

Designing an App to Help Individuals with Intellectual and Developmental Disabilities to Recognize Abuse

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ABSTRACT

In the US, the abuse of individuals with intellectual and developmental disabilities (I/DD) is at epidemic proportions; however, the reporting of such abuse has been severely lacking. It has been found that individuals with I/DD are more aware of when and how to report abuse if they have received abuse prevention training. Consequently, in this paper we present the design of a mobile-computing app called *Recognize* to teach individuals with I/DD about abuse. Our research team is diverse, with both individuals with I/DD and neurotypical individuals. We leveraged this diversity by utilizing a co-design process with our team members who live with I/DD. Our team developed three initial prototypes of the app and performed a qualitative, within-group user study with six separate individuals with I/DD who are themselves experienced teachers to other individuals with I/DD. We found that, overall, the app would be viable for use by individuals with I/DD. We end the paper with a brief discussion of the implications of our findings toward building a full prototype of the app.

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CCS CONCEPTS

• **Human-centered computing** → **Usability testing; Accessibility design and evaluation methods; Accessibility technologies.**

KEYWORDS

empowerment, education, co-design, abuse, intellectual and developmental disabilities

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1 INTRODUCTION

Abuse has reached epidemic proportions in the community of people with intellectual and developmental disabilities (I/DD)¹ [31]. However, incidents of abuse committed against people with I/DD are woefully underreported to the appropriate authorities [43]. Some of the reasons for low reporting include the fact people with

¹Based on the definition from the American Association of Intellectual and Developmental Disabilities, I/DD can be thought of as a set of disabilities that negatively affect the trajectory of an individual's intellectual, emotional, and/or physical development. I/DD appear in childhood and are likely to be present throughout life [1].

I/DD are often not aware of what constitutes abuse or what to do when they do encounter it [20, 29]. People with I/DD often have to self-advocate to prevent others from discounting their voices when it comes to reporting abuse [2]. However, as discussed in our prior work on this topic, they cannot do so effectively unless they understand abuse in its various forms [62].

Consequently, in this work we describe the design of a mobile-computing-based app (called *Recognize*) that can help individuals with I/DD independently learn how to recognize abuse. We selected an app as the modality for this work because it is the best suited for the needs of our population. Mobile computing technologies (like smartphones, tablets, etc.) are regularly used by individuals with I/DD in the US [40, 62]; therefore an app designed for such platforms will enable crucial information about abuse to be always available to them. Abuse prevention training for individuals with I/DD occurs in several locations in the US: some are in-person [41] and others online [47]. Their reach, though, is often limited because they are held at specific times or in a specific location. The use of an app to teach people about abuse therefore has the potential to reach a large number of people in the I/DD community relatively easily. Finally, for people with I/DD who have already attended some form of abuse prevention training, the app provides an easy way to review and better retain the concepts over time. Note that this is on-going work. Therefore, this paper does not describe a finalized artifact (i.e., app) but rather how we went about designing it and what we learned in the process.

We conducted a *co-design* process where a subset of the research team (called *design team 1*), evaluates and ideates over *design concepts* initialized by a mutually exclusive subset of the research team (called *design team 2*). *Design team 1* included four of our co-authors, three of whom are self-advocates and individuals with I/DD and one who is a neurotypical coordinator. All members of *design team 1* have a decade of experience teaching an in-person abuse prevention training, which forms the basis of the learning content within *Recognize* (see Section 1.1). *Design team 2* had four neurotypical members who are HCI and psychology researchers.

Given that *Recognize* is being designed for independent self-learning by individuals with I/DD, the design concepts that *design team 2* initialized fell into two broad categories: *learning and engagement*. The former focused on presenting the learning material that teaches about various forms of abuse. The latter is focused on encouraging individuals with I/DD to maintain consistent use of the app, despite the difficult and potentially triggering material being conveyed. Engagement therefore included activities for emotional self-regulation and maintaining motivation. From the co-design process, we developed six recommendations for the app, to follow.

Based on our findings from the co-design process, we developed three initial *implementation prototypes*² of *Recognize*. All three prototypes showed content presenting what constitutes sexual abuse. The prototypes differed in the types of learning materials they included. Version A presented all of the learning materials statically like a slide presentation. Version B's learning materials had some static content (for presenting the big picture) but its centerpiece was a video that enacts the prelude to a potential sexual abuse

²Implementation prototypes focus on the techniques and components through which a prototype performs its function; that is, how it actually works [30].



(i) Abuse prevention workshop



(ii) Flag activity in the workshop

Figure 1: Scenes from the Awareness and Action (A&A) Abuse Prevention Training; this curriculum is the foundation of *Recognize*

situation³. Version C, similarly, had some static content to set the stage but its main material focused on refining a skill (to identify no-touch regions on the body) to help with abuse detection. All prototypes were implemented with the same additional elements. These included a grounding activity that displayed a xylophone-like interface that allows one to play musical notes and an emoji-based reward mechanism, which generates a new, random emoji from the OpenMoji database [45] whenever someone successfully completes a lesson on the app.

We next performed a *qualitative user study* by recruiting six participants with I/DD who are also instructors for people with I/DD: one was an instructor for an employment training and five were abuse prevention training instructors (described in Section 1.1). These participants were mutually exclusive from the members of *design team 1*. We conducted the entire user study over Zoom because of COVID-19 restrictions. Broadly speaking, we found that the participants felt that *Recognize* would be viable as long as the learning material was presented in an interactive manner, as done in versions B and C. This was despite the potentially triggering nature of the video content in Version B. The participants also stated that *Recognize* would be useful for individuals with I/DD to convince others of what happened to them. This can help to overcome the current issue where individuals with I/DD are not believed when they talk about their abusive experiences [2]. As this is on-going work, we end the paper by describing some of the implications of our findings toward developing a full prototype of *Recognize*. In the rest of the paper, for brevity, we use the terms user(s) and individual(s) with I/DD interchangeably.

1.1 Source of Learning Materials Used in *Recognize*

Before we delve into the details of our design process, we present a quick overview of the learning materials that *Recognize* uses. The learning material in *Recognize* is based on **Awareness and Action (A&A)**, an abuse prevention training conducted by our partners in the project — Massachusetts Advocates Standing Strong (MASS), a self-advocacy organization⁴, with the help of the Massachusetts

³The actors in the video included people with I/DD.

⁴A civil rights group of people with I/DD that advocates for people with I/DD taking control of their own lives.

Disabled Persons Protection Commission (DPPC), a state Adult Protective Services (APS) agency⁵, and the Massachusetts Department of Developmental Services (DDS), a state disability service agency⁶.

