



The Design and Prototyping of an App to Teach Adults with Intellectual and Developmental Disabilities to Empower Them Against Abuse

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In the United States, 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 when they have received abuse-prevention training. Consequently, in this article we present the design and prototyping of a mobile-computing app called *Recognize* that empowers adults with I/DD to independently learn about abuse. To this end, we first conducted an auto-ethnographic *co-design* of *Recognize* with individuals and self-advocates from the I/DD community. Next, based on the outcomes from the co-design process, we developed three *initial prototype variants* of *Recognize* and performed a preliminary user study with six individuals with I/DD who have experience teaching others with I/DD about abuse. Based on the findings of this preliminary user study, we created a *consolidated prototype of Recognize* and performed a more detailed qualitative user study with 11 individuals with I/DD who represented the eventual users of *Recognize*. The participants in this user study found it to be viable for use by individuals with I/DD. We end the article with a discussion of the implications of our findings toward the development of a deployable version of *Recognize* and similar apps.

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

Additional Key Words and Phrases: Empowerment, education, abuse, intellectual disability, developmental disability, user study

K. Venkatasubramanian and T.-M. Ranalli contributed equally to the article.

This activity was supported in part by a grant (grant no. HHS-2018-ACL-AOA-EJSG-0265) from the Administration for Community Living, US Department of Health and Human Services (DHHS). Grantees carrying out projects under government sponsorship are encouraged to express freely their findings and conclusions. Points of view or opinions do not necessarily represent official Administration for Community Living or DHHS policy.

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1936-7228/2023/07-ART16 \$15.00

<https://doi.org/10.1145/3569585>

ACM Reference format:

Krishna Venkatasubramanian, Tina-Marie Ranalli, Jack Lanoie, Alexander Sinapi, Andrew Laraw Lama, Jeanine Skorinko, Mariah Freark, and Nancy Alterio. 2023. The Design and Prototyping of an App to Teach Adults with Intellectual and Developmental Disabilities to Empower Them Against Abuse. *ACM Trans. Access. Comput.* 16, 2, Article 16 (July 2023), 31 pages. <https://doi.org/10.1145/3569585>

1 INTRODUCTION

Abuse has reached staggering proportions in the community of people with intellectual and developmental disabilities (I/DD)¹ [28]. For instance, a 2018 news report by National Public Radio, based on unpublished US Department of Justice data, concluded that people with I/DD are sexually assaulted over *seven times* more often than people with no disabilities [38]. However, incidents of abuse committed against people with I/DD are woefully underreported to the appropriate authorities [38]. Some of the reasons for this scant reporting include the fact that people with I/DD are often unaware of what constitutes abuse or what to do if they do encounter it [17, 25]. 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 [49]. The present work is a means to *empower* individuals with I/DD to understand abuse so that they can then take the lead in reporting/informing others about the abuse.

To this end, in this article we present our work on the design and prototyping of a mobile-computing app called *Recognize* that empowers adults with I/DD to independently learn about various forms of abuse. We selected an app as the modality for this work because it is best suited for the needs of our population. Mobile computing technologies (such as smartphones and tablets) are regularly used by individuals with I/DD in the United States [35, 49]. Therefore, an app designed for such platforms would best enable us to provide our population with access to crucial information about abuse that is always available to them. Abuse-prevention training for individuals with I/DD currently occurs in several locations in the United States: some are in person [36] and others online [40]. 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 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, an app provides an easy way to review and better retain the concepts over time.

This article is an expanded version and continuation of the work reported in our ASSETS '21 paper [27]. In our ASSETS '21 paper, we first presented our work on an auto-ethnographic *co-design* of *Recognize* with self-advocates from the I/DD community who have considerable experience teaching others with I/DD about abuse. Based on our outcomes from the co-design process, we developed three *initial prototype variants* of *Recognize*. These variants differed in the ways in which they presented their learning content. Variant A presented its learning content *statically*, like a slide presentation. Variant B presented its learning content as a *video*. Variant C's learning content focused on refining a pertinent *skill* to help people with I/DD learn about abuse (e.g., identifying the private body parts). Each variant also included 2 to 3 quiz questions to allow individuals with I/DD to test their knowledge of the learning material. The learning content in all three

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].

prototypes focused on sexual abuse. Since we were dealing with sensitive content, each variant included a grounding activity that displayed an interface that allowed the user to play musical notes. This activity appeared after the the variant's main content to help individuals self-regulate in case they found the content to be emotionally challenging. We also included an emoji-based reward mechanism that generated a new random emoji from the OpenMoji database [39] whenever the user successfully completed a topic. We then performed a *preliminary user study* in which we compared the variants (over Zoom, due to COVID-19 pandemic restrictions). We recruited six participants with I/DD (distinct from the co-designers) who also teach the material used in *Recognize* to others with I/DD, thus providing an expert evaluation of the variants. These instructor-participants found that all three ways of presenting the learning content had their respective benefits and the grounding and reward mechanism were useful for individuals with I/DD to mitigate the effects of the sensitive nature of the content.

Based on the outcomes of the preliminary user study, we created a *consolidated prototype of Recognize* that was organized around topics covering specific forms of abuse. Our consolidated prototype consisted of two topics, one on sexual abuse and one on financial abuse. Each topic presented the learning content in static (slides), video, and skill-based formats. In addition, each topic included two quizzes, one based on the static content and one based on the video content. To promote engagement, we included the same emoji-based reward mechanism and added a new grounding activity (for the financial abuse topic) in addition to the original one used in the variants. We then conducted a second *qualitative user study* (again over Zoom, due to the COVID-19 pandemic) with 11 participants with I/DD who represent the eventual users of *Recognize*. This was a within-group study in which every participant interacted with both topics in a counterbalanced manner. The study essentially addressed three research questions: **RQ 1:** How well does the prototype convey information about specific types of abuse to a user with I/DD? **RQ 2:** How effective are the engagement components (i.e., grounding activity and reward mechanism), given the sensitivity (i.e., difficult nature) of some of the material? **RQ 3:** Is this prototype helpful enough to be used by and recommended to individuals with I/DD? Broadly speaking, our analysis of the user study determined that the participants felt that *Recognize* is viable to the I/DD community.

Thus, based on our findings, we provide the following recommendations for developing a deployable version of *Recognize* and similar apps: (1) the content should be presented visually using images and videos in addition to any text; (2) the static content should include narration with captioning; (3) to mitigate the potentially triggering nature of the video content, the videos should be preceded by a notice clarifying their fictional nature, provide more context for the depicted scenarios rather than just focusing on the abuse incident itself, provide narrative closure, and depict empowered individuals with I/DD; (4) any self-regulation activities/suggestions should be varied and include both digital and offline options; and (5) the in-app language should be easy to read, direct, and avoid euphemisms and idiomatic language. Figure 1 shows an overview of the main elements of the article, including sections that cover our preliminary work that was presented in the ASSETS '21 paper and work that is new to this article. Note that we summarize only our preliminary work in this article; details can be found in our ASSETS '21 paper [27].

This project is a collaboration with our partners: a local I/DD self-advocacy² group – Massachusetts Advocates Standing Strong (MASS); a local Adult Protective Services (APS) agency³ – the Massachusetts Disabled Persons Protection Commission (DPPC); and a local disability

²A civil rights group of people with I/DD that advocates for people with I/DD taking control of their own lives.

³APS is a general term for department(s) of various US state, county, and/or local governments responsible for coordinating a response to the abuse of older adults and/or adults with disabilities.

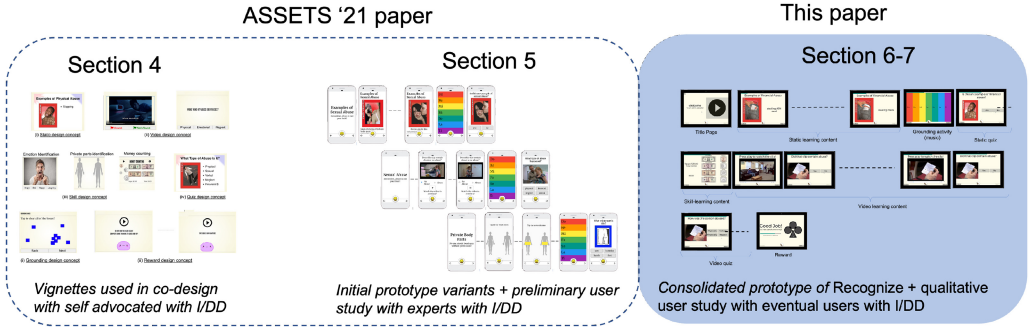


Fig. 1. Illustration of the organization of the main elements of this article, which is an expanded version of our preliminary work on this topic that was presented in our ASSETS '21 paper [27].



