Co-design A Multisensory Tool To Support Collaborative Play With and For Autistic Children: A Methodological Approach

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Abstract. This paper introduces a co-design methodology aimed at the development of a multisensory tool to facilitate collaborative play among autistic children, a demographic traditionally underrepresented in the co-design process. Due to challenges in social and communication skills, autistic children may experience difficulties in engaging in collaborative play. Co-design is used to effectively incorporate the perspectives of all stakeholders, including researchers, developers, and end users when developing a new product. In this work, the co-design methodology was devised following an extensive contextual inquiry study involving interviews and observational sessions of 18 autistic children, based in a disability center and an inclusive school, in Qatar. The research method involves sequential and interconnected stages of logistics setup, familiarization, pair interaction, co-design, and testing, each laying the groundwork for the subsequent phase. Future endeavors should focus on validating and enhancing this co-design approach to ensure its efficacy and adaptability to varying contexts and user needs.

Keywords: co-design, autism, autistic children, collaborative play, multisensory tool, methodology.

1   Introduction

Over the past few years, the number of children diagnosed with autism has increased significantly [1]. In Qatar, where this research is based, one in every 87 children have been diagnosed with Autism [2]. To uphold the identity-first language preferred by

many in the autism community, this paper uses the term "autistic person" to refer to individuals with Autism Spectrum Disorder [3]. This terminology reflects an empowering perspective that respects and appreciates autistic individuals for who they are, rather than defining them by their diagnosis.

Embracing a neurodiversity perspective, autistic children may experience challenges in play, especially collaborative play [4]. Collaborative play, understood as an interaction between at least two children playing towards a common goal, is a crucial facet of children's developmental journey. Not only does it enable children to exercise empathy and negotiation skills, but it also offers a safe space for them to experiment with different conflict resolution strategies [5]. Given its significance, the exploration of how autistic children engage in this type of play can offer valuable insights into how to support their developmental growth.

Recent years have witnessed a progressive shift in the field of Human-Computer Interaction towards a more democratic approach in technology design. Co-design has been adopted as a key strategy to create interactive technologies, recognizing users as integral members of the design team [6], [7]. Originating from the Participatory Design method, this approach advocates for the user's right to participate in the design process at every stage, from the inception of an idea to its final assessment [8]. This shift underscores a more inclusive ethos, valuing diversity and promoting equality in technology design. Involving autistic children in the co-design process, however, brings its unique challenges. However, the benefits of adopting a strengths-based approach far outweigh them. This approach shifts the focus from perceived deficits to the unique strengths, experiences, and interests of autistic children [9]. Although some barriers may arise, especially when working with children who have limited communication abilities, the inclusion of indirect stakeholders, such as caregivers and teachers, can facilitate the process [10].

In the context of these observations, this paper is part of a larger project that aims to co-design, develop and evaluate a multisensory tool to support collaborative play for autistic and non-autistic children [11]. It presents a co-designing methodology, highlighting the importance of inclusive co-design methods that respect and value the unique experiences and abilities of autistic children. This paper starts by offering an overview of the contextual inquiry process, along with associated results. It then outlines the co-design phases, focusing on the first four stages, while noting that the fifth phase remains incomplete. Subsequently, the paper discusses the encountered challenges and their implications on the co-design process. The paper concludes with a synthesis of findings and directions for future work.

2   Requirements Gathering

This project involved ten autistic children from a disability center and eight from an international inclusive school, in Qatar. Prior to data collection, ethical approval was obtained from the Qatar Biomedical Research Institute Research Board. The project's aims and methodology were independently presented to therapists and teachers at both institutions. The team recruited autistic children aged between 7 to 12, ensuring they

underwent comparable assessments, managed by the institutions. A contextual inquiry approach [12] was adopted, encompassing observations and interviews at both sites. The main goal was to discern behavioral patterns and elucidate the challenges and prospects of collaborative play among autistic children.

Both the center and the school collected consent forms from parents and confirmed their availability for interviews, which were conducted with 16 parents, 12 teachers, six speech and language therapists, four psychologists, six occupational therapists, and one physiotherapist across both institutions. Despite two parents being unable to participate, a total of 45 semi-structured interviews were carried out. As well, 48 collaborative play classes, led by teachers, were observed in both sites. Thematic analysis was employed to evaluate the transcribed interviews and video recordings [13].

