxiety from a list of 15 (card C, Appendix 22), as pertaining to her child:

- Pale (*sometimes*)
- Over-reacts
- Talks loudly
- Panics
- Cries when upset

The mother stated that when the child talked loudly it was often in a high-pitched tone.

> *"He can talk quite loud, again in that high-pitched tone, but excitement more than anything."*
> (IP1A/1 line 333)

The mother also reported that although the child did not bite or scratch himself, he frequently picked at his fingers or pulled at his lips.

The teacher selected the following from the list of physical signs of anxiety:

- Over-reacts
- Panics

The teacher also commented that the child would

> *Jump, twitch. Says "yes, yes, okay" rapidly*
> (AQ1: Q7)

Strategies for easing anxiety and stress

The mother reported giving plenty of reassurance at home and preparing the child for events well in advance (e.g. family holidays). The mother also stated that visual cues such as a clock and calendar were used at home, with reminders often being written on the calendar for the child's benefit. Generally, the parents informed the child about changes at a time when he was relaxed and not tired.

> *"We have to write things down ... you've got to pick times of the day when you can really tell him about change as well. When he comes back from school he's quite tired, it's not the best time. He likes to relax for an hour, so probably after teatime."*
> (IP1A/1 lines 371–374)

The teacher reported using strategies in class such as a timetable, schedules for moves, and a task bag for when children visited mainstream classes.

Structured observation study 1

The procedures for the structured observation sessions are set out in the research methodology (section 5.8.4.1). Child 1 was observed in the classroom setting during six activity sessions, in order that a baseline of anxiety related behaviour could be established. These observations took place during the course of one day and the symbolic timetable was used in the usual manner in the classroom. The activities the child was observed during were, 'check timetable time' (20 minutes), 'red ball time' (15 minutes), 'snack time' (20 minutes), 'blue ball time' (20 minutes), 'task time' (20 minutes) and 'visual diary time' (15 minutes). Altogether, child 1 was observed for 110 minutes. In the report that follows the data for 'red ball time', 'blue ball time' and 'task time' sessions have been combined and collated under the heading 'ball time', as these activities involve the child working independently on very similar tasks.

Stereotyped behaviours

Child 1 was witnessed to exhibit 48 behaviours during the 110 minutes when he was observed and these were classified according to seven categories of stereotyped behaviour. These categories were 'sniffing objects or self', 'finger movements', 'gazing', 'postures', 'grimacing', 'constantly feels an object' and 'keeps performing certain movements'. The child was also observed to display behaviours which did not fall into any of the main categories, but which were considered noteworthy and so these were classified under the heading 'other behaviours' (n4). These included behaviours such as the child moving his chair away from another child, blowing through his fingers, talking to himself, and smiling to himself. It was difficult to determine whether these behaviours were specifically characteristic of a child on the autistic spectrum, or not. However, they were considered worth reporting. For example, the child moving his chair away from another child could have been a reaction to a fear of being touched by the other child. Some children with autism are known to have an aversion to being touched by others and the issues of sensory stimulation and heightened sensitivity were discussed in the literature (sections 2.2.3.2 and 2.3.3.1). Similarly, the researcher found the behaviours of the child blowing through his fingers, talking to himself, and smiling to himself difficult to classify as being specifically stereotypical. For example, these behaviours could have indicated an increase in preoccupation, either with the task at hand, or with the child's own personal thoughts. Attwood (1998) and Deudney (2004) suggest preoccupation can be a presentation of anxiety in individuals with autism. As mentioned in the literature (section 2.2.3.1), children with autism are reported to display facial grimaces, particularly when excited, agitated or angry (Lewis, 2003). Whilst the observation of the child smiling to himself could not be classed as grimacing in this case, the child was not seen to use the smile in a socially reciprocal way and so it was felt to be unusual in this respect.

The behaviour 'constantly feels an object' (n14) occurred most frequently throughout the day and was noted to be exhibited during each observation period. A greater proportion of this behaviour occurred during 'ball time' (57.1%). The range of behaviours included in this category were touching or rubbing of hair, face, nose, head, eyes, and ears. Also incorporated in this category were incidents where the child played with a pencil and occasions when the child placed his finger on or in his mouth. The behaviour 'finger movements' was also found to be displayed a great deal (n10) with a high proportion occurring during 'ball time' (80%).

The greatest frequency of behaviours was observed during the activity 'ball time' (n33), a rate of 36 behaviours per hour. The activities where the child was noted to display least stereotyped behaviours were 'snack time' (n3), a rate of nine behaviours per hour, and 'visual diary' time (n3), a rate of 12 behaviours per hour. Table 7.1 demonstrates the frequency of stereotyped behaviours observed.

Table 7.1

Frequency of stereotyped behaviours observed for child 1 – study 1

	Stereotyped behaviours										
Activity	*Sniffing objects or self*	*Finger movements*	*Gazing*	*Postures*	*Grimacing*	*Constantly feels an object*	*Keeps performing certain movements*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Check timetable	1	2	0	0	3	3	0	0	9	20	27.0
Ball time	2	8	1	1	5	8	5	3	33	55	36.0
Snack time	0	0	0	1	0	2	0	0	3	20	9.0
Visual diary	0	0	0	0	0	1	1	1	3	15	12.0
Total	**3**	**10**	**1**	**2**	**8**	**14**	**6**	**4**	**48**[a]	**110**[b]	**26.2**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all stereotyped behaviours in one hour arrived at by dividing the total number SB (48) by the total observation time (110) and multiplying by 60.

Physical signs of anxiety

Child 1 was observed to exhibit seven physical signs of anxiety and these were grouped according to two categories, 'cannot sit still' and 'bites or scratches self'. One other behaviour was observed which did not correspond with the predetermined categories and this was the behaviour of the child banging his fists on his knees.

The behaviour 'bites and scratches self' was observed most frequently (n4) and referred to occasions when the child was seen chewing his lip, picking at his fingers, and picking at his lips. A greater number of physical signs of anxiety were observed during the activity 'ball time' (n5), a rate of 5.5 physical signs per hour. No physical signs of anxiety were observed during 'snack time'. Table 7.2 demonstrates the frequency of the physical signs of anxiety observed.

Table 7.2

Frequency of physical signs of anxiety observed for child 1 – study 1

	Physical signs					
Activity	*Cannot sit still*	*Bites or scratches*	*Other*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Check timetable	0	0	1	1	20	3.0
Ball time	2	3	0	5	55	5.5
Snack time	0	0	0	0	20	0.0
Visual diary	0	1	0	1	15	4.0
Total	**2**	**4**	**1**	**7**[a]	**110**[b]	**3.8**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (7) by the total observation time (110) and multiplying by 60.

Environmental events

During these observations, 25 environmental events were recorded and these were classified under four categories as demonstrated in table 7.3. Events which did not fall into specific categories were grouped under the heading ‘other factors’ and were found to have occurred most frequently (n15). These included events such as, the teacher speaking to the class, the teacher asking child 1 a question, the teacher checking child 1’s work, and the teacher helping child 1 with his task. A greater number of environmental events were noted to occur during ‘ball time’ (n18), a rate of 19.6 per hour. The least amount of environmental events was found to occur during ‘visual diary’ time (n1), a rate of 4 per hour.

Table 7.3

Frequency of environmental events observed for child 1 – study 1

	Environmental events							
Activity	*Noise or disruption from others*	*Changes in schedules or plans*	*Changes in task to a new task*	*Needing to ask for help*	*Other factors*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Check timetable	0	0	1	0	3	4	20	12.0
Ball time	2	0	3	1	12	18	55	19.6
Snack time	1	1	0	0	0	2	20	6.0
Visual diary	1	0	0	0	0	1	15	4.0
Total	**4**	**1**	**4**	**1**	**15**	**25**[a]	**110**[b]	**13.6**[c]

Note. EE = environmental events.
[a] Total number of environmental events observed during study 1. [b] Total duration of observation time for study 1. [c] Scaled average of all environmental events observed in one hour arrived at by dividing the total number EE (25) by the total observation time (110) and multiplying by 60.

Symbolic timetable use

Child 1 was observed to be looking at the symbolic timetable on two occasions. The first was during the activity 'check timetable', when all the children were sat on the floor in front of the timetable while the teacher talked the class through the activities for the day. The second occasion was immediately after 'snack time', when the children again sat in front of the symbolic timetable. Child 1 was not seen to make use of the timetable during any other observation periods. No changes were observed to be made to the timetable by the teacher during these observation sessions.

Structured observation study 2

A series of five direct observations of child 1 were conducted two weeks after structured observation study 1. This was the first opportunity available to observe child 1 following implementation of the interactive timetable and observations were carried out in order to witness behaviour displayed during use of the interactive timetable. During these observation sessions both the interactive timetable and the symbolic timetable were accessible for use by the participating children. Structured observations of child 1 took place on two separate days (six days apart) and were carried out during ‘red ball time’ (20 minutes), ‘snack time’ (20 minutes), ‘red ball time’(20 minutes), ‘snack time’ (20 minutes), and ‘task time’ (15 minutes). Child 1 was observed for a total of 95 minutes. The teacher allocated the child to use the interactive timetable immediately after ‘check timetable’ time on both of the days he was observed.

In the report which follows, data for ‘red ball time’ and ‘task time’ sessions have been combined and collated under the heading ‘ball time’, as these activities involved the child working independently on very similar tasks. Data gathered during the two ‘snack time’ sessions have also been combined.

Stereotyped behaviours

Child 1 was observed to display 52 behaviours and these were grouped under eight categories. Certain behaviours did not fit clearly into the specific categories and these were classified as ‘other behaviours’ (n7). These included incidences of the child smiling, blowing on his hand, turning to look at the symbolic timetable and blackboard, blowing into his cup, and turning to look at the help chart beside the symbolic timetable. As discussed previously for study 1, it was difficult to assess whether certain of these behaviours were characteristic of a child with autism. In particular, the instances of the child smiling to himself and blowing into his cup could indicate a preoccupation of thoughts, a characteristic that is noted in individuals with autism. On the other hand, the instances of turning to look at the visual aids (help chart, timetable and blackboard) could have indicated that the child was having difficulty with his task and required help; a response that any child might show when in difficulty.

The stereotyped behaviours observed most frequently were ‘constantly feels an object’ (n18) and ‘gazing’ (n9), with a greater proportion of these particular behaviours being observed during ‘ball time’. Overall, child 1 was observed to display a greater number of behaviours during ‘ball time’ (n38), a rate of 41.5 behaviours per hour. Table 7.4 demonstrates these findings.

Table 7.4

Frequency of stereotyped behaviours observed for child 1 – study 2

	Stereotyped behaviours											
Activity	*Rocking*	*Body movemt*	*Finger movemt*	*Gazing*	*Postures*	*Grimacing*	*Constantly feels an object*	*Keeps performing certain movemts*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	0	0	3	9	3	6	12	1	4	38	55	41.5
Snack time	2	1	1	0	0	1	6	0	3	14	40	21.0
Total	**2**	**1**	**4**	**9**	**3**	**7**	**18**	**1**	**7**	**52**[a]	**95**[b]	**32.8**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all stereotyped behaviours in one hour arrived at by dividing the total number SB (52) by the total observation time (95) and multiplying by 60.

Physical signs of anxiety

Child 1 displayed 16 physical signs of anxiety and these were grouped according to two categories. Nine incidents did not fall into the specified categories and were classified as ‘other’. These all referred to occasions when child 1 had been witnessed blinking profusely. The physical sign ‘cannot sit still’ was observed frequently (n6) and referred to incidences of child 1 generally shaking his legs or knocking his knees together while sitting at the table. A higher number of physical signs of anxiety were observed during ‘ball time’ (n13) than during the ‘snack time’ sessions. Table 7.5 illustrates these findings.

Table 7.5

Frequency of physical signs of anxiety observed for child 1 – study 2

	Physical signs					
Activity	*Cannot sit still*	*Bites or scratches*	*Other*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	4	1	8	13	55	14.2
Snack time	2	0	1	3	40	4.5
Total	**6**	**1**	**9**	**16**[a]	**95**[b]	**10.1**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (16) by the total observation time (95) and multiplying by 60.

Environmental events

During these observations, 34 environmental events were identified and these were grouped according to five categories. Events not appropriate to the specified categories were classified under the heading ‘other factors’ (n6). These included occasions when the teacher had asked the children a question, when the teacher had been checking the participant’s work, when the teacher had been praising another child nearby, and when the teacher had been prompting child 1 to continue with his work. The environmental event recorded most frequently was ‘noise or disruption from others’ (n17), with the majority of this event being recorded during ‘ball time’ (n16). Overall, a higher number of environmental events were identified as occurring during ‘ball time’ (n26), a rate of 28.4 environmental events per hour. Table 7.6 demonstrates these findings.

Table 7.6

Frequency of environmental events observed for child 1 – study 2

	Environmental events								
Activity	*Noise or disruption from others*	*Changes in task to a new task*	*Moving from one location to another*	*Participating in a group activity*	*Receiving verbal reinforcement*	*Other factors*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Ball time	16	4	0	0	1	5	26	55	28.4
Snack time	1	2	1	3	0	1	8	40	12.0
Total	**17**	**6**	**1**	**3**	**1**	**6**	**34**[a]	**95**[b]	**21.5**[c]

Note. EE = environmental events.
[a]Total number of environmental events observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all environmental events observed in one hour arrived at by dividing the total number EE (34) by the total observation time (95) and multiplying by 60.

Symbolic timetable use

During the first two observation periods (‘red ball time’ and ‘snack time’) child 1 was noted to be sitting in a position where he could see the symbolic timetable, however, no noticeable reference to the timetable was made by the child at these times.

During the third observation period (‘red ball time’), child 1 sat with his back to the symbolic timetable. He was observed to turn and look in the direction of the symbolic timetable on one occasion, but as the teacher was standing beside the timetable talking to the supply nursery nurse at this time, it is possible that child 1 was merely turning to see what the teacher was doing. No further use was made of the symbolic timetable during this observation period.

During the fourth observation period ('snack time') child 1 was noted to be in a position where he would have been able to view the symbolic timetable if required. However, no obvious reference to the timetable was noted. Later, when child 1 had left the snack table and was sitting on the floor in front of the symbolic timetable he was observed to look at the timetable wall and in particular to look at the 'help chart' there. The teacher was heard to ask the children a question relating to 'help tasks' at this time. During the fifth observation period ('task time') child 1 was noted to be sitting with his back to the symbolic timetable and no reference to the timetable was observed.

Interactive timetable use

Child 1 was allocated to use the interactive timetable immediately after 'check timetable' time on both days when he was observed. On the first day, the child spent ten minutes using the interactive timetable, during which time he checked the timetable for that day on the appropriate page when asked and compared it to the symbolic timetable. When prompted, the child made up a version of his own timetable for that day.

On the second day, child 1 was again allocated to use the interactive timetable immediately following 'check timetable' time. The child spent ten minutes using the interactive timetable, during which time he checked the timetable for that day on the appropriate page when asked and compared it to the symbolic timetable. When prompted, the child made up a version of his own timetable for that day, which he printed out.

Summary

A brief summary of the findings for child 1 with regards to studies 1 and 2 is now presented. With regards to the parent and teacher assessment of the child there was found to be little agreement between the parent and teacher. However, as they were assessing the child in different contexts (home versus school) this may have influenced their assessment. Regarding stereotyped behaviour, the parent and teacher both agreed on hand movements as being a behaviour the child frequently demonstrated. Whilst several physical signs of anxiety were identified by the parent, only 'over-reacts' and 'panics' corresponded between the two assessments. However, both parent and teacher agreed that change appeared to be a strong stressor for this child. A discrepancy noted between parent and teacher was the parent's report that the child was "relaxed at school" (IP1A/1 line 306), whilst the teacher reported that the child was often anxious at playtimes. Both parent and teacher agreed that visual aids were helpful in reducing anxiety for this child.

A comparison of the findings from the parent and teacher assessment of stereotyped behaviours is set out in table 7.7 together with findings from studies 1 and 2. This shows that of the stereotyped behaviours observed during study 1, only three concurred with the parent and teacher assessments of what was typical for this child (sniffing objects or self, finger movements, and gazing), whilst during study 2 only two stereotyped behaviours were found to be in agreement with parent and teacher assessments (finger movements and gazing). Table 7.7 also demonstrates that six behaviours were observed which were not considered typical for this child (rocking, body movements, postures, grimacing, constantly feeling an object, and repeatedly performing certain movements) for this child. It is possible that the researcher categorised certain behaviours differently from what the parent and teacher might have done. For example, where the researcher classed the behaviour of 'pulling at his hair' as 'constantly feels an object', the parent and teacher may have considered such behaviour as 'hand movements'. Alternatively, it could be that these behaviours were anxiety related. Clearly it is difficult to be certain.

Table 7.7

Comparison of stereotyped behaviours: reported and observed – child 1

Behaviour	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Rocking			√
Sniffing objects or self	T2 (H)	√	
Spinning **Waving arms**			
Head-rolling			
Whirling			
Body movements			√
Pacing			
Twirling			
Hand movements	T2 (H/A) P1A (H)		
Yelling			
Bouncing			
Running			
Finger movements	T2 (H/A)	√	√
Gazing	T2 (H)	√	√
Postures		√	√
Clapping			
Grimacing		√	√
Flaps arms/ hands			
Constantly feels objects		√	√
Echolalia			
Keeps performing certain movements		√	√
Other behaviours	High-pitched voice tone. Asking to go to toilet. Crying.	√	√

Note. T2 = teacher 2. P1A = parent of child 1. H = habit. A = when anxious.

A comparison of the scaled average rate of stereotyped behaviours per hour for studies 1 and 2 is demonstrated in table 7.8. Data are imported from tables 7.1 and 7.4. The figures for the scaled averages in the final row are arrived at by dividing the total number of stereotyped behaviours by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was an increase in the rate of stereotyped behaviours observed per hour during study 2 when compared to study 1. It can be seen that higher rates of stereotyped behaviours were observed during 'ball time' for both studies. This is a task based activity where the child was expected to work independently, a factor which could be considered to increase stress and anxiety.

Table 7.8

Scaled average stereotyped behaviours per hour – child 1

	Stereotyped behaviours	
Activity	Study 1	Study 2
check timetable	27.0	n/a
ball time	36.0	41.5
snack	9.0	21
vis diary	12.0	n/a
Scaled average	**26.2**	**32.8**

A comparison of the findings from the parent and teacher assessment of physical signs of anxiety is set out in table 7.9 together with findings from studies 1 and 2. This demonstrates that of the two categories of physical signs of anxiety observed during studies 1 and 2, neither concurred with the parent and teacher assessments of the child. It should be noted, however, that the parent did identify the behaviour of picking at fingers and pulling at lips as a physical sign of anxiety, although she did not class it as falling into the category 'bites or scratches self'. The researcher did observe these behaviours (n5) across both studies and classified the behaviour as 'bites or scratches self'.

Table 7.9

Comparison of physical signs of anxiety: reported and observed – child 1

Physical signs	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Breathlessness			
Feeling sick			
Pains in stomach			
Sweaty hands			
Excessive tiredness			
Paleness or redness	P1A		
Aggressiveness			
Anger			
Over-reacts	P1A T2		
Cannot sit still		√	√
Overactive			
Talks too loudly	P1A		
Panics	P1A T2		
Cries for incomprehensible reasons	P1A		
Bites or scratches self		√	√
Other	Picking at fingers Pulling at lips (P1A)	√	√

Note. T2 = teacher 2. P1A = parent of child 1.

A comparison of the scaled average rate of physical signs of anxiety per hour is demonstrated in table 7.10. Data are imported from tables 7.2 and 7.5. The figures for the scaled averages in the final row are arrived at by dividing the total number of physical signs of anxiety by the total observation time and multiplying by 60 to obtain a figure for the hour. An increase was noted in the rate of physical signs of anxiety observed per hour during study 2 when compared with study 1. This was most noticeable during the activity ‘ball time’. This would be when the child would be working independently, which as mentioned earlier could be considered to be a stress inducing situation.

Table 7.10

Scaled average physical signs of anxiety per hour – child 1

	Physical signs of anxiety	
Activity	Study 1	Study 2
check timetable	3	n/a
ball time	5.5	14.2
snack	0	4.5
vis diary	4	n/a
Scaled average	**3.8**	**10.1**

A comparison of the findings from the parent and teacher assessment of environmental stressors is set out in table 7.11 together with findings from studies 1 and 2. It can be seen that although many items were identified by both parent and teacher, there was concurrence on only three (changes in task, changes in environment, and receiving a reprimand). However, concurrence between items reported and those observed was high in study 1, with four of the categories of events observed corresponding with events identified as stressors by the teacher. In study 2 only two of the five categories identified corresponded with those reported.

Table 7.11

Comparison of environmental events: reported and observed – child 1

Environmental events	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Loud noises	T2		
Noise or disruption from others	T2	√	√
Bright lights			
Changes in schedule or plans	T2	√	
Changes in task	P1A; T2	√	√
Moving from one location to another			√
Changes in environment	P1A; T2		
Changes in teacher or supervisor			
Being unable to communicate needs	T2		
Needing to ask for help	T2	√	
Being touched by others			
Waiting for transportation	P1A		
Participating in a group activity			√
Waiting for a not-liked activity to begin			
Having to engage in a not-liked activity			
Receiving a reprimand	P1A; T2		
Being told "no"	P1A		
Receiving verbal reinforcement			√
Receiving tangible reinforcement			
Personal objects out of order	P1A		
Personal objects touched by others	P1A		
Personal objects missing	P1A		
Being prevented from completing a ritual	P1A		
Being prevented from carrying out a ritual	P1A		
Being interrupted while engaging in a ritual			
Other factors		√	√

Note. T2 = teacher 2. P1A = parent of child 1.

A comparison of the scaled average rate of environmental events per hour is demonstrated in table 7.12. Data are imported from tables 7.3 and 7.6. The figures for the scaled averages in the final row are arrived at by dividing the total number of environmental events by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was an overall increase in the frequency of environmental events recorded per hour between the two studies.

Table 7.12

Scaled average environmental events per hour – child 1

	Environmental events	
Activity	Study 1	Study 2
check timetable	12	n/a
ball time	19.6	28.4
snack	6	12
vis diary	4	n/a
Scaled average	**13.6**	**21.5**

Timetable use

Generally, child 1 was observed to make little obvious use of the symbolic timetable during these two studies. Occasions when child 1 was noted to use the symbolic timetable were during specific ‘check timetable’ times or on occasions when his attention was drawn to the timetable by a member of staff.

Use of the interactive timetable by child 1 was noted to occur solely on occasions when the child had been allocated to use the timetable by the teacher.

7.5.1.2 Child 4

The findings of the assessments conducted in relation to child 4 are now set out, beginning with the teacher’s assessment and then continuing with the findings of two observation studies.

Teacher assessment

Information presented here concerning child 4 was gathered from a self-completion questionnaire completed by the teacher during week 111. There is no parental report for this child.

General behaviour

The teacher reported that child 4 was:

> *Quiet, withdrawn, reluctant to talk. Can suddenly cry. Fear of rain, losing items of clothing. Low self-esteem. Poor coordination, ambidextrous. Morbid.* (AQ4:Q1)

Anxiety or stress related behaviour

The teacher reported that the child would cry, look down and withdraw from his task when stressed. She also noted that he had a tendency to discuss his obsession.

Recognised stereotyped behaviour

The teacher selected the following behaviours from those listed in the questionnaire:

- Rocking (from habit and when anxious)
- Spinning (from habit, when anxious and when happy)
- Waving arms (from habit, when anxious and when happy)
- Body movements (from habit and when anxious)
- Hand movements (from habit and when anxious)
- Gazing (from habit and when anxious)
- Flaps arms or hands (from habit and when anxious)

The teacher also commented in the space for ‘other behaviours’ that the child would frequently either sob, or be silent when anxious. She noted also that gore, robots, morbidity, and fossils obsessed the child, and that he had a fear of artificial body parts.

Anxiety provoking events

The teacher reported the following as events which caused anxiety for this child:

- Rain
- Being told off
- Being unable to ask for help, to go to the toilet, or to ask for food

Potential stressors

From the list of 25 potential environmental stressors, the teacher selected the following:

- Loud noises
- Noise or disruption from others
- Changes in schedule or plans
- Changes in environment from familiar to unfamiliar
- Being unable to communicate needs
- Needing to ask for help
- Waiting for transportation
- Receiving a reprimand
- Personal objects missing

Stress related environments

The teacher noted that environments where stressors tended to occur for this child were when travelling on transport between home and school, going on class outings, and certain class activities.

Recognised physical signs of anxiety and stress

The teacher reported that the child cried or appeared nervous at school when anxious and selected the following from the list of 15 physical signs of anxiety presented in the questionnaire:

- Sweaty hands
- Excessive tiredness
- Over-reacts
- Panics
- Cries for incomprehensible reasons

The teacher also documented that the child was reported by his mother to have trouble sleeping at night, to wake sometimes in the night scared, and to complain occasionally of having nightmares.

Strategies for easing anxiety and stress

The teacher commented that potentially frightening subject matter was avoided in class. She also noted that a symbolic timetable was used, that care was taken with the child's possessions, that he was given lots of praise, and that social stories were used to help explain potentially stressful issues.

Structured observation study 1

Child 4 was observed in the classroom setting during four activity sessions, over the period of two days. This was in order to establish a baseline for anxiety related behaviour. During this study, the symbolic timetable was used in the normal way. The child was observed for 65 minutes in total, during the following activities: 'ball time' (15 minutes), 'snack time' (20 minutes), 'circle time' (15 minutes), and 'painting' (15 minutes).

Stereotyped behaviours

Child 4 displayed a range of 30 behaviours over the four observation sessions (table 7.13). Behaviours were grouped according to five categories: 'rocking', 'gazing', 'postures', 'constantly feels an object', and 'keeps performing certain movements'. The child was also observed to exhibit other behaviours which were considered noteworthy, but which did not correspond to any of the predetermined categories. These were categorised as 'other behaviours' (n2) and included occasions when the child was noted to be smiling and laughing. These particular behaviours were only observed during the activity ‘painting’. The behaviour ‘postures’ was observed to occur most frequently (n16) and comprised occasions of stretching, sitting back in the chair with arms above head, sitting with legs crossed at ankles, and sitting resting his fists on his cheeks. The child was seen to display a greater number of behaviours during ‘ball time’ (n15), a rate of 60 per hour, whilst the least number of behaviours were observed during ‘painting’ (n4) a rate of 16 per hour.

Table 7.13

Frequency of stereotyped behaviours observed for child 4 – study 1

	Stereotyped behaviours								
Activity	*Rocking*	*Gazing*	*Postures*	*Constantly feels an object*	*Keeps performing certain movements*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	0	1	7	5	2	0	15	15	60.0
Snack time	1	0	4	1	0	0	6	20	18.0
Circle time	0	0	5	0	0	0	5	15	20.0
Painting	1	1	0	0	0	2	4	15	16.0
Total	**2**	**2**	**16**	**6**	**2**	**2**	**30**[a]	**65**[b]	**27.7**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all stereotyped behaviours observed in one hour arrived at by dividing the total number SB (30) by the total observation time (65) and multiplying by 60.

Physical signs of anxiety

Child 4 was observed to display five physical signs of anxiety over the four observation periods (table 7.14). These were categorised as ‘excessive tiredness’ (n1), which was characterised by yawning and ‘cannot sit still’ (n4), which involved occurrences of the child constantly moving his legs or knocking his knees together. The child was noted to exhibit a higher number of physical signs of anxiety during the activity ‘ball time’ (n4). No physical signs of anxiety were observed during the activities ‘circle time’ or ‘painting’.

Table 7.14

Frequency of physical signs of anxiety observed for child 4 – study 1

	Physical signs				
Activity	*Excessive tiredness*	*Cannot sit still*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	1	3	4	15	16.0
Snack time	0	1	1	20	3.0
Circle time	0	0	0	15	0
Painting	0	0	0	15	**0**
Total	**1**	**4**	**5**[a]	**65**[b]	**4.6**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (5) by the total observation time (65) and multiplying by 60.

Environmental events

During these observations, 15 environmental events were identified and these were grouped into four main categories as demonstrated in table 7.15. Other events, which did not fall into specific categories, were grouped under the heading ‘other factors’ (n6). These included events such as the teacher checking the child’s work, the nursery nurse helping the child with his task, the teacher asking the children a question, and the teacher speaking to the class in general. The event which occurred most frequently was ‘noise or disruption from others’ (n6), with a greater number of these events occurring during ‘ball time’ (n5). A higher number of environmental events were recorded during ‘ball time’ (n7), a rate of 28 per hour, whilst the least amount occurred during ‘painting’ (n2), at a rate of eight per hour.

Table 7.15

Frequency of environmental events observed for child 4 – study 1

	Environmental events							
Activity	*Noise or disruption from others*	*Changes in task to a new task*	*Needing to ask for help*	*Participating in a group activity*	*Other factors*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Ball time	5	0	0	0	2	7	15	28.0
Snack time	0	0	1	1	1	3	20	9.0
Circle time	0	0	0	0	3	3	15	12.0
Painting	1	1	0	0	0	2	15	8.0
Total	**6**	**1**	**1**	**1**	**6**	**15**[a]	**65**[b]	**13.8**[c]

Note. EE = environmental events.

[a] Total number of environmental events observed during study 1. [b] Total duration of observation time for study 1. [c] Scaled average of all environmental events observed in one hour, arrived at by dividing the total number EE (15) by the total observation time (65) and multiplying by 60.

Symbolic timetable use

Child 4 was not observed to make any noticeable reference to the symbolic timetable during these observation sessions. No changes were seen to be made to the symbolic timetable by any staff member during these observations.

Structured observation study 2

Child 4 was observed in the classroom setting on four occasions over two separate days. During this time, the children had access to the interactive timetable in addition to the symbolic timetable. Structured observations took place during 'red ball time' (20 minutes), 'snack time' (20 minutes), 'yellow ball time' (20 minutes), and 'reading class' (10 minutes). Child 4 was observed for a total of 70 minutes. The teacher allocated the child to spend 10 minutes using the interactive timetable immediately after 'check timetable' time on both days. It should be noted that two changes were introduced into the setting at this time; the nursery nurse was absent due to sickness and a supply teacher was assisting with the class. Data for 'red ball time' and 'yellow ball time' have been combined together in the tables which follow, under the heading 'ball time', as these activities involved the child working independently on similar tasks.

Stereotyped behaviours

Child 4 was observed to display 22 behaviours over the four observation sessions and these were classified under four categories of stereotyped behaviour (table 7.16). Four other behaviours were considered noteworthy and were categorised as 'other behaviours'. These included occasions when the child asked for help, put up his hand to answer the teacher's question and talked to another child. These behaviours are not characteristic of a child with autism, nor are they considered stereotypic. However, these were behaviours of a social communication nature and as such were considered important to note, as the fact that the child was interacting in these ways could possibly have induced feelings of anxiety in the child. Of the stereotyped behaviours, 'constantly feel an object'(n8) and 'postures' (n6) were observed most frequently. A greater number of behaviours were observed during 'ball time' (n10), a rate of 15 per hour and during 'reading' (n9), at a rate of 54 per hour.

Table 7.16

Frequency of stereotyped behaviours observed for child 4 – study 2

	Stereotyped behaviour							
Activity	*Gazing*	*Postures*	*Constantly feels an object*	*Keeps performing certain movements*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	2	0	5	0	3	10	40	15.0
Snack time	0	1	0	1	1	3	20	9.0
Reading	1	5	3	0	0	9	10	54.0
Total	**3**	**6**	**8**	**1**	**4**	**22**[a]	**70**[b]	**18.9**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all stereotyped behaviours observed in one hour, arrived at by dividing the total number SB (22) by the total observation time (70) and multiplying by 60.

Physical signs of anxiety

Physical signs of anxiety were only witnessed during the activity 'reading', when five incidences of yawning were observed and these were classified under the category 'excessive tiredness'. Table 7.17 demonstrates these findings.

Table 7.17

Frequency of physical signs of anxiety observed for child 4 – study 2

	Physical signs			
Activity	*Excessive tiredness*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	0	0	40	**0**
Snack time	0	0	20	**0**
Reading	5	5	10	**30.0**
Total	**5**	**5**[a]	**70**[b]	**4.3**[c]

Note. PSA = physical signs of anxiety.

[a]Total number of physical signs of anxiety observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (5) by the total observation time (70) and multiplying by 60.

Environmental events

Twenty-one environmental events were identified and these were classified under six categories as shown in table 7.18. Events grouped under the heading 'other factors' included incidences of the teacher and the speech and language therapist asking the children a question, and of occasions when child 4 was prompted by the teacher in some way. The category 'other factors' was the most frequent (n9), with the next most frequent category being 'changes in task to a new task with new directions' (n5). A greater number of environmental events were observed to occur during 'ball time' (n12), a rate of 18 per hour. It is interesting to note that although during 'reading' only six environmental events were recorded; however, as the session was only 10 minutes in length, this is in fact a rate of 36 events per hour. In addition to the events reported here, it should be recalled that staffing changes were introduced throughout this period of study 2.

Table 7.18

Frequency of environmental events observed for child 4 – study 2

	Environmental events									
Activity	*Noise or disruption from others*	*Changes in task to a new task*	*Moving from one location to another*	*Needing to ask for help*	*Being touched by others*	*Participating in a group activity*	*Other*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Ball time	2	4	0	1	0	0	5	12	40	18.0
Snack time	0	0	1	0	0	1	1	3	20	9.0
Reading	1	1	0	0	1	0	3	6	10	36.0
Total	**3**	**5**	**1**	**1**	**1**	**1**	**9**	**21**[a]	**70**[b]	**18.0**[c]

Note. EE = environmental events.
[a]Total number of environmental events observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all environmental events observed in one hour arrived at by dividing the total number EE (21) by the total observation time (70) and multiplying by 60.

Symbolic timetable use

Child 4 was sat with his back to the symbolic timetable during the first observation period (red ball time) and similarly during the second observation period (snack time). The child was not seen to refer to the symbolic timetable during these periods. From his position at the worktable during the third observation session (yellow ball time) and similarly during the fourth observation, period (reading time) child 4 was seated in a position where he had a clear view of the symbolic timetable. However, the child was not seen to refer to the timetable at these times.

Interactive timetable use

Child 4 made use of the interactive timetable only when asked to. He was allocated to use the interactive timetable immediately following ‘check timetable’ time on both days when he was observed. The child spent 15 minutes using the interactive timetable on the first day, during which time he checked the timetable for ‘Monday’ on the appropriate page when asked and compared it to the symbolic timetable for this day. When prompted, the child tried to make up a version of his own timetable for that day, but had difficulty maintaining his focus and did not complete this task.

Child 4 was allocated to use the interactive timetable a second time, immediately following 'check timetable' time on the second day of observations and spent 15 minutes on this activity. The child was prompted to check the timetable for this day and eventually did so, but was unsuccessful in his attempt to make his own version of the timetable at this time, as he spent a lot of time playing with the symbols.

Summary

A brief summary of the findings for child 4 with regards to studies 1 and 2 is now presented. A comparison of the findings from the teacher's assessment of stereotyped behaviours with those observed during studies 1 and 2 is presented in table 7.19. It can be seen that only two of the behaviours observed (rocking and gazing) corresponded with behaviours reported as being typical for this child by the teacher. The teacher reported that these behaviours could be displayed by child 4 as both habit and when the child was anxious. Four stereotypical behaviours were observed to be displayed consistently by the child across both studies (gazing, postures, constantly feeling an object, and repeatedly performing certain movements); however, of these only 'gazing' was considered typical by the teacher. It is possible that the researcher classified behaviours differently from the teacher. For example, behaviours identified as 'postures' by the researcher may have been interpreted as 'hand movements' or 'body movements' if observed by the teacher.

Table 7.19

Comparison of stereotyped behaviours: reported and observed – child 4

Behaviour	*Teacher assessment*	*Observation study 1*	*Observation study 2*
Rocking	T2 (H/A)	√	
Sniffing objects or self			
Spinning	T2 (H/A/HP)		
Waving arms	T2 (H/A/HP)		
Head-rolling			
Whirling			
Body movements	T2 (H/A)		
Pacing			
Twirling			
Hand movements	T2 (H/A)		
Yelling			
Bouncing			
Running			
Finger movements			
Gazing	T2 (H/A)	√	√
Postures		√	√
Clapping			
Grimacing			
Flaps arms/ hands	T2 (H/A)		
Constantly feels objects		√	√
Echolalia			
Keeps performing certain movements		√	√
Other behaviours	Sobbing. Silence.	√	√

Note. T2 = teacher 2. H = from habit. A = when anxious. HP = when happy.

A comparison of the scaled average rate of stereotyped behaviours per hour is presented in table 7.20. Data are imported from tables 7.13 and 7.16. The figures for the scaled averages in the final row are arrived at by dividing the total number of stereotyped behaviours by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was a decline in the rate of stereotyped behaviours observed per hour between study 1 and study 2.

Table 7.20

Scaled average stereotyped behaviours per hour – child 4

	Stereotyped behaviours		
Activity	Study 1		Study 2
ball time	60	ball time	15
snack	18	snack	9
circle	20		n/a
painting	16		n/a
		reading	54
Scaled average	**27.7**		**18.9**

A comparison of the findings from the teacher assessment of physical signs of anxiety is set out in table 7.21 together with findings from studies 1 and 2. The teacher reported that child 4 was known to demonstrate five of the categories of physical signs of anxiety, but of these only ‘excessive tiredness’ was observed. However, this was observed consistently across both studies.

Table 7.21

Comparison of physical signs of anxiety: reported and observed – child 4

Physical signs	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Breathlessness			
Feeling sick			
Pains in stomach			
Sweaty hands	T2		
Excessive tiredness	T2	√	√
Paleness or redness			
Aggressiveness			
Anger			
Over-reacts	T2		
Cannot sit still		√	
Overactive			
Talks too loudly			
Panics	T2		
Cries for incomprehensible reasons	T2		
Bites or scratches self			
Other			

Note. T2 = teacher 2.

A comparison of the scaled average rate of physical signs of anxiety per hour is presented in table 7.22. Data are imported from tables 7.14 and 7.17. The figures for the scaled averages in the final row are arrived at by dividing the total number of physical signs of anxiety by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was a very slight decline in the rate of physical signs per hour between study 1 and study 2.

Table 7.22

Total physical signs of anxiety per hour – child 4

	Physical signs of anxiety		
Activity	Study 1		Study 2
ball time	16	ball time	0
snack	3	snack	0
circle	0		n/a
painting	0		n/a
		reading	30
Scaled average	**4.6**		**4.3**

A comparison of the findings from the teacher's assessment of environmental events with findings from studies 1 and 2 is set out in table 7.23. It can be seen that although nine items were identified by the teacher, there was concurrence on only two (noise or disruption from others and needing to ask for help) across both observation studies. It can be seen that there was agreement between studies regarding four categories of environmental events. For both studies the events reported as 'other factors' were incidences of social interaction and communication from the teacher, the nursery nurse, and the speech and language therapist. As discussed in the literature (sections 2.2.1.1 and 2.2.1.2) these areas present difficulties for the child with autism and could, therefore, be potential stressors.

Table 7.23

Comparison of environmental events: reported and observed – child 4

Environmental stressors	*Teacher assessment*	*Observation study 1*	*Observation study 2*
Loud noises	T2		
Noise or disruption from others	T2	√	√
Bright lights			
Changes in schedule or plans	T2		
Changes in task		√	√
Moving from one location to another			√
Changes in environment	T2		
Changes in teacher or supervisor			
Being unable to communicate needs	T2		
Needing to ask for help	T2	√	√
Being touched by others			√
Waiting for transportation	T2		
Participating in a group activity		√	√
Waiting for a not-liked activity to begin			
Having to engage in a not-liked activity			
Receiving a reprimand	T2		
Being told "no"			
Receiving verbal reinforcement			
Receiving tangible reinforcement			
Personal objects out of order			
Personal objects touched by others			
Personal objects missing	T2		
Being prevented from completing a ritual			
Being prevented form carrying out a ritual			
Being interrupted while engaging in a ritual			
Other factors	Being unable to go to the toilet. Being unable to ask for food	√	√

Note. T2 = teacher 2.

A comparison of the scaled average rate of environmental events per hour for studies 1 and 2 is set out in table 7.24. Data are imported from tables 7.15 and 7.18. The figures for the scaled averages in the final row are arrived at by dividing the total number of environmental events by the total observation time and multiplying by 60 to obtain a figure for the hour. A rise in the rate of environmental events per hour between study 1 and study 2 can be seen.

Table 7.24

Scaled average environmental events per hour – child 4

	Environmental events		
Activity	Study 1		Study 2
ball time	28	ball time	18
snack	9	snack	9
circle	12	n/a	
painting	8	n/a	
		reading	36
Scaled average	**13.8**		**18**

Timetable use

Child 4 was not observed to make any obvious use of the symbolic timetable during either of the two studies. Furthermore, child 4 was observed to use the interactive timetable only on the occasions when he had been allocated to do so by the teacher.

7.5.1.3 Child 6

The findings of the assessments conducted with child 6 are now presented. The outcomes of the parent and teacher assessments are set out and then the findings of observation study 1 and observation study 2 are presented.

Parent and teacher assessment

The findings presented here concerning child 6 are taken from two sources. The child's parent and the class teacher both filled out a self-completion questionnaire in week (111).

General behaviour

The child's mother reported the following regarding her child:

> *Innately good and can behave very well. Stress can cause poor behaviour, which is difficult to control. Also tends to be very loud in expression of annoyance.*
> (AQP6: Q1)

The teacher offered the following description of child 6:

> *Likes order, always tidying, 'instructive' style of language. Huge comprehension problems. Eager to please. Idiosyncratic. Dislikes back or torso being touched. Responds to praise and rewards. 'Zones out' beside elevators or on transport.*
> (AQ6:Q1)

Anxiety and stress related behaviour

The mother noted that the child presented unusual facial expressions, would complain loudly and would display non-verbal signs such as folding his arms.

The teacher reported that when anxious the child would frequently agree saying *"alright, alright I know"*. She also noted that he would make rapid actions or decisions and shout loudly if someone brushed past him. If there were any loud noises such as bells or music, then he would cover his ears.

Recognised stereotyped behaviours

From the list of 22 behaviours, the mother selected the following as applying to her child:

- Spinning (when happy)
- Twirling (when happy)
- Hand movements (from habit)
- Yelling (from habit)
- Gazing (from habit)
- Grimacing (from habit)

- Echolalia (from habit)

The teacher selected the following behaviours as applying to child 6:

- Yelling (from habit and when anxious)
- Running (from habit)
- Gazing (from habit and when happy)
- Grimacing (from habit)
- Echolalia (from habit)

In addition, the teacher commented at the end of this list that the child frequently hugged toys for security and that he often built lifts from the construction toys.

Anxiety provoking events

The mother observed that her child would become anxious with:

> *Things people say which he perceives as incorrect. Other people singing loudly. Frustration with computer games.*
> (AQP6: Q4)

The teacher reported that a change in routine, lack of visual aids and use of too complex language could lead to anxiety for child 6.

Potential stressors

From the list of 25 possible stressors, the child's mother selected the following:

- Loud noises
- Noise or disruption from others
- Sometimes changes in schedule or plans
- Being unable to communicate needs
- Needing to ask for help
- Sometimes being touched by others
- Sometimes participating in a group activity

- Waiting for a not-liked for activity to begin
- Receiving a reprimand
- Sometimes being told ‘no’
- Sometimes having personal objects missing

The teacher selected the following possible stressors from the list:

- Loud noises
- Noise or disruption from others
- Changes in schedule or plans
- Changes in task to a new task with new directions
- Being unable to communicate needs
- Being touched by others
- Receiving a reprimand
- Personal objects out of order
- Being prevented from completing a ritual (very independent and determined)

Stress related environments

The mother reported:

> *Anywhere, probably more affected by presence of other children. Much better with one-to-one adult care. Environment not particularly relevant.*
> (AQP6: Q6).

The teacher observed that there were *“stressors throughout. Has responded well to TEACCH”* (AQ6: Q6)

Recognised physical signs of anxiety

The child’s mother observed that her child tended to display unusual facial expressions. The following were selected by the mother from the list of 15 physical signs in the questionnaire:

- Breathlessness (asthmatic)

- Feeling sick
- Pains in stomach
- Excessive tiredness
- Paleness or redness
- Anger
- Over-reacts
- Talks too loudly
- Panics

The teacher reported that the child would shout if a person brushed past and that he would grimace if he touched strange textures. The teacher selected the following from the list of fifteen physical signs of anxiety:

- Breathlessness (asthmatic)
- Over-reacts (shouts and jumps)
- Overactive

Strategies for easing anxiety and stress

The mother noted that the child found breathing techniques helpful, such as, counting slowly and deep breathing. She also commented that the child found lying down in a darkened room with a cold compress to his head was soothing.

The teacher reported that a timetable was used in class, as well as a reward system and a task bag. In addition, she explained that the child was given clear objectives.

Structured observation study 1

Child 6 was observed in the classroom setting during four specific activity sessions, in order that a baseline of anxiety related behaviour could be established. The observations took place over a period of three days and during this time the symbolic timetable was used in class as normal. The child was observed during 'red ball time' (10 minutes), 'blue ball time' (20 minutes), 'red ball time' (15 minutes), and 'painting' (15 minutes), a total of 60 minutes. The data collected during the three 'ball time' sessions have been combined and are presented in the tables which follow under the heading 'ball time'.

Stereotyped behaviours

Child 6 exhibited 31 behaviours and these were grouped under five categories of stereotypical behaviour, as demonstrated in table 7.25. Behaviours which did not fall into these categories were classified under the heading 'other behaviours' (n18) and these accounted for just over half (58.1%) of the total number of behaviours observed. Behaviours classified as 'other behaviours' included instances when the child was noted to be talking quietly to himself, to be smiling to himself, to go off to the toilet, and to ask the nursery nurse for assistance. Whilst these behaviours are not characteristic of children with autistic spectrum disorder, these were considered worth reporting. It is possible that the child 'talking to himself' and 'smiling to himself' indicated preoccupation, either with the task at hand or with personal thoughts. It is possible that the child was having difficulty with a task and these behaviours could have been his way of communicating his need for assistance. The greatest frequency of behaviours occurred during 'ball time' (n23), however, table 7.25 illustrates that a higher rate of behaviours per hour were actually recorded during 'painting' (32 per hour).

Table 7.25

Frequency of stereotyped behaviours observed for child 6 – study 1

	Stereotyped behaviour								
Activity	*Pacing*	*Gazing*	*Postures*	*Grimacing*	*Constantly feels an object*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	1	3	3	2	2	12	23	45	30.7
Painting	1	0	0	0	1	6	8	15	32.0
Total	**2**	**3**	**3**	**2**	**3**	**18**	**31**[a]	**60**[b]	**31.0**[c]

Note. SB = stereotyped behaviours.