Fig. 2. Scenes from the Awareness and Action (A&A) Abuse Prevention Training; content in *Recognize* draws from this curriculum.

service agency⁴ – the Massachusetts Department of Developmental Services (DDS). *In the rest of the article, we use the terms individuals with I/DD and people with I/DD interchangeably.*

1.1 Source of Learning Content Used in *Recognize*

Before we delve into the details of our design process, we present a quick overview of the learning material from which *Recognize* gets its content. 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), with the help of the Massachusetts Disabled Persons Protection Commission (DPPC) and the Massachusetts Department of Developmental Services (DDS). 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 2(i)). *The workshop is primarily taught by individuals with I/DD.* It introduces the abuse of individuals with I/DD through five powerful, short videos, a slide presentation, and worksheets. The videos are unique in that the principal actors in these videos are self-advocates and other individuals with I/DD. The comprehensive training closely examines five different types of abuse: physical, sexual, verbal, financial, and neglect. The learning content is specifically designed to be easy to understand for people with I/DD, taking into account their diverse capabilities. 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*, in which participants use a red or green flag to

⁴Department(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.

signal what is and what is not abuse in a video (see Figure 2(ii)). 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 United States and at least 3 other countries over the past 10 years.

We do not believe that *Recognize* should replace any existing or planned in-person abuse training. Instead, 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 a larger audience.⁵

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 the use of technology in teaching individuals with I/DD: In recent years, several research studies 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 [24], using iPods and iPads for instruction [16], ensuring the comprehension of video content [18], the role of massive online open courses (MOOCs) in instruction [29], accessibility barriers in online education [9], online information retrieval [44], and the use of computer-based vocational training in economically developing countries [14]. 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 [22], using tangibles for learning [21], and instructional pacing support for educators [30]. None of this aforementioned work has focused on teaching individuals with I/DD sensitive and triggering content, such as abuse.

e-Learning tools for individuals with I/DD: Much work has been done in developing educational 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 [50], learning through video blogs [20], 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 [33]; understanding shapes, colors, and counting [10, 34]; life-skills training [4, 8, 45]; developing creativity [42]; developing social media-mediated social connectedness [3]; and performing outdoor physical activities [48]. None of these efforts focuses on teaching content that is triggering to individuals with I/DD. Our efforts in this article are thus unique as compared with 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: In that we are building an e-learning tool for individuals with I/DD, 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 [14] and have a good understanding of the standard icons and metaphors used in app 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 guidelines for e-learning tools for use by individuals with I/DD. These include (1) using images [10, 33, 34], interactive content, and videos [7, 18, 19, 33]; (2) using concrete, big, differentiated icons and symbols [9]; (3) making the content accessible by supporting audio description of images [4, 48] and accommodating different levels of literacy [14];

⁵The population may choose to use it as a supplement to in-person training, perhaps as a way of reviewing the material after the in-person session(s).

(4) reducing information overload [14]; (5) providing hints judiciously to prevent individuals with I/DD from becoming too dependent on the hints [29]; (6) using positive reinforcement when successfully engaging with the content [10, 29, 31]; (7) avoiding multiple clicks to complete a task [10]; (8) having a “cooling off” period if the user is frustrated, to improve independent problem-solving regarding using the technology [9]; and (9) providing self-paced learning [29, 30, 34, 42]. Useful as these design considerations are, they were not developed in the context of teaching content that is potentially triggering to individuals with I/DD. One of our efforts in this article is thus to extend these design considerations to meet the needs of imparting sensitive content through e-learning for people with I/DD.

Teaching individuals with I/DD about personal boundaries: An effort complementary to ours was reported in [13], in which 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 the scenarios were acceptable or a violation of personal boundaries. The scenarios presented were randomized via a one-armed bandit lever, which could be “pulled” to create a large set of possible scenarios. One can imagine that individuals with I/DD could play a game such as Boundaries to evaluate how well they have internalized concepts pertaining to, say, unwanted touching, which is covered in our app. In this regard, we view *Recognize* as complementary to Boundaries.

3 A SUMMARY OF THE CO-DESIGN PROCESS

We instantiated *Recognize* through a co-design process with several individuals with I/DD. In this section, we provide a summary of our approach and outcomes. More details on our co-design process can be found in our ASSETS '21 paper [27].

In determining how best to apply co-design to our project, we took inspiration from recent work in two broad areas. In one approach, auto-ethnographic design [32, 37], the designers themselves experience their designs as a way to learn more about their properties. The other features co-design with individuals with I/DD [5, 12, 26, 43, 46, 47], which is a form of participatory design in which 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 design concepts initialized by another subset of the research team (*design team 2*), who are researchers in human-computer interaction (HCI), the humanities, the psychological sciences.

The design teams: Design team 1 was made up of four members. Three of the members are individuals with I/DD and the fourth is a neurotypical person who works with the self-advocates on a daily basis and coordinates services for them. Two of the team members with I/DD are also abuse survivors. All three of the team members with I/DD (supported by the neurotypical member) 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. All members in *design team 1* work for our partner self-advocacy group 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 two years. Some of the highlights of this process include (1) regular meetings during which we not only discussed the project but also got to know one another, (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 COVID-19 pandemic. This close relationship enhanced the creative expression of the team members with I/DD and fostered open discussions of ideas.

During the co-design process, a subset of the authors (who are neurotypical), that is, *design team 2*, initialized several *design concepts* for *Recognize*. We define design concepts as ideas for a design [41]. These were expressed as *vignettes* from the eventual app that described a major aspect of the eventual app (e.g., how to present the learning content 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 [47]. The ideas for the design concepts were generated through a multi-step process. As a first step, *design team 2* iteratively created and evaluated personas and use cases [41] with a focus on design that would be engaging to individuals with I/DD. Several *design team 2* members attended A&A trainings to understand how the topics to be covered in the eventual app are 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 design concepts.

The 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, in which most design decisions were made. The process was repeated asynchronously online once more to confirm the designs.

Design concepts: Overall, six design concepts were produced as an outcome of the co-design process. The design concepts can be divided into two broad categories: (1) design for learning and (2) design for engagement. The former focused on presenting the learning content while the latter was about maintaining engagement for the users and grounding them given the sensitivity of the material.

The *learning design concepts* included four types of learning content. A snapshot of the four learning design concepts is shown in Figure 3. Note that there is a 1 to 1 correspondence between the four design concepts listed below and the four parts in Figure 3:

- *Static:* Here, the idea was to present the learning content in the form of *slides*, similar to presentation slides.
- *Video:* This design concept showed one of the many videos from the in-person A&A training 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 segments of the video that contained 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 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 a sexual assault, they can be triggering to the audience.
- *Skill:* Unlike the previous two design concepts, instead of focusing entirely on the material itself, this particular design concept was proposed as a way to help individuals with I/DD

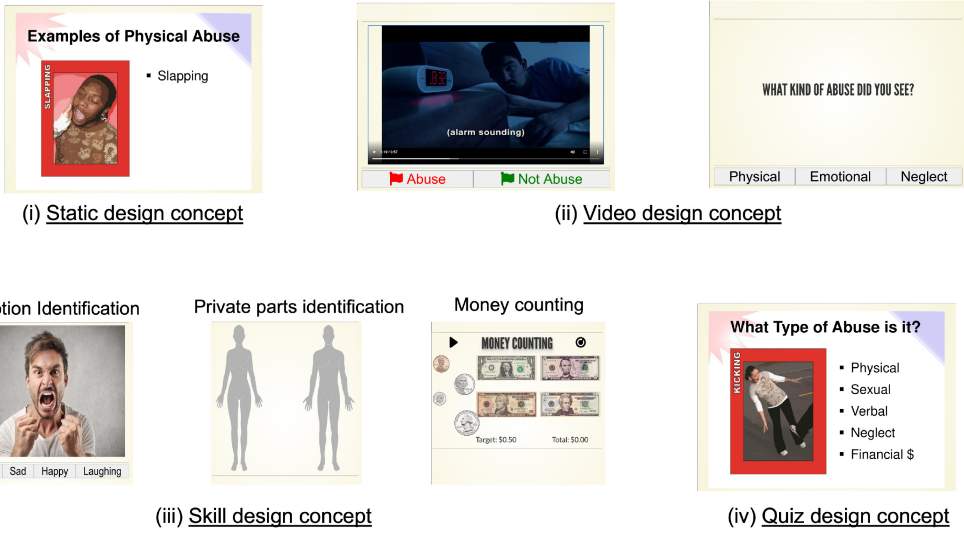


Fig. 3. Learning design concept vignettes discussed during the co-design process.



Fig. 4. Engagement design concept vignettes discussed during the co-design process.

refine skills that could help them become familiar with the nature of abuse. We initialized three forms of interactive skill-building activities: *emotion identification activity*, *private body parts identification activity*, and *money-counting activity*. The emotion identification activity asked users to select the emotion that the person in the image was expressing, thus learning to better identify warning signs of abuse. The private body parts identification activity was about identifying and selecting private body parts on (biologically) male and female bodies on the screen. Finally, the counting-money activity was centered around selecting US currency denominations until they had reached a prespecified amount of money.

- **Quiz:** Finally, this design concept focused on teaching the users about various types of abuse entirely through the medium of binary or multiple choice quizzes.

Similarly, the *engagement design concepts* were of two types, which we summarize below. A snapshot of the two engagement design concepts is shown in Figure 4. Again, there is a 1 to 1 correspondence between the two design concepts listed below and the two parts in Figure 4.