The three-hour-long, in-person, training educates individuals with I/DD and others about understanding abuse committed against adults with I/DD (see Figure 1(i)). *The workshop is primarily taught by individuals with I/DD.* It introduces the abuse of individuals with I/DD through five powerful, short videos⁷, a slide presentation, and worksheets. The comprehensive training closely examines five different types of abuse - physical, sexual, neglect, verbal, and financial. The entire process is highly interactive and attendees are asked to participate in a variety of activities during the course of the training. One example is the *flag activity*, where participants use a red or green flag to signal what is and what is not abuse in a video being played for them (see Figure 1(ii)). Our aim is to not only adapt the curriculum from this training into an app but also to leverage techniques from the in-person training setting that can be translated into our app as a way to improve engagement and independent learning for individuals with I/DD. The abuse prevention training is one-of-a-kind. Its curriculum and outreach materials have been shared with over 75 organizations in 46 states in the US and at least 3 other countries over the past 10 years.

We do not claim that *Recognize* will or should replace any existing or planned in-person abuse training. However, the availability of the app will diversify and increase the options available for individuals with I/DD to learn about abuse and make the information more easily available to them.

2 RELATED WORK

To the best of our knowledge no prior work has focused on the use of technology for teaching individuals with I/DD about abuse. The extant work at the intersection of teaching, technology, and individuals with I/DD can be grouped into four broad categories, which we describe below.

Understanding technology use in teaching individuals with I/DD: In recent years, several research efforts have tried to understand the role and use of technological tools for teaching individuals with I/DD. This research has focused on: the role of technology in face-to-face instruction [28], using iPods and iPads for instruction [19], the comprehension of video content [21], the role of massive online open courses (MOOCs) in instruction [32], accessibility barriers in online education [9], online information retrieval [54], and the use of computer-based vocational training in economically developing countries [16]. Technological tools have also been developed for improving pedagogy for individuals with I/DD. In this regard, research has focused on solutions, such as automated readability assessment [25], using tangibles for learning [24], and instructional pacing support for educators [33]. None of this aforementioned work has focused on teaching individuals with I/DD sensitive and triggering content like abuse.

e-Learning tools for individuals with I/DD: Much work has been done in developing education tools for use by individuals with I/DD. These can be broad tools that aim to improve the learning process for individuals with I/DD, such as smartphone-based tools for inclusive education [63], learning through video blogs [23], and professional training [6]. However, the bulk of the research in this area has been focused on developing specific skills for individuals with I/DD, often leveraging the mobile computing revolution of the last decade and a half. These include developing skills related to: grocery shopping [37]; understanding shapes, colors, and counting [10, 38]; life-skills training [4, 8, 55]; developing creativity and narration [51]; developing social-media-mediated social connectedness [3]; and performing outdoor physical activities [59]. None of these efforts focuses on teaching content that is triggering to individuals with I/DD. Our effort in this paper is thus unique as compared to all of the other online or e-learning work focused on individuals with I/DD that has preceded us.

Designing e-learning tools for individuals with I/DD: We are building an e-learning tool for individuals with I/DD and, therefore, it is important to see how such tools have been built to support the I/DD community in other contexts thus far. Overall, when it comes to e-learning, it has been found that individuals with I/DD are well versed in using apps [16] and have a good understanding of the standard icons and metaphors used in their interfaces [9]. Moreover, it was found that they enjoyed app-based lessons more than paper-based lessons when learning skills [10]. Prior work has also revealed several design lessons for e-learning tools for use by individuals with I/DD. These include: (1) using images [10, 37, 38], interactive content and videos [7, 21, 22, 37]; (2) using concrete, big, differentiated icons and symbols [9]; (3) making the content accessible by supporting audio description of images [4, 59], and accommodating different levels of literacy [16]; (4) reducing information overload [16]; (5) providing hints judiciously to prevent individuals with I/DD from becoming too dependent on the hints [32]; (6) using positive reinforcement when successfully engaging with the content [10, 32]; (7) avoiding multiple clicks to complete a task [10]; (8) having a “cooling off” period if frustrated, to improve independent problem-solving regarding using the technology [9]; and (9) providing self-paced learning [32, 33, 38, 51]. We have incorporated many of these lessons in *Recognize*, such as using: appropriate learning modalities for individuals with I/DD (e.g., incorporating simple text, images, videos, and interactive skill activities); simple interfaces; and positive reinforcement. Thus, what we investigate in this paper, which has not been investigated before, is how well do these design considerations work when dealing with imparting sensitive and triggering content.

Teaching individuals with I/DD about personal boundaries: The work closest to ours was reported in [15], where the author explored a gamification-based approach for developing an understanding of personal relationship boundaries for individuals with I/DD. The idea was to develop an application called Boundaries. It took the form of a flip-book that presented specific scenarios to its users (i.e., individuals with I/DD) and asked them if they were acceptable or a violation of boundaries. The scenarios presented were randomized via a one-armed bandit lever, which could be “pulled” to create an infinite set of new scenarios. Boundaries is a serious

⁵APS is a general term for department(s) of various US states, counties, and/or local governments responsible for coordinating the response to the abuse of older adults or adults with disabilities.

⁶Department(s) within a US state, county, and/or local government responsible for providing support services to adults with disabilities to enable them to participate fully in their communities.

⁷Many of the actors in these videos are self-advocates and other individuals with I/DD.

game that computes a risk score to aid behavioral therapists in identifying risky action, with the goal of starting a conversation with people with I/DD around awareness. We believe our app represents an alternate, broader effort. Once fully developed, *Recognize* will explore abuse in all of its forms, some of which (e.g., financial abuse and neglect) can extend beyond personal relationship boundaries. One can imagine that, after using our app for a while, an individual with I/DD could play a game like *Boundaries* to evaluate how well they have internalized concepts pertaining to, say, unwanted touching, which is covered in the A&A training curriculum pertaining to sexual abuse. In this regard, we view our effort as complementary to *Boundaries*.

3 THE CO-DESIGN PROCESS

We developed *Recognize* through a co-design process with individuals who experience I/DD. In determining how best to apply co-design to our project, we took inspiration from recent works in two broad areas. One, auto-ethnographic design [35, 42] where designers themselves experience their designs, as a way to learn more about their properties. Two, co-design with individuals with I/DD [5, 13, 30, 53, 56, 57], which is a form of participatory design where the opinions of individuals with I/DD are sought when designing technology that supports them. In our co-design process, a subset of the research team (referred to as *design team 1*), made up of individuals with I/DD who are self-advocates and have years of prior experience conducting A&A training, evaluates and ideates over the design concepts initialized by another subset of the research team (*design team 2*) who are researchers in HCI/psychological sciences.