[a]Total number of stereotyped behaviours observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all stereotyped behaviours observed in one hour, arrived at by dividing the total number SB (31) by the total observation time (60) and multiplying by 60.

Physical signs of anxiety

Child 6 was observed to display six physical signs of anxiety during study 1 and these were grouped into four categories. Physical signs of anxiety were observed to occur most frequently during ‘ball time’ (n5). Table 7.26 demonstrates these findings.

Table 7.26

Frequency of physical signs of anxiety observed for child 6 – study 1

	Physical signs						
Activity	*Breathlessness*	*Over-reacts*	*Talks too loudly*	*Bites or scratches self*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	1	1	2	1	5	45	6.7
Painting	1	0	0	0	1	15	4.0
Total	**2**	**1**	**2**	**1**	**6**[a]	**60**[b]	**6.0**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (6) by the total observation time (60) and multiplying by 60.

Environmental events

Seventeen environmental events were found to have occurred during study 1 and these were grouped according to four specific categories. Other events, which were recorded under the heading ‘other factors’ (n7), included occasions when the child was prompted by a member of staff, was asked if he needed help by a member of staff, had his work checked by the teacher, and commented on an object being out of place in the classroom. Environmental events categorised as ‘other factors’ were observed most frequently (n7), whilst ‘noise or disruption from others’ was the second most frequent event observed (n5). A high number of events were observed during ‘ball time’ (n15), a rate of 20 per hour. Table 7.27 demonstrates these findings.

Table 7.27

Frequency of environmental events observed for child 6 – study 1

	Environmental events							
Activity	*Loud noises*	*Noise or disruption from others*	*Changes in task to a new task*	*Needing to ask for help*	*Other*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Ball time	1	5	2	1	6	15	45	20.0
Painting	0	0	1	0	1	2	15	8.0
Total	**1**	**5**	**3**	**1**	**7**	**17**[a]	**60**[b]	**17.0**[c]

Note. EE = environmental events.
[a]Total number of environmental events observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all environmental events observed in one hour, arrived at by dividing the total number EE (17) by the total observation time (60) and multiplying by 60.

Symbolic timetable use

Child 6 was witnessed looking at a symbol representing 'independence', which was lying beside him on the worktable during 'ball time'. (Symbols were sometimes used in this way as an extension of the symbolic timetable, with the teacher placing the symbol on the table at the start of an activity to act as a prompt for the children). No further use of the timetable by child 6 was noted during study 1.

Structured observation study 2

A series of seven observations of child 6 were conducted one week later, during which time the interactive timetable was accessible in addition to the symbolic timetable. The observations took place on three separate days and were carried out during 'red ball time' (20 minutes), 'snack time' (20 minutes), 'red ball time' (20 minutes), 'snack time' (20 minutes), 'red ball time' (20 minutes), 'snack time' (20 minutes), and 'story time' (15 minutes). The child was observed for a total of 135 minutes. The teacher allocated the child to spend 10 minutes using the interactive timetable immediately after 'check timetable' time on each of the three days. It should be noted that the nursery nurse and child 4 were both absent on the third day when child 6 was observed. Data gathered during the 'red ball' sessions have been combined and are presented in the tables which follow under the heading ‘ball time’. Data gathered during ‘snack time’ have also been combined.

Stereotyped behaviour

Thirty-six behaviours were observed to be displayed by child 6 and were classified according to seven categories. Those behaviours which did not correspond with specific categories were classified as ‘other behaviours’ and these were found to occur most frequently (n14). These referred to occasions when the child had been heard to be speaking to himself and to others, to be talking about his obsession, to have smiled to himself, and to have gone out of the classroom to the toilet. Again, these behaviours are not considered characteristic of autism; however, these were judged to be noteworthy. For example, the instances of ‘speaking to himself’ and ‘talking about his obsession’ could indicate a preoccupation, which as discussed earlier (section 2.3.3.3) could indicate anxiety. The category ‘constantly feels an object’ (n8) was the next most frequent behaviour to be observed. Behaviours were found to occur most frequently during ‘ball time’ (n24), a rate of 24 per hour. The least amount of behaviours were observed during ‘story time’ (n2), a rate of eight per hour. Table 7.28 demonstrates these findings.

Table 7.28

Frequency of stereotyped behaviours observed for child 6 – study 2

	Stereotyped behaviour										
Activity	*Pacing*	*Finger movemts*	*Gazing*	*Postures*	*Grimacing*	*Constantly feels an object*	*Keeps performing certain movemts*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	0	1	4	4	0	3	2	10	24	60	24.0
Snack time	1	0	0	1	1	3	0	4	10	60	10.0
Story time	0	0	0	0	0	2	0	0	2	15	8.0
Total	**1**	**1**	**4**	**5**	**1**	**8**	**2**	**14**	**36**[a]	**135**[b]	**16.0**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all stereotyped behaviours observed in one hour, arrived at by dividing the total number SB (36) by the total observation time (135) and multiplying by 60.

Physical signs of anxiety

Child 6 was observed to display 16 physical signs of anxiety. The majority were categorised as 'breathlessness' (n10), while six occasions of excessive blinking were also observed and these were categorised as 'other behaviours'. Physical signs were observed most frequently during 'snack time' (n8) and during 'ball time' (n7). Table 7.29 demonstrates these findings.

Table 7.29

Frequency of physical signs of anxiety observed for child 6 – study 2

	Physical signs				
Activity	*Breathlessness*	*Other*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	6	1	7	60	7.0
Snack time	4	4	8	60	8.0
Story time	0	1	1	15	4.0
Total	**10**	**6**	**16**[a]	**135**[b]	**7.1**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (16) by the total observation time (135) and multiplying by 60.

Environmental events

Thirty-nine environmental events were identified and these were classified according to nine main categories as demonstrated in table 7.30. Events grouped under the heading 'other factors' included occasions when the teacher checked or marked the child's work, when the teacher gave another child nearby a reprimand, when the children were asked a question by a member of staff, when the teacher helped the child with his task, and occasions when the teacher was explaining something to the class. The most frequently observed event was 'noise or disruption from others' (n12), followed closely by 'other factors' (n11). Environmental events were noted to occur most frequently during 'ball time' (n22).

Table 7.30

Frequency of environmental events observed for child 6 – study 2

	Environmental events												
Activity	*Noise or disruption from others*	*Changes in schedule or plans*	*Changes in task to a new task*	*Moving from one location to another*	*Needing to ask for help*	*Being touched by others*	*Engaging in a not liked activity*	*Receiving verbal reinforcement*	*Receiving tangible reinforcement*	*Other*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Ball time	9	0	4	1	1	1	0	1	0	5	22	60	22.0
Snack time	3	1	2	1	0	0	2	0	2	4	15	60	15.0
Story time	0	0	0	0	0	0	0	0	0	2	2	15	8.0
Total	**12**	**1**	**6**	**2**	**1**	**1**	**2**	**1**	**2**	**11**	**39**[a]	**135**[b]	**17.33**[c]

Note. EE = environmental events.
[a]Total number of environmental events observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all environmental events observed in one hour, arrived at by dividing the total number EE (39) by the total observation time (135) and multiplying by 60.

Symbolic timetable use

During the first observation period, (red ball time) child 6 was sat at the worktable and would have had a clear view of the symbolic timetable. He was witnessed to be looking in the direction of the timetable on two occasions. The first occasion was when the teacher was standing beside the timetable talking to a child visiting from another class. On the second occasion child 6 was gazing in the direction of the timetable, but nothing significant which would indicate a use of the symbolic timetable was noted. Child 6 was later noted to be gazing in the direction of the symbolic timetable during the ‘snack time’ session and it is possible that he was referencing the ‘help chart’ at this time.

The child was sat facing the symbolic timetable during the activity ‘red ball time’ and was noted to be gazing in the direction of the timetable on one occasion. This appeared to be related to the teacher putting up a ‘sad face’ on another child’s behaviour chart. Later during ‘snack time’ child 6 was seated in a position where he was able to view the symbolic timetable; however, no use of the timetable was observed.

Interactive timetable use

Child 6 used the interactive timetable only when asked to. Immediately following ‘check timetable’ time, child 6 was allocated to work on the interactive timetable and spent 20 minutes on this activity. The child looked at the correct timetable for that day and spent some time looking at linked areas from this page. He also attempted to make up his own version of the timetable for that day without prompting, but he took some time to do this, continually checking the symbolic timetable before selecting symbols to add. Child 6 made no request to make further use of the interactive timetable on this particular day.

Child 6 was allocated to use the interactive timetable on the second day of observations, prior to commencing his first activity. The child spent ten minutes using the interactive timetable on this day. When prompted, child 6 checked the timetable for this particular day and then later went on to make his own version of the timetable without any prompting. Child 6 made no further use of the interactive timetable on this day. It had been planned that child 6 would have a second session using the interactive timetable prior to ‘story time’, but this did not happen.

Summary

A summary of the findings for child 6 with regards to studies 1 and 2 is now set out. A comparison of the findings from the parent and teacher assessments of stereotyped behaviours with those observed during studies 1 and 2 is presented in table 7.31. It can be seen that there was agreement between the parent and teacher regarding four stereotyped behaviours (yelling, gazing, grimacing, and echolalia), although these were reported to be displayed from habit rather than from anxiety. Two of these behaviours (gazing and grimacing) were observed across both studies. It can be seen that five stereotyped behaviours were observed consistently across both studies for child 6, although these were not identified as being typical for this child by parent or teacher.

Table 7.31

Comparison of stereotyped behaviours: reported and observed – child 6

Behaviour	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Rocking			
Sniffing objects or self			
Spinning **Waving arms**	P6A (HP)		
Head-rolling			
Whirling			
Body movements			
Pacing		√	√
Twirling	P6A (HP)		
Hand movements	P6A (H)		
Yelling	P6A (H) T2 (H/A)		
Bouncing			
Running	T2 (H)		
Finger movements			√
Gazing	P6A (H) T2 (H)	√	√
Postures		√	√
Clapping			
Grimacing	P6A (H) T2 (H)	√	√
Flaps arms/ hands			
Constantly feels objects		√	√
Echolalia	P6A (H) T2 (H)		
Keeps performing certain movements			√
Other behaviours	Hugs toys. Building constructions.	√	√

Note. T2 = teacher 2. P6A = parent of child 6. H = from habit. A = when anxious. HP = when happy.

Table 7.32 compares the scaled average rate of stereotyped behaviours per hour for the two studies. Data are imported from tables 7.25 and 7.28. The figures for the scaled averages in the final row are arrived at by dividing the total number of stereotyped behaviours by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was a notable decrease in the scaled average rate of stereotyped behaviours observed per hour during study 2 when compared to study 1. This may be related to the activities in each study. For example, a high number of behaviours were observed during ‘painting’ in study 1, but the child was not observed during this activity in study 2.

Table 7.32

Scaled average stereotyped behaviours per hour – child 6

	Stereotyped behaviours		
Activity	Study 1		Study 2
ball time	30.7	ball time	24
painting	32	snack	10
		story time	8
Scaled average	**31.0**		**16**

A comparison of the findings from the parent and teacher assessment of physical signs of anxiety is set out in table 7.33 together with findings from studies 1 and 2. The parent and teacher agreed on only two physical signs of anxiety that child 6 was known to demonstrate (breathlessness and over-reacting). ‘Breathlessness’ was the only physical sign to be observed during both studies. The parent and teacher both remarked that child 6 had a tendency to display unusual facial expressions when anxious. It is possible that the ‘smiling’ expressions observed may have been considered as unusual facial expressions by the parent and teacher. Physical signs that were in agreement with parent and teacher assessments in study 1 were ‘talks too loudly’ and ‘over-reacts’.

Table 7.33

Comparison of physical signs of anxiety: reported and observed – child 6

Physical signs	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Breathlessness	P6A T2	√	√
Feeling sick	P6A		
Pains in stomach	P6A		
Sweaty hands			
Excessive tiredness	P6A		
Paleness or redness	P6A		
Aggressiveness			
Anger	P6A		
Over-reacts	P6A T2	√	
Cannot sit still			
Overactive	T2		
Talks too loudly	P6A	√	
Panics	P6A		
Cries for incomprehensible reasons			
Bites or scratches self		√	
Other	Unusual facial expressions (P6A; T2) Shouting (T2)		√

Note. T2 = teacher 2. P6A = parent of child 6.

A comparison of the scaled average rate of physical signs of anxiety per hour for studies 1 and 2 is demonstrated in table 7.34. Data have been imported from tables 7.26 and 7.29. The figures for the scaled averages in the final row are arrived at by dividing the total number of physical signs of anxiety by the total observation time and multiplying by 60 to obtain a figure for the hour. A slight increase in the rate of physical signs of anxiety observed can be seen in study 2 when compared to study 1.

Table 7.34

Scaled average physical signs of anxiety per hour – child 6

	Physical signs of anxiety		
Activity	Study 1	Study 2	
ball time	6.7	ball time	7
painting	4	snack	8
		story time	4
Scaled average	**6**		**7.1**

A comparison of the findings from the parent and teachers assessments of environmental stressors with findings from studies 1 and 2 is set out in table 7.35. It can be seen that the parent and teacher agreed on six items. It can also be seen that there was agreement between studies regarding three categories of environmental events (noise or disruption from others, changes in task, and needing to ask for help), all of which concurred with the parent and teacher assessment for this child.

Table 7.35

Comparison of environmental events: reported and observed – child 6

Environmental stressors	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Loud noises	P6A; T2	√	
Noise or disruption from others	P6A; T2	√	√
Bright lights			
Changes in schedule or plans	P6A; T2		√
Changes in task	T2	√	√
Moving from one location to another			√
Changes in environment			
Changes in teacher or supervisor			
Being unable to communicate needs	P6A; T2		
Needing to ask for help	P6A	√	√
Being touched by others	P6A; T2		√
Waiting for transportation			
Participating in a group activity	P6A		
Waiting for a not-liked activity to begin	P6A		
Having to engage in a not-liked activity			√
Receiving a reprimand	P6A; T2		
Being told "no"	P6A		
Receiving verbal reinforcement			√
Receiving tangible reinforcement			√
Personal objects out of order	T2		
Personal objects touched by others			
Personal objects missing	P6A		
Being prevented from completing a ritual	T2		
Being prevented form carrying out a ritual			
Being interrupted while engaging in a ritual			
Other factors		√	√

Note. T2 = teacher 2. P6A = parent of child 6.

A comparison of the scaled average rate of environmental events per hour is shown in table 7.36. Data have been imported from tables 7.27 and 7.30. The figures for the scaled averages in the final row are arrived at by dividing the total number of environmental events by the total observation time and multiplying by 60 to obtain a figure for the hour. It can be seen that there was a very slight increase in the frequency of environmental events observed between the two studies. Generally the number of environmental events observed was found to be higher during the activity ball time.

Table 7.36

Scaled average environmental events per hour – child 6

	Environmental events		
Activity	Study 1		Study 2
ball time	20	ball time	22
painting	8	snack	15
		story time	8
Scaled average	**17.0**		**17.33**

Timetable use

Child 6 was observed to make use of an extension to the symbolic timetable during study 1. This took the form of a symbol placed on the child's desk. During study 2 the child was noted to be gazing at the symbolic timetable on several occasions; two occasions appeared to be related to incidences when the teacher was standing beside the timetable. Use of the interactive timetable by child 6 was noted to occur on occasions solely when he had been allocated to do so by the teacher.

7.5.1.4 Child 7

The findings of the assessments conducted with child 7 are now presented. The findings of the parent and teacher assessments are set out first and then the findings of structured observation studies 1 and 2 are presented.

Parent and teacher assessments

Questionnaires regarding child 7 were completed by the teacher and parent in week 111.

General behaviour

The child's mother reported that the child:

> *Is generally well behaved. He does however become very easily distracted and can become quite wilful at times. He is fine as long as things are going his way, but can become upset if he has to do something he doesn't want to.*
> (AQP7: Q1)

The teacher described the child as:

> *Bright, lots of 'stories' from obsessions, volatile, poor attention, moody, occasionally aggressive. Improving all the time. Hierarchical, responds to 'strict voice'.*
> (AQ7: Q1)

Anxiety and stress related behaviour

The mother noted that her child becomes

> *Very vocal and appears hyperactive... unable to remain still, running around and in extreme cases becomes aggressive.*
> (AQP7: Q2)

The teacher reported that the child had a tendency to

> *uses 'sound effects' in words, verbalising, stomping feet, bending over, head in hands, crying from fright, covering ears.*
> (AQ7: Q2)

Recognised stereotyped behaviours

From the list of 22 stereotyped behaviours, the child's mother selected:

- Spinning (when happy)
- Waving arms (when anxious)

- Whirling (happy)
- Body movements (happy)
- Pacing (anxious)
- Yelling (anxious)
- Bouncing (happy)
- Running (anxious)
- Constantly feels objects (habit)
- Literally repeats words or sentences just used by someone else (habit)
- Keeps performing certain movements (anxious)

The teacher selected the following stereotyped behaviours as applying to child 7:

- Rocking (habit & anxious)
- Spinning (habit)
- Waving arms (habit)
- Body movements (habit)
- Yelling (habit, anxious & happy)
- Running (habit)
- Postures (habit)
- Grimacing (habit & anxious)

Anxiety provoking events

The child's mother reported that the following events caused anxiety:

- Not winning at a computer game
- Shopping trips
- Leaving friends or relatives to come home
- Going from home to visit friends or relatives

The teacher observed that the child became anxious when he was unable to fulfil the stated aims on the timetable, such as being unable to participate in soft play.

Potential stressors

The mother selected the following from the list of 25 possible stressors:

- Loud noises
- Noise or disruption from others
- Changes in schedule or plans (sometimes)
- Moving from one location to another
- Changes in environment from familiar to unfamiliar
- Changes in teacher or supervisor
- Being unable to communicate needs
- Being touched by others (does not like this)
- Waiting for transportation
- Participating in a group activity
- Waiting for a not-liked activity to begin
- Having to engage in a not-liked activity
- Receiving a reprimand
- Being told "no"
- Receiving verbal reinforcement
- Receiving tangible reinforcement
- Personal objects out of order
- Personal objects touched by others
- Personal objects missing
- Being prevented from completing a ritual
- Being prevented from carrying out a ritual
- Being interrupted while engaging in a ritual

The teacher selected the following as possible stressors for child 7:

- Loud noises
- Noise or disruption from others
- Changes in schedule or plans

- Waiting for a not-liked activity to begin
- Receiving a reprimand
- Being told “no”
- Personal objects touched by others
- Personal objects missing

Stress related environments

The child’s mother noted that the supermarket and the park were two places where her child was likely to feel anxious.

The teacher did not note any specific environments where the child would be likely to feel anxious.

Recognised physical signs of anxiety

The child’s mother noted that her child would bite his lip if reprimanded. In addition, the mother reported that the child would constantly remark that something was sore if he had to go somewhere unfamiliar. From the list of 15 physical signs, the mother selected the following:

- Pains in stomach
- Paleness or redness
- Aggressiveness
- Anger
- Over-reacts
- Cannot sit still
- Overactive (occasionally)
- Talks too loudly (sometimes)
- Cries for incomprehensible reasons
- Bites or scratches himself (bites hand)

In addition, the mother also reported that her child had trouble sleeping at night, often woke up in the night scared and complained of having nightmares, but that this was improving.

The teacher commented that the child did display signs of anxiety and that he would cry or else stomp his feet or hold his head in his hands. The teacher selected the following from the list of physical signs:

- Feeling sick (child claims)
- Excessive tiredness
- Aggressiveness
- Anger
- Over-reacts
- Cannot sit still

The teacher also reported that the child's mother had mentioned that he had trouble sleeping at night.

Strategies for easing anxiety and stress

The child's mother stated that she explains calmly to her child that he has nothing to be scared about and that she tries to remind him of nice things which he is going to be doing the following day.

The teacher noted that the timetable used in class helps the child and that having rewards such as 'choosing' and soft play also help.

Structured observation study 1

Child 7 was observed for three sessions. These were 'check timetable' (20 minutes), 'red ball time' (15 minutes), and 'painting' (20 minutes).

Stereotyped behaviours

Child 7 was observed to display a range of eight stereotyped behaviours across the three observation periods, with 25 behaviours being observed over-all (table 7.37). Four other behaviours were observed. These included incidences of the child talking to other children or to members of staff, talking quietly to himself and to one occasion when the child was witnessed to wipe paint from his fingers surreptitiously onto another child's sleeve. These behaviours are not considered stereotypical, but were recorded as they were considered noteworthy. For example, the incidences of the child talking to other children and to members of staff were behaviours of social interaction and communication, whilst the child talking to himself could indicate preoccupation. The most frequent category of behaviours observed were 'postures' (n8) and these were witnessed during all three of the observation periods. The child was noticed to exhibit the greatest frequency of behaviours during the activity 'check timetable' (n15) and the least amount of behaviours during 'painting' (n3).

Table 7.37

Frequency of stereotyped behaviours observed for child 7 – study 1

	Stereotyped behaviour											
Activity	*Rocking*	*Spinning*	*Finger movemts*	*Gazing*	*Postures*	*Grimacing*	*Constantly feels an object*	*Echolalia*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Check timetable	2	0	1	1	5	1	3	0	2	15	20	45.0
Ball time	0	3	0	0	1	0	1	1	1	7	15	28.0
Painting	0	0	0	0	2	0	0	0	1	3	20	9.0
Total	**2**	**3**	**1**	**1**	**8**	**1**	**4**	**1**	**4**	**25**[a]	**55**[b]	**27.3**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all stereotyped behaviours observed in one hour, arrived at by dividing the total number SB (25) by the total observation time (55) and multiplying by 60.

Physical signs of anxiety

Child 7 displayed only four physical signs of anxiety over the three observation periods and these were grouped according to three categories as shown in table 7.38.

Table 7.38

Frequency of physical signs of anxiety observed for child 7 – study 1

	Physical signs					
Activity	*Excessive tiredness*	*Over-reacts*	*Cannot sit still*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Check timetable	0	0	1	1	20	3.0
Ball time	0	0	1	1	15	12.0
Painting	1	1	0	2	20	6.0
Total	**1**	**1**	**2**	**4**[a]	**55**[b]	**4.36**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (4) by the total observation time (55) and multiplying by 60.

Environmental events

Eighteen environmental events were identified as occurring during the course of the three observation sessions and these were classified according to six categories (table 7.39). Those events which did not fit into the specific categories, but which were considered significant were grouped under the heading 'other factors'. This category was in fact recorded most frequently (n12) and related to occasions when staff members were talking to the children to direct them with their activities, to when the teacher prompted the child, and to an occasion when the child knocked over a pot of paint. A higher percentage of events were noted to occur during 'check timetable' time (44.4%).

Table 7.39

Frequency of environmental events observed for child 7 – study 1

	Environmental events								
Activity	*Noise or disruption from others*	*Changes in task to a new task*	*Moving from one location to another*	*Needing to ask for help*	*Personal objects touched by others*	*Other*	*Total number EE per activity*	*Obs time (mins)*	*Scaled average EE per hour*
Check timetable	0	1	0	0	1	6	8	20	24.0
Ball time	1	0	1	1	0	2	5	15	20.0
Painting	1	0	0	0	0	4	5	20	15.0
Total	**2**	**1**	**1**	**1**	**1**	**12**	**18**[a]	**55**[b]	**19.6**[c]

Note. EE = environmental events.
[a]Total number of environmental events observed during study 1. [b]Total duration of observation time for study 1. [c]Scaled average of all environmental events observed in one hour, arrived at by dividing the total number EE (18) by the total observation time (55) and multiplying by 60.

Symbolic timetable use

The first period of observation was carried out during 'check timetable' time and the nursery nurse was leading this activity on this particular occasion. Child 7 was witnessed to be looking out of the window at one point during this activity and was immediately prompted to pay attention by the nursery nurse. Child 7 was actively involved in part of this session as he was selected to be 'special person', which involved allocating the 'help tasks' for that day. Child 7 was not seen to make any further use of the symbolic timetable during either of the other observation periods.

Structured observation study 2

For study 2, child 7 was observed during eight sessions over two separate days. The first observations were conducted during 'red ball time' (15 minutes), 'snack time' (20 minutes), 'blue ball time' (10 minutes), 'yellow ball time' (15 minutes), and 'game time' (20 minutes). Child 7 was observed during a second consecutive day, during 'red ball time' (20 minutes), 'video' time (10 minutes) and 'yellow ball time' (20 minutes). A substitute teacher was taking the class on the morning of the second day of observations, as the class teacher was attending a review meeting this particular morning. The substitute teacher had previously met child 7 when he had been attending a different school. Following the 'check timetable' session at the beginning of each day, child 7 was allocated to use the interactive timetable for ten minutes prior to commencing his first activity.

Stereotyped behaviour

Child 7 was observed to display 51 behaviours over the course of the eight observation sessions (table 7.40). These were classified according to eight categories, with the majority of behaviours falling under the heading 'other behaviours' (n16). On the whole these behaviours were not believed to be characteristic of a child with autism, but were considered worthy of noting. For example, there was an occasion when the child was seen to be blowing on his hand and this could indicate a preoccupation of thought. Incidences of the child talking to other children round about him are examples of social interaction and communication and could be considered potential stressors. There were occasions when the teacher prompted the child or checked his work and again these could perhaps have been considered stressors for this child. There were incidences when the child was noted to be twisting his arms in his t-shirt and this was considered to be a stereotypical behaviour. However, it was difficult to categorise this particular behaviour, for example, this could have been considered to be 'body movements' or to be 'keeps performing certain movements'. There were also incidents when the child was pretending to be characters in a story (a cat and a monster) and here it was difficult to determine whether this behaviour was stereotypical. The categories 'gazing' (n9), 'postures' (n9) and 'constantly feels an object' (n8) were also observed quite frequently. Stereotyped behaviours were observed to occur most frequently during 'red ball time' (n14) on the first day of observations.

Table 7.40

Frequency of stereotyped behaviours observed for child 7 – study 2

	Stereotyped behaviour										
Activity	*Rocking*	*Pacing*	*Body movemts*	*Gazing*	*Postures*	*Constantly feels an object*	*Keeps performing certain movemts*	*Other*	*Total number SB per activity*	*Obs time (mins)*	*Scaled average SB per hour*
Ball time	1	1	0	8	5	6	5	14	40	80	30.0
Snack time	0	0	1	0	1	0	0	1	3	20	9.0
Game	0	0	0	1	2	2	1	0	6	20	18.0
Video time	0	0	0	0	1	0	0	1	2	10	12.0
Total	**1**	**1**	**1**	**9**	**9**	**8**	**6**	**16**	**51**[a]	**130**[b]	**23.5**[c]

Note. SB = stereotyped behaviours.
[a]Total number of stereotyped behaviours observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all stereotyped behaviours observed in one hour, arrived at by dividing the total number SB (51) by the total observation time (130) and multiplying by 60.

Physical signs of anxiety

A total of six physical signs of anxiety were observed to be displayed by child 7 during the course of this observation study; however there were no physical signs of anxiety observed during three of the sessions (‘snack time’ – day 1, ‘game time’ – day 1, and ‘red ball time’ – day 2). The physical signs of anxiety fell into two categories with ‘cannot sit still’ being observed most frequently (n5). Table 7.41 demonstrates these findings.

Table 7.41

Frequency of physical signs of anxiety observed for child 7 – study 2

	Physical signs				
Activity	*Excessive tiredness*	*Cannot sit still*	*Total PSA per activity*	*Obs time (mins)*	*Scaled average PSA per hour*
Ball time	1	4	5	80	3.75
Snack time	0	0	0	20	0
Game	0	0	0	20	0
Video time	0	1	1	10	6.0
Total	**1**	**5**	**6**[a]	**130**[b]	**2.8**[c]

Note. PSA = physical signs of anxiety.
[a]Total number of physical signs of anxiety observed during study 2. [b]Total duration of observation time for study 2. [c]Scaled average of all physical signs of anxiety in one hour arrived at by dividing the total number PSA (6) by the total observation time (130) and multiplying by 60.

Environmental events

Forty-eight environmental events were identified as occurring over the eight observation periods and these were classified according to eleven categories as demonstrated in table 7.42. Events grouped under the heading ‘other factors’ were observed most frequently (n19). These events included occasions when the teacher checked the child’s work, when the teacher prompted the child, when a member of staff asked the child a question, and when the teacher helped the child with his task. The category ‘noise or disruption from others’ was also noted to occur a great number of times (n15). A higher number of environmental events were noted to occur during ‘ball time’ (n38).

Table 7.42

Frequency of environmental events observed for child 7 – study 2

	Environmental events													
Activity	*Loud noises*	*Noise or disruption from others*	*Changes in schedule*	*Changes in task to a new task*	*Moving from one location to another*	*Needing to ask for help*	*Being touched by others*	*Group activity*	*Receiving a reprimand*	*Receiving verbal reinforcement*	*Other*	*Total number EE per activity*	*Obs time (mins)*	***Scaled average EE per hour***
Ball time	1	13	1	1	2	1	1	0	0	1	17	38	80	28.5
Snack time	0	1	0	0	1	0	0	1	1	0	1	5	20	15.0
Game	0	0	0	2	1	0	0	0	0	0	1	4	20	12.0
Video time	0	1	0	0	0	0	0	0	0	0	0	1	10	6.0
Total	**1**	**15**	**1**	**3**	**4**	**1**	**1**	**1**	**1**	**1**	**19**	**48**[a]	**130**[b]	**22.2**[c]

Note. EE = environmental events.
[a] Total number of environmental events observed during study 2. [b] Total duration of observation time for study 2. [c] Scaled average of all environmental events observed in one hour, arrived at by dividing the total number EE (48) by the total observation time (130) and multiplying by 60.

Symbolic timetable use

Child 7 was sat with his back to the symbolic timetable during ‘red ball time’ and ‘yellow ball time’ on day 1 and no use of the symbolic timetable by the child was observed. During ‘video’ time, the child was sat in the symbolic timetable area, but as the television was positioned in front of the timetable it was difficult to assess whether the child made any use of the timetable during this time. During four of the observation sessions on day 2, child 7 was seated in a position to be able to see the symbolic timetable, however, the child made no obvious use of the timetable.

Interactive timetable use

Child 7 was allocated to use the interactive timetable immediately after ‘check timetable’ time on day 1. The child had commented during ‘check timetable’ time that he had looked at the interactive timetable while at home, although he did not specify exactly when this was. Child 7 spent fifteen minutes using the interactive timetable on day 1. During the session the child made up a version of his own timetable and later when prompted checked the class timetable for the day. Child 7 made no further use of the interactive timetable this day. On day 2, the children were taken through the timetable by a supply teacher. Child 7 spent ten minutes using the interactive timetable immediately after ‘check timetable’ time and although he completed his task he was less focused and more inclined to play around this day. Child 7 made no further use of the interactive timetable on this day.

Summary

A summary of the findings for child 7 with regards to studies 1 and 2 is now set out. A comparison of the findings from the parent and teacher assessments of stereotyped behaviours with those observed during studies 1 and 2 is presented in table 7.43. It can be seen that there was strong agreement between parent and teacher regarding stereotyped behaviours, with five behaviours being confirmed (spinning, waving arms, body movements, yelling, and running). There can also be seen some agreement between behaviours reported and those observed. For example, the behaviour ‘spinning’ was reported by both parent and teacher and was observed during study 1. Similarly, ‘body movements’ was behaviour reported by parent and teacher and was observed during study 2. Furthermore, the behaviours of ‘rocking’ and ‘postures’ reported by the teacher were observed during both studies, as was the behaviour ‘constantly feels an object’, reported by the parent. It can also be seen in table 7.43 that there were three behaviours observed which were not considered typical for this child by the parent or teacher (finger movements, gazing, and echolalia).

Table 7.43

Comparison of stereotyped behaviours: reported and observed – child 7

Behaviour	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Rocking	T2 (H/A)	√	√
Sniffing objects or self			
Spinning	P7A (HP) T2 (H)	√	
Waving arms	P7A (A) T2 (H)		
Head-rolling			
Whirling	P7A (HP)		
Body movements	P7A (HP) T2 (H)		√
Pacing	P7A (A)		
Twirling			
Hand movements			
Yelling	P7A (A) T2 (H/A/HP)		
Bouncing	P7A (HP)		
Running	P7A (A) T2 (H)		
Finger movements		√	
Gazing		√	√
Postures	T2 (H)	√	√
Clapping			
Grimacing	T2 (H/A)	√	
Flaps arms/ hands			
Constantly feels objects	P7A (H)	√	√
Echolalia		√	
Keeps performing certain movements	P7A (A)		√
Other behaviours		√	√

Note. T2 = teacher 2. P7A = parent of child 7. H = from habit. A = when anxious. HP = when happy.

A comparison of the scaled average rate of stereotyped behaviours per hour for study 1 and study 2 is demonstrated in table 7.44. Data have been imported from tables 7.37 and 7.40. The figures for the scaled averages in the final row are arrived at by dividing the total number of stereotyped behaviours by the total observation time and multiplying by 60 to obtain a figure for the hour. A decrease in stereotyped behaviours can be seen in study 2 when compared with study 1.

Table 7.44

Scaled average stereotyped behaviours per hour – child 7

	Stereotyped behaviours		
Activity	Study 1	Study 2	
timetable	45		
ball time	28	ball time	30
painting	9		
		snack	9
		game	18
		video	12
Scaled average	**27.3**		**23.5**

A comparison of the findings from the parent and teacher assessment of physical signs of anxiety is set out in table 7.45 together with findings from studies 1 and 2. This demonstrates that the parent and teacher were in agreement regarding four physical signs of anxiety (aggressiveness, anger, over-reacts, and cannot sit still). Of these, 'cannot sit still' was observed during both studies, whilst 'over-reacts' was observed during study 1. In addition, the physical sign of 'excessive tiredness' identified by the teacher was observed during both studies.

Table 7.45

Comparison of physical signs of anxiety: reported and observed – child 7

Physical signs	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Breathlessness			
Feeling sick	T2		
Pains in stomach	P7A		
Sweaty hands			
Excessive tiredness	T2	√	√
Paleness or redness	P7A		
Aggressiveness	P7A T2		
Anger	P7A T2		
Over-reacts	P7A T2	√	
Cannot sit still	P7A T2	√	√
Overactive	P7A		
Talks too loudly	P7A		
Panics			
Cries for incomprehensible reasons	P7A		
Bites or scratches self	P7A (bites lip & hand)		
Other			

Note. T2 = teacher 2. P7A = parent of child 7.

Table 7.46 demonstrates a comparison of the scaled average number of physical signs of anxiety per hour between study 1 and study 2. Data have been imported from tables 7.38 and 7.41. The figures for the scaled averages in the final row are arrived at by dividing the total number of physical signs of anxiety by the total observation time and multiplying by 60 to obtain a figure for the hour. A decrease in physical signs observed during study 2 can be seen when compared with study 1.

Table 7.46

Scaled average physical signs of anxiety per hour – child 7

	Physical signs of anxiety		
Activity	Study 1		Study 2
timetable	3		
ball time	12	ball time	3.75
painting	6		
		snack	0
		game	0
		video	6
Scaled average	**4.4**		**2.8**

A comparison of the findings from the parent and teachers assessments of environmental stressors with findings from studies 1 and 2 is set out in table 7.47. It can be seen that the parent and teacher agreed on seven items. Furthermore, of these four were observed during these studies (loud noises, noise or disruption from others, receiving a reprimand, and personal objects touched by others). Two events were observed which were not considered as typical stressors for this child by parent or teacher and these were ‘changes in task’ and ‘needing to ask for help’, which were events observed during both studies.

Table 7.47

Comparison of environmental events: reported and observed – child 7

Environmental stressors	*Parent/teacher assessments*	*Observation study 1*	*Observation study 2*
Loud noises	P7A; T2		√
Noise or disruption from others	P7A; T2	√	√
Bright lights			
Changes in schedule or plans	P7A; T2		√
Changes in task		√	√
Moving from one location to another	P7A	√	√
Changes in environment	P7A		
Changes in teacher or supervisor	P7A		
Being unable to communicate needs	P7A		
Needing to ask for help		√	√
Being touched by others	P7A		√
Waiting for transportation	P7A		
Participating in a group activity	P7A		√
Waiting for a not-liked activity to begin	P7A; T2		
Having to engage in a not-liked activity	P7A		
Receiving a reprimand	P7A; T2		√
Being told "no"	P7A; T2		
Receiving verbal reinforcement	P7A		√
Receiving tangible reinforcement	P7A		
Personal objects out of order	P7A		
Personal objects touched by others	P7A; T2	√	
Personal objects missing	P7A; T2		
Being prevented from completing a ritual	P7A		
Being prevented form carrying out a ritual	P7A		
Being interrupted while engaging in a ritual	P7A		
Other factors		√	√

Note. T2 = teacher 2. P7A = parent of child 7.

A comparison of the scaled average number of environmental events per hour between study 1 and study 2 is demonstrated in table 7.48. Data have been imported from tables 7.39 and 7.42. The figures for the scaled averages in the final row are arrived at by dividing the total number of environmental events by the total observation time and multiplying by 60 to obtain a figure for the hour. A slight increase in environmental events can be seen in study 2 when compared with study 1.

Table 7.48

Scaled average environmental events per hour – child 7

	Environmental events		
Activity	Study 1	Study 2	
timetable	24		
ball time	20	ball time	28.5
painting	15		
		snack	15
		game	12
		video	6
Scaled average	**19.6**		**22.2**

Timetable use

Child 7 was observed to make use of the symbolic timetable only during specific ‘check timetable’ sessions during study 1. No obvious use of the symbolic timetable by child 7 was observed during study 2. Child 7 reported using the interactive timetable at home on several occasions. However, in the school setting child 7 was observed to use the interactive timetable only on the occasions when he had been allocated to do so by the teacher.

7.5.1.5 Summary

A great deal of data was generated through these observation studies and these have produced some interesting findings. In particular it has been found that all of the children demonstrated anxiety responses, which were identifiable, and were individual to each child. There appears to be an association with environmental events and stereotyped behaviours for some of the children. Also, it was found that specific activities such as ‘ball time’ appeared stressful for certain children. All of the children were reported to find change stressful, particularly if it affected their routine. Additionally, all of the children were reported to become anxious if they were unable to communicate their needs. A wide range of stereotyped behaviours were identified during these observations and in addition other behaviours were displayed, which it was not possible to categorise according to the predetermined categories.

The children were found to make little obvious use of the symbolic timetable. It may have been that the children were making more subtle use of this timetable, which the researcher was unaware of, or that the children were in the routine of making use of the symbolic timetable only at specific ‘check timetable’ times. One child (child 6) was noted to be gazing in the direction of the symbolic timetable on several occasions, but it was not possible to ascertain whether he was actually making use of this timetable on these occasions. The children used the interactive timetable only when they were allocated to do so by the teacher. The fact that the children were using the interactive timetable only in such a limited way meant that it was not really possible to assess fully whether its use was assisting the children in overcoming anxiety related to changes in daily routine. Use of the interactive timetable by each child would need to be increased to be able to assess this more fully. However, it was found that the children were all able to perform the tasks asked of them and these are discussed further in section 7.5.2.1. Two of the children were noted to lose focus, becoming distracted by behaviours caused by certain images on the interactive timetable and this issue is discussed later (section 7.5.2.1). One child, child 7, reported having used the interactive timetable at home.

7.5.2 Findings relating to Aim 3

This section sets out the findings of the investigations which relate to aim 3: evaluating the effectiveness of the interactive timetable system as a management and communication tool for the teacher and parents. The methods of investigation were discussed in the research methodology (section 5.8.4.2) and include cooperative user evaluation observations, semi-structured interviews, and expert user evaluations. As discussed earlier (section 5.4), use of multiple methods is sometimes referred to as triangulation (Brannen, 1992). By employing multiple methods of data collection, the researcher believed that a more holistic picture of the effectiveness of the interactive timetable from different user perspectives could be gained.

7.5.2.1 Findings of the cooperative user evaluation observations

Observations were conducted with the children on 9 occasions during use of the interactive timetable in the classroom setting and with one of the teachers on one occasion. The findings are now reported here.

Children's use of the interactive timetable

Cooperative user evaluation observations were conducted with the children during weeks 135 to 137. Details of session times are set out in table 7.49. The findings are now set out in order of child 1, child 4, child 6, and child 7.

Table 7.49

Cooperative user evaluation sessions – children

Child	Session number	Week day	Length of session (mins)
1	1	Thursday	11
	2	Wednesday	11
4	1	Monday	15
	2	Friday	15
6	1	Thursday	20
	2	Friday	8
	3	Tuesday	10
7	1	Monday	15
	2	Tuesday	10

Child 1

Child 1 was observed using the interactive timetable on two separate occasions. Summaries of both sessions are now set out.

Session 1

This session took place on a Thursday and lasted for 11 minutes.

Pages visited

Child 1 visited 15 pages during this session in the following order:
'Welcome' page, 'information for visitors', 'welcome' page, 'home' page, 'my timetable', 'class timetable', 'Monday', 'my timetable', 'my helping tasks', 'speech and language therapy', 'Wednesday', 'class timetable', 'Thursday', 'my timetable', and 'check my timetable'.

Actions which the child performed well

Child 1 appeared to recognise the 'welcome' page, remarking that he remembered this page. The child gave the impression he remembered how to use the 'check my timetable' page, immediately setting about dragging the symbols from the left side of the page to the spaces on the grid. Child 1 was able to correctly select his name from the four names listed on the 'my timetable' page. On the 'help task' page child 1 correctly entered his name and selected the correct day from the choices available (Thursday). Child 1 needed to go over to the symbolic timetable to check which task he was to be undertaking on this day.

Problems encountered

Child 1 had difficulty with the log-on page at the start of this session. He entered his password incorrectly, using a password which he most likely used at home. He needed reminding of the correct password to use and also that he should use lower case for this. While the child was making up his own timetable on the 'check my timetable' page, he found there was no symbol for the activity 'trip' and so he ceased working on this task.

Other factors of note

Child 1 used the timetable quite tentatively at first and moved slowly between pages. He took his time looking at the different areas and scrolled down the pages slowly.

The child read out text from different pages on three occasions. He seemed unsure of how to proceed at times and needed prompting to perform the tasks requested. The child also needed to constantly check the symbolic timetable when making up his own version of the timetable on the 'check my timetable' page. For example:

> *He remembered how to use this page and immediately dragged the maths symbol to the red space. He went to the wall timetable to check what he was doing at blue time and then came back and dragged the 'tasks' symbol to the blue space. He remembered that he was going on a trip after break and looked for a 'trip' symbol but there was not one there. He decided he was unable to fill out any more of the timetable.*
> (UC12 lines 67–77)

Session 2

This session took place on a Wednesday and lasted for 11 minutes.

Pages visited

Child 1 visited 13 pages in the following order:

'Welcome' page, 'information for visitors', 'welcome' page, 'home' page, 'my timetable', 'class timetable', 'Wednesday', 'my timetable', 'check my timetable', 'my timetable', 'my happy face targets', 'my timetable', and 'my helping tasks'.

Actions which the child performed well

Child 1 remembered how to log-on and correctly entered his username and password without any prompting. He also made up a version of his timetable without prompting, but did glance at the symbolic timetable to check his activities. Child 1 was able to print copies of his own timetable, of his happy face targets, and of his help tasks when requested. He only needed help with how to do this on the first occasion.

Problems encountered

There were no problems encountered on this occasion. However, child 1 did need prompting on how to proceed when using the 'happy face targets' page and the 'help tasks' page.

Other factors of note

Child 1 appeared more confident at using the timetable, although he still took his time looking at the different areas and scrolled down the pages slowly. Child 1 noticed that the interactive timetable for Wednesday was slightly different from the symbolic timetable for that day, but only appeared to realise this by physically going over and checking the symbolic timetable. The child continued to need to constantly check the symbolic timetable when making up his own version of the timetable on the 'check my timetable' page.

Child 4

Child 4 was observed using the interactive timetable on two occasions. An overview of each of these sessions is now set out.

Session 1

This session took place on a Monday and lasted for 15 minutes.

Pages visited

The child visited 9 pages during this session in the following order:
'welcome' page, 'home' page, 'class timetable', 'Monday', 'red ball time', 'my timetable' page, 'my helping tasks', 'my timetable', and 'check my timetable'.

Actions which the child performed well

Child 4 visited the appropriate pages when prompted, using the correct navigation icons. When encouraged, the child printed a copy of 'my helping tasks' which he filled out correctly.

Problems encountered

The child was distracted several times by the fact that a shadowy quality appeared when he tried to drag images across the page and he spent some time playing with the images in this way.

> *He selected the television symbol and tried dragging it around the page. The image did not actually move, but had a shadowy quality that made it appear to be moving if clicked and dragged.*
> (UC13 lines 35–38)

Certain symbols required for the timetable on this particular day were not available on the ‘check my timetable’ page of the interactive timetable.

Other factors of note

Child 4 was extremely hesitant at using the interactive timetable and required help with how to proceed on several occasions. In particular the child needed assistance to find the correct letters when typing his name. Child 4 had difficulty in using the mouse at times and this kept creeping off the table. The child also appeared to have difficulty in using the scroll bar at the side of the page on some occasions.

Session 2

This session took place on a Friday and lasted for 15 minutes.

Pages visited

Child 4 visited 9 pages during this session in the following order:

‘welcome’ page, ‘home’ page, ‘my timetable’, ‘my happy face targets’, ‘class timetable’, ‘Friday’, ‘class timetable’ page, ‘my timetable’, and ‘check my timetable’.

Actions which the child performed well

Child 4 remembered how to enter his username and password on the log-on page, although he needed assistance in finding the correct letters to type in for his name. He selected his name from the four presented on the ‘my timetable’ page. He selected the correct day (Friday) on the ‘class timetable’ page.

Problems encountered

The child was distracted by the images and spent quite a lot of the time playing with these, trying to drag images which did not move.

Other factors of note

Child 4 appeared quite tired and lethargic and yawned several times during this session. He was very slow at moving around the pages and did not actually complete any of the task pages during this particular session.

Child 6

Child 6 was observed using the interactive timetable on three separate occasions. An overview of each of these three sessions is now set out.

Session 1

This session took place on a Thursday and lasted for 20 minutes.

Pages visited

The child visited the following 17 pages during this session:
'welcome' page, 'home' page, 'my timetable', 'my helping tasks', 'class timetable', 'Thursday', 'trip', 'playtime', 'red ball time', 'blue ball time', ('parents' page', log-on page / no access), 'class timetable', 'my timetable', 'my helping tasks', 'my timetable', 'my happy face targets', 'my timetable', and 'check my timetable'.

Actions which the child performed well

Child 6 remembered how to log-on with his username and password and in particular remembered that these were both to be entered in lower case. The child appeared very confident at using the timetable, selecting his name from the four names listed on the 'my timetable' page and clicking on the image next to his name (a picture of an elevator). On the 'help task' page child 6 correctly entered his name (with a capital letter this time) and selected the correct day from the choices available (Thursday). The child selected the task which had been allocated to him on the help task chart beside the symbolic timetable. The child did not go to check which task he had been allocated that day and so it was not clear whether the child remembered having been allocated this task, or whether this was a task which he frequently performed and so selected it by chance.

