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# Using Crowdsourcing to Foster Creativity in Children with Autism during Idea Generation

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## Autism Spectrum Disorder (ASD)

Autism Spectrum Disorder is a neurodevelopmental condition that affects social interaction, communication, interests and behaviour [1]. In light of the recent discussions around terminology, identify-first language will be adopted in this article [8].

## ABSTRACT

Previous work suggests involving autistic children in participatory design (PD) benefits them. However, such inclusion does not come without challenges. Decision-making and the ability to creatively express thoughts are two of the most acknowledged difficulties autistic children face during the PD process, particularly during the stage of idea generation. These are linked to the disorder-specific impairments in social interaction and rigidity in thought and behaviour. Recent work recommended technology as a tool to support children during idea generation. Building up on these efforts, this paper proposes using crowdsourcing with a team of selected online workers, as a way to generate child-specific hints to help autistic children unlock their creativity. Moreover, machine learning techniques and the majority decision approach are suggested to remove noise, redundancy, and select the child-specific hints.

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## KEYWORDS

crowdsourcing; machine learning; Participatory Design; PD; co-design; children; autism; hints

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## Participatory Design (PD) Definition

The central design philosophy of PD is to give careful attention to the end-users' needs, wants and abilities, by involving them throughout the entire design process as design partners [11].

## INTRODUCTION

Researchers have been increasingly recognising that involving children with Autism Spectrum Disorders (ASD) in the design process of technology through Participatory Design (PD) leads to an increase of appropriateness of the outcomes [2]. It also empowers these children, helping them develop new skills (e.g. social-communication skills and self-esteem). Idea generation, which is one of the early stages during PD, is particularly challenging as it is intertwined with creativity and decision making. Because of their difficulties with social interaction and their rigidity in thoughts and behavior, autistic children have difficulties both in expressing their creativity and making decisions [10]. Moreover, during PD, children have to work in a team with designers, making the process even more challenging taking into account their difficulties in social interaction. Building on the existing research in the PD, one of the authors designed a prototype of a technology-based customisable tool to better support children with ASD during the idea generation stage of PD focused on educational games [4]. The reason was 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). In addition, technology is well placed to provide support for creativity and decision making [12]. For example, children can receive hints when they are stuck and can be encouraged to build on them. In the initial design, the hints were introduced in the system by designers [4] who do not necessarily have experience in autism. We propose now a solution to improve this prototype by using crowdsourcing and machine learning to provide children appropriate hints fostered by people with experience in working with autistic children. This work builds on the research of Lasecki et al. [9].

## THE TECHNOLOGY-BASED TOOL

A prototype has been iteratively developed based on a series of studies (e.g. focus group, interviews, prototyping and task-based evaluation) [4]. These studies involved 6 practitioners experienced in working with children with ASD, 9 researchers in the field of HCI, Psychology and Education, and 5 typically developing children (TD). The initial studies led to a set of high level requirements, which

included: guide children with a virtual customisable character through the design (e.g. introduce the design problem and tasks, provide hints to inspire children), provide sticky notes for children to introduce their ideas in various modalities (e.g. typing, drawing, adding an image from the gallery or voice recording), use rewards to motivate and engage children.

When the child is logged in, the character welcomes the child and prompts them to introduce their names [4]. After choosing their preferred project, the prototype introduces the child to the design problem through a fictional story [6]. The child receives a number of design tasks which are displayed on the screen [4]. They are 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 [5] based on their research with autistic children.

## **USING CROWDSOURCING AND MACHINE LEARNING TO PROVIDE SUPPORT WHICH IS BETTER ADAPTED TO EACH CHILD**

### **Registering Users**

We propose registering both the child, as well as the online workers, on the tool. Children will have their profile set up by their parents in terms of the characteristics of their autism. On doing this, parents will be asked for written agreement that this data about their child (only, no identification data) is shared via crowdsourcing. Online workers who are either specialised in autism, or who work with autistic children, will be invited. They will register themselves on the tool and their level of experience with different characteristics of autism will be evaluated as part of this registration, such that only users with certain levels of experience will be accepted as online workers.

### **Designing a Task for the Online Workers**

When a child gets stuck during idea generation and needs a hint, a task will automatically be designed for the online workers. Its instructions will contain:

- The design problem
- The design task instructions that the child has been given
- The child's profile from his/her registration
- The ideas that the child has come up with so far
- Guidelines for avoiding generating hints which would lead the child to idea fixation or ideas which lack relevance/coherence ([3])

- A request for a one-phrase hint for the child

### **Forming the Group of Online Workers**

Once the task has been set up, a group of online workers will be established to help the child. They will automatically be chosen based on the match between their profile and that of the child (i.e. how experienced they are with the child's autism characteristics), and their availability.

### **Assigning the Task to the Online Workers**

Once the group has been created, the online workers will each individually be assigned the task. Then, workers will each individually propose a one-phrase hint for the child.

### **Evaluating and Selecting Hints**

The generated hints will first only be shared between the online workers. Each worker will randomly receive a subset of the hints provided by others, and will be asked to rate them based on appropriateness for the child and level of support provided, by using a series of questions. The initial crowdsourcing task instructions will also be provided, to aid in this evaluation. The workers will only evaluate hints once they have submitted their own, to avoid the risk of fixation and generating ideas which lack relevance/coherence themselves.

The hints with ranking below a certain threshold will be dismissed. Machine learning will then be used with the remaining appropriate and useful hints, to remove noise and redundancy. Finally, the majority decision approach ([7]) will select the hint which was mostly returned, which will be provided to the child.

## **CONCLUSION, DISCUSSION, FUTURE WORK**

This position paper has introduced the idea of using crowdsourcing in a technology-based tool supporting autistic children during the idea generation phase of PD, to provide hints which are better adapted to each child, and can thus unlock their creativity. We are very excited about the prospect of taking benefit of a 'collective intelligence' and joint experience with autism to best support autistic children in their creative process during PD.

Future work involves implementing the presented approach, and experimenting with using it in PD scenarios. We plan to evaluate with autistic children and practitioners from schools across Edinburgh, UK. Moreover, we plan to extend this approach to also using crowdsourcing to generate child-adapted narratives of the design problem and rewards for children for creative ideas.

Through participation to the workshop, we are looking forward to establishing collaborations with experts in crowdsourcing to further refine our approach.

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