- **Grounding:** The material presented in the application is of an emotionally charged nature. Grounding activities provide a self-regulative 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 [15]. We chose an uncomplicated box-tapping activity in which the individuals with I/DD tapped on boxes that randomly appeared on the screen. The boxes disappeared when tapped. The activity ended when all of the boxes on the screen were tapped.

- *Reward*: The purpose of our reward design concept was to generate motivation for individuals with I/DD to use the app by giving them a reward while at the same time preventing the emergence of extrinsic competition. Given that the learning content 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 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.

Findings from the co-design: The discussion around these design concepts between the two design teams produced several findings that formed the recommendations for building the first prototypes of *Recognize*. We list the recommendations below. The recommendations for learning design concepts are referred to as LRs and those for engagement design concepts referred to as ERs.

- *LR1*: Slides are necessary to convey an overall understanding of abuse and provide the big picture around a topic to the user.
- *LR2*: Interaction with videos should be easy to understand. The approach we used, in which individuals with I/DD were asked to detect segments with abuse as the video was playing, was complicated and difficult to understand for users.
- *LR3*: Skill-building activities should be carefully chosen to avoid triggers. The co-designers found the emotion recognition activity with its variety of unpleasant faces (e.g., angry, threatening) to be potentially triggering for the users and therefore to be avoided. They liked the other two activities.
- *LR4*: Quizzes should be used for enabling users to practice their knowledge and not form the basis of learning the material. Further, the quizzes should not feel like an examination of the user and should be optional.
- *ER1*: The reward elements should not penalize. That is, any reward used should be a monotonically progressing reward mechanism to motivate users to return.
- *ER2*: The grounding activities are necessary and the duration of their use should be determined by the user. Hence, the user should be able to use the grounding activity for arbitrary lengths of time.

Based on the feedback obtained from the co-design process, we created three *initial prototype variants* of *Recognize*, which were then evaluated using a preliminary user study based on opinions of participants with I/DD who were instructors to others with I/DD. We describe this next.

4 A SUMMARY OF THE INITIAL PROTOTYPES OF *RECOGNIZE* AND THE PRELIMINARY USER STUDY

Based on the results of the co-design process, we created three variants of the initial prototypes for *Recognize* and performed a *preliminary user study* of these variants. All of these initial prototypes were created in Dart/Flutter [23]. Once again, we provide only a summary here. For more details on our initial prototypes, the user study, and its findings, refer to our preliminary work on this topic from ASSETS '21 [27].

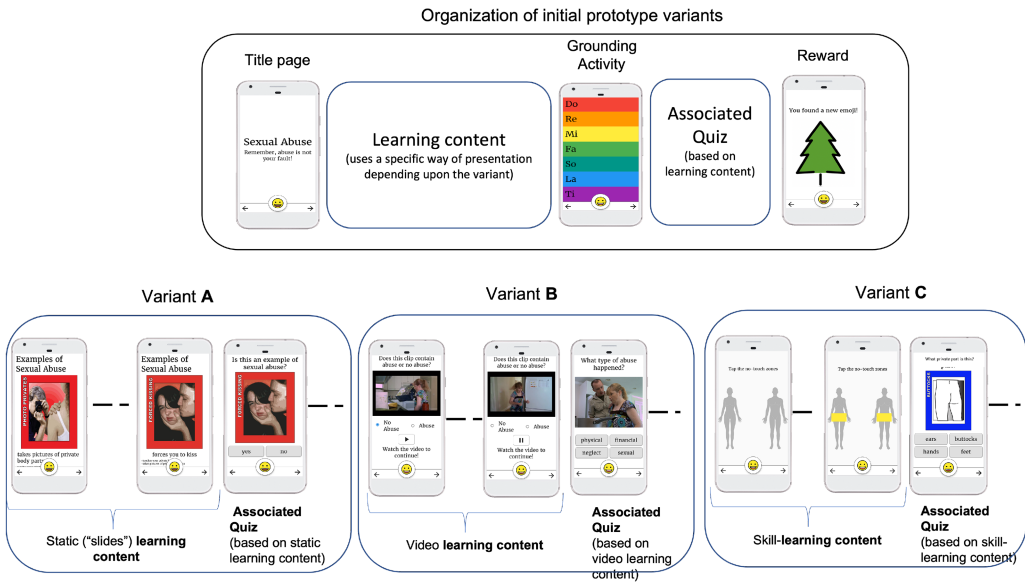


Fig. 5. Overview of the three initial prototype variants of *Recognize*. Note that the small set of static learning content (slides) that preceded the video and skills activity in Variants B and C and used to set the stage for them have not been shown.

4.1 The Three Initial Prototype Variants of *Recognize*

Figure 5 shows an overview of the organization of the three prototype variants. All three prototype variants had the same essential organization: (1) *learning content*, which differed in its presentation in each variant; (2) an *associated quiz* based on the material of the learning content; (3) a *grounding activity* for coping; and (4) a *reward* mechanism for completing the learning content. All four derived their design from the co-design recommendations [27]. All initial prototypes featured learning content on the topic of *sexual abuse*.

The three variants essentially differed in the way they *presented* their learning content, described here:

- **Variant A (static):** This variant presented the learning content in a slide format, which was deemed to be essential by our co-designers (based on LR1; see Figure 5).
- **Variant B (video):** This variant presented the learning content using video. The interactive nature of this variant was simplified (based on LR2). This video, based on LR2, paused at specific intervals to allow users to enter whether they saw abuse in the preceding video clip (see Figure 5). Variant B still used two slides (a subset of the slides in Variant A) to set the stage for the video to follow.
- **Variant C (skill):** This variant presented the learning content using the private parts identification activity, which asked the user to identify the no-touch zones on biologically male and female bodies (based on LR3; see Figure 5). This version started with four slides that identified the various private body parts.

Each variant of the learning content also had an *associated quiz*. The quizzes were implemented as multiple choice questions and focused on the material covered in the learning content of the variant (based on LR4). Each quiz had 2 to 3 quiz questions, each of which provided appropriate

feedback to users via popups both when they got the answer right (a message of praise) and wrong (gentle encouragement to try again).

All three variants incorporated two ways to promote user engagement: a grounding activity and a reward mechanism, described here:

- *Music-based grounding*: We implemented a musical grounding activity in which we used a sequence of seven rainbow-colored bars that, when clicked, played a musical note (see Figure 5). The grounding activity immediately followed the learning content because the information in the learning material could be triggering. Users could engage with the grounding activity as long as they wanted and exit anytime (based on ER2).
- *Emoji-based reward*: To promote engagement, we used an emoji-based reward system in all three variants. Whenever participants viewed all of the learning content and its associated quiz plus the grounding activity, they were rewarded with a random emoji from the OpenMoji database [39]. To ensure that the emojis were appropriate for our context, we manually removed from our library the classes of emoji that were abstract (e.g., boxes) and those with a negative connotation for our context (e.g., a person who is hurt). The emojis were chosen at random to avoid any kind of comparison or competition among users regarding what they earn. Once earned, the emojis would never be taken away (based on ER1).

Note that users did not have to engage with any of the screens in any of the variants and could skip anything they wanted to skip. All versions had the currently selected emoji visible at the bottom of the screen (the smiley in Figure 5). Users could change the emoji being displayed at any time by choosing a new emoji from the available list of emojis, which grows as they complete lessons. Further, the emoji icon itself functions as a button that is always visible at the bottom of every screen. When tapped, it took participants to a menu where they could call an APS agency or an emergency contact in addition to changing the displayed emoji.

4.2 A Summary of the Preliminary User Study and Its Findings

We next performed a preliminary qualitative user study of the variants with several individuals with I/DD (distinct from the members of *design team 1*) who had extensive experience teaching other people with I/DD. Thus, this was an *expert-based evaluation* of the variants. The main aim of this preliminary user study was to accomplish two objectives: (1) to compare and contrast the three ways of presenting the learning content (static, video, and skill) in terms of being conducive for individuals with I/DD to use to independently learn about abuse; and (2) to determine whether the ways to promote engagement (a grounding activity and a reward mechanism) help to mitigate some of the effects of the sensitive nature of content.

There were six participants recruited for this study (three male and three female), all of whom have I/DD per AAIDD's definition (see Footnote 1; e.g., Autism, Williams Syndrome, Pervasive Developmental Disorder). Four of the participants were instructors of both the A&A training and a different employment training, one participant was an A&A training instructor only and one participant was an employment training instructor only. 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.

This preliminary user study was a within-group study (participants saw all three variants in a counterbalanced way) and was completed with one participant per session over the course of two weeks over Zoom (because of the COVID-19 pandemic). Participants used the Zoom remote control feature to remotely control and interact with the three variants being executed on an Android

emulator (in the smartphone form-factor) by the research team.⁶ After going through all three variants, the participants were then interviewed. The participants were asked to (1) compare the learning content of the three variants and (2) comment on the efficacy of the grounding activity and reward mechanism. A thematic analysis of the interviews produced several findings summarized here. You can find more details of this user study and its findings in our ASSETS '21 paper [27].

Preliminary user study findings: Interactive learning content was preferred.