Problems encountered

There were observed to be several problems during this session. For example, it was not possible to save the forms on the ‘help task’ and ‘happy face targets’ pages, a problem the researcher was aware of. Furthermore, the computer printer was not working on this particular day, so it was not possible for the child to print a copy of the timetable he created. Child 6 tried to visit the ‘parents’ page’ using the navigation icon at the bottom of the page. However, the children do not have access to this particular page and so the log-on screen appeared. This was explained to child 6 and he accepted this.

Other factors of note

Whilst looking at the ‘playtime’ page child 6 read some of the words out loud. The child continually made use of the back button to return to the ‘Thursday’ page when he visited links from this page. When on the ‘check my timetable’ page child 6 was able to use the technique of selecting and dragging the symbols well. Child 6 spent some time dragging symbols over to the grid and also kept getting up to go over to the symbolic timetable to check what he would be doing this day.

Session 2

This session took place on a Friday and lasted for 8 minutes.

Pages visited

The child visited the following 21 pages during this session:
‘welcome’ page, ‘home’ page, ‘my timetable’, ‘class timetable’, ‘Friday’, ‘my timetable’, ‘my happy face targets’, ‘class timetable’, ‘Wednesday’, ‘Friday’, ‘my timetable’, ‘my happy face targets’, ‘my timetable’, ‘class timetable’, ‘Friday’, ‘action heroes’, ‘blue ball time’, ‘Friday’, ‘class timetable’, ‘Wednesday’, and ‘class timetable’.

Actions which the child performed well

Child 6 appeared familiar with the interactive timetable and moved quickly around the pages. He used the internal navigation links such as the icons at the bottom of the page and the back button at the bottom of the page rather than the browser navigation tools. The child entered his username and password correctly on the log-on page. Child 6 selected Wednesday from the list of days, but realised that this was not the right day and quickly corrected himself without any prompting.

Problems encountered

Unfortunately the printer was not working on this occasion and so no record was made of the 'happy face targets' page which the child completed.

Other factors of note

The child moved quickly around the pages, not pausing on any page for long. He visited the 'happy face targets' page twice and completed the form on this page twice, both identically. Child 6 did not complete the two other tasks on this occasion. However, he did check the class timetable for the day but made no comment on this when asked.

Session 3

This session took place on a Tuesday and Child 6 spent 10 minutes using the interactive timetable.

Pages visited

Child 6 visited the following 16 pages:

'welcome' page, 'class timetable', 'Wednesday', 'Tuesday', 'red ball time', 'Tuesday', 'my timetable', 'my happy face target', 'class timetable', 'Wednesday', 'action heroes', 'class timetable', 'Tuesday', 'home page', 'my timetable', and 'check timetable'.

Actions which the child performed well

Child 6 entered his username and password correctly. The child performed the task of checking the class timetable for the day when asked. Child 6 filled out the 'my happy face target' page selecting the correct behaviour target and printed a copy of this when asked.

Problems encountered

The only problem of note during this session was that the child became distracted by the fact that the images were creating lines across the screen while they were being dragged to position. He spent a few moments playing with the images when this happened.

Other factors of note

Child 6 moved confidently and quickly around the pages. On two occasions the child selected pages in error, but quickly corrected himself and spoke aloud as he did this. The child used the internal navigation links to move around the pages. When filling out his own timetable, child 6 needed to go over and check the symbolic timetable several times.

Child 7

Child 7 was observed using the interactive timetable on two occasions. An overview of both of these sessions is now set out.

Session 1

This session took place on a Monday and lasted for 15 minutes.

Pages visited

Child 7 visited 22 pages in the following order:

‘welcome’ page, ‘home’ page, ‘my timetable’, ‘check timetable’, ‘class timetable’, ‘Monday’, ‘red ball time’, ‘blue ball time’, ‘playtime’, ‘yellow ball time’, ‘orange ball time’, ‘lunchtime’, ‘class timetable’, ‘Tuesday’, ‘sit’, ‘action heroes’, ‘red ball time’, ‘blue ball time’, ‘class timetable’, ‘Monday’, ‘Wednesday’, and ‘Friday’.

Actions which the child performed well

Child 7 was confident in his use of the pages and acted as if he found them familiar. The child was able to log-on with his username and password without any assistance. He reported that he had been looking at the interactive timetable on his computer at home. On his first visit to the ‘class timetable’ page he selected the correct day of the week.

Problems encountered

At the start of the session the child had appeared awkward when using the mouse. On questioning the child stated he was left-handed, but when asked if he would prefer to use his left hand to control the mouse he declined. Towards the end of the session the child tried to drag images on the ‘Tuesday’ page, such as the ‘diary’ symbol. However, the images on this page do not move, unlike the images on the ‘my timetable’ page. Whilst trying to move the images, the child found that they gave the impression of moving, making a shadowy effect. Child 7 played with the images in this way for four minutes despite prompting from the researcher to explore other pages.

Other factors of note

Child 7 was very talkative when using the interactive timetable, although mostly talking out loud to himself. Whilst making up his own version of the timetable for the day, child 7 did not go and look at the symbolic timetable at all to check what was happening. Child 7 mostly used the internal navigation features, moving between the pages by using the ‘go back’ button at the bottom of the page. Occasionally he used the browser ‘back’ arrow.

Session 2

This session took place on a Tuesday and lasted for 10 minutes.

Pages visited

Child 7 visited 13 pages in the following order:

‘welcome’ page, ‘home’ page, ‘my timetable’, ‘my happy face targets’, ‘my timetable’, ‘check timetable’, ‘my helping tasks’, ‘class timetable’, ‘Monday’, ‘red ball time’, ‘yellow ball time’, ‘orange ball time’, and ‘Monday’.

Actions which the child performed well

Child 7 remembered how to log-on to the interactive timetable web pages using his username and password. The child also remembered how to make up his own timetable.

Problems encountered

At the start of the session the shortcut to Internet Explorer had been missing from the computer desktop and it had taken some time to track down the location of this browser. Child 7 became distracted later in the session, trying to make images move to create a 'ghostly' effect. The printer was not working at this time, so it was not possible to print a copy of what the child had completed. However, a copy was made at a later date, following details transcribed in the field notes.

Other factors of note

Child 7 had hovered over the names of the other children when moving to the 'my timetable' page. When making his timetable he commented that the timetable he had made was that of another child's (C1).

Summary

Findings from these observation sessions were encouraging. All four children remembered how to log-on on their second sessions. All of the children attempted the tasks and performed these well. Two of the children were slightly hesitant when first using the timetable, but generally the children appeared to gain confidence over the sessions. Some issues regarding distractions were noted and were possibly related to the type of computer being used. Individual differences were noted. For example, one child scrolled slowly down each page whilst another child moved rapidly from page to page. In addition, styles of navigation around the timetable application varied from child to child. For example, child 6 used internal navigation features, whilst child 7 made use of both internal and external navigation features.

With regards to aim 3 (effectiveness of the interactive timetable as a management and communication tool), the interactive timetable was found to offer many possibilities. Communication of the timetable information to the home environment was found to be possible. For example, one child had been able to access the timetable at home and had shown this to his mother. Extending the use of the timetable through interactive features was also found to be possible. For example, during these particular observations the children were observed to follow several of the interactive links incorporated within the daily timetable, such as, ‘red ball time’ and ‘lunchtime’. As discussed earlier (6.4.2.5) these pages provided a break down of a particular activity, a feature not always available with symbols presented in the symbolic timetable. Further discussion of aim 3 is given later (section 9.2.3).

Teacher’s use of the interactive timetable

A cooperative user evaluation observation was conducted with one of the teachers during week 140 as a summative evaluation. The protocol for this procedure was discussed earlier (sections 5.7.1, 5.8.3.1, and 5.8.4.2). This particular session was audio-tape recorded with the teacher’s permission. The findings of this observation are now set out according to themes which emerged.

Features the teacher was pleased with

The teacher maintained a commentary as she moved through the timetable pages and the following features were received favourably by the teacher:

- Having different levels of access and being able to restrict the children’s access to certain areas
- Being able to print out copies of tasks once completed
- Use of the word ‘sometimes’ (the teacher explained use of this word aided flexibility)
- The ‘red ball’ symbol changing to ‘diary’ on Monday (this happens when the cursor is held over the symbol)
- Having a break down of each activity (e.g. ‘sit’, ‘playtime’ etc.)
- The fact that the timetable all fits on the screen
- Being able to drag symbols to make up the individual timetable
- Information content of the parents’ page

Less favourable features

The teacher noticed how the images on the 'my timetable page' created a series of lines when dragged across the screen. The teacher commented that she could appreciate how this problem would annoy and distract the children.

Suggestions

The teacher suggested that any copies of the 'behaviour task' pages which the children printed out could be saved in their target books.

Demonstrations

The researcher demonstrated the administration area and discussed options for the teachers in maintaining the application. These included setting up an area where changes could be made between coding, or uploading files to update pages as a simpler method.

7.5.2.2 Findings of the semi-structured interviews

This section sets out the findings of the semi-structured interviews conducted with two parents and two members of the educational team, regarding the effectiveness of the interactive timetable as a management and communication tool. Details of procedures were provided earlier (sections 5.8.2.1 and 5.8.4.2). The parents of child 6 and child 7 were the only parents available for interview at this stage of the study. Child 2, child 3 and child 5 had withdrawn from the study for reasons mentioned earlier (5.6.3.2). The parents of child 1 and child 4 were approached at this time, but were not available to be interviewed. Furthermore, only the family of child 7 had access to the Internet at this stage of the study. In addition, due to technical restrictions, it was not possible for the teacher to make changes to the timetable and so evaluation was limited.

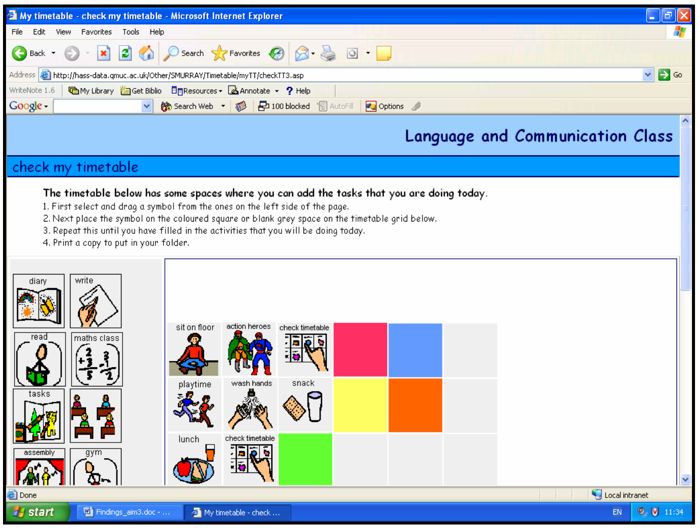
Interview with parent of child 7

The findings of this interview are set out according to four themes: use of the interactive timetable at home by the child, parental opinions regarding beneficial features of the interactive timetable, problems encountered with using the interactive timetable at home, and evaluation of the interactive timetable in the home setting.

Use of the interactive timetable by child

The parent reported that the child had accessed the interactive timetable on the home computer every day for a week. This was typically first thing in the morning and again after school in the evening. The parent stated that the child had found accessing the timetable to be easy and that at times it had been difficult for her to coax the child away from the timetable. The parent reported that the child had appeared most interested in the area 'check my timetable' (figure.7.8). Furthermore, the child made up a version of the timetable using this page and he printed a copy of this to take to school.

> *"Because he wanted to take it to school to say that's what he wanted to do."*
> (IP7A/2 lines 38–39)



The timetable below has some spaces where you can add the tasks that you are doing today.

1. First select and drag a symbol from the ones on the left side of the page.
2. Next place the symbol on the coloured square or blank grey space on the timetable grid below.
3. Repeat this until you have filled in the activities that you will be doing today.
4. Print a copy to put in your folder.

Figure 7.8: Demonstrating the 'check my timetable' page

The parent reported that to begin with she had viewed the interactive timetable with the child. Later, when using the timetable, the child had not shared anything specifically relating to the timetable with the parent. However, the parent did state that the child had told his father about the timetable and had shown the timetable to his father.

> *"When his dad came he told him see I've got this new ... my timetable"*
> (IP7A/2 lines 140–141)

The parent recounted how the child had accessed another child's 'check my timetable' area on the timetable and had made up a version of the timetable there (as all the areas were set up the same and it was not possible for the child to save changes at this time, this was not a problem).

Beneficial features

The parent of child 7 believed that using the interactive computer at home might help remind the child what he has done at school during the day and that this might encourage him to be more communicative.

> *"If I want to talk to him at night, "what did you do at school today?" "Did you do this?" well it might jog his memory, because he forgets, he does forget what he's done."*
> (IP7A/2 lines 416–419)

The parent suggested another beneficial feature was that the interactive timetable might assist the child in preparing for what might be happening at school the next day. The parent was unsure at first whether having access to a timetable for each day of the week would cause child 7 to worry about anything, but then commented that it might be a good thing for the child to see the activities for all the days of the week.

> *"...I don't know, maybe just the next day, but then maybe it might be good to see all the days, because then he can say "I've got this and that and this" and then "oh yes I've got that on that day"..."*
> (IP7A/2 lines 516–519)

Problems encountered

The parent of child 7 reported two problems when using the timetable at home. The first was that the child was unable to save the 'check my timetable' page once he had made up his version of the timetable, and the second problem was that when printing this particular page the orientation setting had to be changed to landscape in order to fit the image on the page.

Evaluation of the interactive timetable in the home setting

At the end of the interview with the parent of child 7, the parent demonstrated how the interactive timetable appeared on the home computer. The timetable was accessed via the favourite's folder and the parent logged on to the timetable using the child's username and password. The parent appeared confident at moving around the timetable pages. The timetable was seen to be displaying well with everything looking as it should. There were no problems with the images on any of the pages which were viewed (at school there had been problems with 'ghost' images).

Interview with parent of child 6

The family of child 6 did not have access to the Internet at this stage of the study and so a locally installed version of the interactive timetable was demonstrated to the parents via a lap-top computer. The findings of the interview are set out according to two themes: parental opinions regarding beneficial features of the interactive timetable and potential limitations of the interactive timetable. The parent had previously been interviewed regarding these themes and the intention of this interview was to ascertain whether opinions remained the same following demonstration of the interactive timetable.

Beneficial features

The parent had previously considered that an interactive timetable might be easier for the teacher to change compared to the symbolic timetable. The parent confirmed that she still held this opinion.

> *"…it's very easy to just click on to the mouse and change things about, yes."*
> *(IP6A/2 lines 136–137)*

The parent stated that she thought all the children in the class would enjoy using the interactive timetable and particularly her son, as he was very keen on using computers. The parent had previously stated that she believed access to the interactive timetable at home would facilitate discussions with her son regarding his activities at school and she confirmed this view.

The parent suggested that use of the interactive timetable might be of benefit for younger children, as accessing it would enable them to learn how to use a computer and so develop computer skills. The parent believed that accessing the timetable from home would allow parents to learn what their child had been doing at school.

> *"Yes I think it would be very helpful for parents to know what they'd been doing."*
> (IP6A/2 line 152)

Furthermore, the parent suggested it would be useful for parents as an information source.

> *"It would be quite useful for us as well. A way to get information as well."*
> (IP6A/2 line 245)

The parent suggested that communicating with the teacher via email might be useful, particularly as she sometimes forgot to write information in the home-school diary.

Potential limitations

The parent indicated a potential problem relating to availability of resources, both at home and at school. For example, those without a computer at home, or with no access to the Internet would be disadvantaged. Also the parent suggested that a lack of computers in the classroom could be a problem.

> *"I suppose it depends how many computers ... they've just got the one computer ... I expect ... to take turns to use that ... that could cause frustration, anxiety as well I suppose."*
> (IP6A/2 lines 193–195)

The mother also suggested that using the interactive timetable in class might be time-consuming.

> *"And how long they would take to ... to use it as well, it might end up being something like ten minutes ... use up too much class time."*
> (IP6A/2 lines 199–200)

Interview with class teacher 1

The findings of this interview are set out according to two themes: opinions regarding beneficial features of the interactive timetable and problems or limitations with using the interactive timetable. The teacher had previously been interviewed regarding these themes and the intention of this interview was to ascertain whether opinions remained the same. The teacher had used the interactive timetable at several stages throughout the study.

Beneficial features

The teacher considered that the timetable would be of benefit in several ways and these are set out according to the themes of communication, organisation of information, functional uses, and autism specific benefits.

Communication

The teacher indicated that the interactive timetable might facilitate communication between child and parent in the home setting.

> *"Certainly with assisting communication with parents and the child at home, I think it would be fantastic for them just because ... the fact that it's exactly the same format."*
> (IT1/2 lines 11–13)

The teacher explained why communication between home and school was important, indicating that the children can behave so differently in the two environments. The teacher reported that it was important for the child to communicate with parents about their day, but the children often forget by the time they get home and parents feel left out if their child is unable to share this with them. The teacher suggested that visual information helped remind the children of what they have done. The teacher also suggested that part of a child's homework task could be to discuss one thing on the timetable with parents.

Organisation of information

The teacher thought that the timetable application would be useful for organising and storing information. For example, she suggested that a library of symbols could be stored there, saving time searching for these.

Functional uses

The teacher suggested that use of the interactive timetable would help the children learn to use a computer in a more functional way and so assist in preparing them for their future as adults.

> *"...for the children's future there ... they will be using computers in a functional way and at home they use it very much for games ..."*
> (IT1/2 lines 29–31)

It was also suggested that the timetable would be useful if a child was changing schools.

> *"...if a child was moving from one school to another, if they could access it and the school could see what activities they were able to pursue.."*
> (IT1/2 lines117–118)

The teacher also suggested the interactive timetable might be useful for children when moving to secondary school, as it would presumably provide a familiar structure which could be referred to throughout the day.

Autism specific

The teacher felt that the timetable would allow children and parents to make quick references at home to what might be happening later in the week. Being able to see what was happening the next day might possibly help relieve the child's anxiety. In addition, the teacher suggested that the timetable could be extended to the home situation, for example, by having a social story put on the child's personal timetable area to be shared with parents at home. The teacher also considered that use of the timetable might help in increasing a child's level of independence.

Limitations

The teacher was of the same mind regarding limitations which she had identified previously (i.e. possibly time consuming to set up the interactive timetable, lack of skills (staff), a lot of adult input required in teaching the children how to use the timetable at start, whether the children would have the initial skills to use the timetable, a lack of computer resources, and whether the timetable would be robust enough). The teacher identified further limitations:

- Would it be difficult to learn to use the interactive timetable?
- How much adult input would be required to teach children how to use the timetable?
- Would it become more functional the more the children used it?
- Having to learn something new (referring to staff and children)

Other issues

The teacher raised a concern that some parents might be apprehensive about using the interactive timetable. In addition, the teacher believed that information of the kind which was communicated in the home – school diary was too confidential to store and communicate on the timetable. Parents would be worried that others would see personal information about their child and might be less inclined to write so frankly.

Interview with class teacher 2

The findings of this interview are set out according to two themes: opinions regarding beneficial features of the interactive timetable and limitations with using the interactive timetable. The teacher had previously been interviewed regarding these themes. The teacher had used the interactive timetable at several stages throughout the study.

Beneficial features

The teacher considered that the timetable would be of benefit in several ways and these are set out according to the themes of learnability, preparedness, and home and school links.

Learnability

The teacher commented that the children had learned quickly how to use the interactive timetable.

> *"I felt the children had learnt to use it and they seemed to find it quite straightforward ... they picked it up really quickly."*
> (IT2/2 lines 7–8)

The teacher also added that training the children how to use the timetable should be straightforward as it could be added to the routine and become part of their day.

Preparedness

The teacher suggested that accessing the timetable at home would allow the children to become prepared for events which were happening the next day.

> *"I think if they were seeing the timetable the night before, then that would probably result in them not having to kind of look at it as soon as they come in…they wouldn't be quite as keen to see what was on the timetable…"*
> (IT2/2 lines 41–44)

Home and school links

The teacher considered the fact that the interactive timetable could facilitate links between home and school to be a major advantage.

Limitations

Several limitations and concerns were identified.

Availability of resources

The teacher expressed concern that there would be problems with availability and access to the interactive timetable, particularly as there was a constant demand on computer resources for other activities. So if a child wished to check their timetable at some point during the day, they may be prevented from doing so if the computer was being used by another individual.

> *"I think the problems are that the computer has to be accessed during the day by the children, by speech therapy ... and we really need another computer in the class."*
> (IT2/2 lines 23–26)

In addition, the teacher was concerned that the interactive timetable would need to be on display continually in the same way that the symbolic timetable currently was.

> *"It would have to be available for the children at all times."*
> (IT2/2 line 28)

An additional problem regarding availability related to the issue of logging-on to the school server. The teacher pointed out that this had to be done whenever there was a need to access the Internet.

Screen size

The teacher was concerned that the computer screen not effective enough for the children to be able to see the timetable from any location in the classroom.

> *"...the actual screen of the computer doesn't really ... is not quite effective for you know, say the children checking from a distance...they're constantly checking throughout the day."*
> (IT2/2 lines 29–33)

The teacher discussed a possibility of having a large screen in the classroom and that this might be a solution. She also suggested that a print out of each child's personal timetable could be kept on the desk beside them as a way of overcoming this problem.

Off task behaviour

The teacher was concerned that the fact that the children would need to get up and go over to the computer to check their timetable would lead to considerable off task behaviour. Also, the constant movement would distract other children. However, she felt this problem could most likely be overcome in time.

Other issues

Several other issues and concerns were raised.

Prompting

The teacher believed that the children would continue to need prompting to use the interactive timetable and that prompt cards might be introduced to facilitate this.

Supervision

The teacher also believed that a level of supervision would be required until the children had reached a point where they could use the timetable functionally without being distracted by stimulants such as the buttons and icons on the page. She suggested that once the children had reached this point the timetable would allow them a degree of independence.

> *"I think it will cut the umbilical cord a bit between us, you know between me and the children. Because they know they can get that information that they need."*
> (IT2/2 lines 303–305)

Loss of social area

The teacher commented that it would be strange if the symbolic timetable were to be removed as the area around the timetable was where the children frequently socialised. Also, removing the symbolic timetable and changing to the interactive timetable would be very upsetting for the children at first. They would find it hard to predict what was coming next, because they were so used to seeing the symbolic timetable.

Summary

Some interesting findings emerged from these interviews in relation to aim 3. The parent who had been able to access the timetable at home reported that her child had used the interactive timetable every day for a week following its implementation.

Furthermore the child had accessed the timetable twice a day, mainly to create his own version of the timetable. Generally participants agreed that beneficial features of an interactive timetable were that it would help prepare the child for the next day at school, it would be able to provide reminders about certain activities, and it would facilitate discussion at home between child and parent. In addition, it was suggested that use of the timetable would allow the children to practise computer skills, would enable organisation and storage of materials, and would provide a useful information source for parents. It would also allow communication to be extended between school and home. There were some concerns that were noted by several participants. Availability of resources both at home and school was a concern. Also noted was a worry that staff might lack the skills necessary to maintain the timetable. One teacher was concerned that the timetable would need to be available at all times in the same way that the class timetable was, but this was a problem due to server issues at school. It was also considered that the interactive timetable might be time-consuming to use in class.

7.5.2.3 Findings of the expert user evaluations

This section sets out the findings of the user evaluations conducted with ‘expert’ users. Five experts were approaches to take part in this study, but only four completed questionnaires were returned. Procedures for this evaluation were discussed earlier (section 5.8.4.2). Essentially self-completion questionnaires (Appendix 28) were sent and returned via email. Four of the five experts approached were academics in the field of computer studies and of these, three were familiar with special needs applications. Additional comments were received from a parent of a child with autism, recruited by one of the academics mentioned above. However, this person only provided comments and did not complete a questionnaire, so this information is not reported here.

Consistency

- It was generally agreed that the design was consistent throughout

- All four respondents agreed strongly that the layout of page headers was consistent
- It was generally agreed that the positioning of navigation icons was consistent throughout

Comments were made regarding consistency:

> *"Page footers should be available on all pages without having to scroll"*
> (Respondent 1)
>
> *"The home page is different from the other page…"*
> (Respondent 4)

Navigation

The purpose of navigation icons was found to be reasonably clear, however, one respondent commented:

> *"It is only clear what the graphics are when used in conjunction with the textual descriptors."*
> (Respondent 4)

One respondent agreed strongly, two agreed and one strongly disagreed that the navigation icons and links were always located where expected. There was one comment:

> *"I would expect the site navigation to follow accepted basic "web conventions" e.g. navigation in a LHS menu or beneath the page headers at the top of the screen, *as well* as some basic navigation at the bottom of the page. Presenting the navigation only at the bottom of the pages means that users have to scroll in order to navigate."*
> (Respondent 4)

One respondent agreed strongly, two agreed and one neither agreed nor disagreed that the explanation of navigation icons provided on the home page was helpful. There was one comment:

> *"To some extent, but users are unlikely to actually read all of the text and are more likely to simply 'dive in' to what looks relevant"*
> (Respondent 4)

Two respondents agreed strongly, one agreed and one neither agreed nor disagreed that the size of the navigation icons facilitated ease of selection with the mouse.

Applying existing knowledge

Two respondents agreed strongly, one agreed, and one neither agreed nor disagreed that they were able to apply existing knowledge of web pages to using the timetable application. There was one comment:

> *"I realise that this site is intended for a specialist user group, but personally I found the site sufficiently different from 'standard' to make me have to work harder than expected to use it."*
> (Respondent 4)

Arrangement of information

Three respondents agreed and one neither agreed nor disagreed that information was arranged logically on the screen.

Ease of use

Two respondents reported finding the timetable easy to use, whilst two reported having difficulty using the timetable at first. There were two comments:

> *"It was necessary to revisit the site to learn more of the main objectives of the site."*
> (Respondent 3)

> *"As previously noted for me it was sufficiently non standard to make me have to think about navigation etc."*
> (Respondent 4)

Learnability

Two respondents reported finding it easy to learn how to find their way around the timetable, whilst one respondent reported that it took some time to learn. There were two comments:

> *"It took a little while to get used to the layout as there are a lot of pages and a lot of options, which children might need time to get used to."*
> (Respondent 3)

> *"Not long in real terms, but longer than I would have wanted!"*
> (Respondent 4)

Use of language

All four respondents agreed strongly that the language used throughout was clear and understandable. There was one comment:

> *"Overall, the website was very well designed for target audience with a simple, clear and consistent interface"*
> (Respondent 2)

Summary

Although the expert users did not agree collectively, possibly because of their differing areas of expertise, there were some positive findings from this evaluation. For example, all four respondents agreed that design and layout were consistent throughout and that language use had been clear and comprehensible. In addition, one respondent thought that the simple and clear interface was appropriate for the target audience. The evaluation provided some useful feedback, which will assist with further development. For example, there were divided opinions regarding ease of use of the timetable application and this is an area that needs to be considered. In particular, one respondent commented on the large number of pages within the structure, suggesting that this might be something that would cause the children using the timetable difficulty in getting used to.

7.6 Conclusion

This chapter has presented the findings of the various investigations conducted during this study. The findings have been set out mainly as a narrative and have been presented in relation to the first four stages of the research plan. During the preliminary investigation stage visits were made to two different educational settings, where many similarities were found despite the fact that the individuals in each setting had such varying needs. Both settings were found to have small classes, to follow the principles of the TEACCH approach and to use daily symbolic timetables to provide visual structure for the pupils. Examples of multimedia software products were also investigated at this preliminary stage and it was found that whilst there were many products available commercially, these were aimed mainly at educational needs such as literacy skills. Only one example of timetable software was identified at this time, a product called Make-A-Schedule, by Do2Learn. Areas of research using multimedia software for individuals with autism were also investigated and many interesting studies were identified.

The role and use of the symbolic timetable in the case study setting was investigated using a task analysis. Observation of the use of the symbolic timetable in the setting together with interview data gathered from educationalists identified the purpose of the timetable as being to provide visual structure for the children. The timetable was found to be the focal point of the room and the children assembled beside the timetable several times during the day to be reminded of the day's activities. The symbolic timetable was found to provide a clear structure and assisted comprehension of the day's events for the children.

A requirements analysis investigated user ability and the information needs for an interactive timetable. The potential users of the interactive timetable were identified as the participating children, the educationalists, and the children's parents. It was considered important to establish an understanding of the users' needs and so ability in using a computer and in using the Internet was investigated. This was to identify potential difficulties and areas where users might require particular assistance. Interviews with parents and educationalists identified potential information content to support the timetable structure. For example, there were suggestions that information relating to homework could be incorporated in some way. Generally, it was agreed that the format of the timetable should be as similar to the symbolic timetable as possible and that the familiar Boardmaker™ symbols be used. Some concerns were raised and these related to access issues and to the possibility of children following their own agenda when accessing the interactive timetable.

Formative evaluations were carried out during the early stages of the system development and these involved cooperative user observations and usability assessment. These were encouraging and identified issues for further development. For example, a recommendation drawn from the cooperative user evaluation observations (Appendix 19) was that future evaluations with the children should include some form of task to be assessed. The usability studies conducted with staff members were useful and identified an issue with the navigation icons used at this stage of development, which enabled consideration of alternative options to be made.

Summative evaluation of the interactive timetable was carried out in relation to aim 2. Data was gathered from the participating children's parents and from the class teacher in order to establish what constituted stereotypical behaviour, physical signs of anxiety, and environmental stressors for each child. Structured observations of the children were then conducted over two study periods. The first study was carried out as a baseline and only the symbolic timetable was in use during this study. The second study was carried out a short time later and both the symbolic timetable and interactive timetable were used at this time. A great deal of data was gathered during these two studies and the children were found to display various forms of stereotyped behaviours. It was also found that change appeared to be a major stressor for these children.

Three forms of investigation were carried out in order to evaluate the effectiveness of the interactive timetable as a management and communication tool. Cooperative user evaluation observations were conducted with four of the children and with one of the teachers. The children were found to gain confidence in using the interactive timetable and all of the children attempted the tasks that they were asked to perform and generally performed these competently. There was noted to be an issue with distraction due to the way that certain images presented on screen and this needs to be resolved for future development. Semi-structured interviews with two parents and two educationalists were carried out to assist in assessing the interactive timetable as a management and communication tool. It was generally agreed that an interactive timetable offered the potential to prepare a child for the next day at school and that it could also enable discussion between parent and child to be facilitated in the home environment. The interactive timetable was also seen as a useful tool for organising and storing materials for use in the classroom and at home. Concerns regarding availability of resources and access were raised and are discussed further in section 8.4.6. Expert user evaluations were also carried out at this stage. These found that the design and layout of the interactive timetable were consistent. A discussion of all these findings together with an evaluation of the research methodology is now presented in chapter eight.

Chapter 8: Discussion

8.1 Introduction

This chapter evaluates the effectiveness of the research methodology and discusses the limitations of this study. In order to assess the effectiveness of the methodology employed in the study it is necessary to consider whether this study actually achieved what it set out to achieve. In addition, it is also necessary to consider any limitations that may have affected the extent to which the aims of the study were achieved.

8.2 Overview

This study set out to explore and assess the practical value of an interactive, computer-based timetable developed for a specific group of primary school children with autism. The study began by asking: "can timetable information be communicated to children with autism in an interactive and computer-based form?" and if so, "can an interactive timetable assist children with autism in coping with changes in their daily school routine?" To reiterate, the aims of the study were:

1. To develop a computer-based, interactive timetable system for a class of children diagnosed as having an autistic spectrum disorder (ASD), allowing individual children to personalise their own timetable

2. To evaluate the effectiveness of the interactive timetable system by considering whether its use in any way assisted the participating children in overcoming anxiety related to changes in daily class routine

3. To evaluate the effectiveness of the interactive timetable system as a management and communication tool for the teacher and parents

4. To examine the feasibility of building a general, interactive timetabling system, capable of widespread implementation

8.3 To what extent were the aims of this study achieved?

The aims of this study were achieved to some extent. Certainly, a prototype interactive timetable was developed. The functionality of the timetable was not, however, completed as far as had been intended and consequently there were limitations to the extent to which the subsequent aims were achieved.

8.3.1 Aim 1: Development of a computer-based, interactive timetable

Preliminary investigations revealed that although software exists for children with special needs such as autism, this was mostly generic, commercially produced, and found to address key pedagogic skills such as literacy and numeric skills. Software intended to address the communication of structure and routine, as in a timetable, was found to be scarce. It was considered necessary, therefore, to develop a timetable application specifically for this study and an artefact – the interactive timetable – was developed in order to explore and assess the practical value of such a tool and to contribute to knowledge in this area (Nunamaker et al., 1990–1991). As reported in the system development methodology (section 6.3), the development framework followed an adaptation of the system life cycle model and generally this was found to be a successful approach. Clear steps were established within the framework, which assisted in guiding the development process, but at the same time the framework was flexible enough to enable steps to be repeated as necessary.

The user-centred, participative approach was considered to have contributed greatly to the design process. Involvement of key user groups facilitated the consideration of factors which were important to the users and enabled these to be incorporated into the design. Whilst more involvement may have improved the design, it was recognised that time constraints and educationalist’s workloads considerably restricted involvement. Furthermore, contribution by the participating children was limited due to the nature of their disorder. It is suggested that had it been possible for the researcher and the teacher to involve the participating children more in the design stage of the interactive timetable system, then a more usable system may have been developed. For example, greater involvement of the children at the early stages of development may have highlighted their understanding or misunderstanding of navigation icons. This is an issue to consider for future studies.

A useful and usable interactive timetable was built, which allowed a lot of interesting study and testing to be carried out. Limitations were encountered, however, in the development of interactive features in the individual timetable area and this restricted the functionality of certain tasks. Specifically, it was not possible at the implementation stage for pages which the children completed as part of tasks, such as 'my helping tasks' (fig. 6.8, section 6.4.2.4), to be saved. In addition, technical difficulties with server permissions meant that administration features were not implemented as intended, with the result that it was not possible for the teacher to make changes to the timetable at this time. This affected the extent to which subsequent aims could be achieved.

8.3.2 Aim 2: Considering whether use of the interactive timetable in any way reduced anxiety related to changes in routine

Examination of relevant literature revealed that children with autism face many difficulties as a result of their disorder (section 2.2). Whilst diagnoses differ and individuals experience varying degrees of impairment, there are central characteristics which are common to all individuals on the autistic spectrum. A reason for spending considerable time in the setting was to enable the researcher to gain a deeper understanding of the difficulties this specific group of individuals faced and to observe strategies used in the classroom to support individuals with autism. A major concern motivating this study was that children with autism experience difficulty coping with change and that this can result in anxiety (Cumine et al., 2000; Groden et al., 1994; Wing 1980). In particular, deficits relating to executive function ability (section 2.2.2.2) are suggested to be responsible for this difficulty and as a result individuals with autism are found to have rigidity of thought processes and behaviour patterns, and frequently exhibit repetitive actions, possibly as a coping mechanism (Cumine et al., 1998; Frith, 2003).

In order to evaluate the effectiveness of the interactive timetable in relation to aim 2, several investigations were carried out as described in the research methodology (5.8.4.1). This aim was achieved are far as was possible within the constraints now discussed. Difficulties encountered with the degree of functionality of the interactive timetable were discussed earlier and to some extent these affected the effectiveness of this evaluation. For example, it was not possible for the teacher to make changes to the interactive timetable during these observation studies and so the class timetable area of the prototype remained static. Whilst this made it difficult to assess fully any reduction of uncertainty with regards to use of the interactive timetable, it should also be noted that no changes were observed to be made to the symbolic timetable during the periods of these observation studies.

The continued use of the symbolic timetable was also considered to limit the achievement of this aim and warrants discussion here. Selection of a setting where a symbolic timetable was being used was considered an important criterion for this study; it was deemed necessary to be able to understand the role and use of an existing timetable system before creating an interactive timetable. The timetable provided structure, was clearly visible and the children were familiar with using this. A decision had been taken, following discussion with the educationalists, for use of the symbolic timetable to continue throughout the study. It was recognised that the structure of the symbolic timetable was extremely important for the well-being of the participating children and that to remove it at any point could possibly have been detrimental to the children's welfare. However, the fact that the symbolic timetable continued to provide structure for the children made assessment of the interactive timetable difficult. It was not possible to determine clearly whether any reduction in uncertainty was in fact due to the presence of the symbolic timetable or to use of the interactive timetable. This is an issue to consider for future studies of this kind. For example, if a longer period of assessment were carried out (months rather than weeks), then it might be possible to phase out use of the symbolic timetable at some point, allowing a computer-based timetable to become the main structure and enabling more effective evaluation to take place.

Factors considered to be out with the researcher's control were also considered to affect the extent to which aim 2 was achieved. Many extraneous variables were noted to occur in the classroom setting. For example, there were frequent disturbances due to members of staff and children entering or leaving the classroom, often there were other visitors present, and on some occasions staff or children were absent due to illness. These events all had the potential to cause anxiety for some individuals. Factors occurring outside the classroom could also have influenced the children's behaviour. However, these factors would be less evident and more difficult for the researcher to identify. For example, a child may have been late getting up in the morning, or his transport might have been late calling for him, or a child may have been feeling tired or generally off colour on a particular day when observations were being conducted. Any number of independent variables of this nature could, therefore, have influenced behaviour.

Whilst it is considered that an interactive, computer-based timetable might also assist in this way, it is also recognised that the very act of introducing a new timetable could be met with resistance from the participating children; introducing an interactive, computer-based timetable would be introducing a change to the way in which the children accessed the timetable information.

8.3.3 Aim 3: Effectiveness of the interactive timetable system as a management and communication tool for the teacher and parents.

The methods of evaluation in relation to aim 3 are discussed in the research methodology (section 5.8.4.2). It was not possible, however, to satisfactorily achieve this aim due to the difficulties encountered in completing the functionality of the interactive timetable, as discussed earlier. Whilst the interactive timetable was usable to a great extent, it was not possible for changes to be made to the timetable by the teacher. This was because of technical issues with server permissions. So although the teacher was able to discuss her views regarding use of the interactive timetable, it was not possible for her to comment on the functionality of the timetable as a management tool. However, whilst it was not possible to conclude whether the interactive system provided a better solution to the system already in place, it was recognised that the experience gained from this study could be generalised for future use.

Regarding the extent to which the interactive timetable was considered usable, several factors need to be considered. Setting aside the fact that functionality was limited in some aspects, usability assessments were encouraging (sections 7.4.1.2 and 7.5.2.1) and on a positive note, one child was reported to have made use of the timetable at home over a period of a week. Use of the interactive timetable in the classroom setting was, however, found to be limited and children were noted to make use of the timetable only at times when they were allocated to do so by the teacher. There are several possible reasons for this lack of use. It could have been that there was limited time available in the structure of the daily routine for children to make informal use of the interactive timetable, or it could have been that when introduced to the timetable, it was not made clear enough to the children that they were allowed to use this whenever they wished. It may of course have been the case that the children were not used to using the computer in an ad hoc way without permission and so were reluctant to do so. Alternatively, the children could have been unsure of the interactive timetable, or found it difficult to use, or simply were not interested in using it. However, findings of the cooperative user evaluations would suggest that this was in fact not the case (section 7.5.2.1 and Appendix 19).

To overcome these issues, a more formal approach to introducing the interactive timetable might have been beneficial. For example, the timetable may have been used more by the children if it had been introduced by the teacher, rather than by the researcher. The teacher's authority and her endorsement of the timetable in this way could possibly have influenced the children's acceptance and interest in the timetable. Moreover, if the timetable had been introduced as a 'whole class tool' in the same way that the symbolic timetable was being used, then acceptance by the children might have been more forthcoming.

A further limitation which affected the achievement of this aim was that only one parent had access to the Internet at this stage of the study. Earlier in the study it had been determined that three of the families had an Internet connection; however, at this late stage two of the families were having access difficulties. Therefore, only one parent was able to access the interactive timetable at home and to provide an insight into her views regarding the usefulness of the timetable. Opinions and views were still sought from staff and parents regarding this aspect of the interactive timetable and some encouraging data were gathered (section 7.5.2.2). The timetable was demonstrated to one parent at home by use of a laptop in order to overcome the problem of access.

8.3.4 Aim 4: Feasibility of building a general, interactive timetabling system, capable of widespread implementation.

This aim has not yet been achieved. It has been possible, however, to determine tentative guidelines for future use (section 8.4.6) as well as recommendations for the development of a future interactive timetabling system as demonstrated in chapter 9 (section 9.4).

8.4 Main findings

Although by the end of this study, findings have been inconclusive, analysis of data gathered from participating educationalists and parents was on the whole encouraging and moreover the children appeared to enjoy using the interactive timetable. For example, as reported in the cooperative evaluation observations conducted at stage 3 (Appendix 19), child 1 was found to be very enthusiastic and excited when first introduced to the interactive timetable. Furthermore, as reported earlier (sections 7.5.1.4 and 7.5.2.2), child 7 was found to be keen to make use of the timetable at home. The main findings are now discussed.

8.4.1 User environment

Preliminary investigations involving visits to a language unit attached to a mainstream school and a specialist setting found many similarities (section 7.2). In each setting a symbolic timetable was displayed prominently, taking up considerable space on a wall in the classroom. Information of a similar type was displayed in each setting and related to daily activities, the calendar, and individual tasks. Picture Communication Symbols by Boardmaker™ were used to communicate the daily activities in both settings. A variation of an individual timetable was also used in each setting. There were also similarities in class sizes, defined by the needs of the children and legislation, with between five and seven children attending in each class. Furthermore, the TEACCH approach was used as a form of structure in each setting. Differences noted were that coloured symbols were used in the mainstream setting, whilst black and white symbols were used in the specialist setting. These observations suggest that there are likely to be many similarities as well as differences in the approach to using symbolic timetables in classroom settings. Therefore, it is likely that any form of interactive timetable software that is developed should be flexible enough to be able to adapt to the requirements of different settings as well as to individual needs.

8.4.2 User ability

It is demonstrated in the literature that individuals with autism have frequently been found to be skilled at using computers and to enjoy the experience (Attwood, 1998; Bell & Potter, 1999; Murray, 1997). Findings from an assessment of computer literacy ability conducted during this study were favourable. It was established that four of the seven participating children had a home computer, with three out of four having access to the Internet at the time this particular set of data was collected. The children were reported to be proficient at using their home computers and three out of four of the children were noted to be competent at accessing the Internet. Four out of four children were reported to understand how to use hyperlinks. The children were found to be competent at using new programs on the computer. One concern was noted; three parents reported having difficulty in getting their child to finish using the computer, possibly indicating rigidity of behaviour or obsessiveness (Powell, 1996).

8.4.3 Usability findings

Usability observations demonstrated that generally the children were able to find the appropriate areas of the interactive timetable when asked and that they were able to do so on several different occasions. How did they achieve this? It is possible that the interface was intuitive enough for them to comprehend the significance of the different areas of the timetable. Alternatively, it could have been that one session of engagement with the interactive timetable was enough to develop a familiarity which would enable the children to recall how to locate specific areas on subsequent engagement. On the other hand, the researcher may inadvertently have prompted the children and so assisted them in locating appropriate areas. The children were already familiar with the principles of using the symbolic timetable and so it was possible that the children were able to relate this prior experience to their use of the interactive timetable. A longer period of observation may have assisted in providing answers to these questions and, therefore, it is suggested that further investigation is required. For example, development of more specific usability tests for this particular user group may assist. Druin (2002) suggests using a qualitative questionnaire to ask children for their views regarding likes, dislikes and difficulties with software. For this particular user group such a questionnaire would need to be carefully worded to ensure comprehension. Druin (2002) suggests incorporating faces with frowns or smiles for children to select if a numerical scale is required for quantitative evaluation.

8.4.4 Anxiety related behaviour

An assessment of anxiety related behaviour of four children participating in this study was carried out by parents and the class teacher to establish a baseline of behaviours and found the children to exhibit similar behaviours, as might be expected. All of the children were reported to find change stressful, particularly if it affected their routine. In addition, the children were all reported to become anxious and stressed if they were unable to communicate their needs. The children were noted to display various forms of stereotyped behaviours and two behaviours found to be common to all of the children were particular body movements and hand movements. In addition, two of the children demonstrated echolalia. All four of the children were reported to demonstrate physical signs of anxiety in the form of crying and over-reacting when unable to cope with stressful situations. Strategies used by the teacher to relieve anxiety in the classroom for these children included use of a symbolic timetable and rewards in the form of play activities. These findings are consistent with descriptions of autistic characteristics reported in the literature.

In the two structured observation studies conducted in the classroom, one during use of the symbolic timetable and one during use of both interactive and symbolic timetables (section 7.5.1), all four of the children exhibited a wide range of stereotyped behaviours and physical signs of anxiety. A range of environmental events was also noted to occur during the observation sessions and it is possible that an association could exist between these events and behaviours observed. In particular, and again not unexpected in view of the literature, it was noticeable that ‘change’ appeared to be a major stressor for all of these children. Findings were inconclusive for these studies, however. For example, when comparing the scaled average rates of stereotyped behaviours per hour for each child (child1: table 7.8; child 4: table 7.20; child 6: table 7.32; child 7: table 7.44) it can be seen that all four children displayed a considerable number of stereotyped behaviours during each study and that three of the children (C4, C6, and C7) were found to exhibit less stereotyped behaviours during study 2. It is not, however, possible to determine whether this reduction in stereotyped behaviour is associated with use of the interactive timetable. As mentioned earlier, many other factors out with the control of the researcher could have been responsible. Increases in environmental events were observed during study 2 and this was consistent across all four children (child 1: table 7.12; child 4: table 7.24; child 6: table 7.36; child 7: table 7.48). This is surprising considering the decrease in stereotyped behaviours observed for three of the children during study 2 and suggests that other factors may have been responsible for the incidence of behaviours observed in study 1. For example, changes were being introduced in the environment in addition to the events observed, such as the presence of the researcher, the introduction of a new task in the form of interaction with the timetable, and a new permissible behaviour on the computer.

Assessing symptoms of anxiety in individuals with autism is reported to be difficult, as there are many similarities between the symptoms of anxiety and autistic traits (Kim et al., 2000). In this particular study this was found to be the case. It was not possible to determine whether behaviours observed were actually associated with anxiety and it is feasible these were in fact autistic traits or habitual behaviours. Therefore, a more effective means of assessing behaviours is required for any further studies. For example, a standardised assessment may be more appropriate. A review of standardised tests carried out early on in this study (Appendix 5) found none that were suitable for the participants or for the particular context of this study. However, there may be new developments in this area and so further review is necessary.