Members in *design team 1* are individuals with I/DD who work for our partner self-advocacy group *Massachusetts Advocates Standing Strong (MASS)*. MASS offers support for people with I/DD to make their own choices, learn skills, and advocate for themselves and others. The group's entire board of directors is made up of people with I/DD. By collaborating with them, we positioned the voices of people with I/DD front and center in our work. Further, we worked hard to build and maintain trust among all members of the team, academics and individuals with I/DD, over 1.5 years. Some of the highlights of this process include: (1) regular meetings where we not only discussed the project but also got to know each other, (2) self-advocates giving guest lectures in researchers' classes, and (3) inviting the self-advocates to teach yoga and mindfulness in online group meetings during the pandemic. This close relationship lowered the natural barriers that can inhibit the creative expression of the team members with I/DD and fostered open discussions of ideas.

3.1 Design concepts

As a first step in conducting the co-design process, a subset of the authors (who are neurotypical), i.e., *design team 2*, initialized several *design concepts* for the app. We define design concepts as ideas for a design [50]. These were expressed as *vignettes* from the eventual app that described a major aspect of the app (e.g., how to present the learning material from the A&A curriculum within the app). We based the vignettes on the concept of design probes, which are instruments that help the research team navigate through the

design space in a structured fashion [57]. The ideas for the design concepts were generated through a multistep process. As a first step *design team 2* iteratively created and evaluated personas and use-cases [50] with a focus on designing the app to be engaging to individuals with I/DD. Several *design team 2* members attended A&A trainings to understand how the learning material used in the app is conveyed in in-person settings. Finally, *design team 2* studied the relevant literature associated with developing educational tools for individuals with I/DD to arrive at the design concepts that could be used as part of the app.

Overall six design concepts were generated and evaluated in the co-design process. Each of these design concepts was implemented as a *vignette*, a snapshot of the app. All of the design concepts were then implemented in HTML/JavaScript, which are illustrated in Figures 2 and 3. The design concepts can be divided into two broad categories: (1) design for learning and (2) design for engagement. The former focuses on presenting the learning material while the latter is about maintaining engagement for the users and grounding them, given the sensitivity of the content. The design concepts can be seen in more detail here: <https://www.tomhoward.codes/thesis/supplementary-materials-01>.

3.1.1 Learning design concepts. These design concepts determine how the app presents the A&A training curriculum material to individuals with I/DD to promote their learning about abuse. We looked at four learning design concepts gleaned from a combination of the A&A curriculum and prior work in teaching individuals with I/DD. A snapshot of the four learning design concepts is shown in Figure 2. There is one-to-one mapping between the following four learning design concepts and the four sub-figures in Figure 2.

Static learning material: The principal way the learning material was structured in the in-person A&A training was through a collection of presentation slides, which had an image of a type of abuse with some simple supporting text. Therefore, one design concept for presenting the learning material within the app was to copy this style and present all of the learning material in the form of "slides" that display the presentation slides from the abuse prevention curriculum in the app, as shown in Figure 2 (i)).

Video-based learning material: Video-based content has been shown to be effective in teaching individuals with I/DD and has been found to improve comprehension, better mental models, and focus attention for individuals with I/DD [7, 21, 22, 37]. Consequently, we wanted to integrate video-based learning material into the app. The A&A training provides videos for the five types of abuse. In this design concept, we aimed to see whether the videos themselves would suffice as adequate learning material when describing different types of abuse. Further, when the videos are shown to the participants during the in-person workshop, it is a very interactive experience. Attendees participate in the flag activity (described in Section 1.1) when watching videos. Taking inspiration from the flag activity, our video-based learning concept showed one of the many videos from the in-person workshop curriculum and asked the users to signal abuse or no abuse by clicking one of two buttons provided as the video is playing. If users successfully marked the abusive segments of the video as containing abuse, they would then be asked to identify the type of abuse. However, if the users did not successfully flag the abusive behavior, a series of questions would

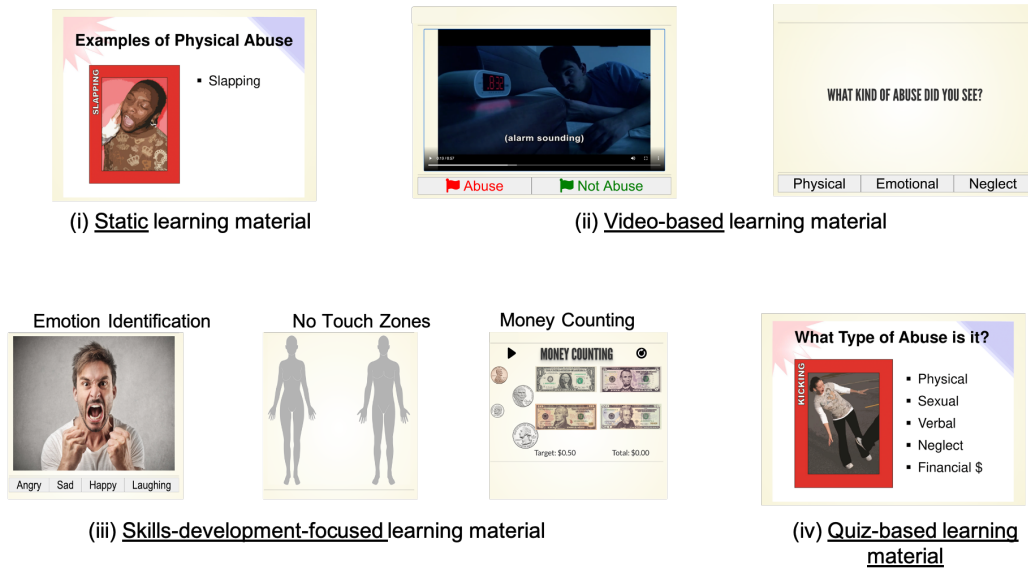


Figure 2: Learning design concept vignettes discussed during the co-design process

follow the video to help them better understand the abusive behavior they witnessed in the video. Note that since the videos show a prelude to sexual abuse, they can be triggering to the audience (see Figure 2 (ii)).

Skill-development-focused learning material: Inspired by previous work in [52], instead of focusing entirely on the material itself, this particular design concept was proposed as a way to help individuals with I/DD refine skills that would help with abuse detection. Our design team 2 initialized three forms of interactive skill-building activities: *emotion identification*, *private body parts identification*, and *counting money*. Inspired by [61], the emotion identification activity asked users to select the emotion that the person in the image was expressing. The hope for this activity was that enhancing somebody’s ability to detect and identify various emotions would help them better identify warning signs of abuse. The private body parts identification activity centered around identifying no-touch zones on (biologically) male and female bodies. Within this activity, users are asked to identify the no-touch zones on drawings of a male and a female body by selecting the zones on their screen. This activity was based on a similar exercise from the A&A training. Finally, the counting money activity was centered around making change, which was inspired by a similar activity developed in [10]. The activity would require users to select US currency denominations until they had reached a pre-specified amount (see Figure 2 (iii)).

