A Computer-Based Story Builder for Children with Autism

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Abstract—This paper discusses a story builder shell- a computer system designed to make it easy for parents and carers of young people with autism to write “stories” that might help the people in their care. User centered design was adopted in the development process which involves specialized teachers for autistic children from the local schools at York. The user-based evaluations of the software provide positive evidence for the usability and acceptability of the software and shed light for the future development of such software.

Keywords— social stories; autism; story-builder software; computer based learning

I. INTRODUCTION

Autism is one of the autism spectrum disorders (ASD) under the DSM-V classification. It is a lifelong disorder, characterised by delay and impairment of a person's development, mainly centred on social interaction and communication disorders, as well as behaviour [1]. The difficulties with social interaction include limited use of body language or facial expressions, inability to develop relationships with peers, and a lack of emotional understanding and empathy. The communication problem involves slow development of verbal language skills, reluctance to start or maintain conversations, inflexible or repetitive use of language, and an unwillingness to engage in social play. The trait of behavioural impairment concerns fixed or repetitive patterns including abnormal preoccupation with an object or activity, repetitive muscle movements, and persistent adherence to routines [2]. People with autism often need support to develop communication skills and interact with other people. The chief concern of this paper is to investigate suitable means for autistic children to develop their social interaction skills.

One of the means is to use social stories. Social stories are short stories describing situations or concepts in a format that is meaningful for people with developmental disorders. These stories focus on the social and emotional implications of a situation. They are usually based on the child's daily experiences and situations that are familiar to them. Social stories help people with developmental disorders to “navigate” a situation which they find difficult to manage [3]. The characteristic difficulties with empathy and social interaction experienced by autistic children make social stories an appealing tool.

Social stories can take many forms - booklets, flashcards, posters and video- and audio-based media have all been employed. The appeal of an interactive medium for social stories is clear – it initiates a two-way process by which the child can contribute to and learn from the stories. The effectiveness of social stories as a learning mechanism for children is supported mostly by anecdotal evidence, though there have been formal studies, e.g. in [4], [5]. The studies reveal that the use of social stories appeared to have an impact on the reduction of negative social behaviours and promoting positive ones. The studies also suggest the importance of tailoring the social stories according to children’s individual needs, interests and learning style, for example, using the picture of their favourite cartoon character.

Recently there has been a considerable amount of research interest in the use of computer based learning (CBL) approach with people with autism. This is based partly on the belief that education is central to improving the lives of people with autism and partly on a belief in the benefits of CBL for people with autism. Many people with autism appear to have a natural affinity for computers and the controlled environment provided by the computer, and they may benefit from the individualised tutoring and repetition of exercises that a computer allows. This paper concerns issues in the development of suitable social story software for autistic people to help them with their social interaction skills. The remainder of this paper is organised as follows. Section 2 discusses the recent development of software for autistic children and argues the need of the story-builder software shell. Section 3 documents the story-builder software that has been built at York. Section 4 discusses the user-based evaluation of the software concerning its usability and acceptability.

II. THE NEED OF STORY BUILDER SOFTWARE

There has been an increasing use of technology to help people with autism [6]. For example, Stone Mountain Software by Windows [7] and Face Say by Symbionica [8] have been designed for autistic people who have difficulties in understanding mental states of themselves and others. This software teaches them to recognize facial expressions and
emotions which lead to a better social interaction. Another type of software called Autism Packages [9], created by Laureate Learning Systems, helps autistic people to develop their language skills and enhance their vocabulary set. This is achieved through various different games. There are also software programs which focus on classification and abstraction of activities and timing. They work in the same concepts as those used in low-technology activity schedules or timetables. For example, Picture Planner developed by Cognitopia Software [10] allows a user to create visual calendars using their own pictures and then print them or share with others through different applications. Further, programs like Bloomkids.com [11] provide a variety of learning games which were created to help autistic children develop different skills such as naming, telling dates, reading, vocabulary, language and computer use training.