8.4.5 The communication task

Observation studies conducted in the classroom setting, together with semi-structured interviews with members of the education team, identified considerable background information relating to the role and use of a symbolic timetable. The findings from these investigations were central to identifying the goals of a symbolic timetable and informing the development of the interactive timetable. The main findings were:

Display of symbolic timetable

Needs to be:

- Highly visible and prominently displayed
- Accessible at all times
- Simple to use
- Inclusive of supporting material

Communication of symbolic timetable

- Timetable of activities created daily
- Normally communicated to the children by the teacher
- Formal communication of the timetable three to four times a day
- Time taken to communicate the timetable was variable depending on day of week and time of day (e.g. Monday morning 45 minutes, Tuesday morning 20 minutes, mid-morning 10 minutes)

Symbol use

- Mixture of PCS (Boardmaker™) and text used in the display
- Created in situ by education team
- Stored close beside the timetable for convenience
- Laminated to preserve, deteriorates over time

- Duplicates necessary as frequently misplaced

Purpose of symbolic timetable

- To prepare the children for what was to come, by providing a clear, visual structure of the day's events
- To maintain behaviour by reducing uncertainty
- Aiding predictability and maintaining consistency

Use of timetable

- To communicate information
- To act as a reminder or prompt
- To support individual needs
- To create awareness of a shared timetable

These findings indicate that the prominence and high visibility of the timetable emphasised the importance of this tool in this particular setting. It was recognised that the timetable needed to be accessible to all of the children at all times. Furthermore, considerable materials supported the communication of daily activities and it was recognised that these were required to be incorporated within an interactive timetable in some way.

The findings of the task analysis (section 7.3.1) generally confirmed what had been reported in the literature review (section 4.2). For example, the purpose of a timetable had been established in the literature as being to provide predictability and to aid development of communication (Mesibov et al., 1994; Peeters & Gillberg, 1999; Quirk Hodgdon, 1995). In addition, it could be seen that use of concrete, visual reminders assisted children with autism in compensating for difficulties associated with executive function deficits (section 2.2.2.2) and communication (section 2.2.1.2).

Static forms of visual communication are generally recognised to be more effective than dynamic forms for children with autism. In particular, 'low tech' forms of alternative and augmentative communication such as symbol sets have been found to be successful, providing permanent and concrete visual support, which can be individualised if required (Hazell & Cockerill, 2001; Johnston et al., 2003). In view of the difficulties individuals have with transient communication, there was a concern whether the interactive timetable would actually be able to communicate information regarding daily activities in a way which would meet the children's needs. For example, would the transient attributes of hypertext be problematic? The non-linear nature of hypertext was considered a potential concern (section 6.2.1.3) and it was possible that the children could 'wander off into hyperspace' being free to control their own movements through the application. To address this potential problem care had been taken to include pointers on pages, such as page headers, to assist with orientation. In addition, internal navigation aids were incorporated. Nonetheless, the fact that screens changed and were, therefore, not static was a concern. Findings from the user ability investigations reported, however, that the children were familiar with use of the Internet and so presumably had encountered this situation before. In fact, during cooperative user observation studies it was noted that frequently the children used the browser back button to recall screens as required, indicating a familiarity and confidence.

Many of the pages included in the class timetable area were in fact static and the children appeared to grasp this fact, returning to these screens frequently. There were, however, pages which could be created dynamically and which would, therefore, change as a result of the children's interaction. For example, pages such as 'my helping task' (figure 6.8, section 6.4.2.4), were ones which the children were encouraged to create themselves and which would produce a dynamic response. A problem encountered during the study was that it was not possible to save these pages once the child had created them. However, should this problem be overcome the children would be able to save the dynamically created pages. A possible solution to these transient pages would be to print a copy for the child to keep as a reminder. The areas the teacher would make changes to would also be renewed, but as the symbolic timetable is renewed each day it is assumed that the children would be used to this form of change.

8.4.6 Concerns regarding use of an interactive timetable

Parents and educationalists raised many concerns regarding use of an interactive timetable during interview:

- Would advance notice of activities cause distraction?
- Would children be tempted to follow their own agenda when engaging with the interactive timetable?
- Will access be a problem?
- Will the size of a computer screen be a problem for access?
- Will there be enough computer resources available for children to access the timetable whenever they require?
- Will those without access to the Internet at home be disadvantaged?
- Will all the children have the motor skills necessary to manipulate the timetable on screen?
- Will members of the educational team have the skills to maintain the timetable online?

It can be seen that the concerns regarding use of the interactive timetable differed from the limitations reported for the symbolic timetable and were mostly related to access issues. This indicates the overriding issue of the solo nature of a computer and the fact that it is not always conducive to being used as a cooperative tool. A response to these concerns is to suggest tentative guidelines for the future use of an interactive timetable. Namely:

- An interactive timetable should be adaptable for individual needs e.g. having the facility to restrict or make available information for individuals as required
- For settings where an interactive timetable would be implemented, consideration should be made regarding hardware requirements to achieve best possible access e.g. increasing number of computer terminals available, or introducing an overhead projector and screen, or an interactive whiteboard

- For children who have difficulty with motor skills, alternative interaction methods should be considered to assist with accessibility e.g. touch screen or keyboard overlays

Limitations of the symbolic timetable included:

- High dependency on the timetable by some children
- Over reliance by some children on specific symbols
- Planning of the timetable can be time consuming
- Limited to some extent by availability of symbols

It is possible that some of the limitation issues relating to the symbolic timetable would arise if an interactive timetable were used for a longer period of time, as these appear to be related to use of structure per se. The children's dependency on such a structure would most likely be transferred from one form of timetable to another and, therefore, similar concerns would become apparent.

8.4.7 Beneficial features of an interactive timetable

Parents and educationalists suggested many beneficial features which use of an interactive timetable could offer:

- Facilitate communication and discussion between child and parents
- Act as a reminder for the child
- Provide a familiar structure
- Prepare child for the next day and in doing so relieve anxiety
- Enjoyment and pleasure for the child - in using the timetable on a computer
- Learn functional computer skills to prepare for future
- Enable parents to see what their child had been doing at school
- An information source for parents
- An alternative way for parents to communicate with teachers
- A means of organising and storing information for teachers

Benefits of the symbolic timetable were identified as:

- Prepares children for the day ahead
- Reduces uncertainty
- Reminded the children of what they had achieved and what remained to be done
- Provides clear signals of what was expected of the children
- The visual structure aids the children's comprehension of the day's events
- An aid for organisation and reinforcement of the day's activities for staff
- Relieves the teacher from continually repeating information throughout the day

Here the beneficial features of an interactive timetable were considered to be very similar to those of the symbolic timetable. In addition, it was suggested that the interactive timetable would be a way of including the family more and facilitating communication between child and parents in the home setting.

8.5 Effectiveness of the research methodology

Criteria used to assess the quality of a research study in the field of quantitative research are validity, generalisability, and reliability (Bryman, 2001; Sarantakos, 1998). In the field of qualitative research, however, there has been much debate regarding the relevance of these criteria, particularly validity, which has connotations of measurement (Bryman, 2001). One position has been to apply the criteria of validity and reliability to qualitative research, but to place less importance on the issue of measurement. For example, Mason (1996) suggests, "validity, generalizability and reliability are different kinds of measures of the quality, rigour and wider potential of research, which are achieved according to certain methodological and disciplinary conventions and principles" (p. 21). Another position has been to use the alternative criteria of trustworthiness and authenticity for assessing qualitative research (Bryman, 2001; Sarantakos, 1998). This study uses the terms generalisability, validity and reliability in this assessment of the effectiveness of the research methodology, but relates these to the criteria of trustworthiness and authenticity as suggested by Bryman (2001). This is because this study was essentially qualitative and the findings reported in this thesis are on the whole presented as a narrative. Therefore, the extent to which the material presented here is authentic and the researcher's propensity to be considered trustworthy in reporting the findings of this study are the main concerns.

8.5.1 Generalisability

This study employed a case study approach; this was considered an appropriate method to facilitate studying the phenomenon of a symbolic timetable in its natural setting. However, a major criticism of the case study approach is that it is not possible to generalise from its findings (Flyvberg, 2004; Gomm et al., 2000; Silverman, 2005; Yin, 2003). Generalising from a case study is considered problematic, mainly because it is not possible to use sampling procedures such as those used in quantitative research (Silverman, 2005). However, if a representative sample of cases were to have been constructed for this study, then the size of the sample would most likely have been too large to allow the intensive analysis which was intended within the time scale of this study (Mason, 1996; Silverman, 2005). Therefore, by using a case study approach with a small sample, an holistic and in-depth study was possible, enabling a rich and detailed picture of the main issues to evolve.

One way in which generalisability could have been achieved is by "combining qualitative research with quantitative measures of populations" (Silverman, 2005, p.128). Gomm et al. (2000) refer to this as empirical generalisation and suggest comparing "the characteristics of the case(s) being studied with available information about the population to which generalization is intended" (p. 105). For example, by comparing the single cases studied in this study, with information about relevant aspects of this particular population as demonstrated in other studies, differences and similarities could be demonstrated. Other studies concerning individuals with autism were discussed in this thesis, but so far no differences or similarities have been discussed and this is something, which could be done to increase the generalisability of this study. Another method suggested for increasing generalisability is that of theoretical sampling, where selection is based on relevance to research questions and the theoretical position of the study (Mason, 1996; Silverman, 2005). This was in fact how participants were selected for this study.

Further criticisms of case study methodologies are lack of rigour, the length of time to gather data, and the fact that very many documents are produced (Yin, 2003). The case study "proliferates rather than narrows" (Stake, 2000b, p. 24) and it is suggested that the best use of the case study is "for adding to existing experience and humanistic understanding" (Stake, 2000b, p. 24). In this study, use of the case study approach has facilitated learning and understanding for the researcher through personal experience, while the process of reporting this research will be beneficial for a wider audience (Flyvberg, 2004; Stake, 2000b). The fact that the researcher spent prolonged periods in the setting, constantly observing the participants and their experiences in using the interactive timetable, demonstrates a serious attention to rigour (Guba & Lincoln, 2005).

8.5.2 Validity and reliability

Ways in which the researcher strove to achieve validity and reliability during this study are now discussed. The researcher spent a great deal of time in the setting, approximately 68 days over a period of 146 weeks, and observation studies were conducted as a key method of data collection. The researcher tried to remain as unobtrusive as possible in the study setting to reduce the possibility of affecting behaviours. Observations can be susceptible to bias, as the observer relies heavily on their own perceptions (Adler & Adler, 1998). One way in which the researcher tried to overcome the problem of bias in this study, was by carrying out multiple observations. The researcher believed that if consistency of findings were achieved, then this would increase the trustworthiness of the findings. An alternative method suggested for increasing reliability of findings is by using a team of observers. However, issues concerning the nature of the setting and participants meant that this was not an option to pursue. In addition to conducting multiple observations, the researcher also used other methods of data collection, such as interview and questionnaire techniques. Using multiple methods in this way enabled the researcher to seek different perspectives, facilitating a more complete picture of different aspects of the study. Furthermore, triangulation of data allowed comparisons to be made between findings.

It is suggested that observation techniques are likely to be accurate only for the particular group which is observed and, therefore, not necessarily the same for the larger population, thus reducing reliability. Generalisability of observations can be enhanced through use of systematic observations and repeated observations over varying conditions. If these yield the same findings then these are more credible. Adler and Adler (1998) suggest the two variables to vary are time and place. In addition, direct observation "enhances consistency and validity" (Adler & Adler, 1998, p. 90). In this study, systematic observations were carried out in the later stages. Each child was observed on several occasions at different times of the day and during different activities in order to increase credibility. It was not possible to conduct the structured observations in exactly the same way each time due to access issues and curricular constraints. In addition, the length of observations varied due to availability of participants and the length of time an activity took place over. For example, a child might be called away during an observation because he had a speech and language therapy session scheduled. Therefore, making comparisons between the findings of these observations was difficult. However, to overcome this problem, frequency figures were collated to average numbers per hour to aid comparisons. Because this study takes an interpretivist position the behaviours reported are the researcher's interpretation of what was observed. A second opinion was sought from the class teacher regarding categorisation of behaviours in order to address subjectivity. To increase reliability further it would have been an idea to show the teacher and parents the observation records and for them to categorise behaviours also. If there was agreement then this would have aided reliability.

8.5.3 Limitations of methodology

Limitations have already been discussed in this chapter in relation to specific examples. A brief discussion of methodological limitations is now presented. The sample size in this study was small and this may be considered by some to be a limitation. However, this study was concerned with in-depth, qualitative understandings of a select population and, therefore, a small sample was considered most appropriate. By studying a small, select sample, the researcher was able to make meaningful comparisons in relation to the research questions (Mason, 1996).

Limitations regarding access were mentioned briefly earlier. The education environment in which this study was conducted is by its very nature constraining; there are set terms during which children attend school and set holidays during which children are absent from school. In special education settings there is a tendency for children to attend school for a shorter day. In addition to these constraints there are factors which are uncontrollable and unpredictable, such as illness for staff and pupils, and these factors did have an effect on data collection. In this particular study there was an additional interruption in the form of ongoing industrial action, which caused significant disruption to data collection and access was considerably restricted at an important time. Consequently, observation periods for evaluation studies were for a much shorter period than planned. In addition, long spells with no access meant that the children may have forgotten the researcher and it was necessary to re-establish a presence.

The possibility of researcher effect and bias in relation to observation studies was mentioned earlier. This is also a concern during interview. In order to overcome these concerns the researcher prepared a list of questions to act as a guide for each interview. This enabled the researcher to ensure that important issues were raised with each interviewee. Where possible interviewees were shown a copy of the interview transcript to enable them to verify that this was what they had actually said.

Construction of questionnaires was carried out carefully to ensure questions were clearly stated and that there was no ambiguity. Where possible all questionnaires were piloted by colleagues in the first instance and this enabled problem questions to be removed or reworded.

Ethical issues were raised in the research methodology (section 5.9). These were issues which the researcher was conscious of throughout the study. One particular limitation was that the researcher was not able to interview the children because of the nature of their condition and the consideration that they were vulnerable.

8.6 Conclusion

This chapter has discussed the effectiveness of the research methodology. It began by considering the extent to which the aims of this study were achieved and it was recognised that while the aims were achieved to some extent, there were limitations. The achievement of the study aims was, therefore, not wholly satisfactory. The main findings of this study were discussed and it was shown that there were interesting findings in several areas. However, the findings in relation to aim 2 and aim 3 of this study were inconclusive. Finally, an evaluation of the effectiveness of the research methodology revealed that generally the researcher believed the study facilitated learning and understanding through personal experience. The final chapter of this thesis presents a conclusion and recommendations for a future study.

Chapter 9: Conclusion

9.1 Introduction

This chapter provides a conclusion to the research which has been discussed in this thesis. Key conclusions for each of the four aims of this study are presented and the contribution which this research is believed to have made to knowledge in this particular area is acknowledged. Recommendations for future research are suggested.

9.2 Key conclusions

This study has examined the issues involved in the processes of developing and evaluating an interactive, computer-based timetable for primary school children with autism. It has considered the experiences of both the researcher and the participants involved in this study. The key conclusions are now set out with regards to each of the four aims.

9.2.1 Development of a computer-based, interactive timetable

In order to create a usable system it is essential to understand the task and goals which it is expected to perform and to have a clear understanding of the users' needs. Reviewing the literature provided background knowledge, but this was not considered adequate to assist understanding fully. Being immersed in a setting where such a timetable was being used did aid understanding. Observing the use of a symbolic timetable at first-hand enabled the researcher to gain an understanding of the functionality of the timetable, while access to the knowledge and understanding of those who used a symbolic timetable as part of their everyday life facilitated an understanding of the purpose and intricacies of such a phenomenon. The timetable was found to provide structure, to aid comprehension and to be important for reducing uncertainty by preparing children for the day ahead, factors which had also been reported in the literature.

Creating a computer-based version of the symbolic timetable was challenging. Although the researcher's understanding of the principles of a symbolic timetable had advanced following intensive investigation, it was still likely that there would be differences between the researcher's ideas of how the timetable should be structured and presented on the computer, with the users' concept of this. Using modelling techniques such as paper models and storyboards enabled the researcher to overcome this difficulty to some extent. The models were helpful in enabling the users to visualise how a computer-based timetable might appear and also encouraged users to be more involved in the design of a useable system.

Development of a prototype model of the timetable was also useful, as it allowed the users to see a working model of the proposed timetable. Conducting formative evaluations such as cooperative user observations and usability testing at the early stages of development were again useful techniques. These made it possible for problems to be identified and for adjustments to be made to the timetable. Evaluations also assisted the users by enabling them to see what could be achieved and as a result, additional requirements and alternative ways in which to present information began to emerge.

Adapting the timetable to the computer screen was challenging. The symbolic timetable was displayed in the classroom as a continuous single row of symbols, moving from left to right. At the later stages of the study this timetable could include as many as 20 symbols. As mentioned earlier (section 6.4.2.4), a grid format was created on the 'check my timetable' page as a solution to fitting the timetable in one screen without scrolling (figs. 6.1.4 and 6.1.5). Symbols were displayed in four rows, with six symbols in each row. Determining whether the children were able to read the timetable in this way, moving from left to right and then back down to begin again at the left side of the next row was not fully established. This is an issue which requires further study and one which relates generally to the issue of trying to adapt computer systems to real life.

9.2.2 Anxiety related behaviour

Examination of the literature revealed that individuals with autism face many difficulties as a consequence of the 'triad of impairments', difficulties with social interaction, social communication, and social imagination. Further difficulties were reported to be related to certain psychological deficits, concerning abilities relating to executive function, central coherence, and 'Theory of Mind'. Observing these children for prolonged periods of time enabled the researcher to gain a clearer understanding of the problems they faced and the types of behaviours which they were likely to present. Questioning those who knew the children well also assisted understanding of behaviours.

Conducting structured observations at first seemed a feasible way to gather data to determine whether an association existed between use of the interactive timetable and a reduction in uncertainty, as manifest by lower levels of anxiety for the children. In practice, however, it proved to be problematic. The researcher's presence in the classroom could have caused anxiety for some individuals and the very fact that the researcher was introducing the children to the interactive timetable could be construed as an event which could introduce anxiety. In addition, the practicalities of observing one child, observing other events which were taking place at the same time, timing periods of behaviour, and writing notes about all of these events made this a difficult task. Future studies might consider video recording such observations, as this would enable events to be repeated endlessly for researchers, ensuring that all behaviours and events could be identified.

9.2.3 A management and communication tool

Spending long periods of time in this particular setting enabled the researcher to gain a deeper understanding of the structures in place and the professional expertise required to assist these children, not just in gaining an education, but in learning and developing essential life skills. Immersion in the setting allowed the researcher to observe strategies used in the classroom to aid the children in overcoming difficulties. It was found that the symbolic timetable was an important structure for the children. It communicated information about the nature of an activity, the time of day when an activity took place and in some cases the length of time the activity would take to complete. The timetable also enabled the children to see each activity in relation to other activities and the sequence in which they were to take place. The timetable was always available to the children. It was a permanent display on the wall and was easy to see from any part of the classroom. The symbolic timetable, therefore, fulfilled its role in communicating the necessary information to the children to help them in coping with their day.

The effectiveness of the interactive timetable as a management and communication tool was not fully assessed and findings were inconclusive. It did emerge that in theory the interactive timetable offered many possibilities for managing and communicating timetable information. In particular, it was seen to be a useful tool for communicating between school and home. However, there were found to be some concerns and these related primarily to access. Whilst it became apparent that the interactive timetable could communicate timetable information both in the classroom and at home, the ability for the children to access this information whenever required was as yet uncertain. Limited resources in the classroom (i.e. only one computer) meant that the children would only be able to access the timetable individually. It was not determined at this stage whether the children would be able to effectively access the timetable unsupervised in pairs or small groups and this is something which would be useful to follow up. The teacher typically explained the symbolic timetable to the children as a group activity, but it can be seen that to gather six children around a computer screen would be problematic. The size of the computer screen is a major issue here. Consideration of alternative forms of hardware might, therefore, be useful. For example, a wide screen display or a data projector could provide practical solutions. Access was also found to be hindered by server permissions within the education environment. It was not possible to remain online continuously and users were required to log-on to the school network whenever they required Internet access. This was, therefore, a problem. It can be seen that although the interactive timetable had potential as a management and communication tool, there were obstacles to access; unrestricted access is essential for the children to achieve the best possible benefit from such a timetable.

9.2.4 Examining the feasibility of building a general, interactive timetabling system

Whilst it has been possible to develop an interactive computer-based timetable for the children in this study, it has not been possible to establish fully whether it is feasible to create a general system for widespread use. This is because evaluations were not completed fully and so it was not possible to answer the second research question “can an interactive timetable assist children with autism in coping with changes in their daily school routine?" Further work needs to be carried out to determine the feasibility of a general, interactive timetable system. What is clear is that this is a very specialist area and that the needs of individuals vary greatly, as do the environments in which they are educated. Therefore, any system which is developed must be adaptable enough to meet these needs.

9.3 Contribution to knowledge

This study has considered an area in which relatively little research has been conducted to date, that of interactive timetabling systems for children with autism. Whilst it has not been possible thus far to construct a specific theory regarding this issue, a model of an interactive timetable was developed and tentative guidelines for use of such a model were suggested. As a result of this study a structure for communicating timetable information was developed and evaluated, providing much useful information. Essentially this study has found that it is possible to communicate timetable information to children with autism in an alternative, computer-based form. Whether this structure would be adaptable to general widespread use has not yet been determined, however, the findings of this study could be used as a basis for further development and study. Criteria for communicating timetable information in a computer-based form were articulated (section 8.4.5), suggesting that accessibility and visibility are issues essential to any form of timetable used for children with autism. Furthermore, tentative guidelines for future use were identified (section 8.4.6). In addition, use of familiar symbols and text are considered to be important, as is the inclusion of supporting materials. Consideration of all these factors can inform future development in this area. In addition, specific beneficial features of an interactive, computer-based timetable were identified. These highlighted the potential of extending the use of the timetable to the home environment, thereby facilitating communication between school and home and between child and parent. The specific concerns regarding hardware resources which were highlighted through this study and which are an important consideration for future system developments of this kind could also be considered to be contributing to knowledge in this field. In addition, this study reinforces the importance of user involvement in system development methodologies, especially when users have such specific needs. Lastly, the multi-disciplinary nature of this study has highlighted the challenges and benefits of working across different areas and there is recognised to be a need for more integration and cooperation in this area.

9.4 Recommendations

To address the limitations found in this study it is suggested that further work in the area of computer-based timetabling is required. In particular, more development of the prototype interactive timetable could be carried out. For example, the administration area could be made functional, by looking in more depth at ways of creating access permissions. This would enable study of an area not fully addressed, effectiveness of the interactive timetable as an information management tool. In addition, the individual timetable area could be developed further. For example, alternative ways of enabling the children to create their own timetable could be investigated; the click and drag method used in this study had limitations as demonstrated in the findings of the cooperative user evaluation observations with the children (section 7.5.2.1). Investigation of touch screen interfaces might offer useful alternatives.

More research could be carried out in the area of usability testing with children with special needs such as autism. For example, more could be done to investigate such children's interaction with the computer interface, to identify common interaction behaviours, which could assist understanding of how effective an interface is. More research regarding anxiety related behaviours would also be valuable.

This study has primarily been concerned with the needs of children with autism. However, it is also recognised that the educationalists involved in a setting where an alternative means of communicating the timetable was introduced would also have needs. Therefore, it is recommended that investigation into the support which professionals working in this environment might require is important. For example, a study investigating educationalists needs regarding IT skills training might be of value.

Appendices

Appendix 1: Diagnostic criteria for autistic disorder

Diagnostic criteria for 299.00 Autistic Disorder (APA; DSM-IV-TR, 2000).

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

    (1) qualitative impairment in social interaction, as manifested by at least two of the following:

        (a) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
        (b) failure to develop peer relationships appropriate to developmental level
        (c) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. by a lack of showing, bringing, or pointing out objects of interest)
        (d) lack of social or emotional reciprocity

    (2) qualitative impairments in communication as manifested by at least one of the following:

        (a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
        (b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
        (c) stereotyped and repetitive use of language or idiosyncratic language
        (d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

    (3) restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:

        (a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
        (b) apparently inflexible adherence to specific, non-functional routines or rituals
        (c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
        (d) persistent preoccupation with parts of objects

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
C. The disturbance is not better accounted for by Rett’s Disorder or Childhood Disintegrative Disorder.

(Source: American Psychiatric Association, 2000, p.75)

Appendix 2: Diagnostic criteria for childhood autism

Diagnostic criteria for F.84.0 Childhood autism (WHO; ICD-10, 1993).

A. Abnormal or impaired development is evident before the age of 3 years in at least one of the following areas:

- (1) Receptive or expressive language as used in social communication;
- (2) The development of selective social attachments or of reciprocal social interaction;
- (3) Functional or symbolic play

B. A total of at least six symptoms from (1), (2), and (3) must be present, with at least two from (1) and at least one from each of (2) and (3):

- (1) Qualitative abnormalities in reciprocal social interaction are manifest in at least two of the following areas:
  - (a) failure adequately to use eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction;
  - (b) failure to develop (in a manner appropriate to mental age, and despite ample opportunities) peer relationships that involve a mutual sharing of interests, activities, and emotions;
  - (c) lack of socio-emotional reciprocity as shown by an impaired or deviant response to other people's emotions; or lack of modulation of behaviour according to social context; or a weak integration of social, emotional, and communicative behaviours;
  - (d) lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. a lack of showing, bringing, or pointing out to other people objects of interest to the individual).

- (2) Qualitative abnormalities in communication are manifest in at least one of the following areas:
  - (a) a delay in, or total lack of, development of spoken language that is *not* accompanied by an attempt to compensate through the use of gesture or mime as an alternative mode of communication (often preceded by a lack of communicative babbling);
  - (b) relative failure to initiate or sustain conversational interchange (at whatever level of language skills is present), in which there is reciprocal responsiveness to the communications of the other person;
  - (c) stereotyped and repetitive use of language or idiosyncratic use of words or phrases;
  - (d) lack of varied spontaneous make-believe or (when young) social imitative play.

- (3) Restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities are manifest in at least one of the following areas:

  - (a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that are abnormal in content or focus; or one or more interests that are abnormal in their intensity and circumscribed nature though not in their content or focus;

(b) apparently compulsive adherence to specific, non-functional routines or rituals;
(c) stereotyped and repetitive motor mannerisms that involve either hand or finger flapping or twisting, or complex whole-body movements;
(d) preoccupation with part-objects or non-functional elements of play materials (such as their odour, the feel of their surface, or the noise or vibration that they generate).

C. The clinical picture is not attributable to the other varieties of pervasive developmental disorder: specific developmental disorder of receptive language (F80.2) with secondary socio-emotional problems; reactive attachment disorder (F94.1) or disinhibited attachment disorder (F94.2); mental retardation (F70-F72) with some associated emotional or behavioural disorder; schizophrenia (F20.-) of unusually early onset; and Rett's syndrome (F84.2).

(Source: World Health Organization, 1993, p.147-149)

Appendix 3: Diagnostic criteria for Asperger's disorder

Diagnostic criteria for 299.80 Asperger's Disorder (APA; DSM-IV-TR, 2000).

A. Qualitative impairment in social interaction, as manifested by at least two of the following:

    (1) marked impairment in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
    (2) failure to develop peer relationships appropriate to developmental level
    (3) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people)
    (4) lack of social or emotional reciprocity

B. Restricted repetitive and stereotyped patterns of behaviour, interests, and activities, as manifested by at least one of the following:

    (1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
    (2) apparently inflexible adherence to specific, non-functional routines or rituals
    (3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
    (4) persistent preoccupation with parts of objects

C. The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.

D. There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).

E. There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behaviour (other than in social interaction), and curiosity about the environment in childhood.

F. Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

(Source: American Psychiatric Association, 2000, p.84)

Appendix 4: Diagnostic criteria for Asperger's syndrome

Diagnostic criteria for Asperger's syndrome (WHO; ICD-10, 1993).

A. There is no clinically significant general delay in spoken or receptive language or cognitive development. Diagnosis requires that single words should have developed by 2 years of age or earlier and that communicative phrase be used by 3 years of age or earlier. Self-help skills, adaptive behaviours, and curiosity about the environment during the first 3 years should be at a level consistent with normal intellectual development. However, motor milestones may be somewhat delayed and motor clumsiness is usual (although not a necessary diagnostic feature). Isolated special skills, often related to abnormal preoccupations, are common, but are not required for diagnosis.

B. There are qualitative abnormalities in reciprocal social interaction (criteria as for autism).

C. The individual exhibits an unusually intense, circumscribed interest or restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities (criteria as for autism; however it would be less usual for these to include either motor mannerisms or preoccupations with part-objects or non-functional elements of play materials).

D. The disorder is not attributed to the other varieties of pervasive developmental disorder: simple schizophrenia (F20.6); schizo-typal disorder (F21); obsessive-compulsive disorder (F42.-); anankastic personality disorder (F60.5); reactive and disinhibited attachment disorders of childhood (F94.1 and F94.2, respectively).

(Source: World Health Organization, 1993, p.153-154)

Appendix 5: Review of anxiety and behaviour scales

Several anxiety and behaviour scales were reviewed in order that an appropriate scale might be found which could be used during the evaluation stage of this study. These are set out here, beginning with anxiety scales and moving on to behaviour scales. Only one was found to be specifically designed for children with autism (stress survey schedule).

Manifest anxiety scale (MAS)

The manifest anxiety scale was developed by Taylor in 1953 to be used as a measure of individual differences in motivation (Spielberger, 1975). This scale was derived from an instrument based on the trait theory of anxiety, the Minnesota Multiphasic Personality Inventory (Reynolds & Richmond, 1978; Spielberger, 1975). The manifest anxiety scale was found to be useful for "identifying individuals characterized by chronic anxiety reactions" (Reynolds & Richmond, 1997, p. 15). This scale was considered inappropriate for this study as it was intended for use with adults.

Children's manifest anxiety scale (CMAS) and Revised children's manifest anxiety scale (RCMAS)

The children's manifest anxiety scale was an amended version of the manifest anxiety scale discussed previously. The CMAS was developed by Castaneda, McCandless & Palermo in 1956 and was based on the trait theory of anxiety (Reynolds & Richmond, 1978). This scale was revised by Reynolds and Richmond (1978) and became known as "what I think and feel".

Reynolds and Richmond (1997) report that the CMAS was revised for several reasons. Firstly, teachers and others administering the instrument noted the scale to include insufficient areas of anxiety in children. Secondly, it was found that some of the words were too difficult for many of the children to understand. Thirdly, many teachers and researchers felt that an instrument was required that could be used from the beginning of a child's school career and that this could then assist in highlighting changes in anxiety as the child developed. Finally, it was felt that it would also be useful to be able to measure the effects of specific treatments on manifest anxiety levels. The revised instrument "what I think and feel" is now somewhat reduced in the number of items included, compared to the original version and has had some wording changed to reflect changes in the use of the English language over time (Reynolds & Richmond, 1997).

The RCMAS is a 37-item, self-report inventory, requiring a yes or no answer and is used to measure anxiety in children. It has been subjected to extensive testing and is considered to be psychometrically sound (Devilly, 2004).

This scale was considered not suitable for this particular study. The fact that the inventory was self-reporting was considered inappropriate: this would be introducing another form of change for the participating children and could have had an affect on outcomes. In addition the inventory included questions which were not considered situation-specific, so were, therefore, not relevant for this study.

State-trait anxiety inventory for children (STAIC)

The STAIC was developed initially as a research tool to study anxiety in elementary school children (Papay & Spielberger, 1986). The STAIC consists of a 20-item scale for the assessment of anxiety at a particular moment (S-anxiety scale) and 20 items for the evaluation of anxiety proneness (T-anxiety scale) (Papay & Spielberger, 1986). The S-anxiety scale is designed to measure transitory anxiety states, that is, subjective, consciously perceived feelings of apprehension, tension, and worry that vary in intensity and fluctuate over time. The T-anxiety scale measures relatively stable individual differences in anxiety proneness, that is, differences among children in the tendency to experience anxiety states (Papay & Spielberger, 1986). The instrument can be self-administered, or administered verbally to younger children.

The self-reporting style of the STAIC was considered inappropriate for this study: this would be introducing another form of change for the participating children and could have had an affect on outcomes. In addition the items included in the scale were not situation-specific.

Stress survey schedule

This instrument was developed by a team at the Groden center, Rhode Island, to measure stress in individuals with autism and other developmental disabilities (Groden et al., 2001). Groden et al. (2001) report that there had been little research in the area of stress in persons with autism to date. Research so far had tended to be related to the general population, or to those involved in caring for persons with such disabilities. Groden et al. (2001) stated “more specifically, there appear to be no surveys, tests, or questionnaires to measure the stress of persons with autism or other developmental disabilities” (p. 207).

Three studies took place during the development of the stress survey schedule. The first study was of an exploratory nature and assisted in the development of the initial stress inventory. Stress related items were identified through the use of an open-ended questionnaire, which was administered to staff and students at the Groden Center’s day and residential programs. Questions asked for typical stressors to be listed as well as the environments in which they were most likely to occur and the time of day of the activity. The data gathered led to commonly identified stressors being grouped into logical categories (Groden et al., 2001).

The second study replicated the results of the previous study to confirm the proposed model and the survey was then revised and modified based on the results of both the first and second study, before a further test of the model was carried out. From the three studies it was found that five categories of stress factors emerged. These were: changes and social threats, ritual related, related to pleasant events, related to unpleasant events, and anticipation (Groden et al., 2001).

The stress survey can be completed in one of three ways and administration method is dependent on the cognitive and communication abilities of the individual in question. It is preferable that the questionnaire is completed by the individual themselves, but if this is not an option, then it may be completed by either interview style with a caregiver asking the individual the questions, or by the caregiver who knows the individual the best answering questions on their behalf (Groden et al., 2001).

This instrument was considered very useful as a way to recognise environmental stress dimensions; for example, as a way of identifying potential stressors to enable a strategy for reducing stress to be developed. With regards to this particular study, administration of the instrument it itself would not have enabled an effective analysis of anxiety to be established. Nor would it have been appropriate for the instrument to have been self-administered by the children. In addition, it would have been very disruptive and time-consuming for the teacher to have administered the instrument for each child after each observation session. However, many of the items in the instrument were considered relevant for identifying potential stressors in the classroom setting. Following consultation with the class teacher, 25 of the 60 items considered most appropriate to the classroom situation were drawn from the schedule to be used as areas of questioning for the parent and teacher baseline assessments and also to assist the observation studies.

The children's social behaviour questionnaire (CSBQ)

The children's social behaviour questionnaire (CSBQ) was developed in 1994 in response to a perceived need for an instrument to describe the "problem behaviours of children with a pervasive developmental disorder in several domains" (Luteijn, Luteijn, Jackson, Volkmar, & Minderaa, 2000, p. 319). The questionnaire was designed to be completed by parents and other caregivers and to assess children aged from 4 to 18 years of age on items of social interaction, communication, stereotypical behaviours, motor behaviour, attention levels, affect regulation, sensory abnormalities, and general understanding of social cues (Luteijn et al., 2000). The items to be included in the questionnaire had been identified through literature review, clinical practice and parental accounts, and the intention was "to develop a checklist of the problem behaviours seen in children with PDD" (Luteijn et al., 2000, p. 321).

An initial study using the CSBQ led to a refinement of the instrument, with the initial 135 items being reduced to 96. The main reasons for this were that some items applied less specifically to Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS) problems, some were deemed unfit for inclusion as they had shown minor variations in scores and some were not expressed very clearly, which presented difficulties for the parents in responding.

The behaviour problems inventory (BPI)

The behaviour problems inventory (BPI) was developed in Germany in the 1980s and at that time took account of items for self-injurious behaviour and stereotypies (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001). The instrument underwent several revisions since then and is currently a 52-item respondent-based behaviour rating instrument. The behaviours it rates are self-injurious, stereotypic and aggressive/destructive behaviour in mental retardation and developmental disabilities (Rojahn et al., 2001). The behaviour problems inventory is a narrow-band instrument in that it is designed to focus on a specific number of conditions (Rojahn et al., 2001). The instrument was designed to be used as a clinical assessment tool, a treatment outcome measure, to assist research into common behaviour problems and to assist administrative decision making (Rojahn et al., 2001).

The BPI-01 contains 14 self-injurious behaviour items, 24 stereotypic behaviour items and 11 aggressive/destructive behaviour items. A recent study conducted by Rojahn et al. (2001) found that the BPI-01 was both a reliable and valid behaviour rating instrument for the area of problem behaviours in mental retardation and developmental disability.

Appendix 6: Education legislation framework

Education legislation framework

Act	Description
Education Act (1944) **Education (Scotland) Act (1945)**	Responsibility lay with local education authorities for identifying, assessing and meeting needs. Categories of handicap introduced, which required special education provision (van der Gaag, 1996). Autism was not identified as a special condition at this time. Individuals “severely subnormal” (IQ below 50) were deemed uneducable and there was no provision for these individuals.
Education (handicapped children) Act (England) (1970) **Education Act (Scotland) (1974)**	All children entitled to education, regardless of intellectual ability. Segregated education and special schools continued for the deaf/partial hearing, blind/partially sighted, mild mentally handicapped/moderate mentally handicapped (IQs 50-75), severe mentally handicapped (IQs below 50). [In England, but not Scotland, children considered “delicate” were also segregated in this way. This was due to a hang over from the 1944 Act]
1978 Warnock Report	Abolished categories of ‘handicap’. Parents more involved in assessment process (van der Gaag, 1996). Concepts of special educational needs and Statement/Records of special needs introduced. Integration of children with special needs into mainstream education. This was functional (real integration in class), social (breaks / lunchtimes only), and by location.
Report on the Education of Pupils with Learning Difficulties in Scottish Schools (HMSO, 1978)	Influential in determining special education and learning support arrangements in Scottish schools and underpins differences in provision regarding Scottish and English provision (van der Gaag, 1996).
Education Act (1981) **Education Act (Scotland) (1981)**	Initiated as a result of the Warnock report. This more or less accepted all recommendations, but did not include mandatory training of teachers for SEN work in mainstream. Term ‘learning difficulties’ replaced ‘handicap’ (van der Gaag, 1996) Forms the basis of special needs legislations with regards identification and assessment of SEN pupils (Farrell, 2001).
1996 Education Act	This act set out the law regarding special education, and had an effect of reducing access to mainstream school, because children with SEN brought exam results down. Funding – additional capitation for SEN children
Special Educational Needs Code of Practice (2001)	Provides guidance for schools and LEAs (Department for Education and Skills, n.d.) Also code of practice to support children

Appendix 7: Letter of approval – Department of Education

Letter of request

Director of Education

Susan Murray
Post-graduate Research Student
Department of Information Management
Queen Margaret University College,
Corstorphine campus
Direct Dial
Tel 0131 317 3513
Email: smurray@qmuc.ac.uk

16 January 2002

Dear

Evaluating the effectiveness of a computer-based, interactive timetable for primary school children with Asperger's syndrome (or unspecific high functioning autism)

I am writing to request permission to conduct fieldwork for a Ph.D. research degree within the special needs unit at ******* primary school.

The project involves developing and evaluating a computer-based interactive timetable for children with unspecific high functioning autism. I have approached the class teacher and she is happy for me to use her class as a case study. I have not as yet approached the head teacher *******.

The research would involve spending time in the classroom, observing how the current paper-based timetable system is used. It would also involve interviewing the teacher, speech therapist and parents, to ascertain the requirements of a computer-based system. The system would be developed at Queen Margaret University College and once developed, I would need to conduct further observations of the children using it, to evaluate its effectiveness in alleviating anxiety and as a management and communication tool. Full details of the proposal and methodology are included along with this letter.

This stage of the research would be anticipated to take place over the period of a year. At no time should I need to have one-to-one access with the children, I will instead be monitoring their use of the timetable and consequent behaviour as a non-participant observer and a teacher will always be presented during my visits to the classroom.

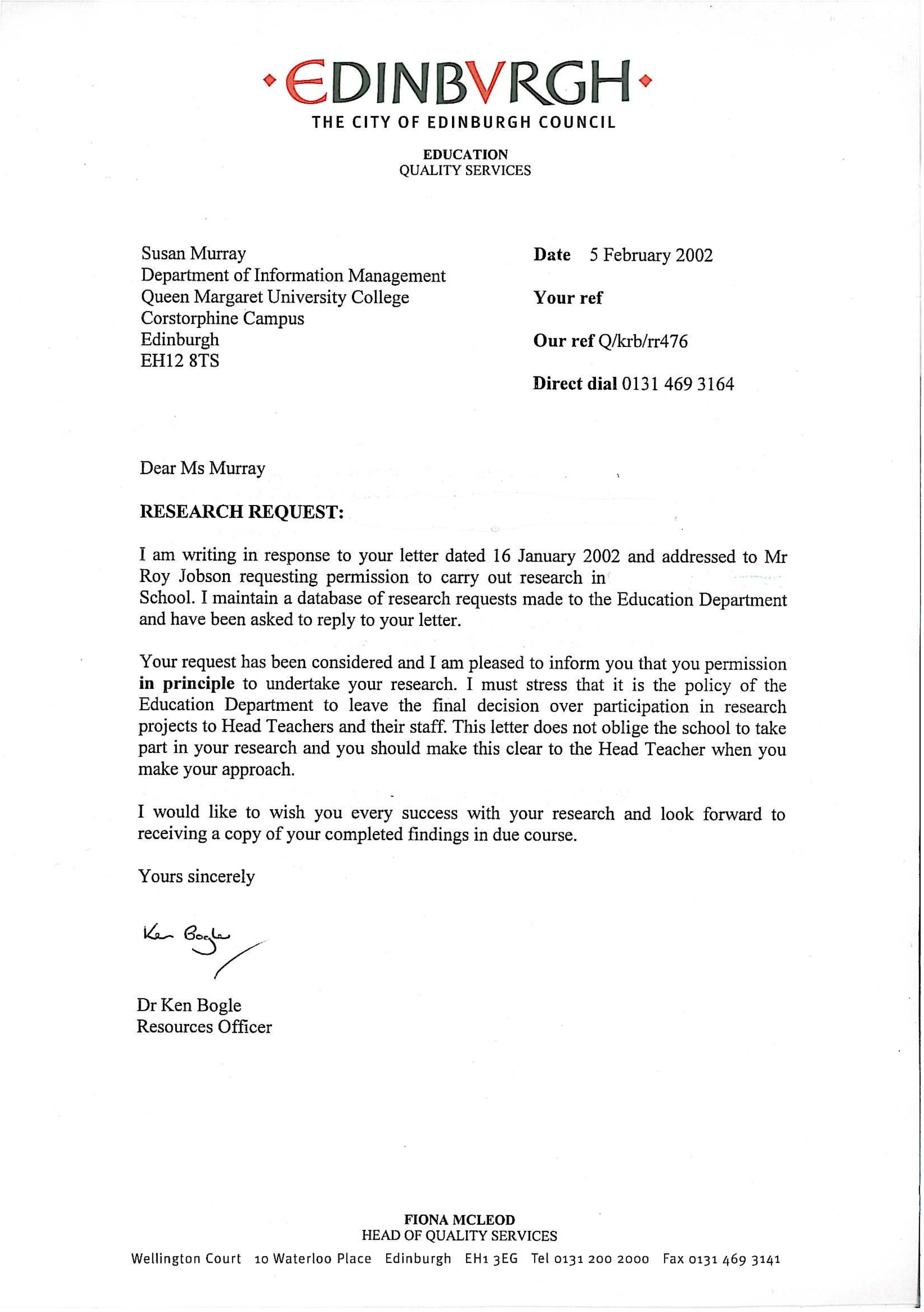
Parents will be given information regarding the project and will be given an opportunity to ask questions before signing a consent form. All data gathered will be treated in strict confidence, will be coded to ensure anonymity and will be stored in a secure environment.
A copy of the research will be sent to you on completion of the project. A letter of reference from my director of studies accompanies this request.

I look forward to hearing from you in the near future,

Yours sincerely

Susan Murray
Post-graduate research student

Letter of approval



◆EDINBVRGH◆
THE CITY OF EDINBURGH COUNCIL
EDUCATION
QUALITY SERVICES

Susan Murray
Department of Information Management
Queen Margaret University College
Corstorphine Campus
Edinburgh
EH12 8TS

Date 5 February 2002

Your ref

Our ref Q/krb/rr476

Direct dial 0131 469 3164

Dear Ms Murray

RESEARCH REQUEST:

I am writing in response to your letter dated 16 January 2002 and addressed to Mr Roy Jobson requesting permission to carry out research in School. I maintain a database of research requests made to the Education Department and have been asked to reply to your letter.

Your request has been considered and I am pleased to inform you that you permission **in principle** to undertake your research. I must stress that it is the policy of the Education Department to leave the final decision over participation in research projects to Head Teachers and their staff. This letter does not oblige the school to take part in your research and you should make this clear to the Head Teacher when you make your approach.

I would like to wish you every success with your research and look forward to receiving a copy of your completed findings in due course.

