IDEAS: An Interface Design Experience for the Autistic Spectrum

Laura Benton
Department of Computer Science.
University of Bath.
Bath, BA2 7AY UK
L.J.Benton@bath.ac.uk

Emma Ashwin
Department of Psychology.
University of Bath.
Bath, BA2 7AY UK
E.L.Ashwin@bath.ac.uk

Hilary Johnson
Department of Computer Science.
University of Bath.
Bath, BA2 7AY UK
H.Johnson@bath.ac.uk

Beate Grawemeyer
Department of Computer Science.
University of Bath.
Bath, BA2 7AY UK
B.Grawemeyer@bath.ac.uk

Mark Brosnan
Department of Psychology.
University of Bath.
Bath, BA2 7AY UK
M.J.Brosnan@bath.ac.uk

CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.
ACM 978-1-4503-0268-5/11/05.

Abstract
Designing products and services to meet the specific requirements of children with Autism Spectrum Disorder (ASD) can be difficult due to their wide ranging and individual needs. Participatory Design (PD) is a design method that could be used to better meet these needs, by giving this population an opportunity to directly contribute to software designed for their use. Researchers have begun to involve children with ASD in the design process, but there is not yet a design method specifically adapted to support the potential difficulties this group may experience during PD sessions. This paper presents a new design method, IDEAS, which attempts to fulfill this need. The development of this method is described along with an initial pilot undertaken to determine the feasibility of using this method with an ASD population. The results indicate that the majority of children with ASD were able to produce a successful final design using this method, and have the potential to be involved in PD sessions as part of a design team.

Keywords
Participatory design, autism, children, interface design

ACM Classification Keywords
H5.2. User Interfaces: User-Centered Design.

General Terms

Design, Human Factors

Introduction

Children with ASD have rarely been involved in the design of products and services developed for their use. However, making appropriate design decisions and assumptions on their behalf can be particularly challenging due to the wide-ranging requirements of this group. The aim of this research is to further investigate the potential inclusion of children with ASD in the design process, specifically through the use of PD. PD provides a means of involving end users as participants throughout the design process. Many PD methods exist, including some specifically aimed at children [1,5,10,12]. Although there are a few examples of minority groups being involved in PD [4,8,11] there are no PD methods specifically developed for use with the ASD population.

ASD encompasses a range of pervasive developmental disorders, from low-functioning autism to high-functioning Asperger Syndrome. Whilst IQ can vary across the ASD population, it is characterized by a triad of impairments: social impairments, communication difficulties, and rigid and repetitive behaviors [13]. The difficulties with social and communication skills (which incorporates a lack of imagination), present several potential barriers to the successful inclusion of children with ASD in PD sessions.

For this study, a new PD method, designed to support the specific needs and impairments of children with ASD, has been developed. This paper describes how this method was developed and the results of an initial trial with 20 children, including 10 children with ASD and a control group of 10 typically developing children. It concludes that children with ASD have the potential to successfully take part in PD with suitable support.

Related Literature

PD methods specifically developed for typically developing children have been used since the late 1990s. Cooperative Inquiry (CI: Druin [1]) is a frequently used method, due partly to the flexibility of the design techniques it incorporates. CI involves a design team of adults and children in activities such as low-tech prototyping, to help develop design ideas. Another well-known PD method (Bluebells [5]) includes design activities based on childhood games. A method specifically designed for a minority group of typically developing children from a rote-learning background, who often struggle with creativity and idea generation, is Comicboarding [10]. It incorporates three different levels of scaffolding using comicbook templates to help provide the appropriate support to individuals. This support could also be applied to other populations with creativity difficulties, such as children with ASD [7].

Madsen et al [8] state that PD ‘is an important part of developing technologies that address the specific needs of under-represented groups, such as those on the autism spectrum’. However, the communication and social difficulties of this group, could explain the lack of research in this area and the use of teachers or parents as proxies, e.g. [3,6]. Recent research has begun to provide opportunities for children with ASD to provide input into software designed for them. Piper et al [11] developed a cooperative tabletop computer game for social skills development with input from a group of adolescents with AS through the use of observations, interview and ‘prototype’ tests. Additionally, children