Social stories have been used in different computer programs for autistic children in different contexts. For example Social Skill Builder [12] uses real-life video and requires child interaction in order to understand and gain social skills. This software offers a game-like atmosphere with readily prepared simulations of everyday social situations. The other social story software is provided by Judy Lynn Software [13]. It strongly reminds the diary or photograph journal for children’s use. They can choose what kind of “story book” they would like to create and then choose what should go into the “book” from the available small stories with pictures. Teacher or parents are able to create the templates for these books.

There are also a number of arguments for using technology to help autistic people. Many children with ASD appear to have a natural affinity for computers. People with autism tend to avoid eye contact. Within a computer-based environment, they can learn social interactions without the fear of difficulties involved in face-to-face interaction [3], [14]. The use of computers with autistic children in a teaching environment can lead to increase in focused attention, in-seat behaviour and better motor skills [15]. In addition, the use of software programs provides researchers and clinicians with opportunities to conduct repetitive learning trials in an identical or similar format, and thus help them to achieve better results. Further, teachers and parents can control the computer environment, give children the necessary cues and allow children to think and learn at their own pace.

There are, however, at least two possible drawbacks with the use of CBL for people with autism. One is that the computer may be so appealing to them that it ‘colludes’ with their autism by making them more obsessive and less interested in communicating with other people. This potential drawback can perhaps be overcome by incorporating real-world social interaction, the child using the computer alongside a parent, support worker or other children. The other drawback is that most CBL systems aimed at helping with social skills education use a small selection of generic social scenarios. They are unlikely therefore to be in line with the different needs and interests of individual people with autism. It is this concern that led us to design and build a “shell” system designed to make it easy for parents and teachers to create their own individualised computerised stories as learning materials for their children. Because of the widely varying nature of people with autism, and also the infinite number of different social situations children may find themselves in, we argue that children with autism may benefit from a program which may be individualised to their own particular needs. By providing a means for the child’s parent or carer to design the materials themselves, via the “shell”, they would be able to tailor the materials for the person in their care, using their own specialist knowledge of the child’s abilities and needs.

The shell may be considered as similar to a word processor, but whereas a word processor allows the user to assemble and edit written documents, the shell may be used to create computerised stories. It may also be thought of as similar to a ‘wizard’ (such as is provided by some Microsoft applications), in that the shell would guide the user through the necessary steps to build a computerised story. The shell we believe gives the flexibility to present a wide variety of social situations. It also enables the parents or teachers to demonstrate the subtle differences between seemingly similar social scenarios by perhaps writing a set of similar but different stories to cover the various eventualities. It also allows stories or routines to be written which are specific to an individual child, and therefore absolutely appropriate for him or her.

III. STORY-.newBuilder SHELL

The story-builder shell has been built using Java and xml technologies [16]. An overview of the software is shown in Fig. 1 below. It contains the story builder software program and an XML file where the data is saved. The program is composed of four main components Supervisor, Story, Child and Main. The software is available for a user on a workstation with latest version of JDK, and does not need an Internet connection. The overall functionalities of the story-builder software are documented in the use case diagram in Fig. 2.

There are two types of primary users of the intended software: teacher/parent and autistic child. For a teacher or parent, there is an option to register as a new user, protected by a password or log on as an existing user. Then the user is able to choose from the following activities: read guidelines for creating a story, write a new story from scratch, or edit a story they wrote earlier (see Fig. 3).

![Fig. 1. Story-builder software overview](image-url)
To write or edit stories, users can add, delete or edit pages and change the order of pages within a story. A user is also able to set the name, select background colour and font for a story, choose the feedback option, preview the story and finally add the children who can read the story (see Fig. 4).

A page in a story can include a sentence, a picture and a sound. To add a new page, the user can write a fresh sentence or select from the bank of sample sentences (see Fig. 5). A picture and a sound can be imported from a prescribed library or a folder of the user’s choice. The picture library offered by Widget - “Communicate: in print” is used as all special schools at York use it. Using familiar pictures in different software might help children to get used to the system easier.