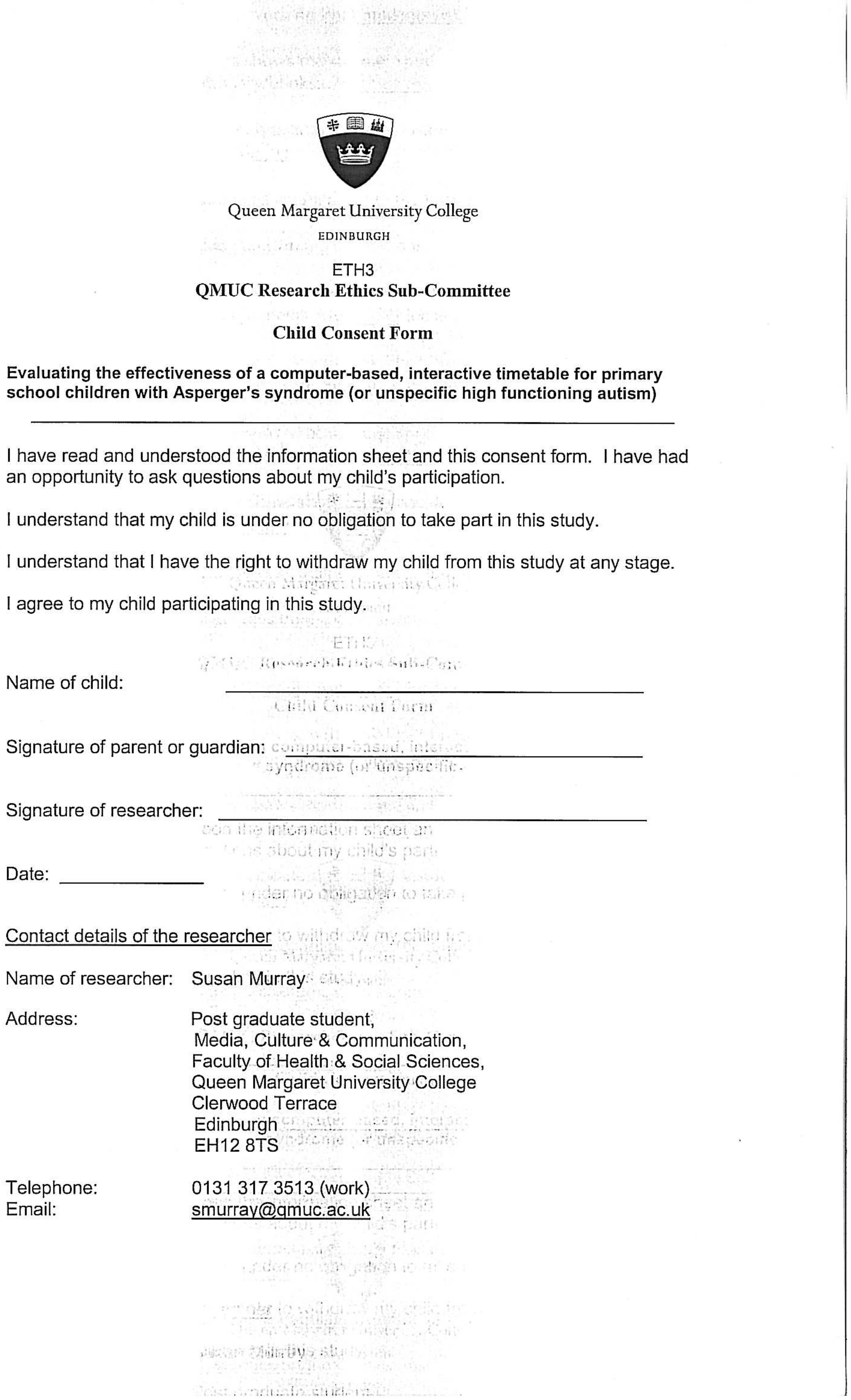
Yours sincerely

Ken Bogle

Dr Ken Bogle
Resources Officer

FIONA MCLEOD
HEAD OF QUALITY SERVICES
Wellington Court 10 Waterloo Place Edinburgh EH1 3EG Tel 0131 200 2000 Fax 0131 469 3141

Appendix 8: Consent form and parent information sheets



Queen Margaret University College
EDINBURGH

ETH3
QMUC Research Ethics Sub-Committee

Child Consent Form

Evaluating the effectiveness of a computer-based, interactive timetable for primary school children with Asperger's syndrome (or unspecific high functioning autism)

I have read and understood the information sheet and this consent form. I have had an opportunity to ask questions about my child's participation.

I understand that my child is under no obligation to take part in this study.

I understand that I have the right to withdraw my child from this study at any stage.

I agree to my child participating in this study.

Name of child: ______________________

Signature of parent or guardian: ______________________

Signature of researcher: ______________________

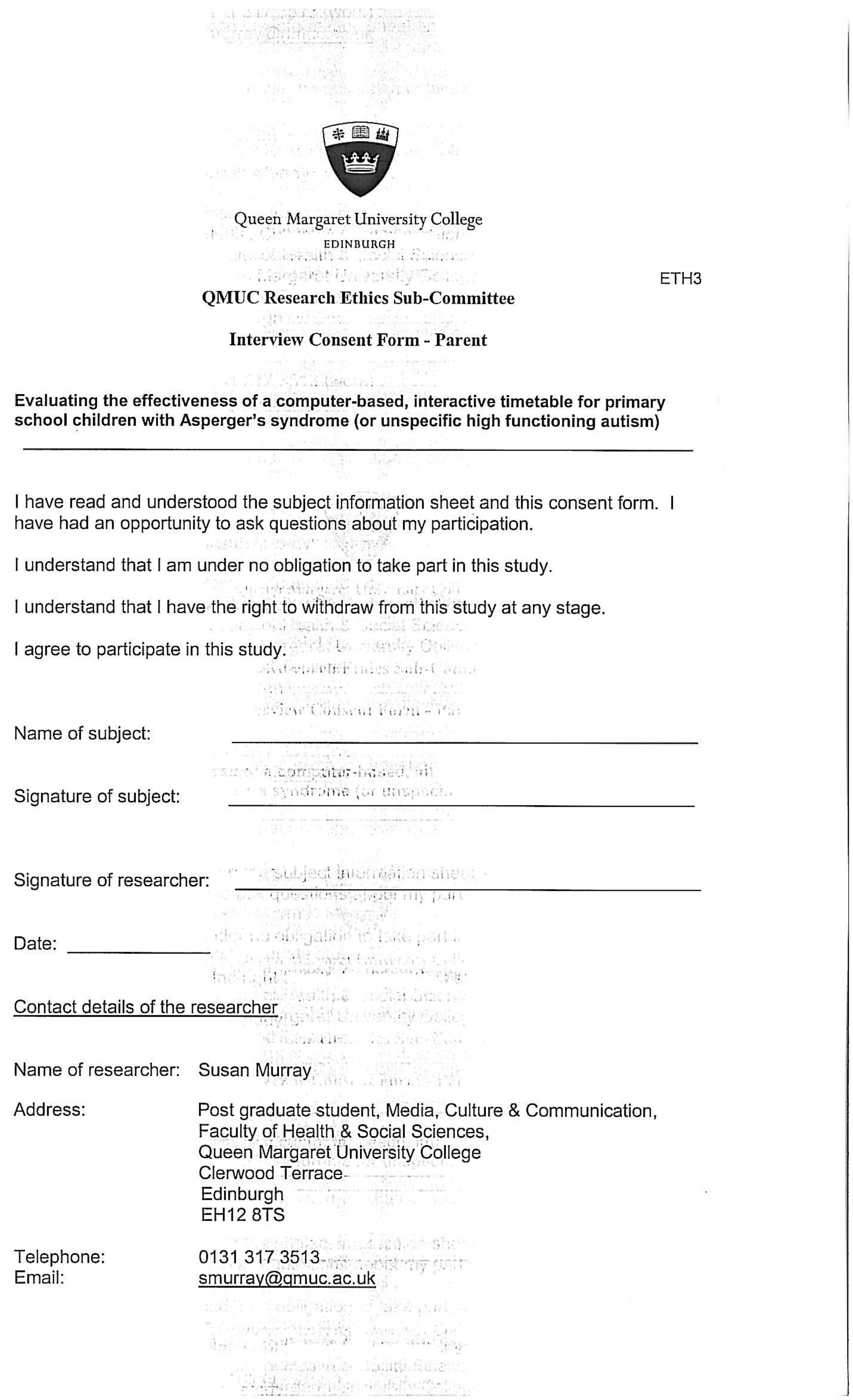
Date: ____________

Contact details of the researcher

Name of researcher: Susan Murray

Address:
Post graduate student,
Media, Culture & Communication,
Faculty of Health & Social Sciences,
Queen Margaret University College
Clerwood Terrace
Edinburgh
EH12 8TS

Telephone: 0131 317 3513 (work)
Email: smurray@qmuc.ac.uk



Queen Margaret University College
EDINBURGH

ETH3

QMUC Research Ethics Sub-Committee

Interview Consent Form - Parent

Evaluating the effectiveness of a computer-based, interactive timetable for primary school children with Asperger's syndrome (or unspecific high functioning autism)

I have read and understood the subject information sheet and this consent form. I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in this study.

I understand that I have the right to withdraw from this study at any stage.

I agree to participate in this study.

Name of subject: ______________________________

Signature of subject: ______________________________

Signature of researcher: ______________________________

Date: ______________

<u>Contact details of the researcher</u>

Name of researcher: Susan Murray

Address:
Post graduate student, Media, Culture & Communication,
Faculty of Health & Social Sciences,
Queen Margaret University College
Clerwood Terrace
Edinburgh
EH12 8TS

Telephone: 0131 317 3513
Email: smurray@qmuc.ac.uk

Information for parents

An investigation into the use of a computer-based, interactive timetable for primary school children with Asperger's syndrome (or unspecific high functioning autism).

Investigator: Susan Murray
Post-Graduate Research Student,
Department of Information Management,
Queen Margaret University College, Edinburgh

Dear Parent,
This booklet provides important information about this study and explains the part you and your child will play, should you decide to take part.

Study title

"An investigation into the use of a computer-based, interactive timetable for primary school children with Asperger's syndrome (or unspecific high functioning autism)"

Who am I?

I would like to begin by introducing myself. My name is Susan Murray and I am the principle investigator for this study. I am a post-graduate research student at Queen Margaret University College, Edinburgh, currently working in the field of Information Management and with a particular interest in interactive information systems. I was formerly a State Registered Nurse and have 15 years of nursing experience. I am married and have three children. If you would like further information at any stage of this study, please feel free to contact me. Details are provided at the end of this document.

Why am I conducting this study?

I understand that a high proportion of children with unspecific high functioning autism find it hard to cope with change in their daily routine and that for some children even small changes can be very upsetting. I believe that many schools use a paper-based activity plan to help children with this problem. I am also aware that many children with this condition are very comfortable using computers.

Through the course of this project I aim to develop and investigate the use of a computer-based timetable for a specific class of primary school children with Asperger's Syndrome, or unspecific high functioning autism. It is hoped that through this investigation, a general system may be created that could benefit children with similar conditions in other schools.

What does the study involve?

In the course of this study I propose to develop an interactive, computer-based timetable for your child's class. I then plan to find out whether such a system would be generally of use to your child. I also would like to see whether such a system would have any benefit in reducing anxiety brought about by changes in daily routines.

It will probably be easier to look at the study as taking place in three stages:

Stage 1: Existing timetable & anxiety related actions

I will start the study by looking at the timetable system currently used by your child. To do this I will need to be in the classroom for one or two weeks and will simply be watching to see how the existing timetable is used. I will also need to establish a base line of your child's anxiety related actions at this stage. This is so that I can develop criteria for assessing whether the interactive timetable is effective in reducing anxiety related to change for your child.

It would be very helpful if I could interview you at this stage. This would involve arranging a convenient time and place for me to meet with you so that I could ask you questions relating to the following issues:

- Does your child become anxious if changes are made to their normal routine?
- How do you know when your child is stressed or anxious?
- Does your child use anything particular to help them to act in an independent and organised manner while at school?

Stage 2: Design and development of computer-based timetable
Once I have assessed the current timetable system, I will begin the development of a computer-based system. At this stage I would like to interview you again, to ask for your views and ideas regarding the design of a timetable for your child. This will involve arranging a convenient time and place for me to meet with you so that I can ask you questions relating to the following issues:

- Your child's general ability in using a computer
- Any problems I should be aware of e.g. with dexterity, vision etc.
- Your child's interests, colour preferences, use of vocabulary

Your ideas are very important and will help me to design a timetable to suit your child. I will be very grateful for any help that you can give me at this stage.

Stage 3: Assessment of the computer-based timetable
Once the development of the timetable system has begun, I will need to watch your child using the timetable in the classroom. This is to make sure that the timetable is easy to use and suitable for your child. This will also allow me to make improvements to the design if needed.

Once everyone is happy with the design of the timetable, I will need to assess its effectiveness. This will involve watching to see how your child uses the computer-based timetable, how often he uses the timetable, whether there is any reduction in the display of anxiety related actions and whether there is a preference for either the interactive timetable or the paper-based timetable. To do this I will need to visit the classroom several times over the period of a few months.

When will this study take place?

It is expected that this study will take place over the period of a year, beginning in May 2002 and finishing around May 2003. I realise that this sounds a long period of time, but as you can imagine, I will need to work within the restrictions of the school term times. Also, there are several stages involved in the development and evaluation of the timetable system, which will take time to carry out.

Where will the study take place?

- The investigation of the existing timetable system and the assessment of the computer-based timetable system will take place in your child's classroom.
- The actual development of the timetable system will take place at Queen Margaret University College, but **this will not involve you or your child**.
- There will be occasions when I would like to ask you some questions and so a suitable place would be arranged with you for this purpose.

Additional information

- I would like to reassure you that a teacher would always be present while I am visiting the classroom.
- I will also be interviewing the class teacher and other staff. This is to find out about the existing timetable, to help with the design of a computer-based timetable and to help me in assessing the value of the computer-based timetable.
- It is possible that I may take some photographs to help me remember particular examples of use. If I do take photographs,

these will only be taken with your permission, will be returned to you on completion of the research and will not be published in any form without your permission.

- I may need to use special software to record the use of the timetable system when I am not in the classroom, but this will be embedded within the computer and will not affect your child in any way.

Participant rights

If you decide to allow your child to participate in this study, you have the right to withdraw at any point. A decision to withdraw from this study, or not to participate from the outset, will not result in any form of disadvantage.

Participation

To participate in study please sign the attached consent forms.

Confidentiality

In order to maintain anonymity and confidentiality, a code number will be assigned to your child to help in the analysis of data. Data will be used strictly within the limits of the research and the identity of your child will not be revealed in the final write up of the research or in any related publications.

Thank you for taking time to read this information booklet.

Further information

Further information about this study can be obtained from:

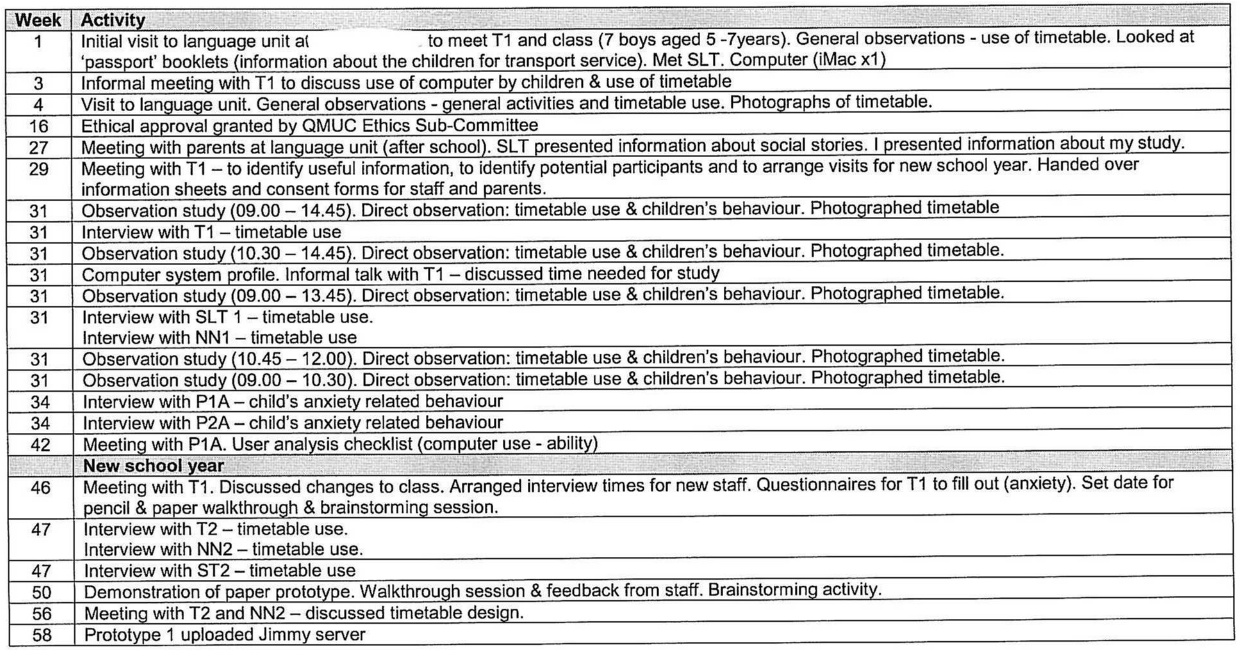
Mrs. Susan Murray
Post-graduate Research Student,
Department of Information Management,
Queen Margaret University College,
Edinburgh
EH12 8TS
Tel: 0131 317 3513
E-mail: smurray@qmuc.ac.uk

Independent information

Independent information regarding any of the above can be obtained from:

Mr. James Herring,
Head of Department
Department of Information Management,
Queen Margaret University College,
Edinburgh
EH12 8TS
Tel: 0131 317 3508

Appendix 9: Timeline of research activities



Week	Activity
1	Initial visit to language unit at [redacted] to meet T1 and class (7 boys aged 5 -7years). General observations - use of timetable. Looked at 'passport' booklets (information about the children for transport service). Met SLT. Computer (iMac x1)
3	Informal meeting with T1 to discuss use of computer by children & use of timetable
4	Visit to language unit. General observations - general activities and timetable use. Photographs of timetable.
16	Ethical approval granted by QMUC Ethics Sub-Committee
27	Meeting with parents at language unit (after school). SLT presented information about social stories. I presented information about my study.
29	Meeting with T1 – to identify useful information, to identify potential participants and to arrange visits for new school year. Handed over information sheets and consent forms for staff and parents.
31	Observation study (09.00 – 14.45). Direct observation: timetable use & children's behaviour. Photographed timetable
31	Interview with T1 – timetable use
31	Observation study (10.30 – 14.45). Direct observation: timetable use & children's behaviour. Photographed timetable.
31	Computer system profile. Informal talk with T1 – discussed time needed for study
31	Observation study (09.00 – 13.45). Direct observation: timetable use & children's behaviour. Photographed timetable.
31	Interview with SLT 1 – timetable use. Interview with NN1 – timetable use
31	Observation study (10.45 – 12.00). Direct observation: timetable use & children's behaviour. Photographed timetable.
31	Observation study (09.00 – 10.30). Direct observation: timetable use & children's behaviour. Photographed timetable.
34	Interview with P1A – child's anxiety related behaviour
34	Interview with P2A – child's anxiety related behaviour
42	Meeting with P1A. User analysis checklist (computer use - ability)
	New school year
46	Meeting with T1. Discussed changes to class. Arranged interview times for new staff. Questionnaires for T1 to fill out (anxiety). Set date for pencil & paper walkthrough & brainstorming session.
47	Interview with T2 – timetable use. Interview with NN2 – timetable use.
47	Interview with ST2 – timetable use
50	Demonstration of paper prototype. Walkthrough session & feedback from staff. Brainstorming activity.
56	Meeting with T2 and NN2 – discussed timetable design.
58	Prototype 1 uploaded Jimmy server

January 2003 – December 2003

Week	Activity
65	Visit to language unit. Photographed timetable using Kodak DX3600 zoom digital camera (prior to children arriving in class)
65	Visit to language unit. Photographed timetable.
65	Visit to language unit. Photographed timetable. Discussed prototype – focus group session. Cooperative user observation session with T1.
65	Visit to language unit. Photographed timetable.
65	Visit to language unit. Photographed timetable.
67	Prototype 2 uploaded CT server
72	Cooperative evaluation of prototype 2 with T1 and T2.
72	Cooperative evaluation of prototype 2 with T2
73	Cooperative evaluation of prototype 2 with T2
74	Interview with P3A – anxiety related behaviour
79	Interview with P3A – timetable use and information needs
79	*Interview arranged with P1A – not at home (parent forgot)*
80	*Interview with P1A – not at home (parent forgot again)*
80	Posted questionnaires to parents – opinions on interactive timetable and information needs (P3B, P4A, P1A & P1B)
81	Interview with P2A – timetable use and information needs
81	Usability evaluations. Collected staff usability questionnaires (5 completed out of 6). Discussed with T1 and T2.
82	Interview ST1 – information needs (ST2 not available at this time)
82	Visit to language unit – observing general use of visual timetable
82	Usability evaluation with C1 and C4
83	Visit to language unit examining IEP documents. Also looked at behaviour folder.
84	Meeting with ST1 – demonstrating SLT area of prototype & discussion. Report of meeting available.
85	Meeting with T1 – discussing situation for new term. Report of meeting available.
85	Interview ST2 – information needs *Interview arranged with NN3, but cancelled as she was ill.*
86	*parent's meeting at LCC – cancelled (T2 had accident & off work indefinitely)*
86	Installed IEP software in LCC at T1's request. To do a presentation for staff on how to use this on 27/08/03. Photographed classroom & SLT room when children were at break.
87	Meeting with CTserver administrator (DR)
	New school year
97	Meeting with T2 – to discuss timetable for autumn. Report of meeting available.

103	*Meeting with T2 arranged. Cancelled.*
105	Interview NN3 – timetable use
106	Questionnaires sent to T2 – anxiety related behaviour of participating children
111	*Meeting with T2 postponed.*
111	Meeting with T2 - discuss implementation of interactive timetable and evaluation plans. Demonstration of a specific area of the interactive timetable. General discussion with T2. Report of meeting Questionnaires sent to T2 (second time) – anxiety related behaviour Questionnaires sent out to parents – anxiety related behaviour.
112	Observation study - use of timetable

January 2004 – December 2004

Week	Activity
116	Observation study - behaviour generally
116	Observation study. C1 behaviour - observation schedule
116	Observation study. C6 & C4 behaviour - observation schedule
116	Observation study - behaviour generally
118	Interview with P6A – timetable use & information needs
118	Interview with P7A – timetable use & information needs
120	Meeting with T2. To discuss proposed observation schedule. Demonstration of timetable pages and discussion of these with T2. Report of meeting available
124	Visit to LCC.
124	Usability observation with C7
124	Usability observation with C6
124	Visit to LCC.
124	Usability observation with C6
124	Usability observation with C1
124	Usability observation with C4
124	Meeting with T2. Report of meeting available
124	Cooperative evaluation with T1 and T2.
124	Cooperative evaluation with T2.
134	Baseline observations. Field notes & observation schedule
134	Baseline observations. Field notes & observation schedule
134	Baseline observations. Field notes & observation schedule
135	

135	'Interactive' timetable use observations. Field notes & observation schedule
135	'Interactive' timetable use observations. Field notes & observation schedule
136	'Interactive' timetable use observations. Field notes & observation schedule
136	'Interactive' timetable use observations. Field notes & observation schedule
136	'Interactive' timetable use observations. Field notes & observation schedule
137	'Interactive' timetable use observations. Field notes & observation schedule
137	'Interactive' timetable use observations. Field notes & observation schedule
137	'Interactive' timetable use observations. Field notes & observation schedule
137	'Interactive' timetable use observations. Field notes & observation schedule
138	Interview with P7A – timetable use/summative
138	Interview ST2 – timetable use/summative
140	Interview T2 - timetable use/summative. Cooperative evaluation
140	Interview T1 – timetable use/summative. Cooperative evaluation
146	Interview with P6A – timetable use/ summative
156 - 162	'Expert' evaluations – self-completion questionnaires. Assessing interface with regards to general principles of usability.

Appendix 10: Research plan

Stage	Research questions	Data source, collection and analysis methods	Rationale
<u>**Stage 1:**</u> Preliminary investigations	What techniques are currently being used in schools to assist children with autism in anticipating and preparing for changes in their daily routine?	1) Visit to potential setting. Informal observation. Informal discussion with staff 2) Visit to a special school for children with autism. Informal observation. Informal discussion with staff 3) Investigate software and systems	Enabled the researcher to encounter the use of a symbolic timetable for the first time and to assess suitability of setting. Enabled the researcher to observe the use of a symbolic timetable by a class of individuals with more severe presentations of autism. Review literature regarding research in field of information systems/autism.
<u>**Stage 2:**</u> Investigating the role, use and content of a symbolic timetable **Instrumental case study approach**	A) <u>System analysis / task analysis</u> *How* and *when* is the timetable used? *What* information is communicated via the symbolic timetable? *Why* is a symbolic timetable used in the classroom context for children with	1) <u>Naturalistic observation</u> [To answer *how* and *what* questions] Conducted overtly by the researcher. Recorded as field notes and transcribed later the same day. Manual analysis of data. 2) <u>Visual records</u> [To illustrate *how* and *what*] Photographs of the symbolic timetable taken at various	Observing use of the symbolic timetable by the case study class in its 'natural' setting: ▪ To get a feel for the setting ▪ To *see* the processes that occurred ▪ To *see* what information was communicated ▪ To identify issues, which were unclear from observation, and which could be addressed through interview later ▪ Created a visual record of ways in which the symbolic timetable was used ▪ Created a visual record of information displayed in the timetable

	autism? *What* are the benefits of using a symbolic timetable? *What* are the limitations of a symbolic timetable?	points throughout the study. Taken when children were absent from the classroom for ethical considerations. 3) <u>Semi-structured interviews</u> [To answer *why, how* and *what* questions]. Staff members and parents. Audio-tape recorded with consent. Transcribed by the researcher. Tapes stored in a secure place. Data analysed using N5 software.	▪ Created a record of how the symbolic timetable changed / evolved from one school year to next ▪ Acted as a point of reference and memory aid for the researcher The focus for interviews at this stage was: ▪ Exploring the role and use of the symbolic timetable – <u>staff only</u> ▪ Identifying benefits and limitations of a symbolic timetable – <u>staff and parents</u>
Investigation and planning for an interactive timetable involved considerations of user needs.	B) <u>Requirements analysis</u> asked the following questions: *What* are the user's requirements for an interactive timetable? *What* are the information requirements for an interactive timetable?	1) <u>Self-completion questionnaire</u> User ability checklist - all participants. Analysed manually to provide user profiles. 2) <u>Semi-structured interviews</u> Available staff & parents Data analysed using N5 software 3) <u>Document examination</u> Conceptual map of pattern of information communication	Intended to gather information relating to participant's abilities regarding use of a computer: ▪ To identify level of ability ▪ To identify specific needs, problems or relevant issues To gather information relating to information needs of users for an interactive timetable Examining key documents to identify information content and relevance to timetable

<u>Stage 3:</u> Developing the prototype interactive timetable (See system design methodology – chapter 6)	<u>Formative evaluations</u> Is the prototype interactive timetable useable? Does the system meet requirements?	1) <u>Cooperative user evaluation observations</u> Participant observations. Staff (wks 65 – 81) Children (wks 82 & 124). Analysed manually. Changes made to 'ITT' according to findings. 2) <u>Usability questionnaires</u> Completed by staff – wk. 81 Analysed manually. Comparisons across. Changes to 'ITT' as a result of findings	To observe use of interactive timetable in 'natural' setting of the classroom & to assess the usability of the interactive timetable. ▪ To observe user performing specific tasks ▪ To identify problems with the prototype ▪ To observe any unexpected behaviour or comments that may indicate a problem Conducted as part of the formative evaluations during the iterative design process: ▪ To assess general design layout, navigation and content of interactive timetable ▪ To assess task performance
<u>Stage 4:</u> Evaluating the interactive timetable **Collective case study approach** Evaluation of the interactive timetable to address research aims 2 and 3.	A) <u>Evaluation: aim 2</u> Does use of the interactive timetable assist in reducing anxiety related to change for the children? - *What* behaviours do the children present?	1) <u>Semi-structured interviews</u> Conducted with two parents. Audio-tape recorded with consent. Transcribed by the researcher. Tapes stored in a secure place. Data analysed manually. 2) <u>Self-completion questionnaires</u> Class teacher and parents Analysed manually. Comparisons with interview data where available. Used to create profile of each child's behaviour.	The focus for these interviews was to gather information regarding anxiety related behaviours of participating children. Specifically: ▪ stereotypical behaviours ▪ physical signs of anxiety ▪ environmental events which might generate anxiety To gather information regarding anxiety related behaviours of participating children. Completed by the teacher in week 111 and by parents in week 112.

		3) <u>Structured observations</u> Children observed individually. Overt observations. Use of an observation schedule, plus additional field notes. Field notes transcribed later the same day. Data analysed manually.	Pilot observation study conducted week 116. Baseline observations conducted during use of the symbolic timetable in the classroom setting (week 134). Observations during use of the symbolic timetable and introduction of the interactive timetable in the classroom setting (week 135 - 137).
	B) <u>Evaluation: aim 3</u> Is the interactive timetable effective as a management and communication tool? - Is the interactive timetable usable? - *What* benefits might the interactive timetable offer?	1) <u>Cooperative user evaluation observations</u> Participant observation with researcher sitting alongside user. Staff and children. Observed individually. Data analysed manually. Comparisons made with earlier observations.	Conducted as part of summative evaluations: ▪ To observe use of the interactive timetable in the 'natural' setting of the classroom. ▪ To observe user performing specific tasks ▪ To identify problems with the prototype ▪ To record comments that could assist with future development
	- *What* are the limitations of the interactive timetable?	2) <u>Semi-structured interviews</u> Conducted with available staff and parents. Audio-tape recorded with consent. Transcribed by the researcher. Tapes stored in a secure place. Data analysed using N5 software. Comparative analysis with earlier data.	The focus for these interviews was: ▪ Assessing the actual use of the interactive timetable ▪ Identifying benefits and limitations of use
		3) <u>'Expert' user evaluations</u> Self-completion questionnaires	As part of summative evaluations: ▪ To assess general layout, consistency and navigation

		via email. Persons with experience of web systems design took part in this evaluation.	according to principles of interface design ▪ To identify technical problems
Stage 5: Developing protocols for recommending a general system	What recommendations can be made regarding a general system?	Analysis of data gathered throughout the study. Reviewing reports drawn up throughout the study.	To develop protocols and recommendations for a future system

Appendix 11: Review of software

A review of software was carried out at the beginning of the study in order to gain a feel for the kind of programs available for the area of special needs education generally and more specifically for those with autism. The researcher was searching specifically for any timetable software that might exist. At the same time the researcher was considering the overall presentation style of educational software that was identified, as well as the type of symbols being used. Sources such as official organisations (e.g. National Autistic Society) were consulted to see what products they endorsed. Educationalist and parents were also consulted to identify specific software used by the participating children. In addition, a review was conducted on the Internet to identify software products. Reviews were carried out periodically throughout the study in order to maintain an awareness of developments in the field. Examples of software identified at the early stages of the study are presented here. The first section sets out general software, whilst the second section sets out software developed for research. The information is presented alphabetically.

General software

There were found to be many companies producing multimedia software for educational needs, of which a large proportion also offered products for the area of special needs. Products were found to be very similar for primary school age and were generally aimed at meeting pedagogic needs in the areas of literacy and numeracy, as well as for recreational use. No products were found which addressed the area of class timetabling in an interactive, computer-based form.

Boardmaker™

Boardmaker™ is produced by an American based company, Mayer Johnson. The company produces a range of symbol based products for individuals with special needs. These include sign language symbols, digital photo sets, AAC devices and books. Boardmaker™ is a picture database software product of over 3,000 picture communication symbols (PCS), for early years and special needs use. The products are available for both Macintosh and Windows operating systems. The symbols are very simple and clearly defined as demonstrated in figure 11.1. The symbols can be set to any size, can be coloured or black and white and can include text. Symbols can be created to meet individual needs. The software product comes in a variety of languages and is available to home users and educational users. The range of products offered by the company has increased over the years. Boardmaker™ PCS were used by the language and communication class participating in this study and were also used by the speech, language and hearing sciences department at QMUC.

Figure 11.1: Example of a Boardmaker symbol

Web address (2001): http://www.granadalearning.co.uk/school/catalog/jsps/product.jsp?product=361
Web address (2006): http://www.mayer-johnson.com/

Do2Learn - Make-A-Schedule

Do2Learn is an American based company which produces a variety of products for children with special needs. Products include print resources such as flash cards, games and workbooks, as well as learning software for home and educational use. There is a research base to this company, focusing on the areas of virtual reality and autism. Make-A-Schedule is a product designed by the company to provide a database of symbols which can be used to create activity sheets, calendars and daily schedules. Users can print these visual aids to use at home or in classroom settings, or alternatively these can be viewed on the computer screen. These are static images and do not have any interactive features. Symbols are clear and simple and may be in colour, or in black and white. Text may also be included. Figure 11.2 demonstrates a screen shot of the Make-A-Schedule software.

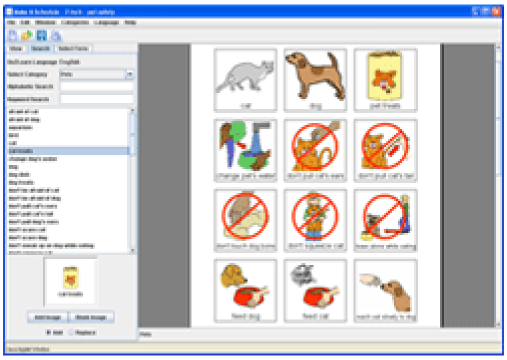


Figure 11.2: A screen shot of the Make-A-Schedule interface

Web address (2001): http://www.do2learn.com/picturecards/howtouse/schedule.htm

Laureate Learning System

This American based company was established in the 1980s and produces multimedia software programs for children and adults with special needs. The areas it specialises in are providing training programs for cause and effect, turn-taking, early vocabulary, syntax, cognitive concepts, auditory processing, and reading. Software is available for purchase by home and educational users. Whilst it was interesting to view the range of products, none were found to be of relevance for this particular study.

Web address (2001): http://www.synapseadaptive.com/laureate/laureate.htm
Web address (2006): http://www.laureatelearning.net/professionals602/

R-E-M

This UK Company has been a producer of educational software for forty years. The company supplies a wide range of products to educational services, to parents and students. Products include printed materials and multimedia software and address all areas of the curriculum. In addition the company aims to meet the needs of all levels of learning, from pre-school through to further education. It was interesting to view the wide range of products available, however, none were found to be of relevance for this particular study.

Web address (2001): http://www.r-e-m.co.uk
Web address (2006): http://www.r-e-m.co.uk/cgi-bin/xrem

Resource Education

This UK Company was set up in 1982 to produce educational software and other materials primarily for use in UK schools. The products include a variety of software for numeracy, literacy and special educational needs. The products were interesting to view, however, none were found to be relevant for this study.
Web address: http://www.resourcekt.co.uk

Research software

There were several examples of areas of research where software was developed for use with children with autism and some of these cases were discussed in chapter 3. The examples presented here were those identified at the very beginning of this study.

AS interactive project

This project was carried out by a team of researchers at the University of Nottingham, in collaboration with the National Autistic Society and the Shirley Foundation. The project began in April 2000 and took place over three years. The aim of the project was to develop and evaluate virtual environments which were intended to support social awareness and social skills for adults with Asperger's syndrome. A range of virtual environments was developed as part of the study. These included single user virtual environments (SVEs) and collaborative virtual environments (CVEs). The study employed a user-centred approach to development and evaluation which was found to facilitate a fuller understanding of the specific design requirements for this particular user group (Parsons et al., 2000). Figures 11.3 and 11.4 demonstrate examples of screen shots from SVE designs. Whilst this study considered the area of virtual reality environments, it did provide a useful insight into the development and evaluation of software for individuals with autism.

Figure 11.3: An example of a SVE (virtual bus) (AS Interactive project, online)

○ When's the next train?

● May I join you?

○ Is it ok if I sit here?

Figure 11.4: An example of a SVE (virtual café) with a speech bubble presenting choices for the user (AS Interactive project, online)

Web address: http://www.virart.nott.ac.uk/asi/

Macinterview

This software product was developed by a postgraduate student at the University of Liverpool in 1994. The project was funded by the Department of Health. The aim of the project was to design a tool which was simple and easily understood by children and which could assist them to identify and describe people, events and places, as well as emotions (Jimmieson, 1994). The software was designed to run on Macintosh systems and to be used by psychologists, social workers, child psychiatrists, health workers, educational workers, and the police, when working with children in an interview situation. Graphics were very simple in appearance and as figure 11.5 demonstrates the software provided the opportunity for users to add expressions to blank faces, which reflected their own feelings in a particular situation. This study provided a useful insight into a systems development project that was aimed at children as users.

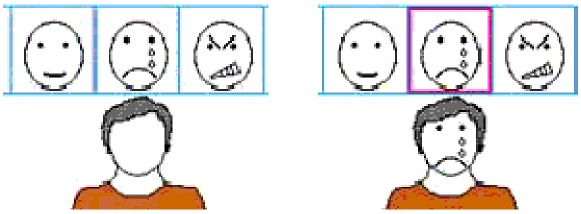


Figure 11.5: An emotion indicator tool (Jimmieson, 1994)

Web address (2001): http://www.csc.liv.ac.uk/~phil/project/index.html
Web address (2006): http://www.inmyshoes.org.uk/

"My friend Ben"

A British company, Asilesp Ltd, joined with a European team to conduct a study (under the European Union (EU) Leonardo da Vinci programme). Questionnaires distributed throughout Europe were used to determine the needs of people with autism. The results formed part of the development of the Educational multimedia CD-Rom known as "My Friend Ben". The target user age for the software product was 16+ and the target group extended from people with autism or Asperger's syndrome to people with related, social or communication difficulties. The software program deals with daily events, such as going shopping, travelling and other important issues. The software used photographs of a diverse range of people and had a clean, clear, modern look. The product could be personalised and was available to individual purchasers as well as educational organisations.

Web address (2001): http://www.asilesp.com/
Web address (2006): http://www.raisinghorizons.com/index.htm (no longer possible to view the software)

Appendix 12: Systems analysis report (recommendations)

Only the final two sections of the system analysis report are included here: recommendations and conclusion. This is because the main body of the report repeats material included within the thesis. For example, the report sets out the background to the study, describes investigation processes for the task analysis and sets out findings for these investigations.

5. Recommendations

This section identifies the fundamental issues of concern raised through this investigation and offers recommendations for accommodating these factors in the design of the interactive computer-based timetable.

5.1 Introduction of the computer-based timetable

From this investigation it has been found that the visual timetable assumes a key role in the classroom situation. It is the focal point of the classroom and is used regularly as a group-meeting place for explaining the activities of the day ahead. It would be difficult to imagine the children coping without the wall-based timetable if it were to be removed overnight and replaced with a computer-based one, so it is recommended that the computer-based timetable be introduced in parallel with the wall-based timetable to begin with. Once the children have learnt to cope with the new form of timetable, it may be possible at a later stage to remove the wall-based timetable.

5.2 Inclusion of ancillary information

The timetable is seen to be part of a larger display of information, which also plays an important role in the children's day-to-day routine and which assists the children in achieving an overall objective of independence. Removing the timetable from the context in which it is currently displayed could cause problems, so it is recommended that key information that is used in conjunction with the timetable be identified and where possible, be integrated within the computer-based timetable system.

5.3 Maintaining familiar symbols

The visual timetable uses symbols which all of the children in this class are familiar with and which it is likely, given the use of these style of symbols within the education community in this area, other potential students are likely to be familiar with. It is recommended therefore, that the Boardmaker™ symbols be used in the design of the timetable interface.

5.4 Accessibility

Both the teaching staff and the children were found to reference the visual timetable frequently, either verbally or by physically going over to it, or by pointing at it. To allow this feature of accessibility to continue, the computer-based timetable needs to be available at any time and to be visible from any area of the classroom. It is recognised from some of the interview responses that this is a potential concern, for many reasons; it may not be possible to have the timetable constantly displayed on the computer screen (e.g. a screen saver may interrupt the display; another person may be using a different software programme; the Internet connection may be disrupted), or with only one computer in the classroom, scheduling access to the timetable may become a problem.

It is recommended that the interface be designed to incorporate the symbols used in the timetable in as clear and simple a way as possible, to enable viewing from a reasonable distance. Regarding access to the timetable, it may be necessary for the teacher to use the timetable in the same way that she currently uses the wall-based timetable to begin with, and to gather the children round the computer in such a way that they can all view the timetable together (e.g. at balloon time, after snack time and at lunch time). Once the children have been shown how to use the timetable and are comfortable using it, it might be possible for the teacher to organise a rota for access.

5.5 Maintaining and making changes to the timetable

It was found that both the teachers and the nursery nurses are responsible for maintaining the visual timetable and that all of these persons may need to make changes to the timetable at any time. It is also recognised that these persons have expressed concern regarding their own skills at using the computer. The following recommendations are therefore made:

- Administration access is set up for these members of staff when the system access priorities are arranged.
- The timetable is designed to enable changes to be made in as straightforward and easy a way as possible.
- User documentation is drawn up to provide guidelines for maintaining the timetable.
- Training is provided for the staff on implementation of the final version of the system.

5.6 Flexibility

It is considered very important that the proposed timetable is flexible enough to enable diversity to be introduced. It was found that variations of the visual timetable are sometimes used and also that the children are different ages, and so may be working at different stages of the curriculum. To accommodate these needs for differences the following suggestions are made:

- The structure of the interface should be designed to allow the use of alternative symbols if required.
- Individual timetables should be incorporated within the system structure, to allow children working at different levels to be provided for.

5.7 Consistency and predictability

It was noted that the presentation of the visual timetable is very consistent and that this enables the children to learn to predict the structure of their school day. It is considered very important that this consistency and predictability is maintained in the computer-based timetable. The following recommendations are made for ensuring this:

- Familiar symbols are used in the display
- Recognizable fonts and text are used
- Sequencing of symbols continues as before

5.8 Use of the timetable at home

The fact that the timetable would be accessible from home and that parents could then see what their children had been doing at school, was viewed as an advantage by the staff. In order that best use is made of the timetable at home, the following suggestions are made:

- An assessment be made of the family's home computer capabilities
- An assessment be made of parent's information technology abilities
- User documentation be provided for home use

- Training or demonstrations be offered to parents as required
- Usernames and passwords be set up for parents to access the timetable

5.9 Learnability

Staff members raised concerns that the timetable would take too long for the children to learn to use and that staff would be tied up with assisting the children when they first began using the new system. To help overcome this problem and to aid learnability, the following recommendations are made:

- The timetable should be designed to be as familiar and as in keeping with the current visual timetable as possible.
- The structure and layout of the timetable should be designed to be as consistent and predictable as possible.
- Navigation aids should be designed to incorporate visual and textual prompts that are recognisable to all users wherever possible.
- A child friendly user guide will be created, that might assist the children in learning how to use the timetable.
- A demonstration of the timetable will be given to all of the children by the teacher once the final version has been implemented.

6. Conclusion

This report has set out details of an investigation into the use of a visual timetable by this particular class of children with unspecific high-functioning autism. It has described the methods of enquiry used and has presented the main findings of the investigation. Analysis of the findings has enabled several key recommendations to be made, which it is hoped will inform the subsequent design and development of an interactive computer-based timetable for use by this class.

Appendix 13: Interview schedule – role and use of a symbolic timetable

Aims:

- To discover why activity plan / timetable is used for the children within the unit
- To identify factors essential to the development of the activity plan
- To identify opinions and perceptions of the advantages and limitations of activity plans per se
- To identify opinions and perceptions of advantages and limitations of an interactive, computer-based activity plan

Q1. Why is an activity plan used?
Purpose?
Behaviour, independence, sequence?
Recommended in teaching guidelines? Personal experience?

Q2. Is this style of activity plan the one that has always been used in this unit?
Any other forms?

Q3. Where is the activity plan displayed?

Q4. Why is it displayed in this way?

Q5. Who creates the activity plan?
Teacher?
Other?

Q6. Who decides on the activities for each day?
Teacher?
Other members of staff?
Children? Curriculum?

Q7. Regarding the activities –
Is it important to have them in any particular order? length of time?
Are they the same each week, or do they vary?
How do you make changes? Who makes the changes?

Q8. Do all the children use the activity plan?
How can you tell if a child is using it?

Q9. What advantages do you think this style of activity plan offers?

Q10. Do you feel that there are any negative aspects of this style of activity plan?

Q11. If an interactive, computer-based activity plan were to be created for your class, what advantages do you think it would offer?

Q12. If an interactive, computer-based activity plan were to be created for your class, what drawbacks do you think it would be likely to have?

Appendix 14: Requirements specification report

(Cover page and contents list have been removed)

1. Introduction

This document attempts to present answers to the following questions, based on information gathered during the initial fact finding stage of this study.

- What is the aim of this study?
- What are the goals of the study?
- What form will the timetable take?
- Who will use the timetable and why?
- Where will the timetable be used?
- What tasks will the timetable perform?
- Are there any constraints on the development and use of the timetable?
- How will the timetable relate to other systems within the classroom, or school?
- What ideas or expectations do the users have?

At this stage, it is not possible to know the full extent of what is needed to create an interactive version of the class timetable. It is likely that as the study progresses some requirements may change or new needs may arise. The views of the system users and the system developer on how the interactive timetable may look and function are likely to be quite different at this stage, so a collaborative approach to compare and exchange ideas is essential, so that an interactive timetable can be created that is both useable and useful.

2. What is the aim of this study?

The aim of this study is to develop an interactive, computer-based timetable for primary school children with Asperger's syndrome (or Unspecific High Functioning Autism), which allows individual children to personalise their schedule.

3. What are the goals of the study?

There are three main goals to achieve during this study:

- To assess the helpfulness of the timetable in reducing anxiety related to changes in daily class routine for the children
- To evaluate the usefulness of the timetable as a management and communication tool for the classroom staff and parents
- To propose and possibly build a general system capable of widespread implementation

4. What form will the timetable take?

The timetable will be created as a series of web pages, forming a web application specifically for the class's use.

That is, it will be created using Hypertext Mark-up Language (HTML), using a special tool such as Macromedia Dreamweaver. The reason for choosing to develop the timetable as a web application is so that it can be viewed on any computer that has an Internet connection. This means that the timetable will be accessible from any computer, regardless of whether it is a PC or a Macintosh machine. It is expected that the timetable will be accessed and viewed on the classroom computer and that the children may also view the timetable at home if they have access to a computer with an Internet connection.

The timetable will be image-based, using the Boardmaker symbols that you currently display on the classroom wall. Discussion will take place at a later date concerning how these images should be laid out on the screen.

5. Who will use the timetable and why?

The timetable is being created for a very specific group of users and it is likely that they will all have varying degrees of ability when it comes to using computers. The intended users of the timetable fall into 3 distinct groups:

5.1 Group 1 – frequent users (children)

This group consists of the children taking part in the study and these are the ones that are likely to use the timetable most frequently.
The characteristics of this group are believed to be:

- Primary school children, aged between 5 and 8 years of age
- Male
- Diagnosis of Asperger's syndrome, unspecific high functioning autism or other autistic spectrum disorder
- Have prior experience of using the classroom computer to interact with educational software
- Levels of ability in using computer software and hardware will vary with individuals. Ability will be assessed for each child by asking parents to answer questions drawn from a 'user analysis checklist'.

It is thought that the children will want to use the timetable for several reasons:

- To check what activities they are having that day
- To check the order of the day's activities
- To remind themselves of what they should be doing
- To remind themselves of what comes next
- To remind themselves how to do specific tasks (e.g. getting ready for break time)
- To look at unusual or one-off events (e.g. outings, parties etc.) and to reassure themselves of what is likely to happen there
- Other reasons as yet unspecified

5.2 Group 2 – frequent users and maintainers (classroom staff)

This group comprises the various adult professionals likely to be involved in using the timetable in the classroom. The characteristics of this group are thought to be:

- Adults of varying ages
- Varying levels of experience in using computers
- Presumably have some experience of using the classroom computer, either to set up educational software for the children to use; to do word processing tasks; to access the Internet for e-mail use; to access the Internet to view educational web sites.
- Levels of ability in using computer software and hardware will vary with individuals. Ability will be assessed for each adult user by asking them to self-complete a 'user analysis checklist'.