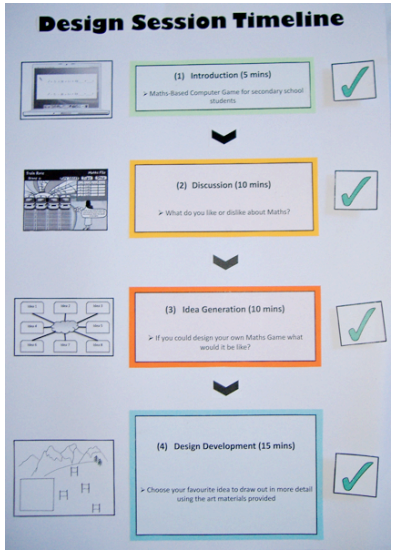

Figure 1: Visual Timeline

Figure 2: Cardboard mock-up computer displaying a child's interface design

with low-functioning autism were involved in the development of play experience software [4]. CI was used in this project, yet the children were unable to be fully involved due to 'their difficulties in social situations being so profound' [4]. This paper builds upon previous research by involving children with ASD further as 'design partners' giving them the opportunity to participate in the design process.

Development of a New PD Method

Although PD methods have not been designed specifically for children with ASD, it cannot simply be assumed that they would be unsuccessful. With this in mind, a number of successful existing PD methods for typically developing children have been analysed for suitability including: Cooperative Inquiry [1]; Mixing Ideas [2]; Bluebells [5]; Comicboarding [10]; IBF Model [12]. This analysis was undertaken using a set of criteria based on the characteristics of the 'culture of autism', as defined in the TEACCH program [9], used worldwide for educating children with ASD and refined to apply directly to a PD context. These criteria highlight where children with ASD could potentially need support. Based on this analysis a new method was developed entitled 'Interface Design Experience for the Autistic Spectrum' (IDEAS). It incorporates features of existing PD methods meeting aspects of the TEACCH-based criteria, and also includes novel features that fulfill the remaining criteria.

The IDEAS design method involves four activities: (1) an introduction to the session, (2) a discussion of previous experience, and demonstration of existing software related to the design topic, (3) generating and documenting design ideas, (4) drawing out an interface design of the best idea. These tasks are explained verbally by an adult facilitating the session and displayed visually on a timeline (fig. 1), which also acts as a checklist to document the session progression and discourages rigid and repetitive behaviors. The key feature of IDEAS is the provision of tailored levels of structured support (scaffolding), using templates similar to [10], to provide this support where it is required (determined by the facilitator), but not to constrain the child's imagination and creativity. This scaffolding is used both during idea generation and interface design tasks, helping to overcome any impairment in the child's imagination. If the child initially struggles to generate their own ideas they are provided with a template containing example ideas (fig. 4). If these examples fail to prompt their own ideas, the child chooses an example idea and is then provided with an interface design template, with basic support or high support, based on this idea (fig. 5 or 6). The other features of IDEAS designed to meet the TEACCH criteria are as follows (referencing the influence of existing PD methods where appropriate):

- *Quiet environment* [12]: to reduce *distractibility.*
- *Initial explanation of session and tasks*: helps support difficulties with *concept of meaning*.
- *Visual timeline:* helps give a clear visual representation and division of tasks to support difficulties with *auditory learning* and *organizing and sequencing*, and helps move focus to the 'big picture' to prevent too much *focus on details*.
- *Demonstration of existing software* [1]: helps support difficulties with *concept of meaning* and *abstract thinking*.
- *Use of typical hobbies and interests:* using results from a questionnaire completed by children with ASD

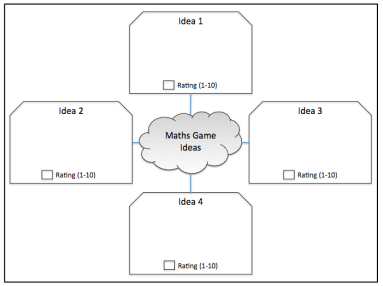

Figure 3: Blank ideas template for children able to generate their own ideas

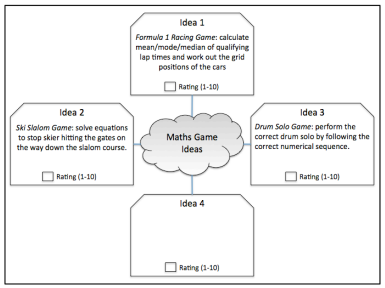

Figure 4: Template with example ideas and some blank spaces for children who have difficulty generating their own ideas

prior to the sessions, the existing software and templates [5] are tailored to match their typical hobbies/interests, to help *distractibility* and use *strong impulses* for their special interests in positive way.