- *Variant A in the lessons was deemed to be less engaging compared with the other two.* Participants preferred Variants B and C over Variant A in terms of receiving learning content because of their interactive nature. Further, we observed that for Variant B, the presence of the question about the video and video player on the same screen was sometimes confusing for the participants, who did not know what to do when the video paused. That being said, they all agreed that slides as seen in Variant A were still necessary to include in the app to provide an overview of a topic.
- *Variant B was considered useful despite its potential to trigger.* The content of the topic (on sexual abuse) was quite sensitive. Therefore, it was very interesting that participants felt the video content to be useful despite its potential to trigger because it showed a version of what could really happen.
- *Quizzes were considered useful.* All participants liked the associated quiz in the three variants. The participants also appreciated the fact that when they chose an incorrect answer, they were encouraged to try again.

Preliminary user study findings: Engagement elements were deemed necessary and useful.

- *The grounding activity was useful for self-regulation.* All participants liked the presence of the music-based grounding activity and communicated its necessity, especially when using the eventual app by themselves at home. When asked whether making music would help individuals regulate themselves when triggered, five of the six participants stated that it would. However, one participant was unsure whether music would have the appropriate calming effect. However, all of the participants seemed to enjoy the music activity. Finally, all participants wanted diversity in the grounding activities.
- *The use of emoji-based rewards was considered motivating.* The participants considered the element of an integrated reward in the form of emojis as useful to motivate individuals with I/DD. Further, the participants enjoyed receiving specific random emojis (e.g., a superhero).

Preliminary user study findings: The eventual app was seen useful enough to be recommended to others.

- *Participants agreed that they would recommend the eventual app to their students.* All participants in this study indicated that they would encourage others, including their students, to download and use the eventual app. Overall, all participants believed that the eventual app would be effective for independent learning. We then asked how often they would use *Recognize*. We received a variety of responses: from every day to users can decide what's best for them as they know the extent of their prior trauma.
- *Participants reported that the eventual app could also facilitate direct and indirect abuse reporting.* Even though one could directly call adult protective services (APS) from the app,

⁶Two participants' (P1 and P5) devices did not allow them to use Zoom's remote control feature. 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.

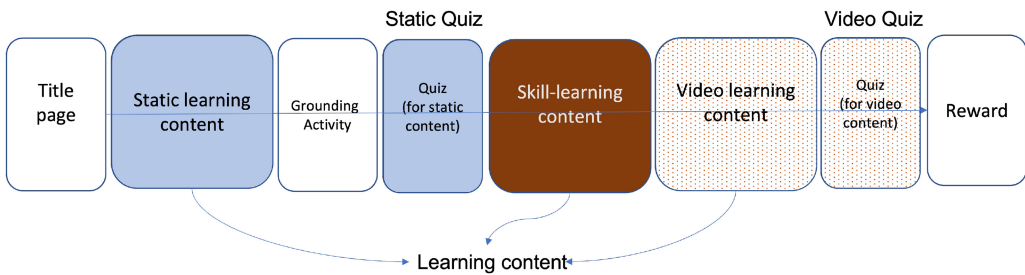


Fig. 6. Diagram of the organization of a topic in the consolidated *Recognize* prototype. The arrows in the diagram show the flow through the prototypes.

the participants emphasized that the app could be used by individuals with I/DD to express what happened to them to a mandated reporter,⁷ who could then report the abuse on behalf of the individual with I/DD. We had not considered this form of indirect reporting given that the variants had direct reporting ability, and found it very interesting. This is an important observation because the voices of individuals with disabilities are often discounted, especially around issues of abuse [49], not to mention that it will also allow nonverbal individuals with I/DD to report abuse as well.

5 A CONSOLIDATED PROTOTYPE OF *RECOGNIZE*

Based on the feedback obtained from the expert-based preliminary user study, we created a **consolidated prototype of *Recognize*** that combined the features of all variants into one consolidated prototype. The consolidated prototype is organized by *topic*, each of which covers a specific type of abuse. Figure 6 shows the typical organization of a topic in the consolidated prototype. We focused on developing an implementation prototype [26] at this stage because we wanted to understand to what extent the manner in which the prototype presented its information would be conducive for self-learning by individuals with I/DD.

We developed the app using the DART/Flutter framework [23], which allowed us to develop the app in a platform-independent manner, meaning that we could have one code base for both iOS and Android versions of the app. The Flutter framework and its ecosystem also provided a variety of libraries that we utilized for our development, such as for state management, a video player, automatic text-resizing, and animation. The app has a SQLite database to store all of the persistent information, such as the prizes unlocked by a user over time.

Topics in the consolidated prototype: Each topic in the consolidated prototype had four broad elements: (1) three types of *learning content*: static, skill, and video; (2) two *quizzes*, one based on the static and another based on the video learning content; (3) a *grounding activity* to help mitigate the effects of interacting with sensitive content within the prototype; and (4) a *reward* mechanism for viewing⁸ all of the learning content (three types), grounding activity (one), and quizzes (two) for a particular topic. We now elaborate on each of these elements.

- *Learning content:* The learning content in the consolidated prototype integrated the static learning content from Variant A, the video learning content from Variant B, and the

⁷A mandated reporter is any person who, in one's professional capacity, is required to report abuse when there is reasonable cause to believe that a vulnerable adult is facing abuse or neglect.

⁸It is possible for a user to click the Next button at any time without first interacting with the content on the screen. Therefore, the user need not do the skill activity, complete the quizzes, or view the videos in order to progress through the prototype.

skill-learning content from Variant C of the initial prototypes. The static learning content was organized exactly as in Variant A, that is, a string of slides. The video learning content in the consolidated prototype was split into three video clips, which were interspersed with a binary question (on a separate screen) that asked whether the preceding clip depicted abuse. This was done to avoid some of the confusion observed in the preliminary study, in which both the question and video were on the same screen and always visible. The static and video learning content in the consolidated prototype were placed at the beginning and end of a topic, respectively, with the skill-learning content in the middle, which was organized like the learning content in Variant C.

- *Quizzes*: To reinforce the understanding and acquisition of the topic, we included two quizzes, one for the static and one for the video learning content. These are shown as *static quiz and video quiz* in Figure 6. We did not include a quiz for the skill-learning content for two reasons: (1) we wanted to prevent the topic from becoming unduly long and (2) the skill-learning content can be seen as a form of quiz, hence, adding more questions to it seemed superfluous.
- *Grounding activity*: The grounding activity was structured in exactly the same way as the grounding activity in the three initial prototype variants. In the consolidated prototype, the grounding activity appeared only once, immediately after the static learning content.
- *Reward mechanism*: Finally, as in the initial prototype variants, the reward was given out at the end of a topic. The earned emojis became part of a personalized collection for the user.

The emoji (default or selected from the personalized collection) was also always visible at the bottom of the screen. It opened a menu that allowed the user to call an APS agency or an emergency contact or to change the displayed emoji from one's collection, as in the initial prototype variants. It also allowed the user to *invoke grounding activities at any point within the app rather than utilizing the grounding activity only when it appears in the individual topic*.

5.1 The Two Topics in the Consolidated Prototype

We implemented two topics within the consolidated prototype of *Recognize: sexual abuse and financial abuse*. Figures 7 and 8 show screenshots of the flow of each topic within the consolidated prototype. We summarize the content of the two topics in this section.

Static and video learning content and quizzes: For the sexual abuse topic, the material for the static and video learning content and their corresponding quizzes was adapted from Variants A and B of the initial prototypes (described in Section 4). For the financial abuse topic, the material for the static and video learning content and corresponding quizzes was adapted from the A&A training. The quizzes used popups to provide feedback. Users were praised when they got an answer right and gently encouraged to try again when they got an answer wrong.

Video learning content was divided into clips: The video learning content for each topic included three clips, which showed the progression of the same scenario. In our estimation, the first clip did not show any abuse, the second clip always did, and the third clip showed abuse in the sexual abuse topic but not in the financial abuse topic (it showed the survivor reporting the abuse instead).

Skill-learning content: Each of the two topics utilized different *activities* within the skill-learning content. The sexual abuse topic featured the private parts identification activity from Variant C of the initial prototypes whereas the financial abuse topic incorporated the money-counting activity that was originally designed in the co-design phase (as reported in Section 3). This latter activity was not included in the initial prototypes as it was not relevant to sexual abuse, the topic of the initial prototypes.

