

Toward a Technology-based Tool to Support Idea Generation during Participatory Design with Children with Autism Spectrum Disorders

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ABSTRACT

Our research explores the development of a novel technology-based prototype to support children and designers during brainstorming, one of the most challenging activities within Participatory Design (PD). This paper describes a proof-of-concept prototype for a tool that aims to empower children with Autism Spectrum Disorders (ASD) during PD to maximise their contributions to the design and their own benefits. Preliminary results revealed that the prototype has the potential for reducing anxiety in children with ASD, and supports unlocking their creativity.

Author Keywords

Participatory Design; Design Methods; Brainstorming; Children; Autism; Requirements

INTRODUCTION

Autism is a lifelong developmental condition that affects how a person communicates and relates to other people [1]. These difficulties are often associated with anxiety and stress, especially when interacting with new people in unfamiliar contexts and/or situations. Recent reports indicate that the prevalence of ASD has increased to more than 1 per 100 individuals [5, 6]. For example, in the UK there are about 700,000 individuals with ASD which raises the total economic cost for supporting this population to £29 billion per year [17].

Currently, there is substantial evidence that technology can help children with ASD overcome their difficulties, as long as it is well designed. In this context, researchers and designers have been increasingly recognising that PD is the best way to build technology for children with ASD [4, 9,

12]. However, because of the challenges that both children and designers face, researchers often collaborate with proxies, such as typically developing (TD) children or practitioners, in place of children with ASD during PD [8]. The idea generation (brainstorming) stage of PD is fundamentally related to creativity [18]. Consequently, this is particularly challenging as children with autism may have difficulties expressing their creativity [18].

Building on the existing research in the PD, our research explores how to design a technology-based customisable tool to better support children with ASD during the idea generation stage of PD focused on educational games. The tool is expected to help children express their creativity, engage in design activities, and reduce anxiety. We believe that a technology-based tool can act as an interface between designers and children with ASD, creating a social distance and a more predictable and controllable environment (compared to traditional approaches to PD). Consequently, we expect to reduce children anxiety, increase confidence and engagement, and support unlocking their creativity.

This paper presents the design of a prototype based on prior research and informed by practitioners and researchers, as well as a plan for a small qualitative study with children with ASD. Our long-term goal is to build a technology-based tool that reduces the barriers to PD for children with ASD and to investigate its benefits in a larger study involving children with ASD and designers/researchers. As far as we are aware, there is not such a tool focused on PD and addressing the special needs of children with ASD.

BACKGROUND

Technology has been effectively used to teach various skills to children with ASD, such as collaboration [15], joint attention [11] or problem solving [20] techniques have been recognised as helpful for designing an effective system, but also suitable for engaging, motivating and inspiring children to become design partners [19]. In addition, participation is an empowering experience for children with ASD, providing opportunities for developing new skills, such as collaboration skills [4].

A series of methods and techniques have been developed for involving children with ASD in PD [3], but also for TD children [10]. Some of these studies imply the use of technology [10, 12]. However, the use of PD with children

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with ASD is still scarce and researchers suggest that specialised tools should evolve in order to give children their deserved place in the technology design process [10].

APPROACH

Our research builds on the existing research, particularly [3] and [8], as well as on our own experience in conducting PD with children with ASD and the design guidelines for children with ASD [3, 14]. We have conducted a number of studies with practitioners and researchers in HCI, Autism, Education and Psychology to inform the tool design.

Pre-design. We conducted a focus group with four practitioners, and interviewed, a pair of researchers and a pair of practitioners. We focused the questions in these studies on the practitioners' and researchers' experience and perspectives on using creative activities with children with ASD, and challenges related to these activities. The data collected were analysed using grounded theory methods (i.e. open coding and axial coding) [21]. The main topics identified led to a set of requirements that we grouped into two categories: requirements for adults and requirements for children. We based our proof-of-concept prototype on the requirements for children, which included: add ideas on sticky notes in various modalities (e.g. typing, drawing, adding an image from the gallery or voice recording), use a virtual customisable character to guide children (e.g. introduce the design problem and tasks, provide hints to inspire children), and provide rewards to motivate and engage children.

Design and formative evaluation. We conducted a 2-hour workshop with three researchers in the field of HCI from the University of Edinburgh to build low-fidelity prototypes based on the requirements for the child interface elicited in the pre-design phase. The main researcher used the paper prototype to create a mock-up prototype in Balsamiq [2]. We evaluated this prototype with the three researchers who participated in the workshop. We then consulted four researchers from the University of Iowa. Each study session and consultation lasted for 1 hour. There were no major usability problems. All the researchers evaluated the prototype as being appropriate for the target users, easy to use and intuitive. The researchers judged the application to be, potentially, effective in supporting at least some children with ASD in expressing their creativity and in reducing their anxiety when working directly with designers. One of the researchers warned that, given the heterogeneity of the autistic population, it would not be realistic to expect that there is a panacea for all children. However, he added that: *"I like that it provides children multiple options for contributing ideas. [...] I think it makes at least some of the children more comfortable as they communicate through the virtual character."*

We collected a series of design suggestions including: reinforce children's ideas by displaying them as a prompt to build on, write fictional stories to make it more likely for the children to empathise with the character and be

motivated to act as experts to help it, and offer reward items. Based on these suggestions, the requirements and the mock-up prototype were refined.

SYSTEM DESCRIPTION

We are implementing a high-fidelity iPad prototype, with a view to using it in a small study with children with ASD and no learning disabilities (LD), aged 7 to 11. It will incorporate only the requirements related to the child interface and will focus exclusively on generating ideas in individual brainstorming.

In the high-fidelity prototype, the virtual character welcomes the child and prompts them to introduce their names. The child has the opportunity to customise the character according to their preferences and to change or turn off the voice. After choosing their preferred project, the prototype introduces the child to the design problem through a fictional story. The prototype then displays a number of tasks on the screen. The child is encouraged to work through the tasks and create as many ideas as they can. The character guides the child to introduce their ideas (e.g. by typing, drawing, adding an image from the gallery or recording their voice). When the child runs out of ideas or is stuck, the character prompts the child to ask for help by pressing a button, which displays hints for the child.

Besides its guiding role, the character has the role of rewarding the child for each achievement. The reward is incremental, reflecting the child's progress, as recommended by [7] based on their research with children with ASD. The child can visit their projects where they can see the ideas they created and edit or build on them.

EVALUATION PLAN

We plan to conduct a within-subject design study counterbalanced to control for order with six children with ASD. We plan to compare outcomes, engagement and anxiety levels when working with technology (condition A) and without (condition B). The overall purpose is to explore whether the technology-based brainstorming has the potential to better support children with ASD create ideas, engage in and reduce anxiety during the PD process compared with traditional method (without technology).

CONCLUSION AND FUTURE WORK

This paper describes a proof-of-concept prototype for a tool aiming at empowering children with ASD during PD to maximise their contributions to the design and their own benefits. Our main purpose was to explore the potential of the tool and identify possible challenges before building the entire system and conducting larger studies with various stakeholders. Preliminary results revealed that researchers perceived the emerging tool as promising for supporting children with ASD to express their creativity, reduce their anxiety and engage in the idea generation activity.

An evaluation study is planned with children with ASD using the high-fidelity prototype. The results will be available at the time of the conference.

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