- *Visual tasks:* all tasks include visual elements such as drawing and writing as well as the visual timeline of the session, matching preferences for *visual learning*.
- *Discussion task* [2]: helps highlight previous experiences of design topic and using computers, to support difficulties with *generalization* of existing skills.
- *Evaluation of ideas:* ideas templates contain space to rate ideas to encourage evaluation of the different positive aspects, supporting difficulties experienced in *combining or integrating ideas.*
- *Computer mock-up* (fig. 2): presents the interface design in a concrete context, to support difficulties with *concept of meaning* and *abstract thinking*.
- *One to one support* [2]: provided through an adult facilitator offering reassurance and praise, and giving the child a chance to discuss their own interests to help combat *excessive anxiety*. The facilitator can use the visual timeline to prevent too much *focus on details*.

Methodology

A key element of PD is collaboration between the design team members, which requires both good communication and social skills to succeed. The triad of impairments associated with ASD [13] affects these skills and could prove a major barrier to participation. It was therefore decided to run an initial pilot of the IDEAS method with individual children to establish if these children are able to successfully undertake each of the tasks involved in the method. The participatory element will then be introduced in future sessions.

The pilot study involved 20 participants aged between 11 and 14 years: 10 children diagnosed with high-functioning autism (from three urban non-faith specialist ASD schools) and 10 typically developing children (from two urban non-faith state secondary schools) as a control group. Selection was based on age and verbal IQ (to ensure ability to understand verbal instructions and contribute verbally to sessions). This was done to ensure a range of children took part and to match the children between groups. The differences in age (t_{18}=-.617 and p=.545) and verbal IQ (t_{18}=-.685 and p=.502) were not statistically significant.

Each child was asked to generate ideas for a mathematics-based game to tutor secondary school students and to draw out the interface design of their favorite idea. A template was provided for the child to note down their ideas (fig. 3 or 4). Materials including felt pens, colored pencils, paper, glue and pre-drawn images were provided during the interface design task. The sessions were undertaken at the child's school in a separate room away from the classroom. Children participated in the sessions individually with an adult administering the tasks and providing support but not directly participating in the session. No time limit was imposed, but it took on average 30 minutes for each session. There was a notetaker in the room who took photographs at regular intervals (from behind to protect each child's identity), but remained silent.

Results

All typically developing participants were successful in generating interface designs that fulfilled the maths game brief, but two children from the ASD group were unsuccessful due to their inability (or unwillingness) to incorporate maths into their design. The overall design

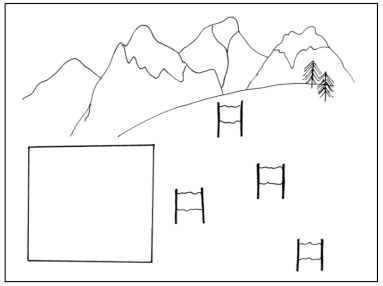

Figure 5: Basic support interface design template containing some elements of game design

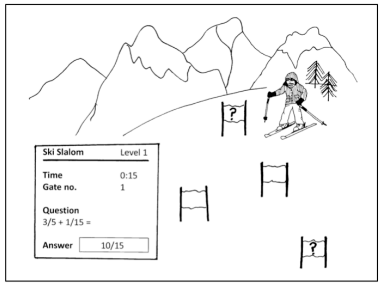

Figure 6: Highest support interface design template containing a complete game design with space for additions or modifications

process has been analyzed against the TEACCH-based criteria to determine what worked well with the ASD group and what would be changed for future iterations:

- *The Concept of Meaning:* the children liked the computer mock-up, with some standing up and pointing to it to explain their idea. Some children were able to draw previous experiences into their design, but as a group they were more likely to copy existing games.
- *Focus on Details; Ability to Prioritize the Relevance of Details:* some children became fixated on certain details, but the facilitator was able to get them back on track by prompting and asking questions, and the children still remembered to tick off the tasks on the visual schedule which helped them to make progress.
- *Distractibility:* the demonstration of existing software was engaging for even the most distracted of children, as was the visual schedule which particularly helped one child focus on the session tasks rather than his prior classroom activities. The pre-drawn images however did distract one child from her own ideas.
- *Concrete vs. Abstract Thinking:* the example ideas template supported a number of children in generating their own ideas and the computer mock-up helped highlight features they had missed from their designs.
- *Combining or Integrating Ideas:* the evaluation of ideas was obsolete in many cases where the children had only generated one idea, however some children were able to integrate elements from the example software or previous experiences into their ideas.
- *Organizing and Sequencing:* all the children were able to follow the session using the timeline and three children asked to tick off the last task before leaving.
- *Generalization:* some children were able to use non-educational games as a basis for their ideas, but a few found it hard to deviate from the original game.
- *Visual vs. Auditory Learning:* most children did not enjoy writing and some also expressed concerns about their drawing skills; it was important to also allow them the opportunity to express themselves verbally.
- *Strong Impulses:* asking about hobbies helped prompt some children to generate ideas and one particularly volatile child was very engaged as the task matched his special interest in game design.
- *Excessive Anxiety:* talking about special interests helped the children relax. They became uncomfortable if they could not think of an idea and templates helped support this by giving them a starting point.