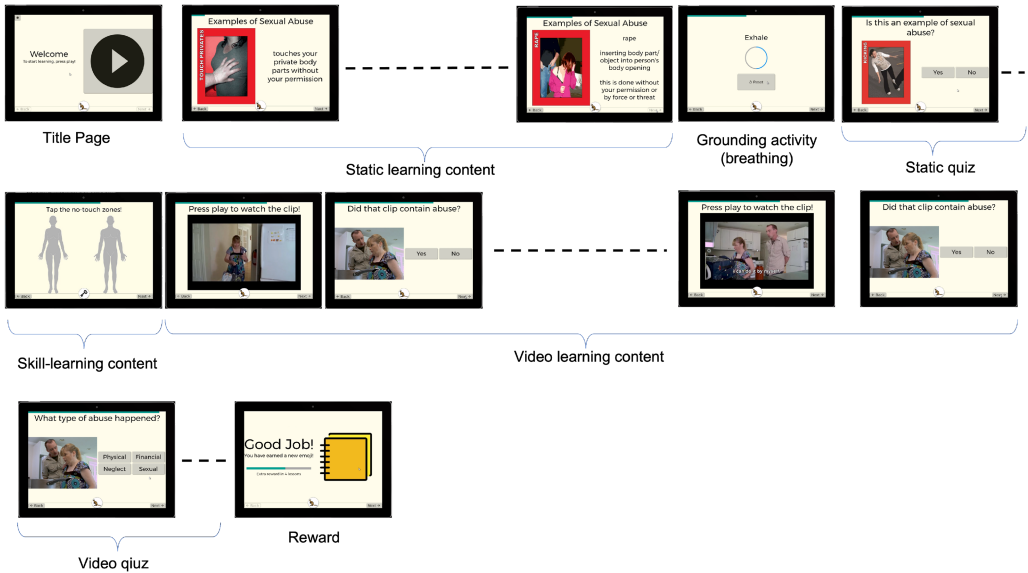


Fig. 7. Screenshots of the sexual abuse topic from the consolidated *Recognize* prototype. Dashed lines between screenshots indicate other screens that are not shown, for brevity.

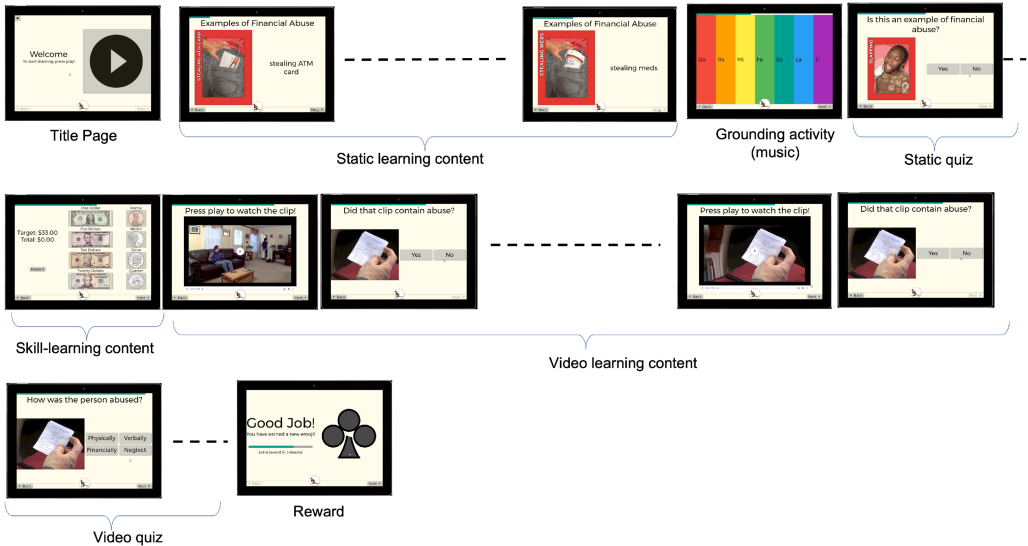


Fig. 8. Screenshots of the financial abuse topic from the consolidated *Recognize* prototype. Dashed lines between screenshots indicate other screens that are not shown, for brevity.

Grounding activities: Each topic incorporated a different grounding activity. The financial abuse topic incorporated the music-based grounding activity from the initial prototype variants, as described in Section 4. The sexual abuse topic incorporated a new breathing-focused grounding activity. We included a new grounding activity for two reasons: (1) our co-designers had recommended guided breathing as a useful grounding activity, and (2) both our co-designers and the instructor-participants from our preliminary study wanted diversity in the grounding

activities included within the eventual app. The breathing activity was chosen because it was one of the activities discussed during the co-design process. The breathing activity in the consolidated prototype featured a start button and a graphic of a gray (unfilled) circle. When the user tapped the start button, the circumference of the circle increasingly turned yellow, from about 12 o'clock to 4 o'clock, while the text "inhale" appeared above the circle (about 4 seconds). At this point, the text above the circle changed to "exhale" and the circumference of the rest of the circle increasingly turned blue, all the way back to 12 o'clock (about 6 seconds; see Figure 7).

Reward mechanism: Both topics contained the same randomized emoji-based reward mechanism described earlier.

6 A QUALITATIVE USER STUDY OF THE CONSOLIDATED *RECOGNIZE* PROTOTYPE

After designing and implementing the consolidated prototype of *Recognize*, we then performed a qualitative user study to evaluate it. We refer to this user study in the rest of the article as the **consolidated user study**. The idea was to perform a within-group user study with individuals with I/DD. For this consolidated user study, we recruited participants who represented the *eventual users of the app*. Therefore, the participants were individuals with I/DD who were neither experts nor instructors of the material covered in the prototype. The study essentially asked three research questions: **RQ 1:** How well does the prototype convey information about specific types of abuse to a user with I/DD? **RQ 2:** How effective are the engagement components (i.e., grounding activity and reward mechanism), given the sensitivity (i.e., difficult nature) of some of the material? **RQ 3:** Is this prototype helpful enough to be used by and recommended to individuals with I/DD?

Consolidated user study design. The consolidated user study was completed over the course of a month. Each participant evaluated the consolidated prototype in a dedicated single session. These sessions each lasted approximately 1.5 to 2.5 hours each and were conducted over Zoom because of the COVID-19 pandemic. Participants initiated the session by signing into the Zoom conference call at a predetermined time via a provided link. Once participants joined the meeting, a researcher verbally walked them through the informed consent form, which they had already signed and submitted to verify their intent to participate in the study. After again confirming that participants understood the nature of the research and agreed to participate, we gave control to them via Zoom's remote control feature when their device made this possible.

This was a within-group study in which each participant was shown both topics (sexual abuse and financial abuse) from the prototype. The order in which each participant viewed the topics was counterbalanced. At the beginning of the study, each participant was given a quick orientation of the prototype, which ran on an iOS emulator (in the tablet form factor). Subsequently, control of the emulator was transferred to the participant. Participants were encouraged to vocalize their thoughts, as much as they felt was appropriate, as they navigated each topic. Once participants went through an entire topic, we asked them questions about that topic and then repeated the process for the second topic. After participants interacted with both topics, they were asked to compare and contrast them and debrief us regarding their overall experience. The participants were asked to comment only on the topics they saw. However, this did not prevent some participants from telling us what they thought about the potential of the app in the future. We also reminded participants often during the study that they could take a break at any time. When sessions ran long, it was because many of the participants were very excited about the app and wanted to talk about it at length. We did not face any issues with participants being tired, bored, or being checked out during the study.

The entire process was video- and audio-recorded using Zoom's recording features for analysis (with the participants' consent). Four participants who completed the study (P2, P5, P6, and P7) were using devices that did not allow us to transfer control to them via Zoom's remote control

Table 1. Demographics of the Participants in the User Study, All of whom have I/DD, per AAIDD's Definition

ID	Gender	Age	Disabilities	Prior A&A attendance	Completed
P1	Female	45	I/DD	Yes	Yes
P2	Female	48	I/DD and multiple skeletal congenital anomalies	Yes	Yes
P3	Nonbinary	30	I/DD	No	Yes
P4	Male	37	I/DD	No	Yes
P5	Male	28	Autism spectrum disorder	No	Yes
P6	Female	27	I/DD and cerebral palsy	Yes	Yes
P7	Female	37	I/DD and speech impairment	Yes	Yes
P8*	Female	40	I/DD and speech impairment	No	No
P9	Female	34	I/DD and vision impairment (low vision)	No	Yes
P10	Female	49	I/DD, cerebral palsy and motor impairment	No	Yes
P11	Female	29	I/DD and speech impairment	No	Yes
P12*	Female	57	I/DD	No	No
P13	Female	40	I/DD	No	Yes

A&A refers to the *Awareness and Action* training mentioned in Section 1.1. P8 and P12's responses were not included in the analysis because their sessions were incomplete.

feature. P10 could not use Zoom's remote control feature because P10 has a severe motor impairment and hence could not interact with our emulator over Zoom using the computer's pointer device (mouse or hands). In such cases, as in the preliminary user study, the participants verbally told us what to click and when on the emulator. The control of the navigation was always with the participants. We acted solely as the "hands" of the participants.

Consolidated user study participants. We interviewed 13 participants, all of whom had some form of I/DD and were familiar with the use of apps and mobile devices. Participants were recruited through our partner non-profit self-advocacy agency (MASS) that works with people with I/DD. The participants had mild-to-moderate I/DD. Participants were free to disclose the nature of their I/DD but we did not compel them to do so. Most participants preferred not to disclose the nature of their I/DD. Based on our experience of working with this population for several years, we have found that the individuals with I/DD in our region are mostly literate (though they may prefer not to read when there is an alternative because of the high cognitive load that reading entails) and have considerable digital skills, that is, they are adept at using apps and mobile computing technologies. We have reported on similar findings in our prior work in CHI '21 [49]. Some of the participants ($N = 3$) were already familiar with the A&A training on which the prototype's content is based, while most were not ($N = 10$). As far as we know, the participants completed the user study independently (without help from a caregiver). The demographics of our participants are shown in Table 1. Two of the 13 participants (P8 and P12) did not complete the study. The responses from their partial session were excluded from the subsequent analysis. P8 could not finish because of technical issues. P12 was triggered while going through the sexual abuse topic; thus, we had to stop her session. We give more details about these situations below when we discuss the ethical considerations of our work.