Two sets of themes were generated separately from the interviews and observation sessions. From the interviews, themes emerged offering insights into autistic children and collaborative play, structured around a 5W-H model. This model addresses parameters to gather the "who," pertaining to the individuals involved; "where," exploring various play settings; "what," investigating technologies used; "why," discussing motivations; "which," addressing the sensory stimuli; and "how," detailing strategies for collaborative play. Observation sessions yielded themes of "collaborative play", "coordinated activity", "potential for collaboration", and "collaborative activity". Collaborative play implies shared goals and encompasses awareness, coordination, and communication [14], [15]. "Coordinated activity", often teacher-guided, was a dominant feature in the observed incidence, while "potential for collaboration" indicated activities that missed one of the collaborative play components with a potential for evolving into collaborative play. The theme of "collaborative activity" emphasized working collectively towards a common goal without adult's guidance.

Overall, this contextual inquiry provided valuable insights into understanding collaborative play among autistic children. The results shed light on the occurrence and nature of collaborative play in both sites. They also highlighted the potential benefits of collaborative activities for autistic children. These findings have implications for practitioners, educators, and researchers working with autistic children. They underscore the importance of creating environments that foster collaborative play and facilitate social interactions among autistic children.

3 Co-design Phases

This paper entails a step-by-step co-design process shown in **Fig. 1**. These stages are sequential and interconnected, each setting the foundation for the next. At the time of writing this paper, we find ourselves in phase 4.
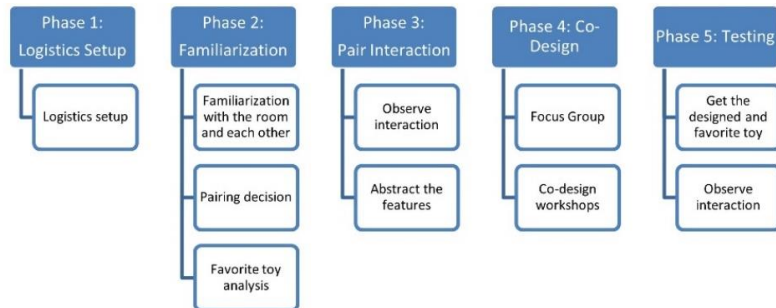
Fig. 1. Co-design study process

3.1 Phase 1: Logistics Setup

The first phase was the 'setup of logistics'. The process was a collaborative effort involving the research team, therapists, and teachers from both institutions. These stakeholders were asked to assist in establishing a conducive environment that entailed a room familiar to the children participating in the study, equipped with toys that the children regularly interacted with. Creating a familiar environment enables autistic children to feel comfortable and at ease, enabling them to freely express themselves. This room served as the setting for all subsequent phases of the study.

3.2 Phase 2: Familiarization

This phase comprised daily sessions of 30 minutes each, to help the children be accustomed to each other as well as the room setup. Over five days, the sessions were captured using three fixed and one moving camera operated by a researcher, while another two researchers were taking notes. Throughout the sessions, the children were allowed to play freely without adult interference. Following the fifth session, an analysis of the recorded footage was carried out, to group the children into pairs, in view of mutual attraction to the same toy during these initial sessions.

3.3 Phase 3: Pair Interaction

This phase aimed to foster rapport between children and researchers and promote collaborative play. Three 30-minute sessions were held for each pair, focused on the mutually selected toy from the previous sessions. To eliminate distractions, no other toys were present. Each session, documented by two fixed cameras and annotated by a pair of researchers. The researchers initiating the session with verbal (i.e., "hi") and non-verbal (i.e., handshaking, waving, and AAC [16], [17]) greetings, utilizing the "circle of friends" technique [18]. Subsequently, a 'toy play' segment involved guided interaction with the chosen toy, transitioning gradually into 'free play'. Post-session, the recordings underwent analysis to discern children's interaction with the toy, extracting its features and sensory attributes for subsequent co-design phases.