It is thought that the adults in the classroom will want to use the timetable for several reasons:

- To put up the timetable for each day
- To make changes to individual children's timetables
- To make changes to the overall timetable as needed
- To remind themselves of the day's activities
- To refer the children to the timetable when needed
- To communicate with the parents at home
- Other reasons as yet unspecified

5.3 Group 3 – less frequent users (parents/carers)

This group consists of the parents or carers of the children taking part in the study. The characteristics of this group are likely to be:

- Adults of varying ages
- Varying levels of experience in using computers
- Varying levels of skill in using computer hardware and software. Ability will be assessed for each user in this group by asking them to self-complete a 'user analysis checklist'.

It is thought that the parents/carers group will want to use the timetable for several reasons:

- To see what their child has done at school that day
- To see what their child is doing on the next day
- To use the timetable with their child to discuss various activities
- To communicate with the teacher and other classroom staff
- Other reasons as yet unspecified

6. Where will the timetable be used?

It is expected that the timetable will be used on computers in several places:

- The language unit classroom
- Possibly in classrooms within the main school building (due to one child spending time with a mainstream class for part of his school day)
- At the children's homes
- Possibly at the teacher's home

7. What tasks will the timetable perform?

The interactive timetable will continue to perform the same functions as the existing visual timetable, which is displayed on the classroom wall; it should display activities for each day in correct order, allowing children and staff to see the day's timetable at a glance and it should allow staff to make changes quickly and easily.

It is also hoped that the new timetable will be able to provide additional functions that will add value to the overall timetable concept for this particular class. This will be in the form of breaking particular tasks down into individual actions and by displaying unusual or one-off activities. Other tasks may include communication between school and home, such as information pages and calendar updates.

8. Are there any constraints on the development and use of the timetable?

The main user group are particularly vulnerable and so it is suggested that the web application be password protected. This is so that only those users that have a right to access the web application can do so.

9. How will the timetable relate to other systems within the classroom or school?

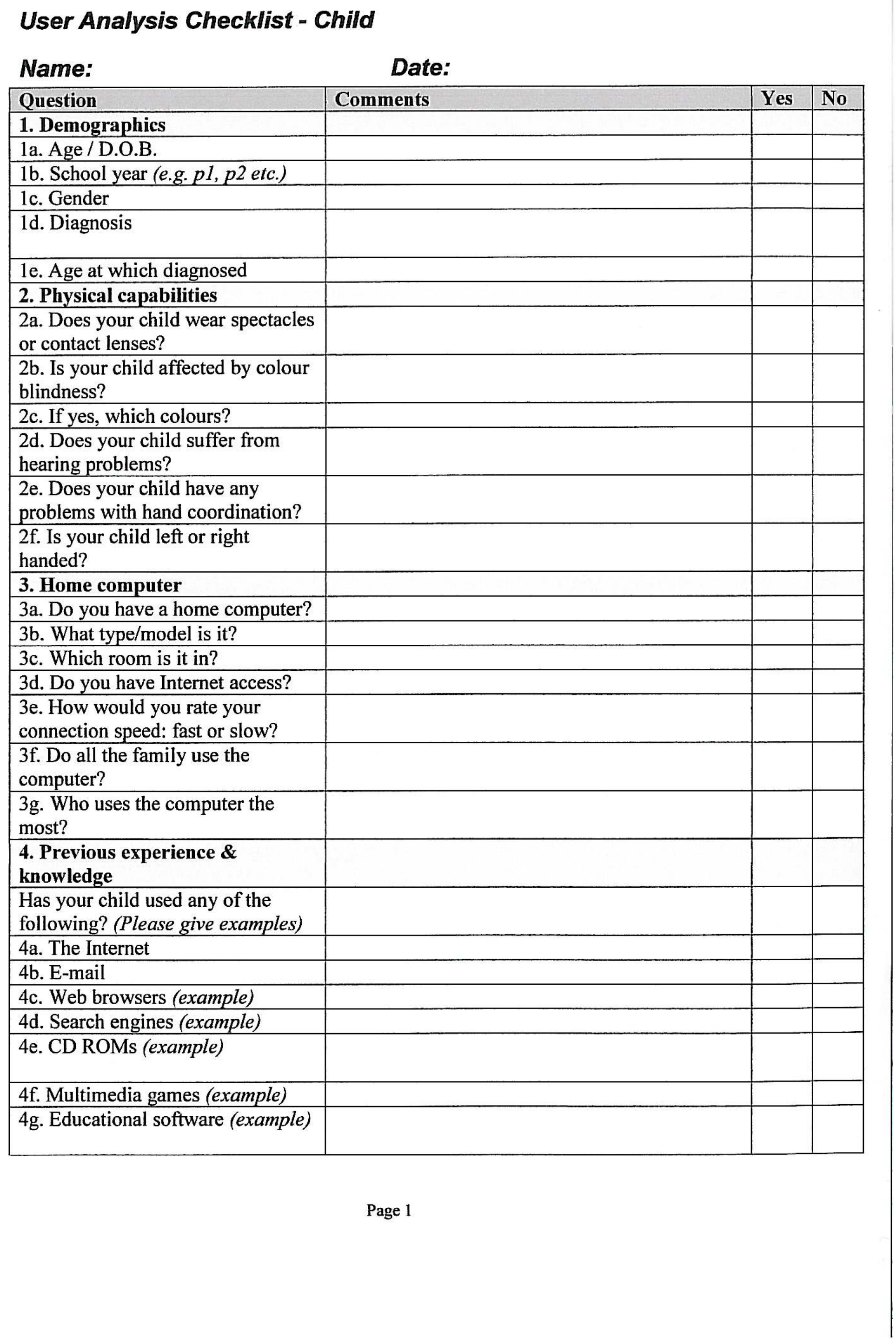
This is still to be determined and a meeting with the IT coordinator for the school will be necessary to identify the possibilities in this area. One child is to spend half of the school day with a mainstream class, so it is likely that he may need access to the timetable in another classroom. If the school has a web site of its own, then it is hoped that the timetable can eventually be added to this and be accessed from the school web site.

10. What ideas or expectations do the users have?

This is not clear as yet and requires more input from potential users to determine this.

- It is understood that the interactive timetable would be running at the same time as the existing visual timetable. Do staff members see the interactive timetable as eventually replacing the visual one?
- The existing timetable appears to fulfil its function adequately. Are there any improvements that staff members would like to be made, that could be included in the interactive timetable?

Appendix 15: User analysis checklist - child

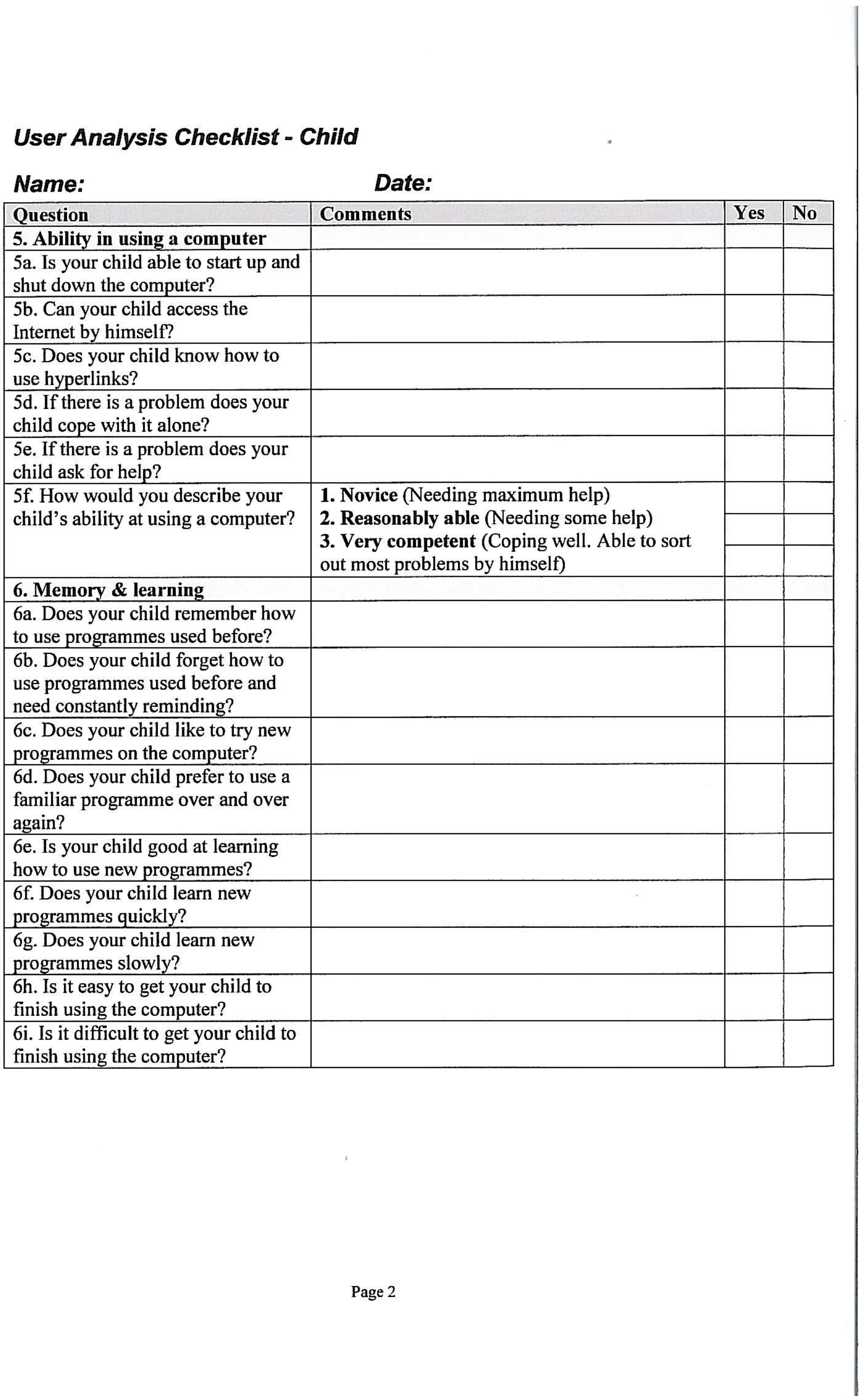


User Analysis Checklist - Child

Name: ***Date:***

Question	Comments	Yes	No
1. Demographics			
1a. Age / D.O.B.			
1b. School year *(e.g. p1, p2 etc.)*			
1c. Gender			
1d. Diagnosis			
1e. Age at which diagnosed			
2. Physical capabilities			
2a. Does your child wear spectacles or contact lenses?			
2b. Is your child affected by colour blindness?			
2c. If yes, which colours?			
2d. Does your child suffer from hearing problems?			
2e. Does your child have any problems with hand coordination?			
2f. Is your child left or right handed?			
3. Home computer			
3a. Do you have a home computer?			
3b. What type/model is it?			
3c. Which room is it in?			
3d. Do you have Internet access?			
3e. How would you rate your connection speed: fast or slow?			
3f. Do all the family use the computer?			
3g. Who uses the computer the most?			
4. Previous experience & knowledge			
Has your child used any of the following? *(Please give examples)*			
4a. The Internet			
4b. E-mail			
4c. Web browsers *(example)*			
4d. Search engines *(example)*			
4e. CD ROMs *(example)*			
4f. Multimedia games *(example)*			
4g. Educational software *(example)*			

Page 1



User Analysis Checklist - Child

Name: ***Date:***

Question	Comments	Yes	No
5. Ability in using a computer			
5a. Is your child able to start up and shut down the computer?			
5b. Can your child access the Internet by himself?			
5c. Does your child know how to use hyperlinks?			
5d. If there is a problem does your child cope with it alone?			
5e. If there is a problem does your child ask for help?			
5f. How would you describe your child's ability at using a computer?	**1. Novice** (Needing maximum help) **2. Reasonably able** (Needing some help) **3. Very competent** (Coping well. Able to sort out most problems by himself)		
6. Memory & learning			
6a. Does your child remember how to use programmes used before?			
6b. Does your child forget how to use programmes used before and need constantly reminding?			
6c. Does your child like to try new programmes on the computer?			
6d. Does your child prefer to use a familiar programme over and over again?			
6e. Is your child good at learning how to use new programmes?			
6f. Does your child learn new programmes quickly?			
6g. Does your child learn new programmes slowly?			
6h. Is it easy to get your child to finish using the computer?			
6i. Is it difficult to get your child to finish using the computer?			

Appendix 16: Interview questions – information needs

Interview with parents: Opinions of the interactive timetable and views on information for inclusion

Aims of the interview:

- To examine opinions on the perceived advantages and disadvantages of an interactive computer-based timetable
- To explore the parent's ideas for their own child's individual timetable
- To identify information parents would like to see included in the parents' area of the class web site

1. Examining parent's opinions on the perceived advantages and disadvantages of an interactive computer-based timetable

1a) Have you had a chance to see the prototype of the compute-based timetable yet? If so, could you give a general opinion of what you think of it so far?

Prompts:
- Useful? Not useful?
- Easy to use? Difficult to use?
- Interesting? Dull and uninteresting?
- Other comments?

(If parent has not seen the timetable, demonstrate by showing printouts of main pages).

1b) Do you think a computer-based timetable has any advantages to offer compared to a wall-based timetable?

Prompts:
- For your child?
- For the teacher?
- For you?

1c) Do you think that a computer-based timetable is likely to have any disadvantages?

Prompts:
- For your child?
- For the teacher?
- For you?

2. Exploring the parent's ideas for their own child's individual timetable

2a) How do you picture an individual timetable for your child looking?

Prompts:
- Similar to the class timetable?
- More adapted to his individual needs? In what way?

2b) What do you think is most important to include in the individual timetable for your child?

Prompts:
- Things that he needs reminding of most?
- Things relating to a particular interest?
- Work tasks?
- Homework?
- Other suggestions?

3. Identifying information that parents would like to see included in the parents' area of the web site

3a) Do you think it would be useful to have information for parents included in the class web pages?

3b) What would you like to see included for parents on the class web pages?

Prompts:
- Similar information to what you already receive about the class and your child? What does this currently include?
- Information you don't currently receive in printed format. Examples or suggestions?
- Suggestions?
- Progress information
- Homework information
- School calendar details
- Information about trips

Interview with speech and language therapist: information needs for the interactive timetable

Aims of interview:

- To identify the role or purpose of having speech and language therapy information displayed as part of the interactive timetable.
- To identify the kind of information that would be required to be displayed and the form it would take.
- To ascertain where the information is currently stored and how often it is changed.
- To find out opinions on perceived advantages and disadvantages of displaying SLT information on the web pages.

1. What role or purpose do you see information for speech and language therapy having within the structure of an interactive timetable?

- Do you see it having a role?
- For communicating information?
- Or something more related to what you do?

2. What type of information would you want to present or communicate?

- Type?
- Format?
- Similar to what's already there?
- Symbols, text?
- Other? E.g. social stories?

3. Where do you store this information at the moment? What form it's in?

4. How often is this information likely to change?

5. Would there be any benefits for you in having SLT information displayed on the computer?

6. Any disadvantages for you in having SLT information displayed on the computer?

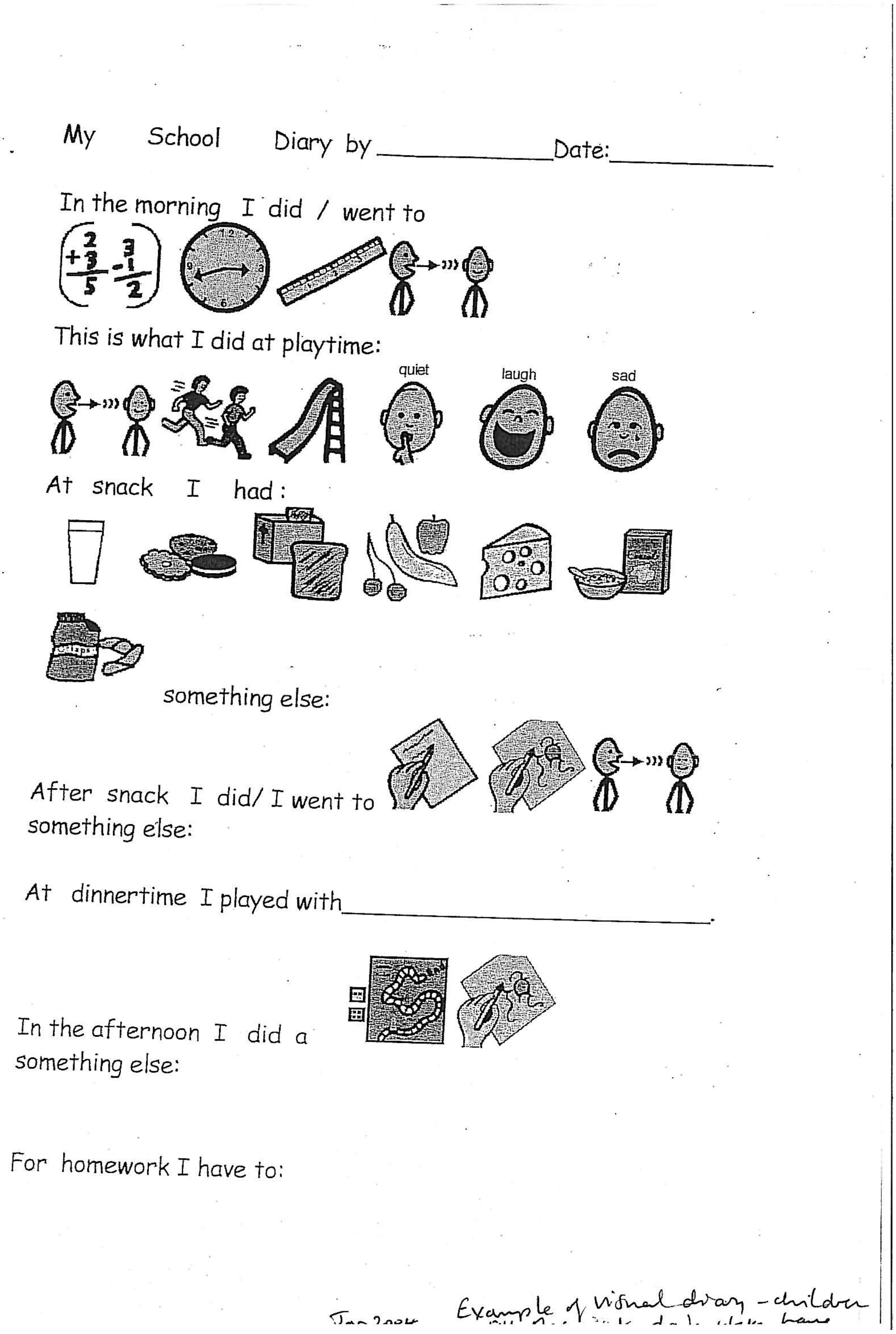
Appendix 17: Information-communication map

Information-communication map – Language and Communication Class

Person(s) responsible for development	Information artefact	Information use
Created by school office? Or class teacher? Is based on the curriculum and is developed to fit in with mainstream activities for integration.	**Master timetable**	Class teacher uses this document to plan daily visual timetable.
The teacher makes up the visual timetable daily, using Boardmaker symbols, stored adjacent to the timetable space. Boarmaker software is available on the classroom computer and symbols are processed from here.	**Visual timetable**	The timetable follows the curriculum and also accommodates individual needs. Provides a visual reminder of the sequence of activities throughout the day for pupils and staff.
Information is passed between LCC staff and the child's parents via this book. Information from parents includes details about weekend activities at home and any significant events through the week.	**Home diary**	The Teacher, Nursery Nurse and Speech and Language Therapist write in this book to report to parents about events, progress, and concerns at school.
This is a pre-formatted information sheet, which is created by the teacher and is completed by each pupil at the end of the day. The child draws and writes about the activities they have carried out during their day at school.	**Visual diary**	▪ Assists child to remember activities of the day ▪ Provides parents with information about the child's day ▪ Provides a starting point for communication between child and parent about the school day
Passed on by school office or class teacher. Intended to provide information to parents about events, the school calendar, activities taking place in the school or class, trips, visits etc.	**Letters**	Sent to the parents via the child. Placed in child's satchel by the Teacher or Nursery Nurse. A note is usually written in the home diary to draw attention to the fact that a letter is in the child's satchel.

Reports written by all professionals involved with the child (Teacher, SLT, other therapists, educational psychologist etc). Intended to provide a progress report for the parents.	**Annual review**	Sent out to the parents. Intended to provide a review of progress over the year and a starting point for discussion between parents and professionals. A consultation follows and recommendations / plans for child's future are discussed.
Developed by teacher to be used daily by the nominated 'special person'. This is a laminated chart with symbols of tasks displayed in sequence as they occur at snack time. Space is left in front of each task for a name to be added daily.	**Help chart**	The 'special person' completes this chart first thing in the morning. The children can refer to it at snack time to be reminded of the task they are to perform that day.
Paper 'pink pigs' were developed by the teacher and are displayed on the visual timetable wall. Teacher and nursery nurse add green 'smiley faces' or red 'sad faces' as appropriate to each child's pig.	**Token economy system**	A behaviour reward system, which was developed in March 2004, to extend the existing system. Information about the token economy is displayed on the wall beside the 'pink pigs'. Smiley faces are motivation for specific behaviours, which children are advised of in their behaviour target charts.
Charts are developed by the teacher and are recorded on by the children and staff.	**Behaviour target charts**	Used to highlight specific behaviours that the children should aim to achieve at school. Some of the children are able to select their own targets, whilst others need help with this. Time is spent discussing these with the children at circle time.

Appendix 18: Visual diary sheet



My School Diary by_______________Date:_______________

In the morning I did / went to

This is what I did at playtime:

quiet laugh sad

At snack I had :

something else:

After snack I did/ I went to
something else:

At dinnertime I played with___________________________.

In the afternoon I did a
something else:

For homework I have to:

Jan 2004 Example of visual diary - children

Appendix 19: Formative cooperative evaluation report

(Cover page and contents list have been removed)

1. Introduction

This document presents an assessment of an investigation into the usability of the prototype interactive timetable interface, version 2, by Child 1 (C1) and Child 4 (C4) who are members of the case study class (Class 2). The document begins with a brief overview of the setting for the evaluations and a rationale for the investigation. It then proceeds by setting out the aim and objectives of the investigation, before going on to offer a brief a description of the methods used for data collection and analysis. The findings of the investigation are then presented and certain recommendations are put forward.

2. Overview of evaluation setting

The usability evaluations took place within the natural setting of the children's normal classroom on Friday 23rd May 2003. This particular Friday was chosen by the teacher as a suitable time for the observation to take place. Friday's are normally a half-day for the children, in-line with the local region's policy and so the teacher felt that for the children to take part in an evaluation on this day would be less disruptive to their schooling than on other days of the week. (It should be noted that there are frequently visitors to the class, ranging from the educational psychologist, students from areas such as speech and language therapy, researchers such as myself, and other interested parties, which does mean that there is frequently a strain on both the teacher and children when trying to carry on with their daily activities in these circumstances).

I was present in the classroom when the children arrived and observed the routine that normally takes place first thing in the classroom. On arrival at the building, the children take off their coats and change from outdoor footwear to indoor footwear in the entrance hall. The children then move to their respective classrooms and sit on the floor in front of the visual timetable and are then taken through the activities for the day by the class teacher. This is done using the visual symbols displayed on the timetable wall and by verbal instruction from the teacher.

C1, C3 and C4 were in attendance in Class 2 today, however, C3 was very tired on arrival at school and so had been taken to a quiet room to rest for a while. C2 was absent from class, as he normally attends his local primary school on a Friday due to the fact that he travels a fair distance to school. Teacher 2 (T2) was in charge of Class 2, assisted by nursery nurse 3 (NN3), who was looking after C3 in the quiet room at this time.

The children were introduced to me (they had already met me on several previous occasions) and my photograph was attached to the visual timetable to remind them that I was visiting for the morning. The teacher (T2) informed C1 and C4 that they would be working with me on the computer at blue ball time and red ball time respectively. This would allow each child to use the prototype interactive timetable for approximately 15 minutes. The classroom computer is sited at the back of the classroom and is an iMac with a flat panel LCD display.

3. Rationale

A usability study had been conducted with members of the language and communication class staff over the preceding two weeks, which involved the use of self-completion questionnaires. It was considered important to gain an insight into the children's perspective of the usability of the prototype in addition to the staff member's views, before any further changes were made to the timetable interface.

4. Aim and objectives

The overall aim of this observation study was to assess the prototype timetable interface for usability by the children. The principles of usability are generally recognized to encompass learnability, flexibility and robustness[1] so in order to assess these areas of usability; the following objectives were set out for this investigation:

- To find out if the children understood the meaning of each of the navigation icons.
- To see if the children knew how to use hyperlinks.
- To generally observe the children's skills in using the mouse, the scroll bars and the back buttons on the web browser screen.
- To note whether the children were able to read the text on the screen and to assess whether the wording was generally understandable.
- To observe whether the children were able to navigate the pages straightforwardly, to note the ways in which they navigated the pages and to record any significant problems the children had with navigation.
- To note the children's initial reactions to the pages.
- To find out opinions regarding the colours used on the pages and to note the children's favourite colours in general.
- To note any specific problems the children were having in using the timetable pages overall.

5. Method

5.1 Data collection

It was decided that the most appropriate way to evaluate the usability of the prototype interface from the children's perspective was by conducting an observation known as a co-operative user observation[2]. This procedure was conducted by myself as observer, sitting beside each of the children in turn and observing them using and interacting with the timetable interface. The teacher allocated each child to work with me separately in this way and explained that they would be looking at a timetable that I had been making for the computer.

The children sat directly in front of the screen when it was their turn and were given control of the input device (mouse), which effectively gave them control of how they chose to view the web pages. As observer, I made notes of each child's choices of navigation buttons and hyperlinks, as well as their reactions and any comments they made. Working together in this way, I was also able to ask each child if there was an action he performed that I needed clarified, or to ask for his opinions on areas that I wanted to know more about.

Observations were noted down in a field notebook and were typed up into a detailed account as soon as possible after the event, to ensure the greatest recall of what had occurred.

5.2 Analysis

The narrative texts produced from the field notes were read through carefully, in order to identify categories and these were then coded and analysed manually.

6. Findings

This section sets out the findings of the cooperative user evaluations. It begins with a general description of each child and then proceeds following the order of the objectives set out in section 4.

---

[1] Dix, A., Finlay, J., Abowd, G., & Beale, R. (1998). *Human computer interaction* (2nd ed.). London: Prentice Hall.

[2] Cox, K., & Walker, D. (1993). *User interface design* (2nd ed.). Singapore: Prentice Hall.

6.1 General description of the children

6.1.1 Child 1 (C1)

C1 was very talkative and enthusiastic about the web pages. He seemed very interested in the photograph of the staff members on the home page and pointed to various ones and said their names. He was very quick to recognise the similarities between the timetable on the screen and the one on the classroom wall (he even ran over to the wall to check it was the same). He was quite excited at times and said the word 'wow' on several occasions. C1 appeared very at ease in using the mouse and generally seemed to find his way around the web pages quite easily. He talked out loud the whole time, repeating what was written on the pages and at times saying that this was what he himself did in class. He spent approximately 20 minutes looking at the site. C1 was noted to leave the study briefly within the first five minutes, to go to the toilet. He returned straight after to continue the study.

6.1.2 Child 4 (C4)

C4 appeared a very quiet and reserved child. He recognised the members of staff in the photo on the home page and seemed pleased with the photo. He appeared to recognise quite quickly that the web pages were similar to the timetable on the classroom wall. He moved back and forward between pages very quickly, and there was one page that he returned to several times by choice, 'action heroes'. He became distracted by another web site (Thomas the Tank engine), which he somehow managed to access and so lost interest in the prototype web pages after a period of 10 minutes.

6.2 Understanding of navigation icons

Both C1 and C4 had difficulty in understanding the implied meaning of the site navigation icons at the bottom of the 'home' page. To assess their understanding, I pointed to each icon in turn and asked them what they thought it meant.

6.2.1 'Home' page

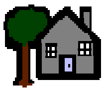


Fig. 1: Home page icon

Both boys recognised the icon for 'home' and seemed to understand the inferred meaning of a 'home' page.

6.2.2 'Individual timetable'

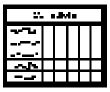


Fig. 2: Individual timetable icon

C1 thought that the icon for individual timetable meant 'writing', while C4 indicated that he had no idea what this icon was supposed to be.

6.2.3 'Today' page icon

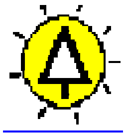


Fig. 3: Today page icon

C4 thought that the icon for ‘today’ meant ‘point’, while C1 indicated that he had no idea what this icon was supposed to be.

6.2.4 ‘Speech therapy’ page icon

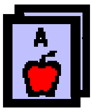


Fig. 4: speech therapy page icon

Neither child had any idea what the icon for speech therapy was supposed to mean.

6.2.5 ‘Parent’s’ page icon

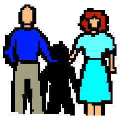


Fig. 5: Parent’s page icon

C1 thought that the icon for ‘parent’s’ page meant family (which is arguably close) while C4 thought that it meant ‘going somewhere’.

6.2.6 ‘information’ page icon

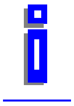


Fig. 6: Information page icon

Neither child recognised the meaning of the information page icon.

6.3 Understanding the concept of hyperlinks

Each child was asked if they understood what it meant when the mouse cursor arrow turned into a hand (this was demonstrated on screen at the same time as the question was asked).

C1 said that it meant that you could click on something when it showed the hand. I agreed with him and explained that there were several places on the page where this happened and if he clicked on the place it would take him to another page. I suggested to him that he try and find a place where the cursor changed to a hand (a link to another page). He moved the cursor over the navigation icons at the bottom of the page and chose the ‘today’ symbol to click on.

When asked if he knew what the hand meant, C4 said that he did not know, but he soon demonstrated that he was in fact aware of this concept (he may just have not understood my explanation in the first instance). Throughout the observation C4 moved the cursor over the page deliberately as if looking for hyperlinks and followed several.

6.4 Skills in using input device (mouse) and scroll bars

C1 appeared at ease using the computer generally and had good co-ordination with the input device (mouse). He demonstrated good ability in using scroll bars and in using the browser back button.

C4 was slightly less skilful, and it could be possible that he has problems with his fine motor skills. This would need to be queried with the teacher or parents. He had difficulties with the mouse at one point, but this may have been due to it not sitting on the mouse mat at the time. Also C4 had difficulty with the right scroll bar and did not seem to be able to grasp the correct arrow to move down the page.

6.5 Readability of text and wording

I asked C1 to read out the text on the 'home' page, which he did very well. He then proceeded to read out the entire wording on each page that he viewed, without being asked. He appeared to have no problems with any of the wordings or size of font, but I was unable to ascertain at this time whether he understood the meaning of all of the words.

I asked C4 to read out the text on the 'home' page, but he was reluctant to do this. The only wording that he did read out was on the 'playtime' page and this was very quietly, to himself.

6.6 Ability to navigate the pages

C1 tended to use the navigation buttons provided within the prototype web pages, while C4 was noted to use the browser back button more frequently. Both children moved well around the pages, but as the site is new to them, it was hard to tell whether they navigated with intention, or just out of curiosity.

6.7 Initial reactions to the pages

C1 was noted to be very excited when viewing the pages; he said the word 'wow' several times and was genuinely keen to explore the pages. He showed a liking for the staff photo on the 'home' page. He was also observed to physically go and look at the visual timetable on the wall as if to compare it to the computer timetable.

C4 appeared pleased at first when he viewed the photo of the staff on the home page. He seemed to like viewing the 'action heroes' page, returning to this several times. He lost interest in the pages after approximately 10 minutes, as he had managed to open another web page (Thomas the tank engine) and was keen to look at this instead.

6.8 Use of colour

Preference for colour use was difficult to assess, as neither boy made specific comments. When asked specifically, C4 said that his favourite colours were blue and green.

6.9 Specific problems in using the timetable

The only problem of any significance that was identified was the ineffectiveness of the navigation icons in representing understandable meanings of the pages they were representing. It should be noted that this was the first time that either child had seen the timetable and so they were both generally just exploring at this stage, which made it quite difficult to assess the prototype for particular problems. If the children had been asked to perform specific tasks, then specific problems might have been more identifiable.

7. Analysis

This section sets out a brief analysis of the findings of this usability study. It begins with a comment on the children's initial reaction to the web pages and then follows the order as set out in the findings section.

7.1 Initial reaction of the children to the timetable pages

From the observation study, the initial impression of the children was of genuine interest in the prototype timetable, with C1 being particularly enthusiastic.

The fact that C4 found a way to access another web site (Thomas the tank engine) whilst using the computer does draw attention to the possibility of the children becoming distracted and not remaining on task (i.e. checking the timetable).

7.2 Understanding of navigation icons

Both children had difficulty in understanding the implied meaning of the navigation icons, which is a significant problem and which should be addressed as soon as possible.

7.3 Understanding the concept of hyperlinks

C1 clearly understood the concept of hyperlinks, both acknowledging verbally his understanding and demonstrating by his actions that he certainly did know how to use them. C4 did not acknowledge verbally that he understood the concept of hyperlinks, however his actions showed that he did in fact understand how to use them.

This demonstrates that both children have presumably learned through earlier experiences of using hypermedia, the concept of hyperlinks and that they have been able to apply this knowledge to this specific experience.

7.4 Skills in using input device and scroll bars

Both children showed knowledge of how to use the browser back button, demonstrating a skill presumably learned though previous experiences of hypermedia environments and also showing their ability to apply these skills to similar situations such as this.

C1 appeared at ease using the computer, and demonstrated a general familiarity with computers. C4 also showed a general familiarity with computers, but was less skilful in using the mouse to manipulate the right side scroll bar. This may have been due to motor skills problems rather than a lack of understanding of what to do.

7.5 Readability of text and wording

C1 confirmed that text was of an adequate size to read, by actually reading out loud the text on all pages that he viewed and he also demonstrated an understanding of what was written in places, by agreeing that this was what he actually did at certain times (e.g. at play time).

7.6 Ability to navigate the pages

The study clearly showed that each user has individual preferences for navigating web-based environments. C1 mainly used the prototype navigation buttons, whilst C4 mainly used the browser navigation buttons (e.g. back button). It was also apparent that the children navigated out of curiosity at this stage, rather than with purposeful intention. C1 for example, worked his way systematically through each of the days of the week pages, whilst C4 returned frequently to a page that interested him (action heroes).

7.7 Use of colour

No specific problems with colour usage were observed, but that is not to say that there may not be problems, as the participants in this study form only part of the user group. Advice should continue to be sought from parents and teachers regarding this issue.

8. Recommendations

The following suggestions are now set forward with regards to the further development of the interactive timetable interface and for consideration for future usability studies.

- The format of the general navigation icons at the foot of each page should be investigated further, to ensure that symbols are used, which are universally known to the children, staff and parents using the interactive timetable. It is recommended that Boardmaker™ images continue to be used, as these are what the children are most likely to be familiar with, but advice needs to be sought from staff and parents as to which are the most appropriate ones to use. It is also recommended that text be included with the image, to aid comprehension and encourage literacy.

- Teachers should be aware of the possibility of the children using the time on the computer to view other ‘favourite’ web sites instead of accessing the timetable.

- Including special interest features such as for example, ‘Thomas the tank engine’ and other individual preferences may help the children to stay on task when using the timetable.

- For future usability evaluations it is recommended that some form of task be set and assessed, to increase the likelihood of identifying specific problem areas.

It was found to be a difficult task to assess the usability of the interface with the children using a cooperative user observation technique. This is most likely due to a lack of experience on the part of the investigator, but also it may help to have a more structured approach to such observations in the future. An observation chart might prove helpful, with specific areas set out that can be ticked if applicable, or possibly printouts of the interface pages, on which navigation buttons could be ticked or circled if used. An alternative could be to videotape the observation session, so that it could be evaluated in more detail.

9. Conclusion

This report has documented the usability studies that took place in May 2003, involving C1 and C4 in using the prototype interactive timetable interface, version 2. The findings of this study have been reported, together with an analysis and recommendations made for both the further development of the interface and for future usability studies in this project.

Appendix 20: Usability questionnaire

Queen Margaret University College
EDINBURGH

Language and Communication Class
[redacted]

Susan Murray
Post-graduate Research Student
School of Social Science, Media & Communication
Faculty of Health & Social Science
Queen Margaret University College,
Corstorphine campus
Tel 0131 317 3513
Email: smurray@qmuc.ac.uk

29th April 2003

Usability questionnaire for staff members: April 2003

I would be very interested to know your thoughts and opinions regarding the trial version of the computer-based timetable that I have been developing for [redacted] class. I appreciate that you are all very busy, but it would help me greatly it you could spare some time to complete the attached questionnaire for me please.

In order to develop a resource that will be useful, easy to use and hopefully something that everyone will enjoy using, I need to know your honest opinions and comments about the general layout, design and functionality so far.

As this is a prototype, or trial version of the planned timetable system, only certain parts are working at the moment. These are the 'home' page, the 'today' page, the days of the week from Monday through to Sunday, and the 'information' page (which has only a small amount of information at present). There are also some pages with a breakdown of certain activities, such as 'action heroes', 'playtime', 'lunchtime' and 'ball time'.

I would like to start by asking you to comment on aspects of general design, navigation features and content. Then I would like you to complete some specific tasks using the timetable web pages and to write down beside the task how successful you were. This will be very valuable for me, as it will help me to identify any basic problems you may have with navigating the pages. The questionnaire should only take approximately 5 minutes to complete and the tasks around 2 – 3 minutes.

If you have any further comments or suggestions to make, these are very welcome and can be added to the back of these sheets. I'd like to take this opportunity to thank you for your help with this particular investigation and for your continued support with the project overall.

Yours sincerely,

Susan Murray

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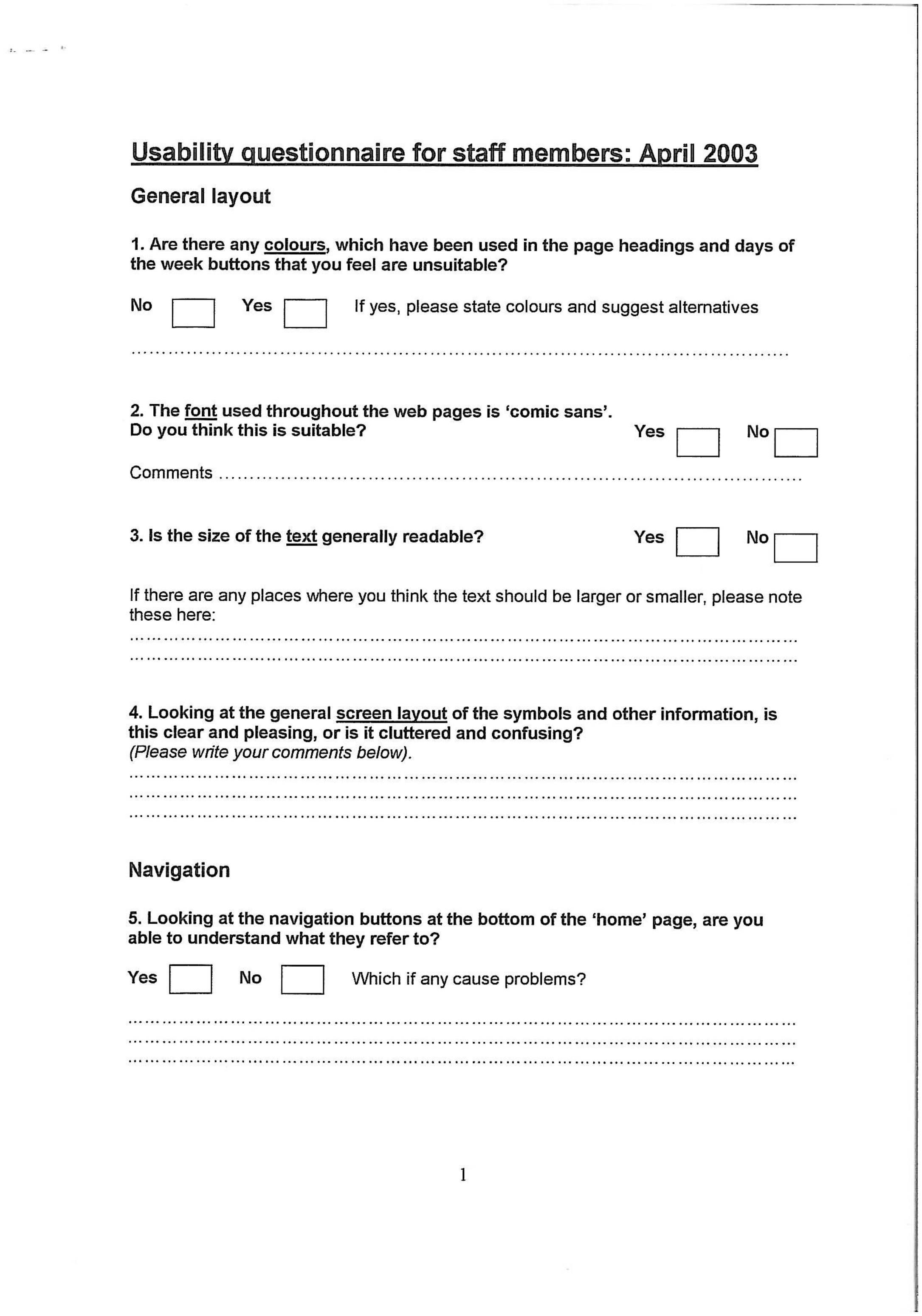


Usability questionnaire for staff members: April 2003

General layout

1. Are there any colours, which have been used in the page headings and days of the week buttons that you feel are unsuitable?

No ☐ Yes ☐ If yes, please state colours and suggest alternatives

………………………………………………………………………………………………………

2. The font used throughout the web pages is 'comic sans'.
Do you think this is suitable? **Yes** ☐ **No** ☐

Comments ………………………………………………………………………………………

3. Is the size of the text generally readable? **Yes** ☐ **No** ☐

If there are any places where you think the text should be larger or smaller, please note these here:

………………………………………………………………………………………………………

………………………………………………………………………………………………………

4. Looking at the general screen layout of the symbols and other information, is this clear and pleasing, or is it cluttered and confusing?
(Please write your comments below).

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

Navigation

5. Looking at the navigation buttons at the bottom of the 'home' page, are you able to understand what they refer to?

Yes ☐ No ☐ Which if any cause problems?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

1

6. Are you able to tell from the page headings, which page you are viewing?

Yes ☐ **No** ☐

Which pages, if any, cause problems?

……………………………………………………………………………………………………
……………………………………………………………………………………………………

7. When first trying the web pages, which of the following apply most to how you found your way about? *(Please tick the box beside the choice that applies most)*

☐ Very quickly & easily
☐ Reasonably quickly & easily
☐ Fairly slowly and with some difficulty
☐ Very slowly and with great difficulty

Content

8. Can you suggest any information that you think is important to display on the ‘information’ page?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

9. Can you suggest any information that you think is important to display on the ‘parent’s’ page?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

10. It is intended that individual timetables be created for each child in addition to the class timetable. Can you suggest the type of information that you think is important to display on the individual timetables?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

Usability tasks

Please complete the following tasks on the computer, using the Language and Communication Class web pages: http://ctserv.qmuc.ac.uk/online/smurray/default.htm and write your comments in the space provided.

1. Go to the page for 'Monday'.
How did you get to this page? *(Please write down the steps you took to find this page)*
……………………………………………………………………………………………………
……………………………………………………………………………………………………
Any problems? ……………………………………………………………………………………

2. Scroll down the 'Monday' page.

Is it clear which day of the week you are viewing? Yes ☐ No ☐

3. How many activities do the children have before snack time on Monday?
(Please write the number in the box) ☐

4. Is the wording above each row of timetable symbols clear and easily understood?

Yes ☐ No ☐

If unclear, please note down any problems
……………………………………………………………………………………………………
……………………………………………………………………………………………………

5. Now go to 'Tuesday's' page.
How did you get to Tuesday? *(Please write down the steps you took to find this page)*
……………………………………………………………………………………………………
……………………………………………………………………………………………………
Any problems? ……………………………………………………………………………………

6. On Tuesday's page, find out what happens at blue ball time.
How did you do this? *(Please write down the steps you took)*
……………………………………………………………………………………………………
……………………………………………………………………………………………………
Any problems? ……………………………………………………………………………………

7. Return from blue ball page to 'Tuesday's' page.
How did you do this? *(Please write down the steps you took)*
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

Appendix 21: Interview questions – anxiety related behaviour

Interview with parent - anxiety

Aims:

To identify stress / anxiety related behaviour
To identify events or factors (triggers) that lead to anxiety / stress
To identify outward or physical signs of anxiety / stress

* Remember to sign consent forms (parent & child)
* Ask for permission to tape interview

---

1. How would you describe your child's behaviour generally?

Prompts:

- If you could sum him up in a nutshell…..
- Easy going? Happy? Cautious? Easily upset?

2. What would you say represented anxiety or stress related behaviour for your child?

Prompts:

- How do you know when he is anxious or stressed?
- Are there outward signs? Facial expressions?
- Repetitive or obsessive behaviours?

SHOW CARD A – STEREOTYPED BEHAVIOURS

- Does your child display any of these behaviours?
- Just when he is anxious or at other times?

3. What kinds of events or factors cause your child to become anxious or stressed?

Prompts:

- Specific triggers? Specific environments?
- People? Tasks/activities? Trying to communicate his needs?
- Pleasant or unpleasant events?

SHOW CARD B – STRESS TRIGGERS

4. In which environment do stressors tend to occur?

Prompts:
- School? Home? Other?

5. Does your child display any physical signs of stress or anxiety?

SHOW CARD C – PHYSICAL SIGNS

6. How do you ease his anxiety?

Prompts:
- Techniques you use?

Appendix 22: Prompt cards A, B, and C

Card A - Stereotyped behaviour

Rocking
Sniffing objects or self
Spinning
Waving arms
Head-rolling
Whirling
Body movements
Pacing
Twirling
Hand movements
Yelling
Bouncing
Running
Finger movements
Gazing
Postures
Clapping
Grimacing

Flaps arms/hands
Constantly feels objects
Literally repeats words or sentences that have (just) been used by someone else
Keeps performing certain movements (e.g. turning round and round)

Sources: American Psychiatric Association (2000); Luteijn, Luteijn, Jackson, Volkmar, & Minderaa (2000); Rojahn, Matson, Lott, Esbensen, & Smalls (2001); WHO (1993).