The informed consent process. In order to ensure that our participants fully understood what they were consenting to, we used two documents to supplement the informed consent form: (1) a guide and (2) a checklist. The guide provided a pictorial overview, with supporting text, of the study and what to expect. The checklist was similar in scope but was presented as a set of questions for the participants to answer to ensure that they understood the information presented in the guide. The original version of these documents, which we edited for this study, was created by our

colleagues who are individuals with I/DD (who are self-advocates and regularly run abuse-prevention training workshops). We have used this format for all of our research with this community. These materials were described in our CHI '21 paper [49]. The informed consent form, guide, and checklist were made available to the participants before the study and we scheduled a session only when we received a signed informed consent. We also reviewed these documents verbally with participants at the beginning of each session. Further, as part of the informed consent, we gave explicit instructions that participants should not disclose abuse to us during the study as we would have to report it, as mandated by law in the state of Massachusetts in the United States (more on this later). As stated earlier, this was to preserve the agency of the individual with I/DD to determine when to report any abusive incident the participant may have experienced in the past. All participants were compensated for being in the study. Finally, all documents used for this study were approved by the relevant ethics boards: the University of Rhode Island and Worcester Polytechnic Institute Institutional Review Boards (IRBs) and the Research Review Committee (RRC) of the Department of Developmental Services (DDS) of the state of Massachusetts, all in the United States.

Ethical considerations in recruiting participants. Given the sensitive and potentially triggering nature of some of the content of the prototype, we had several discussions with our partners about who should participate in our studies. There was a choice between including only people with I/DD who identified themselves as being abuse survivors or simply including individuals with I/DD without having knowledge of whether they had been abused previously. Between the two choices, for ethical reasons, we decided to recruit a general population of individuals with I/DD who had not necessarily disclosed prior abuse. Asking someone about past abuse can be triggering in itself. We absolutely do not believe that any potential research gains that this information might have added would be worth the harm that asking about prior abuse would have inflicted on participants. We also strongly believe in preserving the agency of people with I/DD to disclose and discuss prior abuse at the time they feel comfortable. Therefore, based on discussions with stakeholders in the community and current best practices with respect to working with this community, we did not ask our participants about any prior abuse. Irrespective of whether participants had experienced abuse, we wanted to mitigate any potential negative consequences of the content used in the study. Thus, we had a counselor present during the study to talk privately with any participant who might be potentially triggered. All participants were informed that if they felt uncomfortable at any time or for any reason, they had the option to either go into a private break-out session (in a separate Zoom room) where they could talk to the psychologist one-on-one or stop the study altogether if they wanted to. Only one participant (P3) opted for a session with the psychologist for a short period of time before resuming the study.

As mentioned earlier, P12 was triggered and her session had to be stopped. As she was going through the sexual abuse topic, P12 appeared increasingly uncomfortable. When we asked whether she was doing okay, P12 disclosed having been sexually abused in the past and having been reminded of that incident by the topic. We stopped the study immediately, as we did not want her to be in any more distress. Further, as we did not know whether this was a new disclosure or a previously reported incident, we immediately contacted the group home where P12 lived to inform them about the disclosure and to make sure that she was okay. Disclosures of sexual abuse need to be reported to Adult Protective Services in Massachusetts, where the study was conducted. Therefore, we coordinated with the management of the participant's group home and the state APS agency to make sure that the disclosure was not new. It turned out that P12 was reminiscing about an unfortunate incident in her past and it was not a new disclosure. We did not want P12 to be in any more distress; therefore, we did not continue the study with her at a later time.

Consolidated user study analysis. After the user study, the collected Zoom recordings were transcribed. The first two authors then performed a reflective thematic analysis of the study transcripts. We used Braun and Clark's 6-step recursive approach to thematic analysis for our work, as described in [11]. The first two authors collaboratively performed the coding and analysis in order to achieve a richer interpretation of meaning than attempting to achieve consensus would generate. The coding and theme development were conducted inductively and evolved throughout the analytic process. The results of our analysis are summarized in the findings in the next section.

7 CONSOLIDATED USER STUDY FINDINGS

In broad terms, almost all participants liked most of the four elements of the consolidated *Recognize* prototype. The exception to this general liking of the prototype was P5, who was the only consolidated user study participant who did not like any of the prototype's content. P5 was diagnosed as being on the autistic spectrum and yet, per someone who assists him, rejects his diagnosis and views disability in general in a negative light. Indeed, his comments during the study consistently reflected a negative attitude toward anything associated with disability, which was unlike any other participant. We have included counts, where appropriate, to indicate participants' preferences as they interacted with the consolidated prototype. The quotations given in the following subsection are lightly edited for clarity.

7.1 Findings: Static and Video Learning Content Effectively Convey Information about Abuse

In this section, we describe our findings from the consolidated user study with respect to the participants' reactions to the three types of learning content and the related quizzes.

7.1.1 Participants Found the Static Learning Content Effective, Especially Its Use of Images. The static learning content in the consolidated prototype provided an overview of various examples of each type of abuse in the form of slides with an image and text that defined an aspect of that type of abuse. All of the images in the static learning content were photographs of actors (often with I/DD) in various situations. Most of the participants ($N = 9$) stated that the static learning content was helpful in learning about abuse. Further, the participants found the images within the slides to be the most useful aspect of the static learning content: "... pictures help me and other people understand what abuse is more clearly and have a better understanding of it. So, I feel like the more you have pictures and art... the more you'll have a better understanding of what's going on." (P6). This observation made a lot of sense in light of the fact that during the course of this consolidated user study, we observed that more than a quarter of the participants ($N = 4$) seemed not to read the text, prompts, or instructions that were part of the prototype. We did not probe the participants as to why they appeared not to read the text, as we did not want to make them feel embarrassed or self-conscious in any way. Although participants liked the inclusion of images in the static learning content, it is important to note that not all concepts are easily conveyed through images alone. Therefore, some images end up being more abstract and difficult to understand without also reading the accompanying text. A participant who noticed this dilemma suggested something akin to a text-to-speech feature: "... [for] people with disabilities that are vision-impaired, if you had a voice button that clicked on it and said this picture is an image of someone, like describing the picture." (P3).

7.1.2 Participants Found the Video Learning Content Useful Despite its Potential to be Triggering. Overall, almost all of the participants ($N = 10$) liked the video learning content (referred to as videos in the rest of the section) and found it to be an effective way to learn about how abuse can transpire: "If we didn't have the videos... I think it'll be harder for people to make a decision of what's what. So I think that's really good, to keep the videos and stuff on because not everybody

will understand what it is without it... so it's good." (P6). Not surprisingly, given the nature of the content, about half of the participants found the videos to be emotionally difficult to watch: "It can bring up a lot of reality... like family or group homes." (P2). Some participants reflected on how others might react to the videos in the prototype in addition to answering for themselves as an individual: "Every video could be triggering for someone. For me it was." (P3).

When asked about why the video content was emotionally difficult, we found the reason fairly consistently to be that the participants were empathizing with the abuse survivor in the video. We found this to be case for both the financial abuse topic – "It hurt me a little that [the caregiver in the video] took advantage of [person with I/DD]." (P13) – and the sexual abuse topic – "I felt bad for the [survivor]. If I was there, I would kick the [perpetrator's] ass." (P2). It was interesting to observe a qualitatively different reaction to the videos from one participant who found the financial abuse topic not emotionally difficult at all and the sexual abuse topic a little emotionally difficult. While most participants seemed to empathize with the actors with I/DD and some even identify with them, as stated earlier, the participant seemed to distance himself from the actors/characters in the video scenarios: "I didn't really like [the videos] that much, to be honest with you (P5). When we asked why, he responded: "the actors are very poor actors... and they just, I mean, I know it's not, they're not going for an Academy Award but it's just they're bad actors, okay, they're all bad actors." (P5).