Discussion and Conclusions

This study investigated the potential use of a newly developed design method, IDEAS, for children with ASD. IDEAS has been developed based on TEACCH characteristics [9], and existing PD methods for children, as well as including some novel features. The key feature of IDEAS is the customizable structured support using templates, based on [10], and supports the communication impairment of the triad [13], which includes a lack of imagination. The visual schedule also provides support by encouraging progression in a clear and visual manner, and discouraging rigid and repetitive behaviors.

As a result of an initial pilot study, undertaken with both ASD and typically developing groups, it can be concluded that children with ASD do have the potential to participate in the creative activities representative of PD sessions. However, some children require additional

support to participate fully, particularly those who struggle with idea generation. A customizable design method like IDEAS is able to provide a suitably structured form of this support. The main unsuccessful element of their final designs was the exclusion of the maths component of the game. This method could be improved further by providing template support for different elements of the design, such as maths content, which could then be combined with the aspects of the idea the children are able to generate. The next step in this research is to trial the IDEAS method with a realistic participatory design team incorporating both adults and a number of children with ASD. This will determine if the structured IDEAS approach can also support the social and further communication difficulties that this population may encounter when working in a design team.

Acknowledgements

The first author thanks Mike Ashworth for her PhD scholarship funding, the schools that took part, and all the children for sharing their ideas with us.

References

[1] Druin, A. Cooperative inquiry: developing new technologies for children with children. *Proc. CHI 1999*, ACM Press, 595-599.

[2] Guha, M.L., Druin, A., Chipman, G., Fails, J.A., Simms, S., Farber, A. Mixing ideas: a new technique for working with young children as design partners. *Proc. IDC 2004*, ACM Press, 35-42.

[3] Hirano, S.H., Yeganyan, M.T., Marcu, G., Nguyen, D.H., Boyd, L.A. and Hayes, G.R. vSked: Evaluation of a System to Support Classroom Activities for Children with Autism. *Proc. CHI 2010*, ACM Press, 1633-1642.

[4] Keay-Bright, W. The Reactive Colours Project: Demonstrating Participatory and Collaborative Design Methods for the Creation of Software for Autistic Children. *Design Principles and Practices: An International Journal*, *1*, 2 (2007), 28-35.

[5] Kelly, S.R., Mazzone, E., Horton, M. and Read, J.C. Bluebells: A Design Method for Child-Centred Product Development. *Proc. NordiCHI 2006,* ACM Press (2006), 361-368.

[6] Kientz, J.A., Hayes, G.R., Westeyn, T.L., Starner, T. and Abowd, G.D. Pervasive Computing and Autism: Assisting Caregivers of Children with Special Needs. *IEEE Pervasive Comp. Magazine 6*, 1 (2007), 28-35.

[7] Craig, J. and Baron-Cohen, S. Creativity and imagination in autism and Asperger syndrome. *Journal of Autism and Dev Disorders*, 29, (1999), 319-326.

[8] Madsen, M. el Kaliouby, R., Eckhardt, M., Hoque, M.E., Goodwin, M.S. and Picard, R. Lessons from participatory design with adolescents on the autism spectrum. *Proc. CHI 2009*, ACM Press, 3835-3840.

[9] Mesibov, G.B., Shea, V. and Schopler, E. *The TEACCH approach to autism spectrum disorders*. Springer, New York, 2004.

[10] Moraveji, N., Li, J., Ding, J., O'Kelley, P. and Woolf, S. Comicboarding: using comics as proxies for participatory design with children*. Proc. CHI 2007*, ACM Press, 1371-1374.

[11] Piper, A.M., O'Brien, E., Moris, M.R. and Winograd, T. SIDES: a cooperative tabletop computer game for social skills development. *Proc. CSCW 06*, ACM Press, 1-10.

[12] Read, J.C., Gregory, P., MacFarlane, S.J., McManus, B., Gray, P. and Patel, R. An Investigation of Participatory Design with Children – Informant, Balanced and Facilitated Design. *Proc. IDC 2002,* Shaker Publishing (2002), 53-64.

[13] Wing, L. and Gould, J. Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Childhood Schizophrenia, 9*, 1 (1979), 11-29.