Card B – stress triggers

Loud noises
Noise or disruption from others
Bright lights
Changes in schedule or plans
Changes in task to a new task with new directions
Moving from one location to another
Changes in environment from familiar to unfamiliar
Changes in teacher or supervisor
Being unable to communicate needs
Needing to ask for help
Being touched by others
Waiting for transportation
Participating in a group activity
Waiting for a not-liked activity to begin
Having to engage in a not-liked activity
Receiving a reprimand
Being told “no”
Receiving verbal reinforcement
Receiving tangible reinforcement
Personal objects out of order
Personal objects touched by others
Personal objects missing
Being prevented from completing a ritual
Being prevented from carrying out a ritual
Being interrupted while engaging in ritual

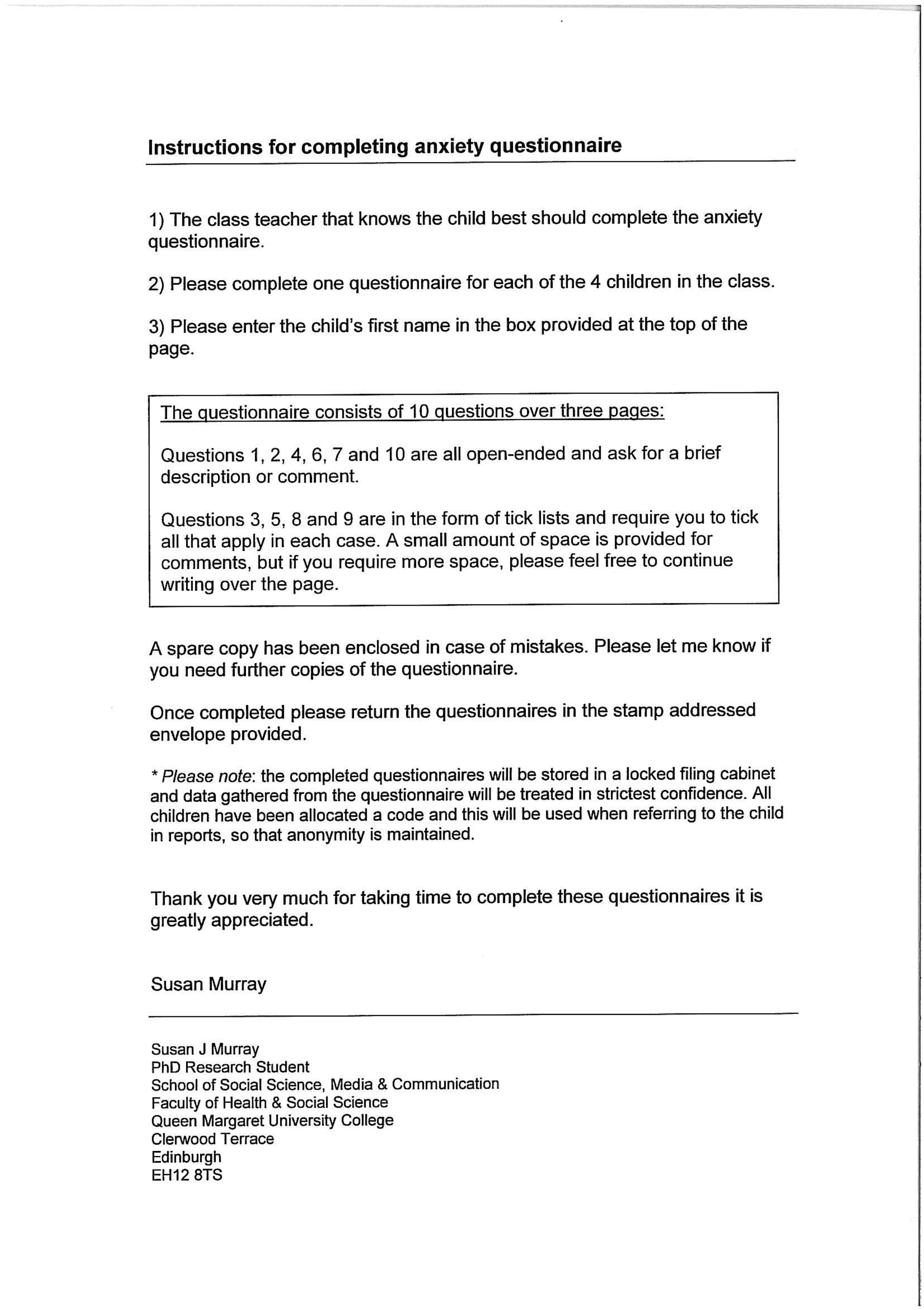
Source: Groden, Diller, Bausman, Velicer, Norman, & Cautela (2001).

Card C – Physical signs

Breathlessness
Trouble sleeping at night
Feeling sick
Pains in stomach
Sweaty hands
Excessive tiredness
Nightmares/bad dreams
Waking up in the night scared
Paleness or redness
Aggressiveness
Angry
Over-reacts
Overactive
Cannot sit still
Talks too loudly
Panics
Cries for incomprehensible reasons
Bites or scratches himself

Sources: Reynolds & Richmond (1997); Luteijn, Luteijn, Jackson, Volkmar, & Minderaa (2000).

Appendix 23: Self-completion questionnaire – anxiety related behaviour (teacher's copy)



Instructions for completing anxiety questionnaire

1) The class teacher that knows the child best should complete the anxiety questionnaire.

2) Please complete one questionnaire for each of the 4 children in the class.

3) Please enter the child's first name in the box provided at the top of the page.

The questionnaire consists of 10 questions over three pages:

Questions 1, 2, 4, 6, 7 and 10 are all open-ended and ask for a brief description or comment.

Questions 3, 5, 8 and 9 are in the form of tick lists and require you to tick all that apply in each case. A small amount of space is provided for comments, but if you require more space, please feel free to continue writing over the page.

A spare copy has been enclosed in case of mistakes. Please let me know if you need further copies of the questionnaire.

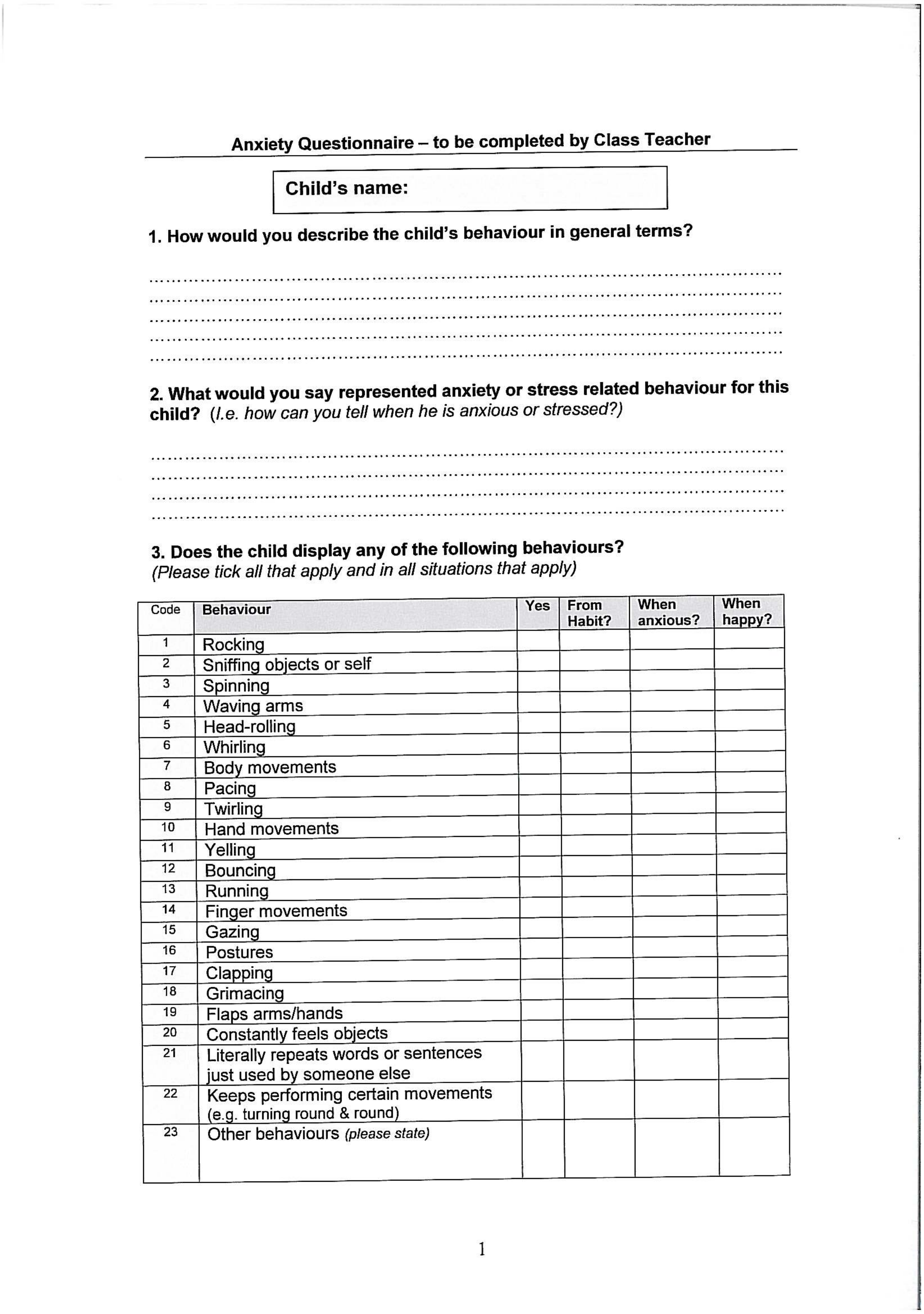
Once completed please return the questionnaires in the stamp addressed envelope provided.

* *Please note*: the completed questionnaires will be stored in a locked filing cabinet and data gathered from the questionnaire will be treated in strictest confidence. All children have been allocated a code and this will be used when referring to the child in reports, so that anonymity is maintained.

Thank you very much for taking time to complete these questionnaires it is greatly appreciated.

Susan Murray

Susan J Murray
PhD Research Student
School of Social Science, Media & Communication
Faculty of Health & Social Science
Queen Margaret University College
Clerwood Terrace
Edinburgh
EH12 8TS



Anxiety Questionnaire – to be completed by Class Teacher

Child's name:

1. How would you describe the child's behaviour in general terms?

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

2. What would you say represented anxiety or stress related behaviour for this child? (*I.e. how can you tell when he is anxious or stressed?)*

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

3. Does the child display any of the following behaviours?
(Please tick all that apply and in all situations that apply)

Code	**Behaviour**	**Yes**	**From Habit?**	**When anxious?**	**When happy?**
1	Rocking				
2	Sniffing objects or self				
3	Spinning				
4	Waving arms				
5	Head-rolling				
6	Whirling				
7	Body movements				
8	Pacing				
9	Twirling				
10	Hand movements				
11	Yelling				
12	Bouncing				
13	Running				
14	Finger movements				
15	Gazing				
16	Postures				
17	Clapping				
18	Grimacing				
19	Flaps arms/hands				
20	Constantly feels objects				
21	Literally repeats words or sentences just used by someone else				
22	Keeps performing certain movements (e.g. turning round & round)				
23	Other behaviours *(please state)*				

4. Do any specific events or issues cause this child to become anxious or stressed?

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

5. Below is a list of possible stressors.
Do any of the following items cause anxiety or stress in this child?
(Please tick all that apply)

Code	Stressor	Yes	No	Any comments?
1	Loud noises			
2	Noise or disruption from others			
3	Bright lights			
4	Changes in schedule or plans			
5	Changes in task to a new task with new directions			
6	Moving from one location to another			
7	Changes in environment from familiar to unfamiliar			
8	Changes in teacher or supervisor			
9	Being unable to communicate needs			
10	Needing to ask for help			
11	Being touched by others			
12	Waiting for transportation			
13	Participating in a group activity			
14	Waiting for a not-liked activity to begin			
15	Having to engage in a not-liked activity			
16	Receiving a reprimand			
17	Being told "no"			
18	Receiving verbal reinforcement			
19	Receiving tangible reinforcement			
20	Personal objects out of order			
21	Personal objects touched by others			
22	Personal objects missing			
23	Being prevented from completing a ritual			
24	Being prevented from carrying out a ritual			
25	Being interrupted while engaging in ritual			
26	Other factors not mentioned above *(Please state)*			

6. In which environment do stressors tend to occur more for this child?
(E.g. classroom, playground, outings, home etc.)

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

7. Does this child display any physical signs of stress or anxiety at school?
(Please describe)

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

8. Below is a list of physical signs of stress.
Does this child display or complain of any of the following physical signs while at school? *(Please tick as appropriate)*

Code	Physical sign of stress	Yes	No	Unknown	Comments
1	Breathlessness				
2	Feeling sick				
3	Pains in stomach				
4	Sweaty hands				
5	Excessive tiredness				
6	Paleness or redness				
7	Aggressiveness				
8	Anger				
9	Over-reacts				
10	Cannot sit still				
11	Overactive				
12	Talks too loudly				
13	Panics				
14	Cries for incomprehensible reasons				
15	Bites or scratches himself				
16	Any other physical signs? *(Please state)*				

9. Does the child or his parents mention any of the following occurring at home? *(Please tick as appropriate)*

Code	Physical sign of stress	Yes	No	Unknown	Comments
1	Trouble sleeping at night				
2	Waking up in the night scared				
3	Nightmares/bad dreams				
4	Other *(please state)*				

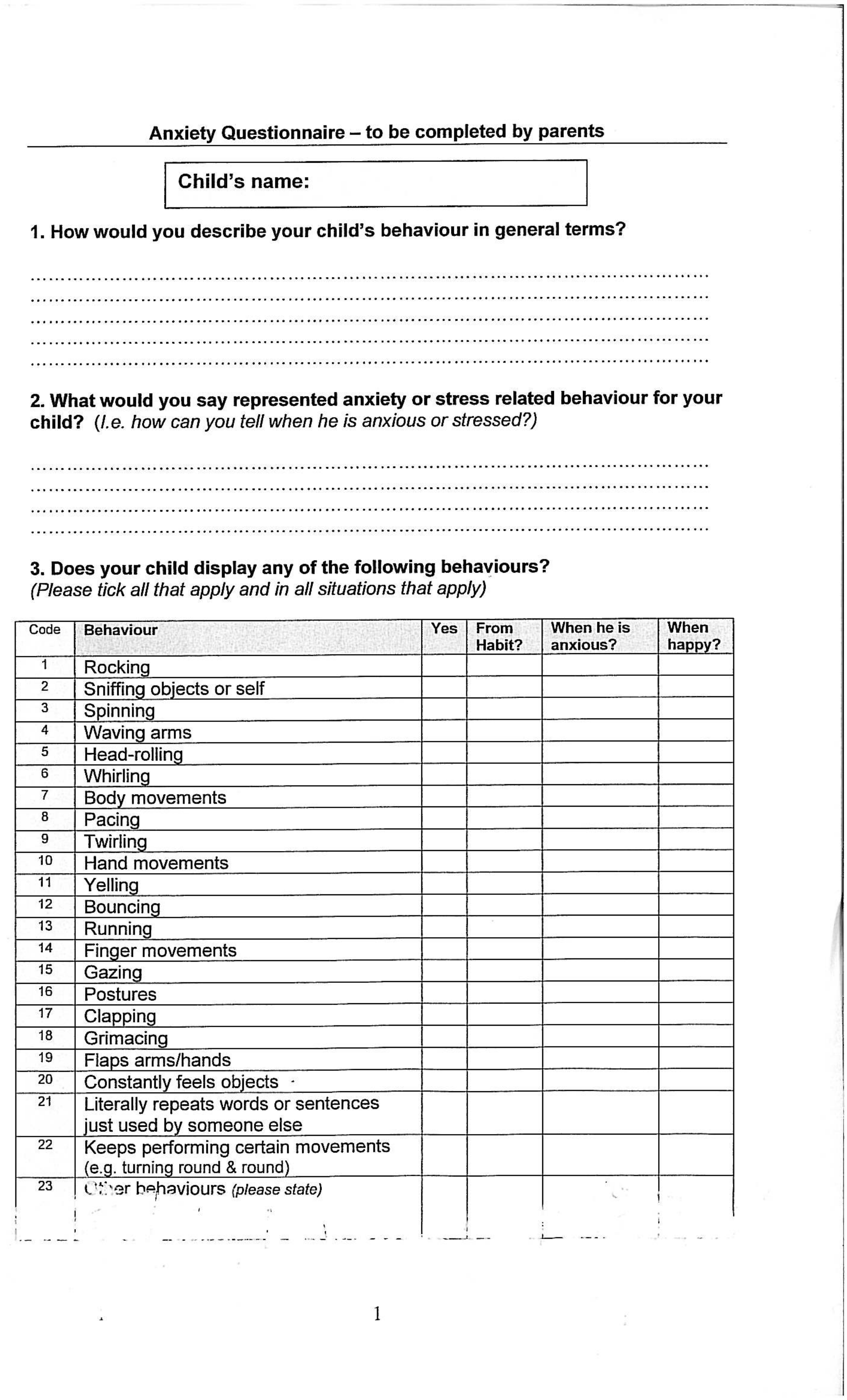
10. How do you attempt to ease anxiety or stress for this child while at school?
(E.g. are there any techniques or strategies that you specifically use)

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Thank you for taking time to complete this questionnaire. If you wish to add any comments or information please write on the back of this sheet.

3

Appendix 24: Self-completion questionnaire – anxiety related behaviour (parent copy)



Anxiety Questionnaire – to be completed by parents

Child's name:

1. How would you describe your child's behaviour in general terms?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

2. What would you say represented anxiety or stress related behaviour for your child? *(I.e. how can you tell when he is anxious or stressed?)*

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

3. Does your child display any of the following behaviours?
(Please tick all that apply and in all situations that apply)

Code	**Behaviour**	**Yes**	**From Habit?**	**When he is anxious?**	**When happy?**
1	Rocking				
2	Sniffing objects or self				
3	Spinning				
4	Waving arms				
5	Head-rolling				
6	Whirling				
7	Body movements				
8	Pacing				
9	Twirling				
10	Hand movements				
11	Yelling				
12	Bouncing				
13	Running				
14	Finger movements				
15	Gazing				
16	Postures				
17	Clapping				
18	Grimacing				
19	Flaps arms/hands				
20	Constantly feels objects				
21	Literally repeats words or sentences just used by someone else				
22	Keeps performing certain movements (e.g. turning round & round)				
23	Other behaviours *(please state)*				

1

4. Do any specific events or issues cause your child to become anxious or stressed?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

5. Below is a list of possible stressors.
Do any of the following items cause anxiety or stress in your child?
(Please tick all that apply)

Code	Stressor	Yes	No	Any comments?
1	Loud noises			
2	Noise or disruption from others			
3	Bright lights			
4	Changes in schedule or plans			
5	Changes in task to a new task with new directions			
6	Moving from one location to another			
7	Changes in environment from familiar to unfamiliar			
8	Changes in teacher or supervisor			
9	Being unable to communicate needs			
10	Needing to ask for help			
11	Being touched by others			
12	Waiting for transportation			
13	Participating in a group activity			
14	Waiting for a not-liked activity to begin			
15	Having to engage in a not-liked activity			
16	Receiving a reprimand			
17	Being told "no"			
18	Receiving verbal reinforcement			
19	Receiving tangible reinforcement			
20	Personal objects out of order			
21	Personal objects touched by others			
22	Personal objects missing			
23	Being prevented from completing a ritual			
24	Being prevented from carrying out a ritual			
25	Being interrupted while engaging in ritual			
26	Other factors not mentioned above *(Please state)*			

6. In which environment do stressors tend to occur more for your child?
(E.g. classroom, playground, outings, home, supermarket etc.)

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

7. Does your child display any physical signs of stress or anxiety?
(Please describe)

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

8. Below is a list of physical signs of stress.
Does your child display or complain of any of the following physical signs?
(Please tick as appropriate)

Code	Physical sign of stress	Yes	No	Unknown	Comments
1	Breathlessness				
2	Feeling sick				
3	Pains in stomach				
4	Sweaty hands				
5	Excessive tiredness				
6	Paleness or redness				
7	Aggressiveness				
8	Anger				
9	Over-reacts				
10	Cannot sit still				
11	Overactive				
12	Talks too loudly				
13	Panics				
14	Cries for incomprehensible reasons				
15	Bites or scratches himself				
16	Any other physical signs? *(Please state)*				

9. Does your child suffer from any of the following? *(Please tick as appropriate)*

Code	Physical sign of stress	Yes	No	Unknown	Comments
1	Trouble sleeping at night				
2	Waking up in the night scared				
3	Nightmares/bad dreams				
4	Other *(please state)*				

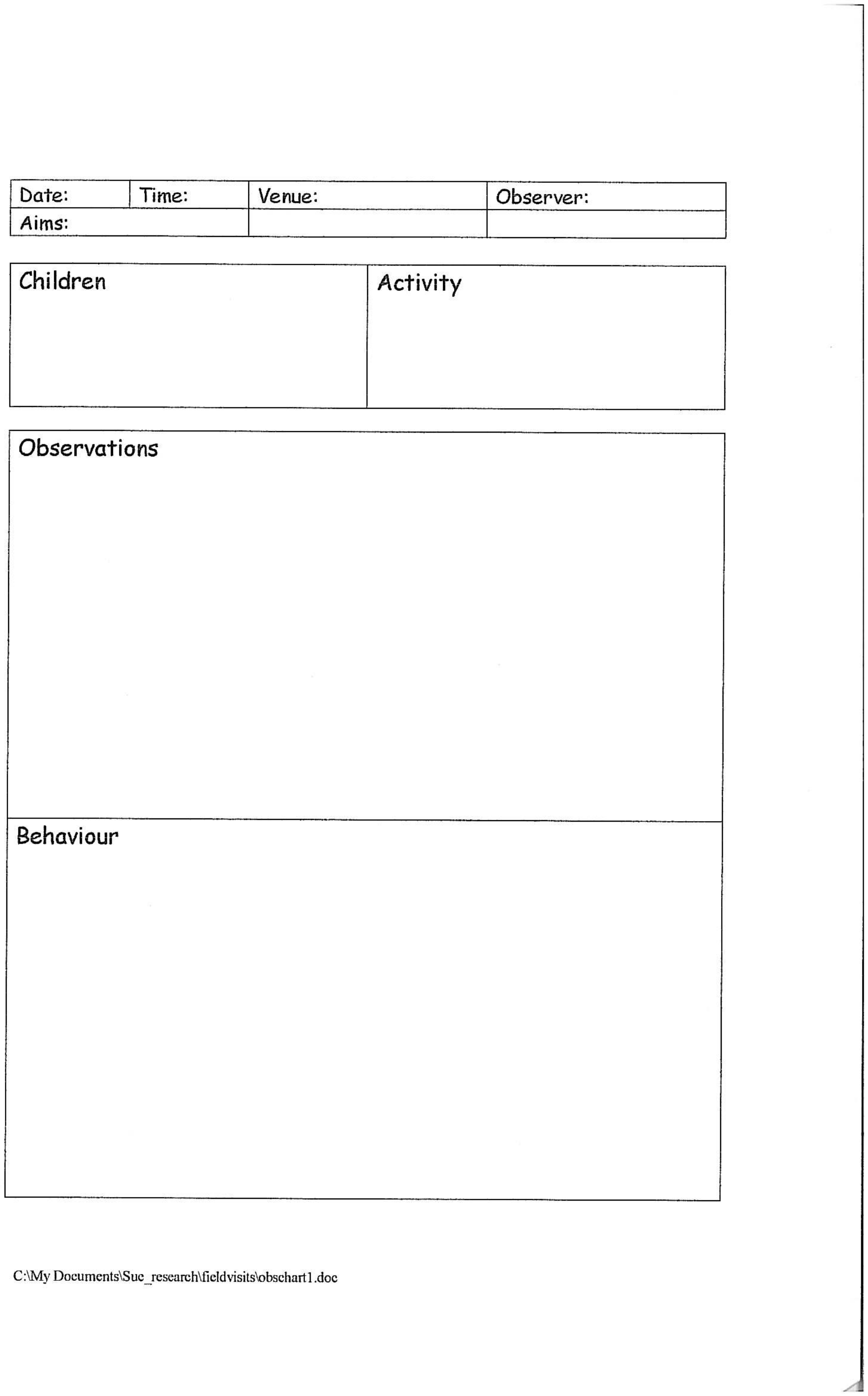
10. How do you attempt to ease anxiety or stress for your child?
(E.g. are there any techniques or strategies that you specifically use)

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

Thank you for taking time to complete this questionnaire. If you wish to add any comments or information please write on the back of this sheet.

Appendix 25: Structured observation chart

Pilot chart



Date:	Time:	Venue:	Observer:
Aims:			

Children	Activity

Observations
Behaviour

C:\My Documents\Sue_research\fieldvisits\obschart1.doc

Observation schedule: anxiety-related behaviour

Ob.no./ Date:		**Child's name:**		**Activity:**	
Observer:		**Staff present:**		**Children present:**	
Setting:					
Aim:					
Objectives:					

Behaviour / physical appearance	Start	Duration	Event	Intensity	Environmental event	Impact / outcomes

Appendix 26: Behaviour categorisation chart

This document presents a categorisation of the stereotyped behaviours, physical signs of anxiety and environmental events observed during structured observation studies during January 2004, May 2004 and June 2004. These studies were conducted as part of a pilot, baseline and implementation phases of the research investigation. The behaviours displayed by the participants during the observation studies were categorised according to the record of stereotyped behaviours and physical signs of anxiety listed in the questionnaire previously shown to the teacher and parents. Many of the behaviours observed were difficult to categorise and so in order to assist standardisation between participants and to aid further analysis, the categories behaviours were allocated to are presented in tabular form in this document.

Stereotyped behaviour

A list of 22 stereotyped behaviours was used to elicit from the class teacher and parents the type of behaviours that each child tended to display. A final category for 'other behaviours' was also included, in order to allow classification of behaviours that did not fit into the stereotyped behaviour categories presented. This same list was then used to aid the categorisation of the behaviours that were observed. Each grouping of stereotyped behaviour is now presented in tabular form, listing behaviours noted for each of the four children participating at this stage of the study.

Physical signs of anxiety

A list of 18 physical signs of anxiety was shown to parents and the class teacher to establish the type of physical signs of anxiety that each child exhibited. A category for 'other' was included to allow classification of signs which did not fit easily into the categories presented. This list was then used to aid the categorisation of the physical signs that were observed. Each grouping of physical signs of anxiety is now presented in tabular form, listing signs noted for each of the four children participating at this stage of the study.

Environmental events

A list of 25 potential environmental stressors was shown to parents and the class teacher to establish the type of events that each child was likely to be stressed by. A category for 'other factors' was included to allow classification of events which did not fit easily into the categories presented. This list was then used to aid the categorisation of the environmental events that were observed. Each grouping of environmental events is now presented in tabular form, listing those observed during the studies for each of the four children participating at this stage.

(as this is a very large document only the stereotyped behaviours section is included here)

1: Rocking

Child	Behaviour
1	Rocking body while sitting on floor Rocking side to side in chair
4	Rocking slightly when sitting crossed legged Rocking when sat in a chair
6	No rocking observed
7	Rocking backwards & forwards while kneeling on cushion Rocking foot

2: Sniffing objects or self

Child	Behaviour
1	Sniffing hand, fingers
4	No sniffing observed
6	No sniffing observed
7	No sniffing observed

3: Spinning

Child	Behaviour
1	No spinning observed
4	No spinning observed
6	No spinning observed
7	Rolling over on the floor Swinging computer chair round and round

4: Waving arms

Child	Behaviour
1	No waving of arms observed
4	No waving of arms observed
6	No waving of arms observed
7	No waving of arms observed

5: Head rolling

Child	Behaviour
1	No head rolling observed
4	No head rolling observed
6	No head rolling observed
7	No head rolling observed

6: Whirling

Child	Behaviour
1	No whirling observed
4	No whirling observed
6	No whirling observed
7	Rolling over on the floor Swinging computer chair round and round

7: Body movements

Child	Behaviour
1	Sudden jerky movements
4	None observed
6	Odd body movements. Startled body movements (jumping) Punching the air - arm straight upwards Strange movements when walking (gait)
7	Strange body movements Moving arms in strange way (when pretending to be a monster)

8: Pacing

Child	Behaviour
1	Keeps getting up from worktable to fetch equipment (rubber, book etc.)
4	No pacing observed
6	Some pacing observed. Keeps getting up to fetch equipment
7	Wandering around the classroom

9: Twirling

Child	Behaviour
1	No twirling observed
4	No twirling observed
6	No twirling observed
7	Rolling over on the floor Swinging computer chair round and round

10: Hand movements

Child	Behaviour
1	Hands together, palm-to-palm
4	Rubbing his hands together
6	Some odd hand movements observed
7	No hand movements observed

11: Yelling

Child	Behaviour
1	No yelling observed
4	No yelling observed
6	Exclaiming in response to a sudden loud noise (physical sign)
7	Exclaiming in response to knocking object over (physical sign)

12: Bouncing

Child	Behaviour
1	No bouncing observed
4	No bouncing observed
6	No bouncing observed
7	No bouncing observed

13: Running

Child	Behaviour
1	No running observed
4	No running observed
6	No running observed
7	No running observed

14: Finger movements

Child	Behaviour
1	Playing with his fingers Putting fingers together, tips touching Flicking fingers Rubbing fingers on table Waving fingers under his nose Rubbing fingers under his nose Flicking a pencil with his fingers and between fingers Tapping fingers on lips and chin
4	Flicking pencil between fingers
6	Playing with his fingers Flicking pencil between fingers
7	Playing with his fingers

15: Gazing

Child	Behaviour
1	Gazing around generally Looking at other children's work books Looking across at other children & staff Watching other children or teacher
4	Gazing around generally Looking at the teacher talking to other children Watching other children or teacher Looking at other children's work books
6	Gazing around generally Looking at other children's work books Looking across at other children & staff Watching other children or teacher
7	Gazing around generally Watching other children Looking at other children's work books

16: Postures

Child	Behaviour
1	Resting face on hands Holding hands on face Hand on head Sitting sideways in his chair Stretching back in his chair, stretching generally Legs crossed under the worktable

4	Hand(s) on head or face Chin resting on fist Fists on cheek Face resting on hand Hands together Walking on tiptoe Hand in trouser pocket Leaning back in chair with arm behind him resting on chair back Leaning back in his chair and stretching, stretching generally Leaning back in his chair with arms above head
6	Resting head on arm or hand Covering ears with hands (when there is a loud noise) Hand on forehead Leaning back in his chair Leaning generally Stretching generally Arms folded Hands in pockets when standing
7	Holding his arm over his mouth Kneeling on cushion Lying on the floor cushion Legs crossed under the table Arm down inside the back of his t-shirt Sitting crossed legged Leaning back in his chair, arms above head Leaning against objects, leaning towards another person

17: Clapping

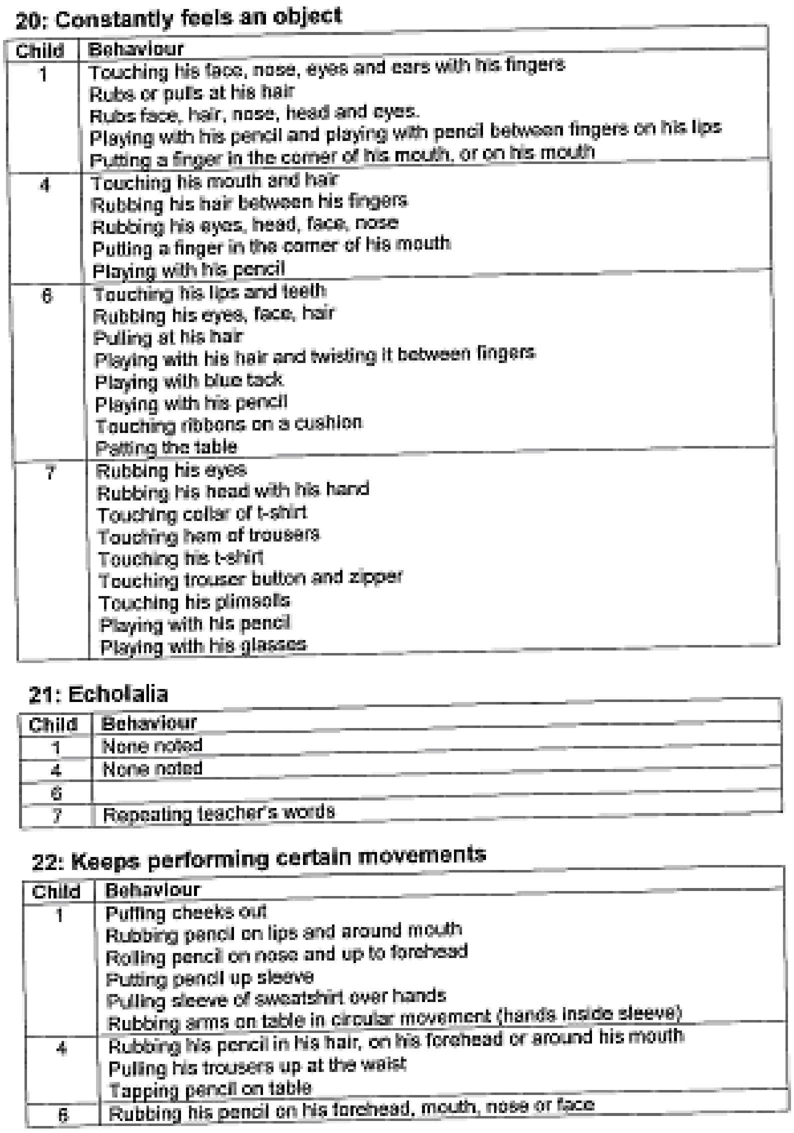
Child	Behaviour
1	No clapping observed
4	No clapping observed
6	No clapping observed
7	No clapping observed

18: Grimacing

Child	Behaviour
1	Frowning Screwing up his eyes
4	No grimacing observed
6	Strange facial expressions observed
7	Facial expressions observed

19: Flaps arms / hands

Child	Behaviour
1	No flapping of arms or hands observed
4	No flapping of arms or hands observed
6	No flapping of arms or hands observed
7	No flapping of arms or hands observed



20: Constantly feels an object

Child	Behaviour
1	Touching his face, nose, eyes and ears with his fingers Rubs or pulls at his hair Rubs face, hair, nose, head and eyes. Playing with his pencil and playing with pencil between fingers on his lips Putting a finger in the corner of his mouth, or on his mouth
4	Touching his mouth and hair Rubbing his hair between his fingers Rubbing his eyes, head, face, nose Putting a finger in the corner of his mouth Playing with his pencil
6	Touching his lips and teeth Rubbing his eyes, face, hair Pulling at his hair Playing with his hair and twisting it between fingers Playing with blue tack Playing with his pencil Touching ribbons on a cushion Patting the table
7	Rubbing his eyes Rubbing his head with his hand Touching collar of t-shirt Touching hem of trousers Touching his t-shirt Touching trouser button and zipper Touching his plimsolls Playing with his pencil Playing with his glasses

21: Echolalia

Child	Behaviour
1	None noted
4	None noted
6	
7	Repeating teacher's words

22: Keeps performing certain movements

Child	Behaviour
1	Puffing cheeks out Rubbing pencil on lips and around mouth Rolling pencil on nose and up to forehead Putting pencil up sleeve Pulling sleeve of sweatshirt over hands Rubbing arms on table in circular movement (hands inside sleeve)
4	Rubbing his pencil in his hair, on his forehead or around his mouth Pulling his trousers up at the waist Tapping pencil on table
6	Rubbing his pencil on his forehead, mouth, nose or face

7

	Dropping his pencil
7	Rubbing his head against objects Swinging his legs and feet under the table Placing his pencil on his forehead Rubbing his pencil on his forehead, face and glasses Pulling his trouser leg up Moving chair backwards and forwards Playing around on his chair

23: Other behaviours (not necessarily stereotypical)

Child	Behaviour
1	Moves his chair away from another child Speaking to himself, muttering Talking to other children Smiling, laughing Looking in direction of visual timetable Blowing on and through hands and fingers Blowing into his drinking cup Putting his hand up to answer a question Going to the toilet Prompting another child about his task
4	Smiling , laughing Turning to look at the blackboard Asking for help with tying apron strings Putting his hand up to attract teacher's attention Talking to self and others
6	Talking to self or to others Acting like the teacher, correcting other children *(if he thinks they have done or said something wrong)* Correcting the teacher Putting his hand up to attract teacher's attention Asking for help or asking the teacher a question Asking to go to the toilet Turning round in his seat Looking in direction of visual timetable Repeating his own words not others Smiling, laughing
7	Talking to self or to others Blowing on his hand Making up stories about things he has done (e.g. at weekend) Wiping paint off his fingers onto another child's sleeve Being clumsy – knocking things over Cramming food in his mouth Pretending to lick something Pretending to be a cat or a monster Twisting his arms in his t-shirt Putting back of t-shirt over chair back behind him Turning round in chair

Appendix 27: Interview questions – summative evaluation

Interview with parents: summative evaluation of the interactive timetable

Aim: to evaluate the overall usefulness of the interactive timetable for the child and parents

Objectives:

- To learn what use the child has made of the interactive timetable at home and to discover what his attitude toward the timetable might be
- To explore the parent's views regarding the key benefits of a computer-based, interactive timetable
- To identify any problems that the parent has found through use of the interactive timetable at home

1. Has your child looked at the timetable at home over the last 2 weeks?

On his own?
With you? With others?
When? Time of day – length of time?

2. What area does he spend most time looking at?

Why do you think this is?
Does he read anything out? Does he print anything out? Does he show you anything on the screen?

3. Does he talk about the interactive timetable?

Does he ever mention the symbolic timetable?

4. In your opinion, would you say that he appears to like the interactive timetable, or to dislike it?

What does he like / dislike most?

5. Has your child found the timetable pages easy to use and understand? Have you?

6. Have you found any problems with using the interactive timetable at home?

Technical problems?
Behavioural problems from your child?

7. Have you found any benefits with being able to see the timetable at home?

Has the timetable helped to remind your child of things?
Has it helped with communication about what happens at school?

8. How has your child's behaviour been while he has been accessing the timetable at home?

9. What do you like most about the timetable? And least?

10. If there were to be a similar timetable system in use in the future, do you think you and your child would use it? Or not?

Reasons?

Appendix 28: Expert evaluation questionnaires

Dear,

I have developed a prototype, web-based, interactive timetable system for primary school children with High-functioning Autistic Spectrum Disorder as part of my doctoral research and wondered if you would be kind enough to carry out a usability evaluation of the user interface for me please?

I know that you have experience of web interface design and would very much value your opinion. I appreciate that you are likely to be very busy and so do not wish to take up too much of your time. However, if you feel that you could spare time to have a look at the system sometime over the next few weeks, I would be extremely grateful.

The address for the prototype is:
http://ctserv3.qmuc.ac.uk/online/smurray/timetable/default.asp

When you try to enter the site using the 'home page' icon you will be asked for a username and password. I have set these up for you and they are both in lower case:

Username:
Password:

I would also be interested to hear of any specific problems that you find with regards to compliance of the interface with the recognised principles of usability as set out by Nielsen (1993)[4]. For example, does the system:

- Use simple and natural dialogue
- Speak the user's language
- Minimize user memory load
- Demonstrate consistency
- Provide feedback
- Provide good error messages
- Prevent errors

I have included a questionnaire, but would also appreciate a note of any problems you encounter, their source and any possible solutions you might recommend (only if you have time to do this). The questionnaire is a word document and you should be able to complete this on your own computer, using 'Insert symbol' to place a tick in the box. If you could save the questionnaire to your own machine (in case there is a problem opening the document at my end) and then email (smurray@qmuc.ac.uk) a copy back to me, I would be very grateful - thanks.

Technical Background

The application was developed using Dreamweaver MX and is written in XML version 1.0. The dynamic nature of the application is produced through the use of Active Server Pages and connection to a back-end database. Cascading Style Sheets are used throughout.

---

[4] Nielsen, J. (1993). *Usability engineering*. London: Academic Press.

Users

The main users of the system are a class of 5 special needs children aged 6 to 9 years, the class teacher, nursery nurse, speech and language therapist and the children's parents (accessing the system from home via the Internet). The children taking part in the study are all male and have a diagnosis of Autistic Spectrum Disorder. The APA (2000) describes the main features of Autistic Disorder as being "the presence of markedly abnormally impaired development in social interaction and communication and a markedly restricted repertoire of activity and interests. Manifestations of the disorder vary greatly depending on the developmental level and chronological age of the individual." [5] These children attend a special unit at a mainstream school and are considered 'high functioning'.

The children follow a highly visual timetable in class, which uses Boardmaker™ symbols (used in the field of speech and language science) and which is displayed across one of the classroom walls. The teacher makes up the timetable daily and changes it in front of the children when required. My research aim was to see if it was possible to develop a computer-based version of the timetable that the children could personalise and which the parents could also access at home.

There are several problems that I have discovered and have been unable to rectify so far:

- The dragging action of images on the 'check my timetable' page are only supported by Internet Explorer

http://ctserv3.qmuc.ac.uk/online/smurray/timetable/myTT/checkTT3.asp

- I have not succeeded in creating a way of saving changes made on the 'check my timetable' page nor on the 'my helping tasks' page:

http://ctserv3.qmuc.ac.uk/online/smurray/timetable/myTT/helptask_processor.asp

Nor on the 'my happy face targets' page:

http://ctserv3.qmuc.ac.uk/online/smurray/timetable/myTT/happyface_processor.asp

- When the children viewed the timetable on a Macintosh machine, they tried to drag the images on the class timetable page even though these images do not drag (they applied knowledge of the 'check my timetable' page to these images). This resulted in the images appearing to move in a ghostly sort of way, creating a distraction.

- Also noted when using a Macintosh to view the 'check my timetable' page, the images that did drag created a series of lines across the page, which followed the path of their movement and which again created a distraction from the task at hand.

---

[5] American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV* (4th ed.). Washington: American Psychiatric Association.

To what extent do you agree or disagree with the following statements:
(Please tick your choice: 1 = Strongly Disagree; 5 = Strongly Agree)

1. The screen design is consistent throughout the site.

Strongly disagree **Strongly agree**

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Comments: ....

2. The layout of page headers is consistent throughout the site.

Strongly disagree **Strongly agree**

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Comments: ....

3. The positioning of the navigation buttons is consistent throughout the site.

Strongly disagree **Strongly agree**

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Comments: ....

4. It is clear what the navigation buttons at the bottom of the page are for.

Strongly disagree **Strongly agree**

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Comments: ....

5. The navigation buttons and links were always located where I expected.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

6. The explanation of the navigation buttons on the "Home page" was helpful.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

7. The size of the navigation buttons makes them easy to select when using the mouse.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

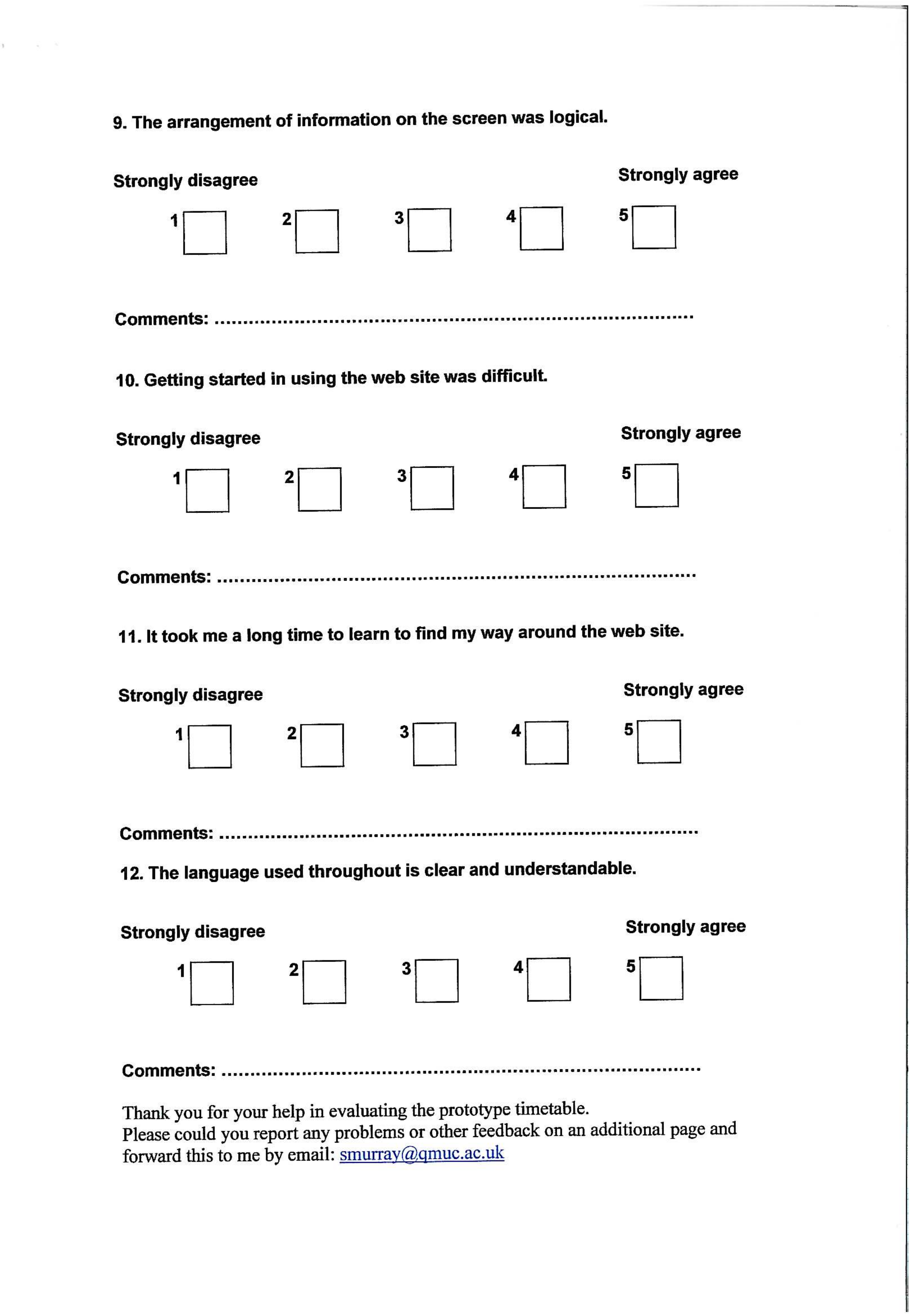
Comments: ....

8. I was able to apply my existing knowledge of web pages to using this application.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....