7.1.3 Participants Wanted the Video Learning Content Scenarios to Provide More Context. The videos included in the prototype were relatively short and focused only on the actual act of (sexual or financial) abuse. We did this because it paralleled how the in-person A&A training incorporated the videos based on our observation of the training. However, when viewing these scenarios in the prototype, a few participants felt that the scenarios could be confusing to people with I/DD because of their lack of context. Our analysis determined that the participants' comments about what they felt the videos lacked generated three properties that the eventual app should include:

- **More specificity:** The participants wanted to know more specific information about the various characters so that they could better understand the scenario: "The video didn't explain, is [the perpetrator] a support staff, or is that [the survivor's] part or anything. It didn't say who that person was. That's the thing that wasn't specific." (P3).
- **Narrative closure:** The participants wanted to know what happens to the characters after the abusive incident, for instance, whether the incident was reported or the perpetrator was brought to justice:⁹ "... at the end [the video] didn't show that [the survivor] can get help. Where was her [personal care assistant]? Who helped her? Is she still being abused today? Or did she call [the APS agency] or did she call 911? Who did she call?" (P2). It seems that ending the videos *in medias res* (in the middle of things) likely contributed to the emotional difficulty experienced, especially given the likelihood for viewers to empathize with the survivor. Another participant brought up a very interesting point. After viewing the video learning content in the financial abuse topic, she stated that she would have liked to know why the perpetrator did what they did: "... because the money [video] didn't go back to the woman and try to talk to her: why did she buy all new clothes... And then if she says no, you would have to call the police and they have to look into it." (P10).
- **Character empowerment:** In the video from the financial abuse topic, a personal care assistant (PCA) who supports the abuse survivor (a person with I/DD) is the one who discovers and reports the abuse that was perpetrated by another PCA. An interesting point raised by one of the participants was that the participant wanted to see the survivors in the scenarios respond to and report the abuse themselves: "I'm glad the [PCA] reported [the financial

⁹This was particularly the case for the sexual abuse video, which ended with the occurrence of the abuse itself.

abuse] immediately... but not everyone is going to [report it] either. But it should've been [the survivor]... to go to his [PCA] and say something is wrong... [The survivor] really didn't care... [The survivor] needs to advocate for themselves." (P2).

That being said, the video in the financial abuse topic depicted a complex fraud scenario in which a PCA uses her client's money to buy high-priced clothes for her own son while claiming to have bought the clothes for the client, who gets thrift store clothing instead. This video was both specific and had narrative closure (the abuse is shown to be reported). It did not show character empowerment as discussed earlier. However, even if it did, the scenario was quite complex and over half of the participants ($N = 6$) found it confusing. We were not in a position to change the scenarios depicted in the videos because we were relying on the material provided to us from the A&A training. Therefore, it is important to view these three properties as necessary though not sufficient conditions for the video learning content. The complexity of the scenarios depicted is another dimension to consider.

7.1.4 Several Participants Found the Activities in the Skill-Learning Content to be Confusing.

Even though a majority of the participants were able to do the skill activity in both topics, some found the activities to be confusing. Overall, the participants found the private parts identification activity to be much more difficult to engage with as compared with the money-counting activity.

About a quarter of the participants ($N = 4$) did not do the private parts activity at all, preferring to skip it. Out of the remaining participants ($N = 7$) who completed the activity, one needed an explanation from the researchers before being able to complete the activity (despite the presence of instructions in the prototype). Only one participant stated liking the activity. Interestingly, out of the four participants who did not complete the activity, two did not control the emulator directly and, thus, had to verbally instruct a researcher to navigate the prototype for them. This may have affected how some participants approached this activity, as having to tell a researcher where to tap on an anatomical diagram seemed to have made one participant more uncomfortable than the individual would have been if the individual had control of the emulator: *"The no touching part... the only thing that was weird was 'okay [researcher's name] touch this part, touch that part.' But that's just me." (P6).* That being said, P6 did complete the activity. Further, there was no requirement for participants to use any specific words for body parts; they were free to indicate where to click on the body diagram however they wished (e.g., they could have said "move down" and then told us when to stop moving the cursor down or said "between the legs" or "under the belly," etc.). The two other participants who had to verbally instruct during this activity completed the activity without any issues. We did not notice any such problems in our preliminary user study, in which the instructor-participants who did not have control of the emulator similarly had to select the private parts of the body.

All participants ($N = 11$) successfully completed the money-counting activity. That being said, two participants did not know what to do until given an explanation. They were then able to successfully complete the activity. However, one participant brought up the important point that the activity might not work for people with limited literacy *"Now what do you want me to do? Click on the money thing? [...] Now people won't be able to do [this] if they can't read or write." (P2).*

7.1.5 Asking Participants to Distinguish between Different Types of Abuse in the Quiz Was Confusing.

Each topic in the consolidated prototype had two quizzes based on the static and video learning material. The quizzes included questions that asked the user to specify the exact type of abuse. For instance, in the quiz based on the static learning content, a quiz question showed an image of a female-presenting person's leg being kicked and asked if that was an example of sexual abuse (see the static quiz in Figure 7). We were surprised to find that a good number of the

participants answered that it was sexual abuse ($N = 5$): “Kicking?! Looks like it’s sexual abuse because it’s kicking in the private parts.” (P2). Similarly, the quiz based on the video learning content from the sexual abuse topic showed a still from the video (in which the perpetrator has hands on the shoulders of the survivor¹⁰) and asked what type of abuse was shown. Again, a good number of participants ($N = 4$) answered that it was physical abuse. We suspect that the confusion regarding sexual abuse being seen as physical abuse could have been due to priming from the private body parts identification activity that preceded the video learning content. This activity may have misled participants into thinking that anything involving the private body parts was necessarily sexual abuse and that all aspects of sexual abuse had to involve these parts. Three of the four participants who incorrectly identified the kicking image as sexual abuse also answered the video quiz question wrong (did not identify sexual abuse).

In terms of their thoughts on the quizzes overall, most participants ($N = 10$) liked both the static and video quizzes. In particular, participants appreciated that the quiz feedback was designed to praise them when their choice was correct and encourage them to try again when their choice was incorrect: “It made me go back to the [content] and it made me think about “Oh, is this abuse or it’s not abuse?” The good thing is I like how you can go back and fix your answer because, say you thought kicking was abuse. It’ll explain why or why not and it’ll give you another option to fix it or to make it better, I mean your answers. I feel like that’s very helpful.” (P6).

7.1.6 The Learning Content was Generally Reminiscent of the A&A Training. A subset of the participants ($N = 3$) had previously attended the A&A training on which the consolidated prototype was based. All three of these participants stated that the content in the prototype was a good review of what they had previously seen in the A&A training: “[It helped me remember] a lot because... it’s good to refresh your memory... Because abuse can come in many different ways, so... looking back at certain scenarios will help people understand what abuse is or... what to look out for when you are being abused. Not that abuse is clear to see but just to give you some warning signs of what to look out for.” (P6).

7.2 Findings: The Prototype Has the Potential to Engage Users

Here, we describe our findings from the consolidated user study with respect to the participants’ reactions to the engagement components of the consolidated prototype. Generally speaking, the participants liked the engagement components in the prototype but suggested a few improvements.

7.2.1 The Reward Mechanism Was Understood But Requires Better Nomenclature. Almost all participants ($N = 10$) liked the emoji-based reward mechanism in the prototype: “I loved the emojis because it’s just like, ‘oh you’re doing a great job!’ And I’m a gaming person in general so I feel like... the more you have awards, the better you’ll feel about [it] and you’ll want to keep going. So I feel like that was great to have because it’s like motivation to keep going.” (P6). In expressing that they liked the emoji in the prototype “a lot,” one participant also mentioned fondness for emojis in general: “I love emoji!” (P10). All participants understood the purpose of the emoji as a reward given for completing a topic, with some being quite excited to see which emoji they received: “Look at that! I got a saw.” (P9). Interestingly, a few participants brought up the point that calling them emojis in the app could be misleading: “I wouldn’t put ‘emojis.’ Because emojis, they’re thinking faces.... You [could] write emoji prizes.... Because you say change emoji and it’s like yeah, whatever, let’s get this

¹⁰The still is from a part of the video before the full-blown assault, in which the perpetrator performs unwanted touching of the survivor’s body.

done.” (P2). It is interesting to note that the instructor-participants in the preliminary user study who saw the same emoji-based reward in the three variants did not mention any downsides to using the term *emoji* in the eventual app.

7.2.2 Participants Thought the Grounding Activities Were Useful. Each topic we showed the participants had one grounding activity to help users cope in the event of being affected by the content. The sexual abuse topic had a breathing activity and the financial abuse topic had a music activity. Most of the participants ($N = 8$) generally liked the breathing activity: *“If [users] ever get upset or if they are feeling anxious or if they they cannot take a breather, then they can always use those exercises to help them breathe. That way they know that they are not doing something wrong and they are doing breathing okay.”* (P9). However some participants who liked the breathing activity cautioned that it may not be appropriate for everyone: *“Yeah. Some people do better with breathing. Breathing helps some people but not all people. Different things help different people.”* (P13). Most participants ($N = 9$) generally liked the music activity as well: *“Yes, I liked that. That was fun.... If [users] ever get agitated or feel anxiety or get nervous, they can always make a little beat with it... and say, ‘I feel better now.’”* (P9). Once again, the same participant cautioned that while the music activity can be helpful for people — *“Music can kind of get their mind into something nice, think of something nice, so like get their mind off of it. Use it as a coping skill...”* (P13), the music activity in the prototype may not appeal to everyone: *“[I only liked the music activity a little] because I don’t listen to stuff like that; I listen to a different kind of music.”* (P13).