Quiz-based learning material: Numerous prior studies focused on teaching individuals with I/DD have included a short quiz as part of their learning materials [11, 38, 52, 63]. The A&A training uses quizzes with multiple-choice questions extensively as well. Therefore, we envisioned a design concept where the entire app was a collection of binary or multiple choice quiz questions. The idea was to ask questions as a way to teach about abuse, similar to the Boundaries app [15] (see Figure 2 (iv)).

3.1.2 Engagement design concepts. These design concepts were focused on implementing techniques within the app that encourage users to maintain their independent self-learning over time. This is important because, given the sensitive nature of the material in the app, individuals with I/DD using the app may feel triggered, which could potentially dissuade them from going through some or all of the content. Further, users may need additional motivation to keep using the app even after they have seen all of the learning material (maybe several times) in order to help them retain the material over time. We looked at two engagement-related design concepts. They are independent of the learning material and are necessary because of the sensitive nature of the content. The interfaces pertaining to these concepts are shown in Figure 3. Once again there is one-to-one mapping between the two engagement design concepts described below and the two sub-figures in Figure 3.

Motivation: Inspired by the work in [36], the purpose of our motivation design concept was to generate motivation for individuals with I/DD using the app by giving them a reward for using the app while also preventing the emergence of extrinsic competition. Rewards have been used with individuals with I/DD as a way to motivate them in learning in the past [63]. Our design concept to motivate individuals with I/DD to use the app was based on using an *anthropomorphic virtual being*. Even though anthropomorphic virtual beings are often used in design for engaging children [14, 27, 46], there have been prior efforts in using such virtual beings for adults as well. Most of the effort on this topic has focused on engaging older adults as a way to help them with: issues of loneliness [12, 48], activities of daily living [60], depression [18], and even suicide prevention [39]. Given that the learning material can be triggering and the self-learning process can be isolating and lonely, we decided to use an anthropomorphic virtual being as a way to encourage the individual with I/DD to continue using the app. To wit, we implemented an *in-app virtual friend* in the form



Figure 3: Engagement design concept vignettes discussed during the co-design process

of a pink blob, called *Bob*, that would be happier (i.e., smiling) if the app was used and this happiness would decay over time (i.e., acquire a frowning face), thus encouraging frequent use of the app to keep Bob happy (see Figure 3 (i)).

Grounding: The material presented in the application is of an emotionally charged nature, especially considering that many individuals with I/DD may have experienced abuse first-hand [2]. Grounding activities provide a therapeutic and creative tool that aims to strengthen the connection to one’s body and to one’s personal reality and can thus help in calming a person in the event of trauma or triggers [17]. In the end, we chose an uncomplicated box-tapping activity for grounding purposes, based on its simplicity and the fact that similar activities that have been designed for use by individuals with I/DD (though not in the context of grounding or self-regulation) when using mobile computing devices [49] (see Figure 3 (ii)).

3.2 Co-Design methods

The two design teams conducted an intensive co-design process to determine which (if any) of the design concepts considered were worth pursuing further as part of *Recognize*. Specifically, our aim with the co-design process was to answer *two broad research questions*. **RQ1**: How should the design concepts be structured to promote *learning* by individuals with I/DD via the app? **RQ2**: How should the design concepts be structured to promote *engagement* by individuals with I/DD via the app?

3.2.1 Co-Design participants. *Design team 1* consisted of the fourth, fifth, sixth, and seventh authors, referred to as C1-C4, respectively, for brevity. Three of them are individuals with I/DD, C1 (female), C2 (male), C3 (male). C1 has limited reading, writing, and spelling skills. C2 is legally blind. C3 has cerebral-palsy-related speech and mobility impairments and uses a motorized wheelchair. C2 and C3 are also abuse survivors. The other member of design team 1 is a neurotypical woman (referred to as C4) who works with the self-advocates on a daily-basis and coordinated services for them. C1-C3 (supported by C4) have each led A&A trainings for over 10 years and conducted over 100 trainings. They also played an important role in putting together the original training curriculum. Finally, C1-C3 are self-advocates, leaders, and very active in advocating for themselves and their community’s needs. All of them (i.e., C1-C3) can express themselves clearly and, given their training experience, have a superb understanding of the problems that others with I/DD face while learning, which is reflected in the recommendations in

Section 3.3 and includes keeping evaluation optional and ensuring that any motivational elements do not penalize the user. *Design team 2* was made up of five of the authors: the first three authors and the ninth and tenth authors, all neurotypical.

3.2.2 Co-Design process. The first intensive meeting of the co-design process was done in-person. For this meeting individual design concept vignettes were initialized by *design team 2* and brought to the meeting. These vignettes were projected onto a large main screen in the room and also printed so that they could be distributed to all participants within a physical binder. Members of *design team 1* were free to ask *design team 2* to click anywhere they wanted on the individual vignettes so that they could experience the interaction with the design concept. *Design team 2* took members of *design team 1* through each of the aforementioned design concepts one by one. As mentioned before, the two design teams being tight-knit allowed individuals with I/DD to be vocal and candid about their needs and thoughts with respect to the design concepts being discussed. *Design team 2* members took notes during the session, which was also audio-recorded in its entirety with consent from all members of *design team 1*. The co-design process was designed to be iterative; however the excellent working relationship between both design teams made it shorter than originally planned. We had one in-person synchronous session just before the COVID-19 shutdown, where most design decisions were made. The process was repeated asynchronously online once more to confirm the designs.

3.2.3 Co-Design analysis. Members of *design team 2* transcribed the co-design process. Several members of *design team 2* then reviewed the transcript for common themes and frequency of responses for each of the design concepts. After merging these codings into one data file, the first author (who was a member of *design team 2*) then analyzed the data, based on the frequency of themes, for each of the design concepts. The first author then iteratively reorganized the themes until we arrived at the categories described below.

3.3 Co-design findings: Both learning and engagement design concepts need to be designed to be easy to understand, while also avoiding potential triggers

Our findings from the co-design process are listed as recommendations, which are split into recommendations for learning-related design concepts (referred to as LRs), followed by engagement-related design concepts (referred to as ERs).

3.3.1 Recommendations for learning. We had four design concepts associated with learning. We describe the recommendations from the co-design process for all four next.

LR1: Static content is necessary to convey an overall understanding of abuse. In general, design team 1 liked the idea of using “slide”-like static learning material directly from the workshop curriculum. They felt that the static content was necessary to make sense of the bigger picture of the type of abuse being described in the lesson. As stated by C3, “I mean yeah, as much [of] the slides that you can use for the training would help out with the app and with everything like that.”