9. The arrangement of information on the screen was logical.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

10. Getting started in using the web site was difficult.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

11. It took me a long time to learn to find my way around the web site.

Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

12. The language used throughout is clear and understandable.

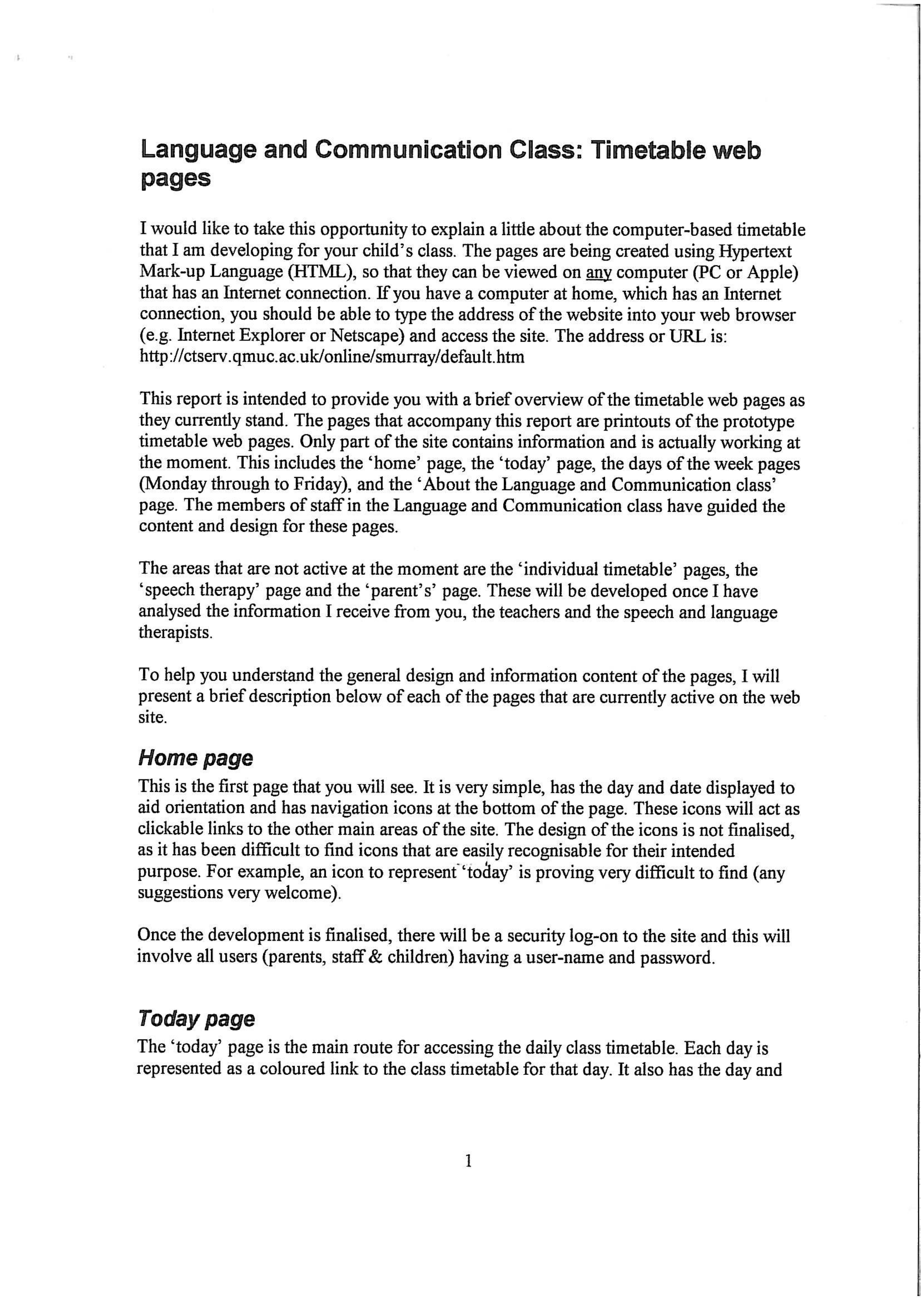
Strongly disagree **Strongly agree**

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐

Comments: ....

Thank you for your help in evaluating the prototype timetable.
Please could you report any problems or other feedback on an additional page and forward this to me by email: smurray@qmuc.ac.uk

Appendix 29: Example of progress report



Language and Communication Class: Timetable web pages

I would like to take this opportunity to explain a little about the computer-based timetable that I am developing for your child's class. The pages are being created using Hypertext Mark-up Language (HTML), so that they can be viewed on <u>any</u> computer (PC or Apple) that has an Internet connection. If you have a computer at home, which has an Internet connection, you should be able to type the address of the website into your web browser (e.g. Internet Explorer or Netscape) and access the site. The address or URL is: http://ctserv.qmuc.ac.uk/online/smurray/default.htm

This report is intended to provide you with a brief overview of the timetable web pages as they currently stand. The pages that accompany this report are printouts of the prototype timetable web pages. Only part of the site contains information and is actually working at the moment. This includes the 'home' page, the 'today' page, the days of the week pages (Monday through to Friday), and the 'About the Language and Communication class' page. The members of staff in the Language and Communication class have guided the content and design for these pages.

The areas that are not active at the moment are the 'individual timetable' pages, the 'speech therapy' page and the 'parent's' page. These will be developed once I have analysed the information I receive from you, the teachers and the speech and language therapists.

To help you understand the general design and information content of the pages, I will present a brief description below of each of the pages that are currently active on the web site.

Home page

This is the first page that you will see. It is very simple, has the day and date displayed to aid orientation and has navigation icons at the bottom of the page. These icons will act as clickable links to the other main areas of the site. The design of the icons is not finalised, as it has been difficult to find icons that are easily recognisable for their intended purpose. For example, an icon to represent 'today' is proving very difficult to find (any suggestions very welcome).

Once the development is finalised, there will be a security log-on to the site and this will involve all users (parents, staff & children) having a user-name and password.

Today page

The 'today' page is the main route for accessing the daily class timetable. Each day is represented as a coloured link to the class timetable for that day. It also has the day and date at the top of the page, which changes automatically to the correct day. Again this is intended to aid orientation and remind the children which day it is.

Saturday and Sunday have been included at the teachers' request and the format of these two pages is still to be decided. Ideas and suggestions from you are very welcome.

The navigation icons appear again at the foot of the page. These are different from the ones on the 'home' page, to demonstrate other ideas for the icons.

Special days page

There is a link to a 'special days' page at the bottom of the 'today' page. This page will have symbols or photographs of special days such as birthday parties, Christmas, Guy Fawkes Night, and Halloween etc. The children could then use this resource to help remind themselves of special days which occur infrequently.

Rewards page

There is a clickable link to the 'rewards' page; shown by a star symbol and this can be found at the bottom of the 'today' page and also at the bottom of each of the days of the week pages. The format is not finalised for this page, but it is likely to show symbols of the types of rewards that the children can expect daily and weekly. For example, for daily rewards it might have symbols of activities that the children enjoy such as games, construction or cooking, while weekly rewards might be symbols of trips etc. It has also been suggested that photographs of the children might be used on this page, such as those taken at

Monday page

This page is reached by following the coloured 'Monday' link on the 'today' page. The page is set out to display the class timetable for that day and uses the Boardmaker™ symbols that the children are used to seeing in class. Words are also included to explain the symbol.

The activities are set out in rows, with a maximum of 5 or 6 activities per row. This is so that the activities can be seen at a glance, without the need for scrolling sideways. The symbols should fit on your computer screen width-wise (if there is a problem please let me know). As the day progresses, the children will need to scroll down the page to see the activities.

Some of the activities are clickable links and if followed will take the children to a breakdown of that particular activity. For example, if you were to hold the mouse cursor over 'Action heroes' and click, it would take you to a page called 'Action heroes' and on this page there is set out the steps that would happen during this activity at school. The activity is set out with a number, symbol and words to explain what is happening.

At the foot of the 'Monday' page there is a link to the 'reward' page, links to each day of the week, a button for going to 'yesterday' and 'tomorrow' and also the general navigation icons that are present on every page.

All of the days of the week pages (Monday through to Friday) follow this same format.

Saturday & Sunday pages

The format for these pages is not finalised.
Ideas & suggestions very welcome!

Speech Therapy page

This area will begin development soon, and the speech and language therapists will guide the ideas for content and design.

Parent's page

This is intended to be an area to provide information for you, the parents. Content will be guided by the information and feedback that I receive from you in the questionnaires. Remember, any suggestions and comments that you can contribute to this will be very useful and will help me to develop an area that will hopefully be useful to you.

About the Language and Communication class page

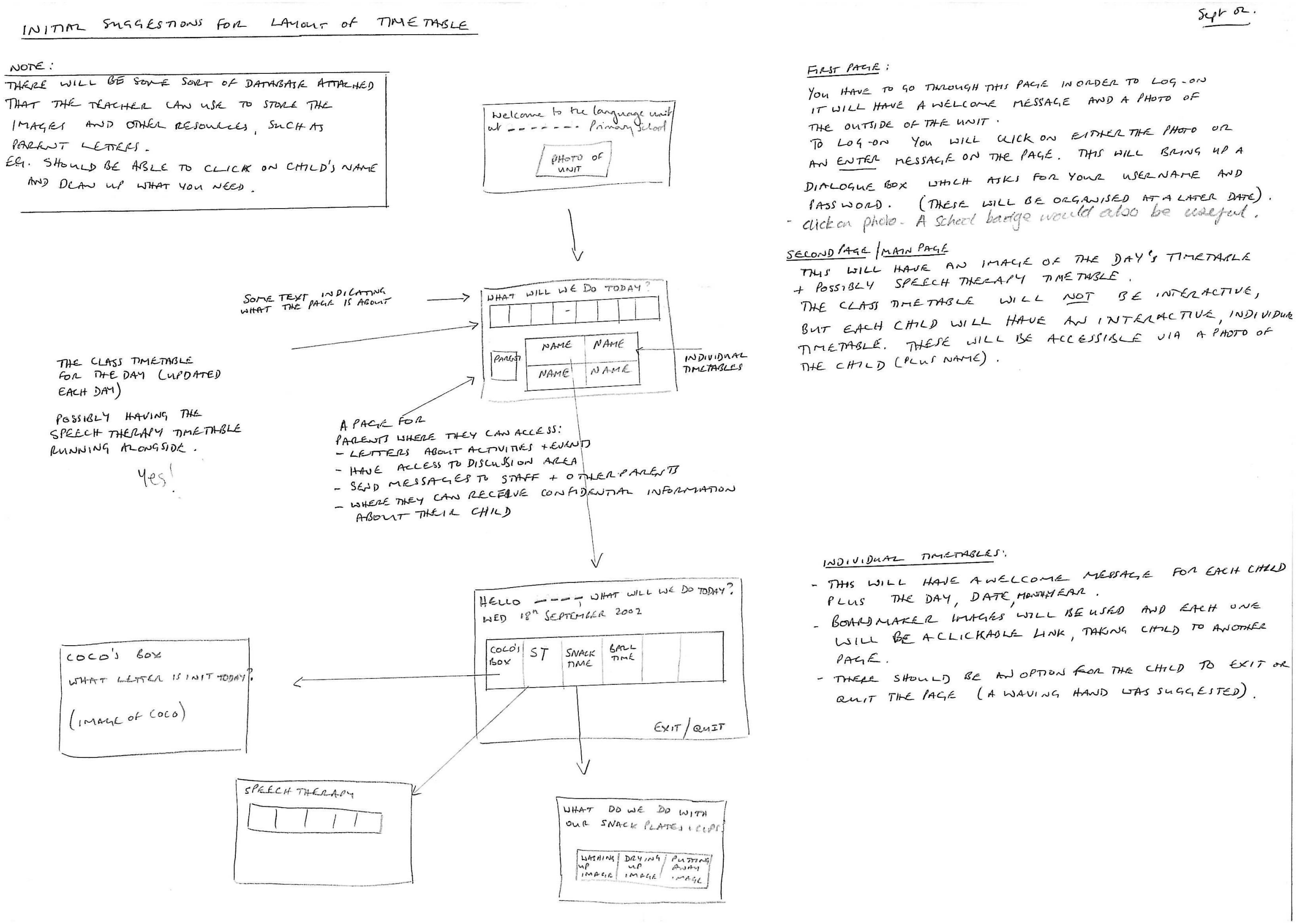
This page is really intended to provide general details about the unit, the staff and school hours etc. It is proposed that this page be a general area that visitors to the site, such as future parents or education workers could access (while all other areas would be restricted to those with usernames & passwords).

I hope this brief explanation has been useful in demonstrating what is happening with the development of the interactive timetable. If now that you have read this, you find that you have suggestions or comments to make, then please feel free to write them down and return them with the questionnaire in the stamp addressed envelope I have enclosed. Alternatively, you are very welcome to e-mail me at any time, if an idea occurs to you at a later stage, or if you have any questions to ask. My e-mail address is: smurray@qmuc.ac.uk

Thank you for taking time to read this report and for completing the questionnaire.

Susan J Murray
Research Student
School of Social Science, Media & Communication, Faculty of Health & Social Science
Queen Margaret University College, Clerwood Terrace, Edinburgh, EH12 8TS

Appendix 30: Paper model



INITIAL SUGGESTIONS FOR LAYOUT OF TIMETABLE

Sept 02.

NOTE:
THERE WILL BE SOME SORT OF DATABASE ATTACHED THAT THE TEACHER CAN USE TO STORE THE IMAGES AND OTHER RESOURCES, SUCH AS PARENT LETTERS.
EG. SHOULD BE ABLE TO CLICK ON CHILD'S NAME AND DRAW UP WHAT YOU NEED.

FIRST PAGE:
YOU HAVE TO GO THROUGH THIS PAGE IN ORDER TO LOG-ON IT WILL HAVE A WELCOME MESSAGE AND A PHOTO OF THE OUTSIDE OF THE UNIT.
TO LOG-ON YOU WILL CLICK ON EITHER THE PHOTO OR AN ENTER MESSAGE ON THE PAGE. THIS WILL BRING UP A DIALOGUE BOX WHICH ASKS FOR YOUR USERNAME AND PASSWORD. (THESE WILL BE ORGANISED AT A LATER DATE).
- click on photo - A School badge would also be useful.

SECOND PAGE / MAIN PAGE
THIS WILL HAVE AN IMAGE OF THE DAY'S TIMETABLE + POSSIBLY SPEECH THERAPY TIMETABLE.
THE CLASS TIMETABLE WILL NOT BE INTERACTIVE, BUT EACH CHILD WILL HAVE AN INTERACTIVE, INDIVIDUAL TIMETABLE. THESE WILL BE ACCESSIBLE VIA A PHOTO OF THE CHILD (PLUS NAME).

INDIVIDUAL TIMETABLES:
- THIS WILL HAVE A WELCOME MESSAGE FOR EACH CHILD PLUS THE DAY, DATE, MONTH YEAR.
- BOARDMAKER IMAGES WILL BE USED AND EACH ONE WILL BE A CLICKABLE LINK, TAKING CHILD TO ANOTHER PAGE.
- THERE SHOULD BE AN OPTION FOR THE CHILD TO EXIT OR QUIT THE PAGE (A WAVING HAND WAS SUGGESTED).

SOME TEXT INDICATING WHAT THE PAGE IS ABOUT

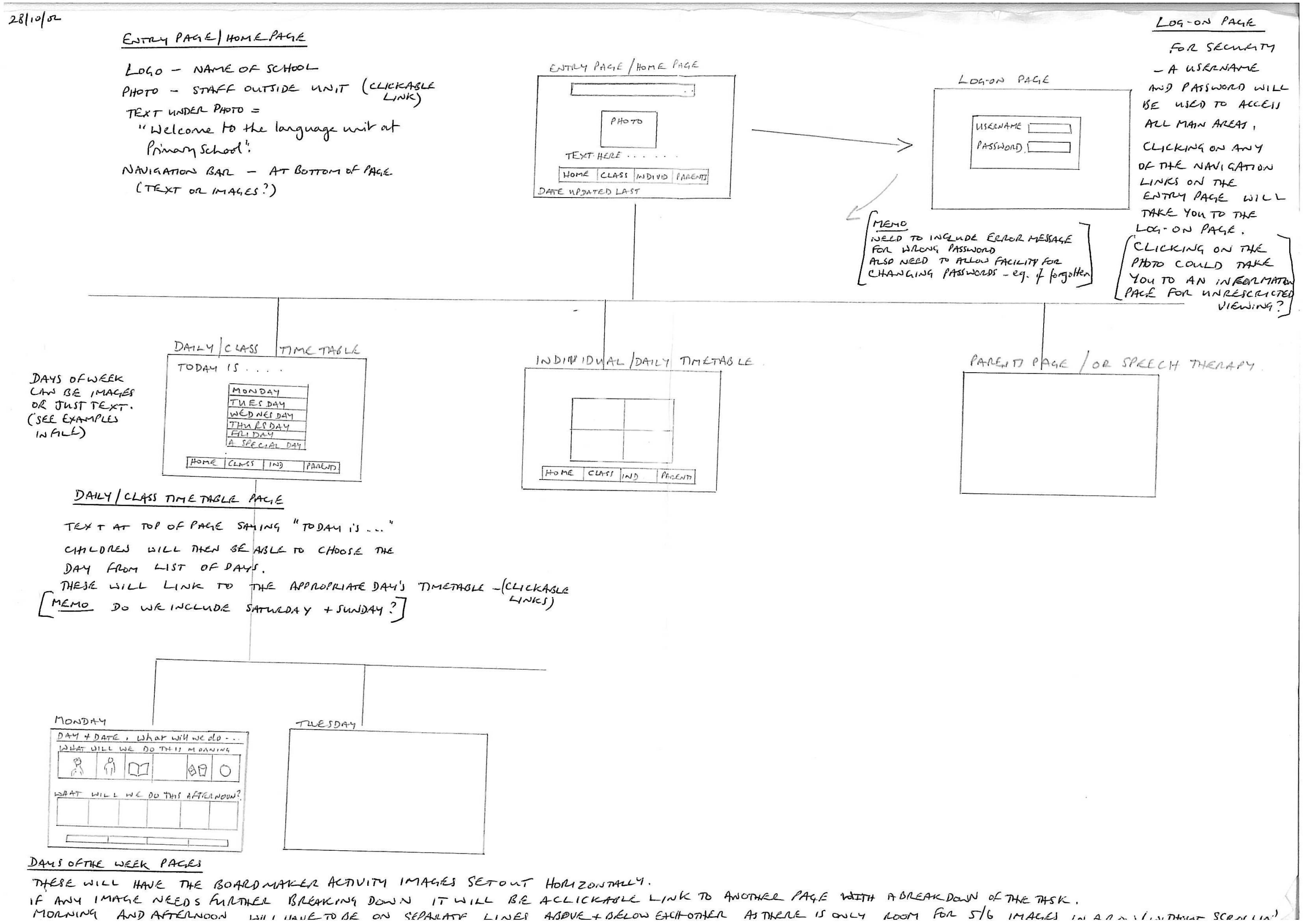
THE CLASS TIMETABLE FOR THE DAY (UPDATED EACH DAY)

POSSIBLY HAVING THE SPEECH THERAPY TIMETABLE RUNNING ALONGSIDE.

Yes!

A PAGE FOR PARENTS WHERE THEY CAN ACCESS:
- LETTERS ABOUT ACTIVITIES + EVENTS
- HAVE ACCESS TO DISCUSSION AREA
- SEND MESSAGES TO STAFF + OTHER PARENTS
- WHERE THEY CAN RECEIVE CONFIDENTIAL INFORMATION ABOUT THEIR CHILD

INDIVIDUAL TIMETABLES



28/10/02

ENTRY PAGE / HOME PAGE

LOGO – NAME OF SCHOOL
PHOTO – STAFF OUTSIDE UNIT (CLICKABLE LINK)
TEXT UNDER PHOTO =
"Welcome to the language unit at Primary School".
NAVIGATION BAR – AT BOTTOM OF PAGE (TEXT OR IMAGES?)

LOG-ON PAGE

FOR SECURITY – A USERNAME AND PASSWORD WILL BE USED TO ACCESS ALL MAIN AREAS,
CLICKING ON ANY OF THE NAVIGATION LINKS ON THE ENTRY PAGE WILL TAKE YOU TO THE LOG-ON PAGE.
[CLICKING ON THE PHOTO COULD TAKE YOU TO AN INFORMATION PAGE FOR UNRESTRICTED VIEWING?]

[MEMO
NEED TO INCLUDE ERROR MESSAGE FOR WRONG PASSWORD
ALSO NEED TO ALLOW FACILITY FOR CHANGING PASSWORDS – eg. if forgotten]

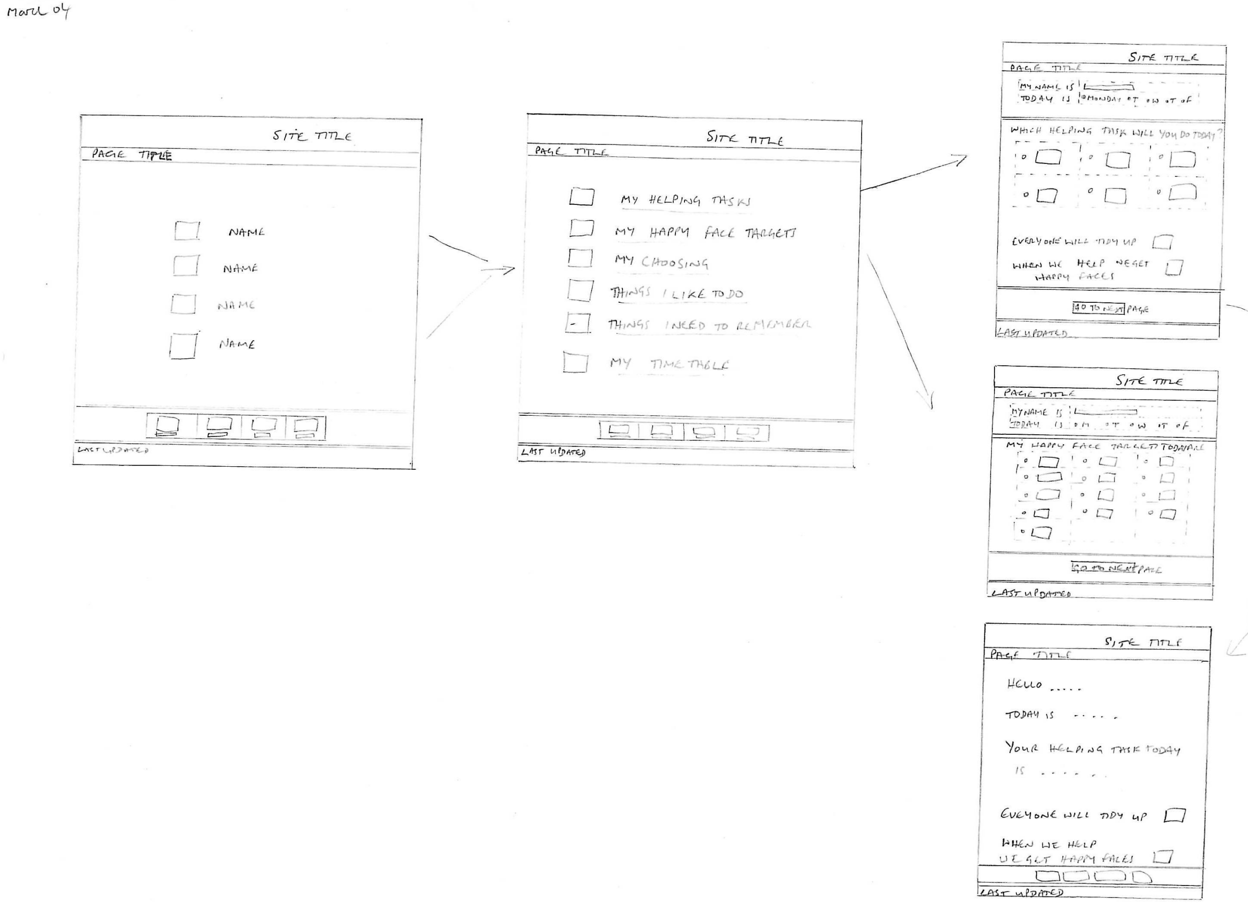
DAYS OF WEEK CAN BE IMAGES OR JUST TEXT. (SEE EXAMPLES IN FILE)

DAILY / CLASS TIMETABLE PAGE

TEXT AT TOP OF PAGE SAYING "TODAY IS . . ."
CHILDREN WILL THEN BE ABLE TO CHOOSE THE DAY FROM LIST OF DAYS.
THESE WILL LINK TO THE APPROPRIATE DAY'S TIMETABLE – (CLICKABLE LINKS)
[MEMO DO WE INCLUDE SATURDAY + SUNDAY?]

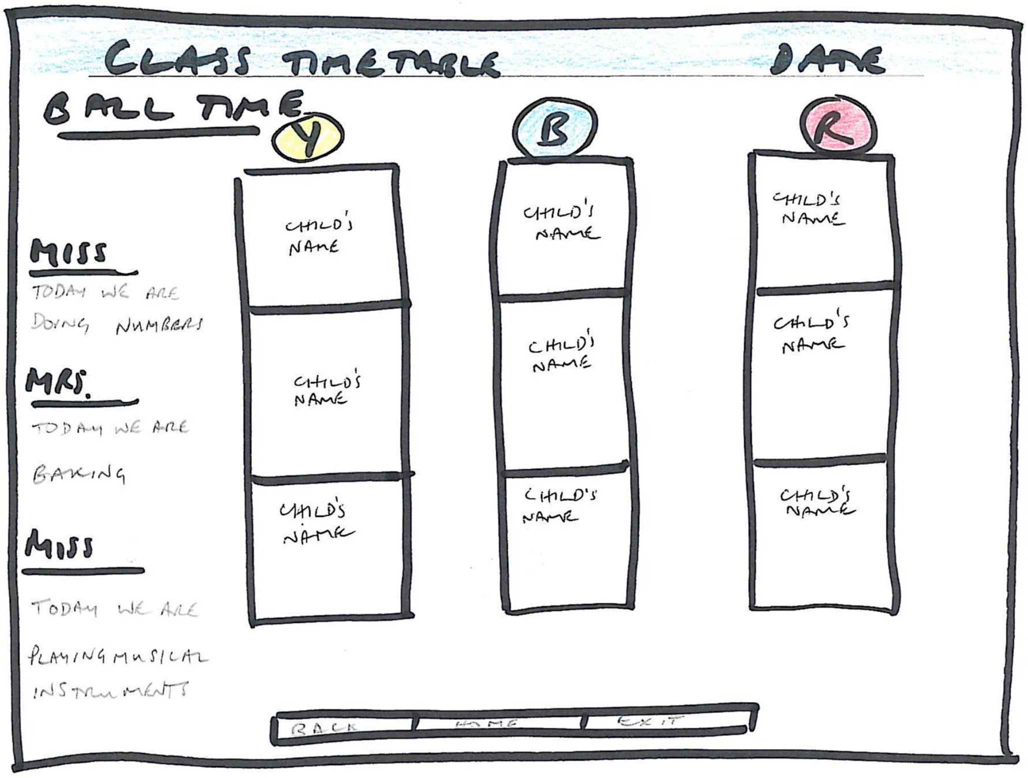
DAYS OF THE WEEK PAGES

THESE WILL HAVE THE BOARDMAKER ACTIVITY IMAGES SET OUT HORIZONTALLY.
IF ANY IMAGE NEEDS FURTHER BREAKING DOWN IT WILL BE A CLICKABLE LINK TO ANOTHER PAGE WITH A BREAKDOWN OF THE TASK.
MORNING AND AFTERNOON WILL HAVE TO BE ON SEPARATE LINES ABOVE + BELOW EACH OTHER AS THERE IS ONLY ROOM FOR 5/6 IMAGES IN A ROW (WITHOUT SCROLLING)

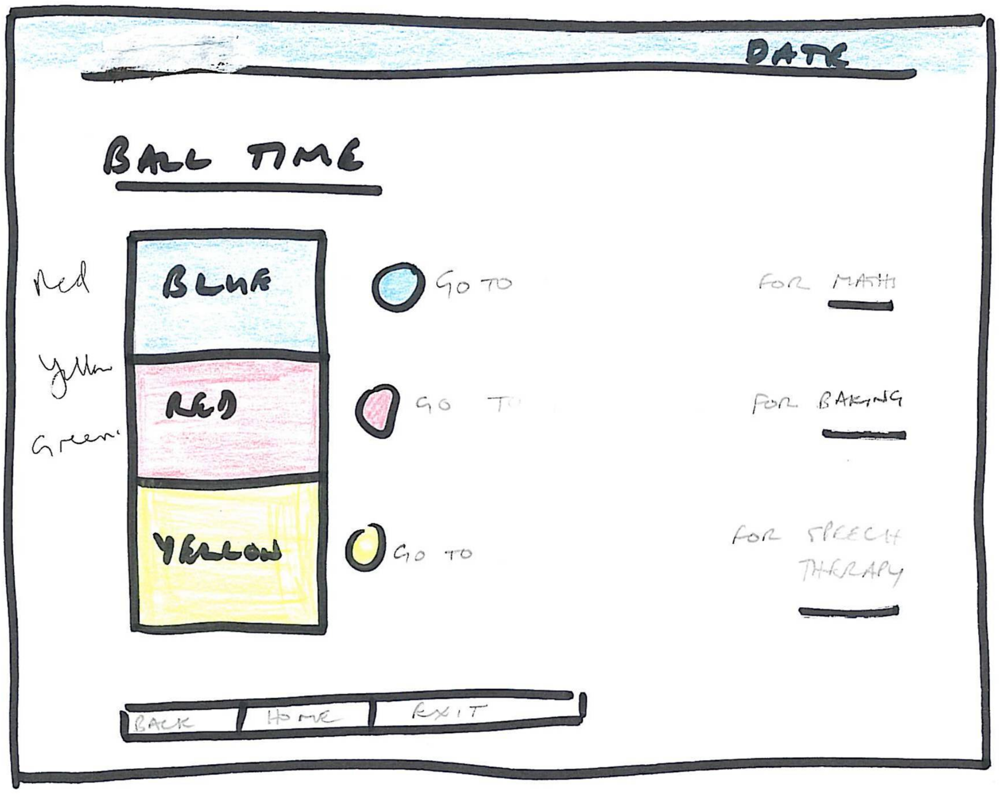

March 04
SITE TITLE
PAGE TITLE
NAME
NAME
NAME
NAME
LAST UPDATED
SITE TITLE
PAGE TITLE
MY HELPING TASKS
MY HAPPY FACE TARGETS
MY CHOOSING
THINGS I LIKE TO DO
THINGS I NEED TO REMEMBER
MY TIME TABLE
LAST UPDATED
SITE TITLE
PAGE TITLE
MY NAME IS
TODAY IS MONDAY
WHICH HELPING TASK WILL YOU DO TODAY?
EVERYONE WILL TIDY UP
WHEN WE HELP WE GET HAPPY FACES
GO TO NEXT PAGE
LAST UPDATED
SITE TITLE
PAGE TITLE
MY NAME IS
TODAY IS
MY HAPPY FACE TARGETS TODAY ARE
GO TO NEXT PAGE
LAST UPDATED
SITE TITLE
PAGE TITLE
HELLO .....
TODAY IS .....
YOUR HELPING TASK TODAY IS ......
EVEYONE WILL TIDY UP
WHEN WE HELP WE GET HAPPY FACES
LAST UPDATED

Appendix 31 Storyboard

EXAMPLE OF LINK

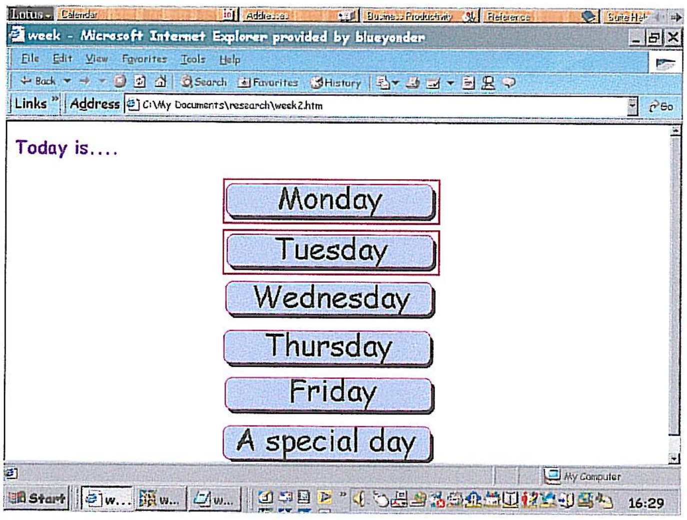


INDIVIDUAL TIMETABLE

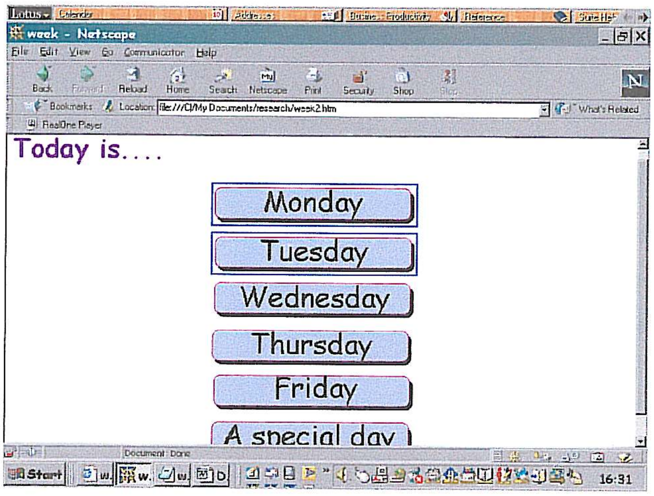


4

Example/week2.htm: showing different images as buttons which can be used to navigate to next level of timetable.
Viewed in Internet Explorer version 5.0 and Netscape version 4.7.

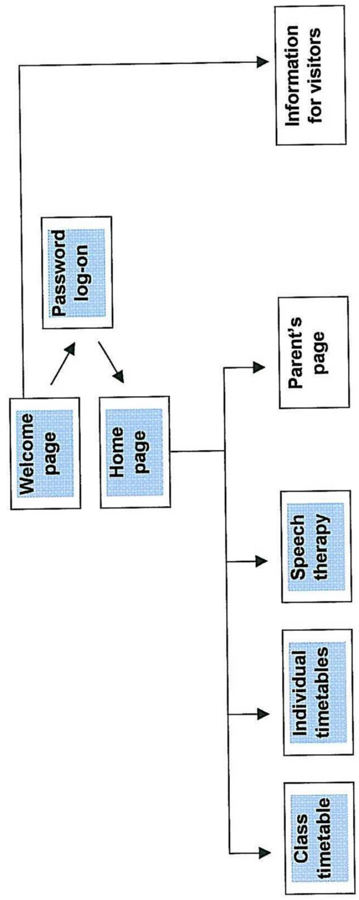


Today is....



Today is....

Appendix 32: Interactive timetable structure

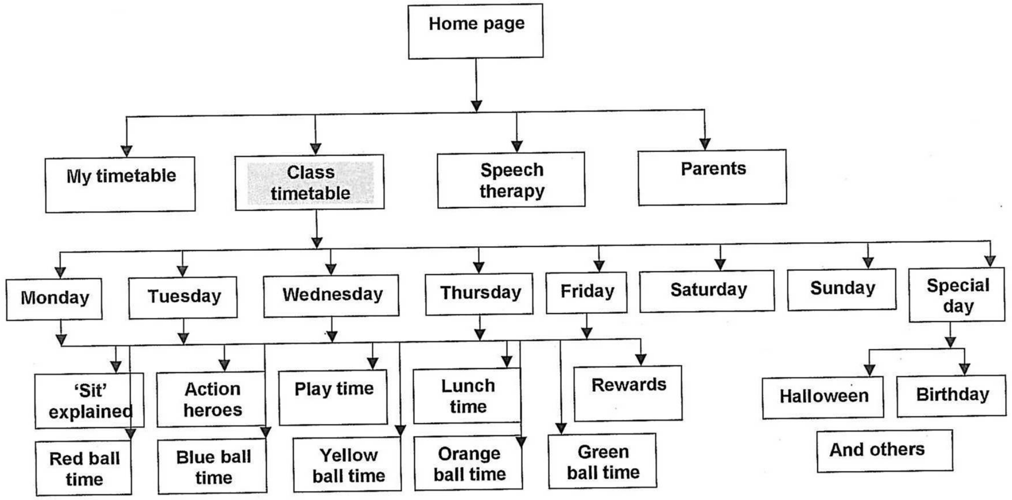


Demonstrating first level hierarchy of timetable web pages

Note: Blue indicates areas accessible to the children only

Structure of ‘Class timetable’ page –‘ timetable

(Revised September 2003)



C:\My Documents\research\web_pages\todayStructure.doc
Last printed 09/10/2003 13:06

Appendix 33: Login instructions

1. Introduction

The information presented here is a step-by-step guide to using the Language and Communication Class (LCC) computer-based, interactive timetable application. For ease this will be referred to throughout this document as the LCC interactive timetable. This guide aims to assist those that are new to the interactive timetable and also to provide a point of reference for those already accustomed to using it.

2. Background information

The LCC interactive timetable was created as part of a research study, with the intention of exploring the possibilities a computer-based, interactive timetable has to offer primary school children with high-functioning autistic spectrum disorders. The study began in September 2001 and is due for completion at the end of 2004.

The LCC interactive timetable that you see is a prototype, which means that it is a functional system, displaying examples of most areas of a proposed final product. However, the system requires further use and assessment by all levels of user to ensure that it meets their needs and that it is working as expected. It is anticipated that the findings of these evaluations will help guide the development of a general system capable of widespread use.

The LCC interactive timetable was developed in collaboration with staff members and through consultation with parents of children attending the class and it aims to follow a similar format to the visual, wall-based timetable currently used by the children in the classroom.

The LCC interactive timetable:

- ✓ Uses familiar Boardmaker symbols
- ✓ Uses text and symbols together to assist literacy
- ✓ Displays information sequentially
- ✓ Includes supporting materials where possible

The LCC interactive timetable also aims to provide additional features:

- ✓ It should be accessible from any computer with an Internet connection - making it is possible to use it at home
- ✓ Children should be able to adapt their own individual timetable for use in the classroom
- ✓ Supportive material such as explanations of activities and events will be included - allowing children to remind themselves of specific activities
- ✓ It is planned that a variety of information will be available to parents via the LCC interactive timetable

3. Technical background

The LCC interactive timetable was created in Extensible HyperText Markup Language (XHTML™), a successor of Hypertext Mark-up language (HTML), which is used for publishing hypertext on the World Wide Web. The dynamic nature of the application is produced through the use of Active Server Pages and connection to a back-end database.

4. Accessing the interactive timetable website

For the duration of this study the LCC interactive timetable can be accessed from any computer with an Internet connection, using the following address: http://ctserv.qmuc.ac.uk/online/smurray/timetable/default.asp

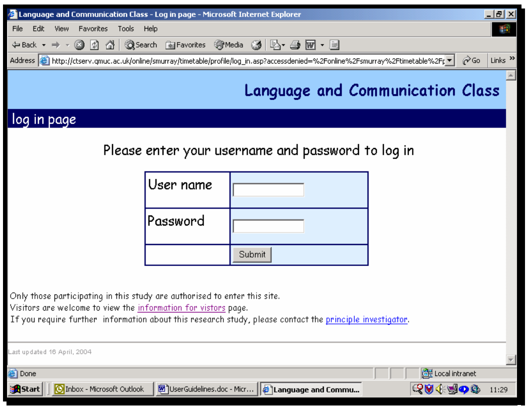
Note: As you will be visiting this page quite often, you may wish to 'bookmark' it or add it to your 'favourites'.

You do not require any special software to use the LCC interactive timetable, just a web browser (e.g. Internet Explorer or Netscape Navigator).

5. Log in page

Due to the need to protect the privacy of those involved in this study, a security set-up is in operation and access within the site is restricted to those participating in the study.

What this means is that when you move from the 'welcome' page to the 'home page' using the 'home page' navigation symbol, a username and password dialogue box will appear, just like the one shown below:



Language and Communication Class

log in page

Please enter your username and password to log in

User name

Password

Only those participating in this study are authorised to enter this site.
Visitors are welcome to view the information for vistors page.
If you require further information about this research study, please contact the principle investigator.

Last updated 16 April, 2004

Fig 1: screen shot of the log-in page

You should have been sent details of your username and password to use with this log-in page, but should you lose these, or experience difficulty in using the log-in page at any time, please contact the principle investigator, Sue Murray at: smurray@qmuc.ac.uk

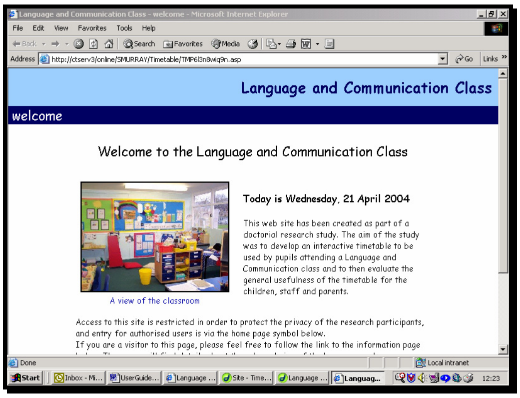
Note: It is important to remember that the username and password are both set in lowercase (e.g. msmith)

6. Areas of the interactive timetable

A brief description of each of the areas of the LCC interactive timetable will now be given. The areas include: 'welcome' page, 'home page', 'my timetable' page, 'class timetable' page, 'speech therapy' page, 'parent's page', 'information' page, and links to additional areas such as 'administration', 'comments', 'questionnaire', 'site map' and 'user guide'.

6.1 Welcome page

The 'welcome' page is the main entry page for the LCC interactive timetable. Access to the rest of the site is restricted to those involved in the study. There is however, an 'information' page, which allows open access to any visitors.



Language and Communication Class

welcome

Welcome to the Language and Communication Class

A view of the classroom

Today is Wednesday, 21 April 2004

This web site has been created as part of a doctorial research study. The aim of the study was to develop an interactive timetable to be used by pupils attending a Language and Communication class and to then evaluate the general usefulness of the timetable for the children, staff and parents.

Access to this site is restricted in order to protect the privacy of the research participants, and entry for authorised users is via the home page symbol below.
If you are a visitor to this page, please feel free to follow the link to the information page

Fig. 2: Screen shot of the 'welcome' page

There are two links at the bottom of the 'welcome' page:

A link to the 'home' page, which provides access to all areas of the site once you have logged in.

A link to the 'information' page may be accessed by anyone, without restriction.

6.2 Home page
The 'home' page provides access to all areas of the LCC interactive timetable. You can only view this page once you have logged in with your username and password.

Note: Once you close your browser you are effectively logging off and will need to submit username and password details again to gain entry.

To access other areas from the 'home' page, use the grey symbols on the left side of the page (see screenshot below).

Appendix 34: Security options review

Issues relating to development of the interactive interface

---

1. Introduction

During the development stage of the interactive interface several issues or problems have arisen as a result of the need to fulfil certain functions or tasks. The main areas of concern are security, maintenance and being able to allow the children to personalise their own timetable.

2. Security

It is acknowledged that the web-based timetable needs to have restricted access for several reasons.

- The privacy of the users needs to be protected from outside sources
- The Boardmaker symbols need to be protected from the risk of being copied by unauthorised users
- The areas accessible by the children should be limited to avoid the possibility of distraction from the task in hand
- To grant permissions for different levels of use e.g. teacher needs to have full access to allow her to make changes, but parents and children need limited access

There are several solutions for securing access to the server:

2.1 Internet Protocol address restrictions

This is a check that can be performed to see whether the person connecting to the server is using an IP address that you have allowed access (Wille & Koller, 1999). It means that the web administrator has the option of deciding on which specified computers are allowed access to the site. The reverse is also possible, in that any computer can be allowed to access the web site, apart from specified IP addresses (Wille & Koller, 1999). To set up IP address restrictions, the Properties dialog box of the web site is used.

The main problem with this option is that the web administrator would need to know all the IP addresses of all users. This could be simple enough to organise with regard to the classroom computer, but would be more difficult to set up for home use. In particular, children may use computers not just at home, but at a friend's or relative's house and in that case would not be able to access the site.

Another difficulty may be that the web administrator does not have access to the properties dialogue box and may have to rely on the server administrator's cooperation in setting this option up.

2.2 User authentication

This involves authentication with the server, by supplying a username and password (Wille & Koller, 1999).
There are three methods of authentication:

- Basic authentication: enforced if anonymous connections are disallowed. Username and password sent in clear text across the Internet (Wille & Koller, 1999).
- Windows NT challenge/response: username and password not transmitted across the Internet, but are challenged by the web server (Wille & Koller, 1999). A valid response is then sent provided the username and password is recognised (Wille & Koller, 1999).

Only available for Internet Explorer.

- Client certificates: contain user information and cryptographic key (Wille & Koller, 1999).

These options are possible if the site maintainer has permission to access the authentication methods dialogue box. In the current situation this is not possible and the server administrator is not willing to set up authentication in this way.

2.3 IIS directory permissions

It is possible to set up access control and content control for the web directories (Wille & Koller, 1999). To do this it must be possible to access the web site properties dialogue box.

2.4 NTFS directory and file permissions

These are permissions that can be set on a per-file basis on a NTFS drive (Wille & Koller, 1999). For example it is possible to restrict access to teachers only, or deny access specifically for visitors.

This would be very useful if the web administrator had permission to access the file server, but this may not be an option.

2.5 Other options

2.5.1 Use a simple gatekeeper script

The password for this password protection script isn't actually in the code; it's just the filename of the protected page without the .html ending. For example, if your protected file were called 'secret.html' the password would be 'secret' (without quotes). Also, make sure that that you have an 'index.html' page on your site, to prevent people from defeating this script by getting your directory listing.

2.5.2 Use Asp and database on the server

2.5.3 Using forms-based authentication

This is a fairly simple process requiring no administrative access to the web server (Buyens, 2002). Buyens (2002) explains how this can be set up using a folder scheme whereby either the entire application is protected except for one folder, or only one folder in the application is protected (Buyens, 2002). A web.config file needs to be created to activate forms-based authentication and which specifies the areas to protect as well as specifying the name of the logon page (Buyens, 2002).

3. Maintenance

Following investigations into the task functions of the timetable it has been recognised that the teacher and possibly other members of staff would need to be able to make changes to the timetable and to be able to add new material.

3.1 Areas expected to require frequent changing

The following files are likely to require being constantly changed by the teacher or by other members of staff:

- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Parents page
- Information for visitors page
- Speech and language therapy pages (Monday, Tuesday, Wednesday)
- It may be necessary to change the activity pages at some stage, but this would most likely require the whole page to be updated.

3.2 Possible methods for facilitating changes in the timetable

The symbols that make up the daily timetable may require changing on many occasions and so it is important to provide the teacher with a user-friendly way of selecting different symbols and replacing the symbol currently on display. Various options for allowing changes to be made have been considered and it is essential that the following criteria for making changes to the timetable are considered.

Changes must be able to be made:

- Quickly
- Easily
- From any computer
- Only by authorised persons

3.2.1 Menu selectors

One possible method to use is a drop-down or pop-up menu, which offers a selection of choices. Many users are accustomed to using this style of selection menu either from using word processing packages or from using the Internet and this is, therefore, considered a strong option for providing a way to access the symbols.

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