Guidelines on how to create the story are available prior to and during the writing of a story. A story can be saved for further editing or when it is complete. Gradually they will build up a bank of stories. To use a story with their child, they can choose from the available stories then either run it on the computer (see Fig. 6) or print it out. At the end of the reading of a story, feedback can be collected concerning the user’s feeling of reading the story (see Fig. 7).
The story-builder software shell has been evaluated at different stages of its development [16]. An initial design was drawn up, based on literature concerning CBL for social skills education, the previous version story builder software [17] and interviews with a Senior Practitioner for ASC (teaching a number of children with autism) at the York City Council, in the shape of a series of storyboards. This design was evaluated by the Senior Practitioner and feedback was used to inform the development of the first software prototype of the story builder.

This prototype then underwent a usability evaluation, with 4 people performing the “heuristic evaluation” technique. The outcome from this informed amendments to the next prototype (the current version of the software). This was then taken to a set of three specialised teachers of children with autism, for further evaluation, to assess the shell’s usability and acceptability with the target audience. Two teachers conducted cooperative evaluations in a controlled environment, while the third evaluated the shell on her own at her convenient time. Participants were asked to perform the following tasks: create a new child user, create a new adult user, create a new story, modify a newly created story, and read a newly created story from a child profile. Each evaluation took around an hour. At the final stage of each evaluation, a System Usability Scale (SUS) questionnaire was filled and collected.

The overall response to the system was very positive. The users learnt to use all the functionalities in less than 10 minutes, and they find the software is easy and intuitive to use. They particularly like the feature of “bank of sample sentences” argue it being a good way to help parents to create a story. They are also appreciated with the use of pictures from Widget. The average SUS satisfaction score of the “Story Builder” is 73.16, well above the average of 68, which affirms the usability of the software.

Participants said the best thing about this program is its instant results. They thought the tool enables them to write the sort of stories they wanted and the autistic children would want to use the stories written with the shell. Participants in the evaluation suggested other uses for the shell as well as writing stories, such as creating timetables or schedules. It was also suggested that children could use it to keep a diary, and one of the teachers proposed using it for literacy work at school, as a “writing framework”.

The evaluations brought to light some additional features and enhancements that could usefully be made to the shell. One enhancement that might be particularly useful would be the addition of question pages, which would enable stories to be written that present children with choices and then show the consequences of the choice they make. A further enhancement would be to incorporate text editing, formatting and automatic spelling check facilities to assist users writing story text. The participants also suggest incorporating “computer read a story”. They argue that a computer voice could allow children to concentrate more on the story reading and for children who are not able to read yet can still follow the stories by listening and looking at provided pictures. They further argue that this provision could help some autistic children match words with sounds. And finally, stories in the current story-builder shell can only be read on a computer screen. Teachers may wish to share the stories with parents and children might want to put that story in their diary books. Thus, it is ideal that the shell provides facilities to transform the story into a .pdf format or print the story on paper.

V. CONCLUSION

A story-builder software shell has been iteratively built via user centered design, with the involvements of specialized teachers from local schools at York. The current version of the shell is fully functional, and we hope that, as our evaluation data suggests, parents and teachers will find it a useful tool to enable them to write stories for the specific interest and needs of their children.

As well as catering for the possible enhancements suggested by the user evaluations with the specialised teachers, we are planning to conduct user-based evaluations with the autistic children. The evaluations may be conducted at different stages, e.g. no social story intervention, with social story intervention and follow-up with social stories stopped for a certain period, and then compare the behaviours of the participants. We are also planning to incorporate dialogue interactions (e.g. [18-20]), one enhancement that might be particularly useful would be the addition of question pages, which would enable stories to be written that present children with choices and then show the consequences of the choice they make.

REFERENCES