LR2: Interaction with videos should be easy to understand. For the video-based learning material, each video was divided into a discrete number of shorter clips that were coded as containing abuse or not containing abuse. When the video played, if a participant failed to signal a clip that contained abuse as having abuse, the system would record this event and react at the end of video by asking appropriate follow up questions, as described in the previous section. Overall, members of *design team 1* believed that having such a video would be helpful but that its workflow was too complicated. C3 joked, “Can you see the smoke coming out of my ears yet?”, when mentioning the need to flag abuse or the lack thereof as the video was playing. Instead of playing the entire video and then asking questions, C3 suggested that we break the video down into clips, stop after every clip and ask if the user believed abuse had occurred in it, by stating, “stop the video, ask a question, then go on.”

LR3: Skill development activities should be carefully chosen to avoid triggers. The idea behind skills activities was to develop higher-order skills that would benefit the user by helping them identify abuse. The first skill evaluated was the emotion identification activity, which showed an image and required the selection of the emotion that the person in the image was expressing. The identifying-emotions skill was quickly rejected by design team 1. The team members thought that such activities might be misconstrued by individuals with I/DD. As C3 put it, “To some people, that’s gonna be a scary thing because they’re gonna see that and they’re gonna say is that guy gonna hurt me?” Similarly C1 stated, “I think that mad face may not work for some audience members.” The other two activities were favorably reviewed. All team members thought the private body parts identification skill was important and suggested that the activity provide clear feedback when a correct region was selected. When it came to the counting money skill the team thought it was a good idea to teach such a skill; as stated by C4, “I have incidents of people borrowing money, or taking it and ‘here I paid you back’ and it’s, you know, someone takes a dollar [instead of] twenty [from someone without their knowledge].”

LR4: Quizzes should be used for enabling users to practice their knowledge and should be optional. Members of *design team 1* felt that a quiz had a role to play in the app but as a way of allowing users to practice what they learned and not as the primary way to learn about abuse. As C3 put it, “[The app] should either, you know, talk about... abuse or show [a] video before asking any [quiz] questions.” Further, members of *design team 1* understood that quiz questions might be anxiety-provoking to some individuals with I/DD due to (1) the potential sensitivity of the quiz question and (2) the perceived evaluatory nature of the quizzes. However, at the same time, they also realized that it was often necessary for users to practice what they had learned in order to internalize the material. As C3 put it, “[The quiz] seems uncomfortable; it may trigger even more. It may be something people don’t like to take because it feels like an exam... but to see if you’ve learned something, it seems [necessary].” As a compromise, C4 suggested that the quiz questions in the app might be designed to be “an option for anyone who chooses to take it.”

3.3.2 Recommendations for engagement. We had two design concepts associated with engagement: the use of a virtual friend for motivation and a grounding activity in the form of a box-tapping activity. We describe the recommendations from the co-design process for both.

ER1: Ensure that motivational elements do not penalize. Overall, members of *design team 1* did not support the idea of having a virtual friend (i.e., Bob) that would become unhappy over time, as a way to maintain engagement with the app. They believed that many individuals with I/DD may not understand why Bob became unhappy over time. Further, *design team 1* unanimously agreed that motivational elements of the app should not be designed such that they negate past successes of users. As C4 put it, “[The app should] never take anything away from somebody.” To compensate, they suggested the use of a monotonically progressing reward mechanism to motivate users to come back to the app, as evident in the following statement by C4: “If you were able to have different items that they could access as they level up; they never get taken away from them.”

ER2: The grounding activities are necessary and the duration of their use should be determined by the user. Overall, the app is being designed for individuals with I/DD to use by themselves. Members of *design team 1* observed, based on the the content of the various design concepts, that the application contains material that could be triggering to individuals with I/DD who may need something to help emotionally regulate themselves. As observed by C1, “It can be a little hard for people [to go through the training] but we understand.” C2, similarly stated, “The... one that really triggers is the sexual one.” They unanimously agreed that the grounding activity design concept could be used to calm users and keep them using the app; as stated by C2, “[Grounding activities] keep more people engaged.” Finally, the team suggested that grounding activities should not be of a specific duration but that the user should decide when they want to exit the activity. As stated by C4, “So, if you could x-out of [the grounding activity] if you didn’t need to continue. But if you wanted to, you could [continue] with some sort of [grounding activity].”

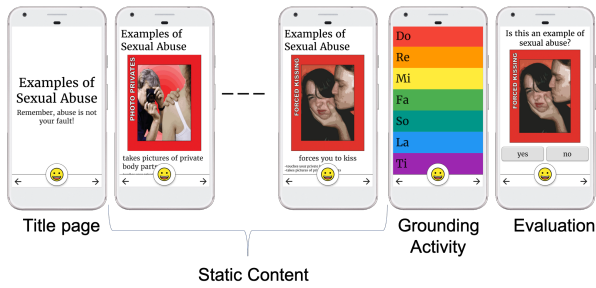


Figure 4: Screenshots from the version A prototype of *Recognize*. This version contains only static content pages (aka “slides”). Only one quiz question is shown for each prototype even though we used 2-3 questions in each prototype. Dashed lines between screen shots indicate other screens that are not shown for brevity.

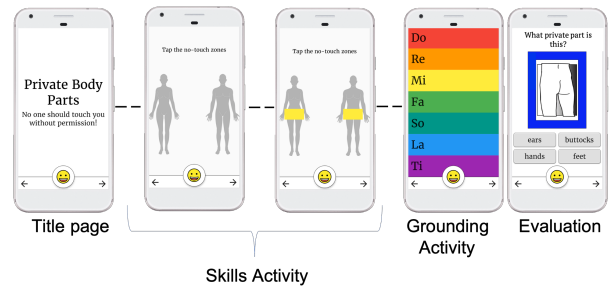


Figure 6: Screenshots from the version C prototype of *Recognize*. We do not show the static content pages that preceded the skill activity. Only one quiz question is shown for each prototype even though we used 2-3 questions in each prototype. Dashed lines between screen shots indicate other screens that are not shown for brevity.

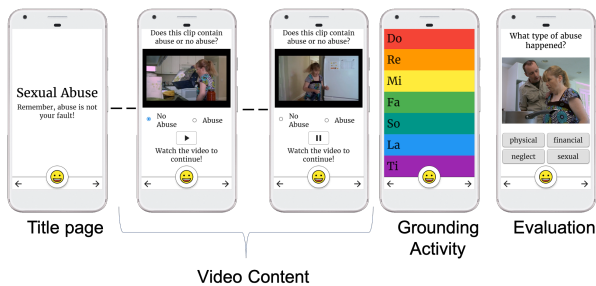


Figure 5: Screenshots from the version B prototype of *Recognize*. We do not show the static content pages that preceded the video content. Only one quiz question is shown for each prototype even though we used 2-3 questions in each prototype. Dashed lines between screen shots indicate other screens that are not shown for brevity.