3.4   Phase 4: Co-design

This phase aimed to initiate the prototyping process of a multisensory tool. It began with a focus group meeting involving therapists and teachers. The aim of this focus group was to explore the concepts and skills involved in collaborative play through open-ended questions and discuss the findings of previous stages. Such discussions were intended to foster a deeper understanding of collaborative play skills as observed among the children in previous phases. The next step involved the researchers sharing their plans for the forthcoming co-design sessions, facilitating a constructive dialogue to agree on a feasible structure. It is worth noting here that at the time of writing this paper, only the focus group meeting was carried out. Hence, modifications may arise later during co-design implementation. This co-design phase will encompass several workshops, each one focused on one of three main stages: features selection, prototyping, and collaborative play scenario design. In the features selection stage, a Paired Choice Preferences Assessment Procedure [19] will be used, a method that is known to be particularly effective in understanding the preferences of autistic children. This will involve displaying a variety of extracted feature options on an extendable tray. The options selected from this stage will then be compiled into a bag of stuff, which the children will utilize to create their own mascots. During the prototyping stage, the children will encounter 'start' and 'end' stations. Here, they will assemble a track that extends from the start to the end. Their self-designed mascots will be placed in a container at the start, which will traverse the path they have assembled towards the destination. As part of this journey, the children will have the opportunity to introduce obstacles requiring collaborative tasks, such as pressing a button, to facilitate the container's passage from start to end. Upon reaching the destination, the mascots will be released. Throughout this journey, the children will continuously receive auditory and visual feedback and stimuli, fostering an engaging and interactive experience.

3.5   Phase 5: Testing

In the final phase, the prototype will be tested to determine if it facilitates collaborative play among autistic children. The prototype will have undergone refinement to ensure it aligns with a high-level design. The resultant product will then be introduced to the same children who participated in the prior phases. The structure of these sessions will remain consistent with that of Phase 3. The behavior and interactions of the children will be observed during these sessions to identify any potential modification that could enhance their collaborative play experience with the developed tool. This phase will be vital to ensure that the co-designed prototype aligns with the intended goal of encouraging collaborative play, effectively integrating the insights and preferences gathered from the children throughout the process.

4   Challenges and Reflection on co-design

The planning of the co-design sessions was based on the findings from the contextual inquiry and Phase 1 was relatively easy. However, facilitating the children's familiarity

with the playroom presented a challenge, as the children were used to follow the guidance of the teacher in this space rather than to engage in free play. However, as Phase 2 approached its conclusion, the children began to perceive the room as a space for free play, resulting in an observable increase in enjoyment and spontaneous activity.

In Phase 3, the children initially displayed a lack of participation in the sessions. The implementation of the 'circle of friends' at the beginning and the subsequent sessions was instrumental in fostering this bond. In phase 4, a significant challenge arose in the technique of collecting the children's preferences. Given that the children were unable to draw, craft, or verbally articulate their imagined tool, the implementation of the paired choice preferences assessment became an indispensable solution to this impediment. As this assessment was already in use at the center to evaluate the children's stimuli, the children were accustomed to the process.

Another hurdle involved the limitation of variables in the choice preferences. Focusing exclusively on one feature while eliminating others proved to be a complex task. Hence, the proposed solution involves developing a 3D-printed extendable tray to simplify the children's selection process. Feature choices will be presented on a small board attachable to the tray, allowing variable options. This method will provide a consistent display of options, thereby effectively constraining variables.

5 Conclusion and Future Work

This paper proposes structured methodology to co-design a multisensory tool that enhances collaborative play among autistic children. Even though it builds upon pre-existing practices, the approach sets itself apart by tailoring these phases to the target demographics. The inclusion of autistic children in the design process sets a significant addition in inclusive design practices, underscoring the value of including their perspectives and experiences. Even though the methodology's individual components are not novel, their integration into a unified process provides a meaningful contribution to the field. Looking ahead, the methodology invites further application to other settings and across a wider spectrum of autistic children. Future work also includes the continued improvement of the designed tool, driven by ongoing cycles of user experiences and feedback. Such practices ultimately contribute to an increasingly inclusive and empathetic environment that promotes collaborative play for all children, regardless of their neurotype. This research not only contributes to new conceptualizations of practical tool design, but also encourages further discourse on the importance of inclusivity in play - critical aspects of childhood development.

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