Figure 7: Screenshots from the always available emoji menu in *Recognize*. It provides the ability to call an APS agency or an emergency contact as well as the ability to change the emoji icon at the bottom on the app screen.

4 THE THREE PROTOTYPES OF RECOGNIZE

Based on the feedback obtained from the co-design process, we created three *implementation prototypes* [30] of *Recognize* in Dart/Flutter [26]. We focused on developing implementation prototypes at this stage because we wanted to understand to what extent the manner in which the app presented its information would be conducive for individuals with I/DD to use for self-learning. These prototypes contained four *elements*: (1) a lesson (i.e., learning material) on a specific type of abuse, (2) one or more quiz questions based on the learning material, (3) a reward mechanism for completing a lesson, and (4) a grounding activity for coping. All derived their design from the co-design recommendations. For the purposes of this study, all prototypes featured a single lesson on *sexual abuse*. Below we describe our three prototypes, named versions A, B, and C.

4.1 Learning elements across prototypes

The prototypes differed in the types of material that formed the centerpiece of the lesson. Quiz questions were included in all three versions to help them evaluate their understanding of the lesson

content. We describe the lessons across the prototypes below. All of the content for these prototypes was obtained from the A&A training.

4.1.1 Lesson based on static content: The lesson in this version (version A) consisted of a set of static content pages with a representative image and some associated text (also referred to as “slides”) about various forms of sexual abuse. Based on *LR1*, this static content was deemed essential for users’ broader understanding of each specific type of abuse. Version A had 10 slides, which formed the centerpiece of the lesson (see Figure 4).

4.1.2 Lesson based on video content. The lesson in this version (version B) also focused on sexual abuse. It had two “slides” to set the stage but the centerpiece of this version was an interactive video. This video, based on *LR2*, paused at specific intervals to prompt the user to enter whether they saw abuse in the preceding video clip (see Figure 5).

4.1.3 Lesson based on a skills activity. This version (version C) used four “slides” that described various private body parts. We used a skills activity as the centerpiece of this version. Based on *LR3* of

the co-design process, we focused on using a private body parts identification skill and clearly provided feedback on the success or failure of an individual's response (see Figure 6).

4.1.4 Quiz for practice. As can be seen in Figures 4, 5, and 6, all prototypes had a quiz toward the end of the lesson. These were implemented as either yes/no or multiple choice quiz questions and pertained to the material covered in the lesson. From *LR4* we know that quiz questions in the app should be based on specific lessons shown to participants. Therefore, each lesson was followed by 2-3 quiz questions, depending on the lesson content. The questions changed in each of the prototypes, based on the learning material. When a participant pressed the wrong answer, the app would gently inform the user that the answer was wrong and encouraged them to try again. As recommended in *LR4*, the quiz was optional and the participant could click the forward arrow button (at the bottom of the screen) to move on without answering any of the quiz questions.

4.2 Engagement elements across prototypes

The reward delivery mechanism and grounding activity were the same across all three prototypes (versions A-C). Based on the recommendations from the co-design process, we designed an emoji-based reward mechanism for motivating users and a music-based grounding activity. The reason we kept the engagement elements the same across prototypes was because we were primarily interested in knowing whether engagement elements were necessary for individuals with I/DD in using the app or not. We describe these engagement elements below:

4.2.1 Emoji-based motivation. For promoting engagement with the app, we used an emoji-based reward system in all three prototypes. Whenever a participant completed a lesson, they were rewarded with a random emoji from the OpenMoji database [45]. The OpenMoji database was not used in its entirety, as it has several emojis that are featureless (e.g., boxes) or others that can have a negative connotation in our context (e.g., a person who is hurt). We manually removed such classes of emojis from our database before incorporating it in the prototypes. Based on *ER1* of the co-design process, we designed each user's emoji list to be ever-growing. The emojis were chosen at random to avoid any kind of comparison or competition among multiple users on what they earn. Users can change the emoji being displayed at any time by choosing a new emoji from the available list of emojis, which are accrued as they complete lessons. All versions have the currently selected emoji visible at the bottom of the screen. Further, the emoji icon itself functions as a button that, when clicked, takes the participant to a help menu where they can ostensibly call an APS agency or a trusted friend or change the emoji (see Figure 7).

4.2.2 Music-based grounding. It has been shown that music can play an important role in regulating individuals with I/DD in the event of trauma or anxiety [58]. Therefore, instead of using the box-clicking grounding activity from the co-design process, we implemented a musical grounding activity where a xylophone-like interface would allow users to play musical notes as a way to regulate themselves (see Figures 4, 5, and 6). Based on *ER2*, participants were given the opportunity to ground themselves after encountering difficult material. Consequently, the grounding activity always

immediately followed the learning material. The grounding activity could be exited anytime a participant wanted by clicking the forward arrow button.

Once these prototypes were developed, the two design teams discussed the prototypes to confirm that we had incorporated all of the recommendations from the co-design process. We next performed a qualitative user study of the prototypes with several individuals with I/DD who had extensive experience teaching other people with I/DD. We describe this below.

5 USER STUDY: QUALITATIVE EVALUATION OF THE *RECOGNIZE* PROTOTYPES

In this study, we evaluated the three prototypes of *Recognize*. The idea was to answer three important research questions: (**RQ 3**): Which of the learning elements would be the most effective for individuals with I/DD when using the app? (**RQ 4**): Are the engagement elements useful within the app? (**RQ 5**): Is this app helpful enough to be used by and recommended to individuals with I/DD? Initially, we had intended to evaluate our prototypes on actual devices in person. However, because of COVID-19, we had to move our prototype evaluation online to be conducted via Zoom. Participants used the Zoom remote control feature to remotely control and interact with the three prototypes being executed on an Android emulator by the research team. Before going into the details of the results, we first provide details of the study methods and the participants.

5.1 User study methods

This study consisted of recruiting several participants with I/DD (distinct from the members of *design team 1*) and asking them to evaluate the three prototypes. These participants were very familiar with the material being taught in the app and had considerable experience in teaching workshops for other individuals with I/DD. This study was therefore a form of expert-based evaluation [34] of the design decisions of the app.

5.1.1 User study design. Evaluations were completed with one participant per session over the course of two weeks. Each session lasted approximately one hour. Participants initiated the session by signing into the Zoom conference call via a provided link at a pre-determined time. Once a participant joined the meeting, a researcher verbally walked them through the informed consent form. After confirming that the participant understood the nature of the research, we commenced the user study. The informed consent forms were specifically designed to be easy to use and understand by individuals with I/DD, as we did in our prior work [62]. The consent forms had already been signed and submitted prior to scheduling the user study session.

During each session three distinct prototypes were shown to the participant, one by one. The order in which the participants viewed each version was counterbalanced. At the beginning of the study, each participant was given a quick orientation of the application running on an emulator. They were encouraged to vocalize their thoughts as they navigated the version being presented to them, as much as they wanted. Subsequently, control of the emulator was transferred to the participant via Zoom's remote control feature. Once a participant went through an entire version, we asked them questions about the version they just saw, with the same process

ID	Gender	Age	Disabilities	Type of instructor	Length of teaching experience
P1	Male	34	Autism	A&A training	7 years
P2	Female	46	I/DD and Partially hearing impaired	A&A training and employment training	15 years
P3	Male	29	Autism and seizure disorder	A&A training and employment training	6 years
P4	Male	43	I/DD and Acquired brain-injury	A&A training and employment training	10 years
P5	Female	27	Williams Syndrome	A&A training and employment training	3 years
P6	Male	43	Autism and Pervasive Developmental Disorder	Employment training	7 years

Table 1: Demographics of the participants, all of whom have I/DD per AAIDD’s definition (see page 1), in the user study.

being repeated for all three versions. Finally, after a participant interacted with all three versions, they compared and contrasted the three versions and debriefed us regarding their overall experience. The participants were given ample time to go over the three prototypes and answer questions, which were interspersed between versions. The entire process was video- and audio-recorded using Zoom’s recording features, for analysis (with the participants’ consent). Two participants (P1 and P5) could not use Zoom’s remote control feature from their devices. In such cases, participants verbally told us what to click and when. The control of the navigation was always with the participants. For these two cases, we acted solely as the “hands” of the participant. All documents used for this study were approved by the relevant ethics boards.

5.1.2 User study participants. There were six participants recruited for this study. All six participants were individuals with I/DD who are self-advocates with Massachusetts Advocates Standing Strong (MASS), our partner self-advocacy agency. As our three implementation prototypes were focused on the functionality of the app and not its look and feel, we specifically recruited individuals who were instructors and very familiar with the content of the abuse prevention workshop to evaluate the prototypes. To minimize the cognitive load on the participants of the user study, we recruited from a pool of instructors who could communicate effectively and were intimately familiar with the training material. Four of the participants were both A&A training and a different employment training instructors, one participant was just A&A training instructor and one instructor was just an employment training instructor. The latter had attended the A&A training before and was familiar with the material. All of the participants had several years of teaching experience. The profiles of our user study participants are listed in Table 1.

5.1.3 User study analysis. After the user study, the collected Zoom recordings were transcribed. We performed an inductive thematic analysis of the interview transcripts with the goal of identifying participants’ sentiments toward each prototype version. The codes that emerged from the thematic analysis were coalesced into one data file. The first author then analyzed the transcripts based on the frequency of themes for each of the prototypes. The results of our analysis are summarized in the findings below.

5.2 User study findings: Participants liked learning elements that were interactive in nature

The three prototypes mainly differed in the way they displayed the learning material. Below we describe our findings in the user study with respect to our participants’ reactions to the learning elements in the three prototypes.

5.2.1 Static content in the lessons was deemed to be less engaging. Not surprisingly, most of the negative reactions were reserved for version A, which was static in nature and did not involve any interaction with the user except in the quiz portion. This static content was often considered boring. As P1 put it, *“It’s not engaging.”* When asked to rate the best of the three versions, version A was never preferred. When asked why they did not prefer version A, the response was mostly that it was monotonous. As P5 put it, *“I think if you just have slides, then the slides just run together.”*

5.2.2 Video content was liked despite its potential to trigger. The content of the app (i.e., information sexual abuse) is sensitive and potentially very triggering. It was therefore very interesting that videos were preferred over slides despite their more visceral nature as compared to the other versions. P6 said, *“The video content may [be] uncomfortable, as it was [suggesting sexual] abuse.”* In fact, version B received the most positive comments of all three versions⁸. P1 put it quite explicitly, commenting during his interaction with version B, *“[I] definitely like this version better because it plays the video clips... because you get to see [an example of abuse] in action.”* Even though P4 and P5 preferred version C at the end, they both shared some key insights as to why the videos were so effective. P4 stated, with regard to the video, *“[Individuals with I/DD will] understand it better [with videos] than if you’re just showing pictures.... How do we know what it means if we don’t have the video in it?”* Similarly, P5 stated, *“[The slides] don’t give you an example of reality but when you put in videos, now you have a reality.”*

5.2.3 Quiz questions were considered useful. All six participants liked the quiz and its interactive nature and thought the quiz questions were useful to have. As P3 put it, for multiple choice questions, *“I like that it asked... multiple choice questions and that it gave four different answers and that... it looked like it had one of the correct answers on there and the other three were like random”.* When a participant pressed the wrong answer, the app would encourage the user to try again. This feature was especially appreciated by P4, who suggested that, in addition to encouraging the user, the app should provide some feedback on why the answer was wrong. He stated, *“Actually, it’s really good to have two different options so they can press on one and, if it doesn’t seem to be the right answer, they’ll click on the other one and then [make it] explain, kind of, why.”*

5.3 User study findings: Participants found the engagement elements necessary and useful

In this section, we detail the participants’ experience with the engagement elements of the prototypes.

⁸Overall, versions B and C were liked equally by the participants with P1, P3, and P6 stating that they liked version B the best and P2, P4, and P5 stating they liked version C the best.

5.3.1 The use of emoji-based rewards was considered motivating. Our participants considered integrating the element of a reward in the form of emojis as useful to motivate individuals with I/DD. For instance, P4 stated, “[Individuals with I/DD] will probably be happy with that [emojis-based reward]. They’ll probably be like ‘Oh, another emoji!’... I think the emoji should definitely be where it is.” Moreover, the menu items from the emoji (see Figure 7) were also well liked by our participants. P4 again described this well, when she stated, “I actually like the smile emoji ‘cause that actually... Ooh I like that. It’s actually cool. Just click that emoji and then boom, you get three options. Wow. I like that idea.” Further, the emojis themselves were enjoyed by all six participants. For instance, P3 was excited by the emoji he received, chuckling, “I got like a super-hero.”

5.3.2 The grounding activity was considered useful for self-regulation. We used a music-playing activity for grounding users as a way to help them deal with the potentially difficult material they may encounter when completing a lesson on the app. All participants liked the presence of the grounding activity and communicated its necessity. As P5 aptly pointed out, when completing these types of lessons at home, if one were to be triggered “Where is there to go? Where is there to feel safe if you’re technically supposed to already be in the safe spot?” P5 continued that, “the good thing about the [in-person] trainings we do is you can take a staff and go out into the hallway and cool down.” These excerpts clearly demonstrate the seriousness of keeping individuals who use this learning app grounded during the learning process. When asked if playing music would help individuals regulate themselves when triggered, everyone but P1 stated it would. For instance, P5 stated “I also liked the music’s calming effect... To me music is much more calming than [a] breathing exercise.” P1, on the other hand, stated, “I’m kinda on the fence with it.” One interesting observation was that all of the participants seemed to enjoy playing the music.

5.4 User study findings: Participants felt that they would use the app themselves and suggested its use for reporting abuse

After interacting with all three prototypes, participants gave us their overall impression of *Recognize*. Below we describe our findings.

5.4.1 Participants agreed that they would recommend the app to their students. All six participants in this study indicated that they would encourage others to download and use the application, including their students. Overall, all participants believed that the app would be effective for independent self-learning. We then asked how often they would recommend that others use this app, if at all. We received a variety of responses. P1 stated that he would recommend that his students use the application “every 48 hours, every two days.” Similarly, P2, P3, P4, and P6 also stated that others should use the app either daily or every other day so that they remember the content. Somewhat differently from all of the other participants, P5 strongly emphasized that users should only use it “as they’re comfortable,” focusing on the fact that individuals may have experienced different amounts of trauma and that they know what is best for them.

5.4.2 Participants reported that the app can also facilitate abuse reporting. Even though our focus with *Recognize* was on teaching

individuals with I/DD about abuse, our participants saw the app as a way for individuals with I/DD to report abuse as well. In our prior work, we had found that survivors often don’t know whom to call to report abuse or if they will be believed [62]. In fact, *Recognize* offers multiple ways for someone with I/DD to report abuse. The more obvious way was for a user to go to the always available help menu (using the emoji-button at the bottom of the screen) to call their local APS agency, whose number is now easily findable for the user of the app⁹. The other, more interesting, option described by the participants was that they believed that individuals with I/DD could use this application to express what happened to them to a mandated reporter¹⁰, who could then report the abuse on behalf of the individual with I/DD. P2 described how individuals with I/DD could communicate abuse via *Recognize*: “[Individuals with I/DD can show others] this is what happened to me and they can click on the picture and show the [other] person.... I think people are going to call [APS agencies] more... than what they’re doing right now.” This is an important observation because the voices of individuals with disabilities are often discounted, especially around issues of abuse [62].

6 DISCUSSION: A PATH FORWARD

The participants had an overall positive impression of *Recognize* and the prototypes. They were excited enough about the prototypes to recommend *Recognize* to others. As this is on-going work, next we outline some of the implications of our findings with respect to implementing a high-fidelity prototype of the app. We follow this with a discussion of the limitations of our work.

6.1 Static content cannot be completely avoided

One of the main takeaways from the user studies was that version A was boring because its entire lesson was a series of static “slides”. However, based on the discussion between the design teams during the co-design process, it was clear that static content cannot be fully avoided because slides are often used to set the stage and provide context for the more interactive content that is introduced. This point was also understood by participant P4, who noted that “It is important to have the [static content]. It’s going to be confusing without [it].” In fact, we included static content in versions B and C to set the stage for the interactive video and skills activity, respectively. The participants did not find the static content to be boring in those versions. Therefore, as long as the content has enough interactivity in it, our findings show that some static content should be acceptable. Finally, just showing the static content may not be sufficient for everyone; in the actual abuse prevention workshop the slides are accompanied by a presentation/commentary by the instructors. We should enable the static content to be instrumented with a narration so that individuals with I/DD can listen to it, if needed, to better understand the full context of the “slides”.

⁹As APS agencies are run by states, their phone number is different in every state and therefore not consistent like the national 911 emergency number. In the same vein, calling 911 is not always the best place to call for reporting abuse. The 911 emergency system in the US triggers a medical, fire, or law enforcement response. Many allegations of abuse are not emergencies and require a response from social or adult protective services to provide appropriate support to the survivor [62].

¹⁰A mandated reporter is any person who in their professional capacity has reasonable cause to believe that a vulnerable adult is facing abuse or neglect.

6.2 Grounding activities need to be diversified and always available

In our prototypes we only included one form of grounding activity, which involved playing music using a xylophone-like setup. However, not everyone would want to be grounded in the same way. The ways in which people deal with trauma and the strategies they use to respond to it vary from person to person [17]. Consequently, in order to be useful to a larger group of individuals with I/DD, we have to consider a variety of grounding activities. Examples of additional options to consider include counting, moving around, reciting something, and meditation [44]. Finally, in the prototypes studied, grounding activities were introduced post-lesson, as the chance of triggers was high at that point. However, ideally we would want the activity to be available at all times in case a user wants to ground themselves at any time while using the app. As different people self-regulate differently, it should not be up to the designers to try to decide when the grounding modality should be available.

6.3 Evaluating the utility of the app to a broad audience of individuals with I/DD

Once a high-fidelity prototype of the app has been developed, it will be important to understand its generalizability. That is, while evaluating the efficacy of the app, it might be worthwhile to see how well it works (in terms of improving understanding and retention of concepts about abuse) for those individuals with I/DD in two groups: those who have attended the A&A training versus those who have not attended A&A training. An interesting question in this regard would be to see how participants who have attended a different but related training, such as one on relationships, personal boundaries, or an abuse prevention training other than A&A, perceive the content in the app.

6.4 Limitations

Although the user study we conducted yielded positive results, there were two main limiting factors to the study. One, participants of the user study were self-advocates who were also instructors for individuals with I/DD. Recruiting from this population for these evaluations may have biased results in the positive direction, as these participants have a direct interest in the A&A training curriculum we used. Two, for this study, users were asked to join the Zoom session for the user study using the device of their choosing. Unfortunately, we found that when a participant joined the Zoom call with a smartphone, it prevented us from ceding control of the emulator to the participant. The inability of certain participants to control the emulator (and therefore the app) due to technical limitations of Zoom may have caused misunderstandings between the participant and the researcher acting as their “hands”. For example, when a participant dictated something like “next”, the researcher controlling the emulator would take that to mean clicking on the arrow to move the screen forward. However, the participant could have meant something different, such as scroll down, but never corrected the researcher.

7 CONCLUSIONS

Facilitating the recognition of abuse for individuals with I/DD is essential to ensure that it be reported in a timely manner. To this end, we present the design of a mobile-computing-device-based app called *Recognize*, which is being designed for independent self-learning by individuals with I/DD. This paper presents our findings with respect to the app’s design, where we refined design concepts through a co-design process. Based on the outcomes of the co-design process, we developed three prototypes of the app that each prioritized a different way of displaying the primary learning material. These prototypes were then compared and evaluated by six individuals with I/DD who were also instructors and self-advocates. The findings demonstrated that the app is viable for the I/DD community as long as the learning material is presented in an interactive manner. We are already working on building on these results to implement higher-fidelity prototypes of the app to evaluate it with a larger and more diverse population of individuals with I/DD.

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