Further, several participants ($N = 7$) suggested numerous additional grounding activities that could be implemented in the eventual app. These included going for a walk ($N = 2$); yoga, stretching, shoulder-rolls ($N = 3$); listening to music ($N = 2$); picture coloring/painting ($N = 2$); guided meditation ($N = 2$); watching funny videos ($N = 1$); word search games ($N = 2$); writing down one’s thoughts ($N = 1$); talking to someone ($N = 1$); any distracting activity ($N = 1$); or thinking about something else and then returning to the activity ($N = 1$). The sum of the individual counts is more than the total because each of the seven participants suggested several activities. These findings were roughly in line with what the instructor-participants suggested in the preliminary user study: that the eventual app should offer more options, as everyone copes differently.

7.2.3 Several Participants Wanted the Prototype to Be More Colorful. We had deliberately designed the prototype with neutral colors so that it would be acceptable to people with different tastes. Most participants ($N = 7$) stated that they liked the colors in the prototype. However, four participants, including P5, commented that the prototype should be more colorful in order to attract users and keep them engaged: *Color is great because it attracts; color attracts everyone. Self-advocacy loves color.... Very Important”* (P2). When asked what kind of color palette should be used, the participants generally agreed that it should be bright and warm: *“Even having some warm colors in the background... I don’t know, is there a way that you can make each section different colors, like something that shows not just a plain background... bright colors that are like warm.”* (P3). When asked whether bright colors might be distracting to some people, the participant stated: *“I think it [bright colors] will cheer people up because that way it’ll get their mood up after seeing the depressing video.”* (P3).

7.3 Findings: The Participants Considered the Eventual App to Be of Value

In this section, we describe our findings from the consolidated user study with respect to the participants’ reactions to the overall utility and value of the eventual *Recognize* app. Generally speaking, the participants appreciated the potential value of the eventual app: *“On the right track. Once finalized, it can be a great tool.”* (P2).

7.3.1 Almost All Participants Would Use the Eventual App Themselves and Recommend It to Others. When asked, almost all participants ($N = 10$) stated that they would use the eventual *Recognize* app for themselves once it becomes available. Most ($N = 8$) stated they would use *Recognize* on a regular basis (weekly, $N = 3$; monthly, $N = 2$; every three months, $N = 1$; regularly but did not clarify how often, $N = 2$): “*I would probably use it every other month or something like that because it’s always good to review abuse.*” (P3). Two participants stated that they would use *Recognize* if they ever end up in an abusive situation: “*If I was in this situation, I would use it.*” (P10).

We then asked the participants if they would recommend the eventual app to others. Almost all participants ($N = 10$) stated that they would share the eventual app with others: “*To be honest, I would share it with all my friends and my family because it’s a really great thing to have... [I would recommend this app to others] 100%.*” (P3). The one participant who stated not wanting to recommend the app clarified that it was because of not knowing anyone who needed it: “*Well, I would not recommend it—I hate saying it but... because I don’t know anybody that’s ment... One of my aunts is mentally challenged, so, but I wouldn’t recommend it to her because she’s... I don’t think she needs it. So, no, I don’t really know anybody of... mentally challenged.*” (P5). When asked if he would recommend the app if he ever met someone with I/DD, he responded: “*If, yeah, I probably would. If I knew someone...*” (P5).

7.3.2 A Few Participants Thought the Eventual App Will Help Some People with I/DD Narrate Abuse. Even though our focus with *Recognize* is on teaching individuals with I/DD about abuse, two participants also saw the eventual app as a tool for individuals with I/DD who have difficulty expressing themselves. They could use *Recognize* in a manner similar to a communication aid, to help them explain what happened to them (e.g., by pointing to a photo or scene in a video) to a mandated reporter who would then report the abuse to the authorities on behalf of the individual with I/DD: “*The app would be useful for [an individual with I/DD] to come in and say, ‘hey I have been abused’ or ‘hey I have been financially or verbally [abused]’.*” (P2). This observation was also made by the instructor-participants in the preliminary user study [27]. Interestingly, the same participant pointed out that this interaction could also work in reverse. An APS investigator could use *Recognize* to elicit what happened by showing the (alleged) survivor content from the app, where the latter could indicate which example matched the experience: “*When you get someone [from an APS agency who can find out] did something happen? Did your money get taken away? Or did somebody scream at you for verbal abuse? And work on it immediately.*” (P2). The fact that the participants saw the potential of *Recognize* to help make the voices of people in the I/DD community heard, believed, and understood was a benefit we had not expected from our design.

8 DISCUSSION

Overall, the participants had positive impressions of the consolidated prototype.¹¹ In this section, we outline some of the design implications of our findings, all of which extend the prior work done on designing e-learning tools for people with I/DD. We have framed the design implications in this section in terms of developing the consolidated prototype into a deployable version of *Recognize*. We believe that these implications also convey actionable recommendations for other researchers who want to explore similar topics.

¹¹This was largely similar to the positive impressions the instructor-participants had of the initial prototype even though the latter saw a prior version of the app.

8.1 The Static Learning Content Should Include Narration and Captions

One of the main takeaways from our findings was the value of the images in the static learning content given that many people with I/DD may not be able to or want to read the text in the eventual app (perhaps to avoid additional cognitive load). Therefore, to make this type of content more accessible to people with I/DD (in *Recognize* as well as in other apps), narration with captions should be added to remove the necessity of reading for all users, not just those who use operating-system-wide text-to-speech features. We suggest writing a narration script to accompany each slide. This script should provide more context than just voicing the text on the screen plus any alt-text for the images would provide and aid in the comprehension of abstract concepts. The narration would provide another layer of information to help all users of the app better understand its content even if they are also reading the screen. The accompanying captions would be helpful for users who are deaf or hard-of-hearing. Of course, when introducing narration and captioning into an app, it should offer various speeds of narration and captioning and provide a diverse set of voice options (in terms of intersectionality: race, gender, etc.) for the narration.

8.2 Video Learning Content Should Include More Context, Narrative Closure, a Pre-video Clarification, and an Empowered Person with I/DD

The video learning content was almost universally appreciated for its ability to show how abuse can transpire in the real world. However, since the videos depict sensitive content, they should include more context, narrative closure, pre-video clarification, and an empowered person with I/DD.

In the consolidated prototype, the video learning content was implemented as three video clips interspersed with a question inquiring as to the presence or absence of abuse in the preceding clip. Further, the videos, particularly the one on sexual abuse, were focused around the incident itself without giving any larger context about the scenario in which the abuse was happening. However, these decisions unfortunately obfuscated the larger context of the situation being shown for many participants, which made the videos confusing. Therefore, it is crucial that video learning content should not split videos into shorter segments unless it is certain that no meaning would be lost. Moreover, the videos should endeavor to describe the environment in which the depicted scenarios transpire along with the relationship between the characters. Some participants also wanted to know what happened after the abuse incident shown in the video, namely, to see a response to the abuse, an improved situation for the survivor, and the perpetrator held accountable. Their wanting to see a (positive) denouement of the depicted scenarios represents a desire for narrative closure to the story. Thus, it is crucial that videos used in apps keep the idea of *narrative closure* in mind.

To minimize some of the emotional toll of the videos, we believe it would also be beneficial to show a *pre-video clarification* that explicitly states that the stories depicted in the videos are not real and are instead role plays enacted by actors — that no one was actually hurt.¹² Finally, given the importance of *empowerment* for the I/DD population, it is important to depict empowered people with I/DD in apps about them. Therefore, it is important whenever possible for *Recognize* and similar apps to show learning content in which survivors take the initiative to report or tell others about their abuse.

¹²The full videos created for the A&A content do include all three of these elements. However, over the years, the in-person A&A training evolved into showing only the portions of the videos focused on the abuse itself. The A&A training's use of "curtailed" videos had influenced us into using the same "curtailed" videos in the consolidated prototype design. Going forward, we plan to include the full videos that tell the entire story, thereby providing context and narrative closure, and precede each video with a content warning about the staged nature of the videos.

8.3 The Skill-Learning Activities Need to be Redesigned

Although the participants generally successfully completed the skill-learning activities in the consolidated prototype, these activities had several shortcomings. The money-counting activity was only tangentially related to the financial abuse concepts we were trying to teach individuals with I/DD and, as P2 pointed out, they would not work for someone with limited literacy. An issue with the private body parts identification activity is that it could potentially prime users into thinking that all aspects of sexual abuse must involve the private parts of the body. We suspect that one of the reasons many participants were confused as to whether the part of the video (which followed the private parts activity in the topic) in which the perpetrator stands uncomfortably close to the survivor while caressing her shoulder showed sexual or physical abuse was because the perpetrator was not touching any private parts of the survivor's body. Another aspect of note is that the private part identification activity was essentially asking users to "touch a private part" on the screen as a way to teach them not to do so, which can be viewed as giving mixed messages while trying to impart a clear understanding. Further, the user study led us to conclude that asking participants to distinguish between specific types of abuse (e.g., sexual abuse and physical abuse) is counterproductive to the overall goal of the app, which is to help individuals with I/DD recognize whether or not abuse has occurred.

Therefore, we have determined that skill activities should have three main properties: (1) They should primarily help users differentiate between what constitutes abuse and what does not. Focusing on teaching how to identify abuse in general does not limit users from reporting the abuse and getting help because they can then use the app to communicate to others what kind of abuse happened to them. (2) Activities should not require reading or writing skills. (3) Activities have to be designed not to send mixed messages. One activity that could be used in a future iteration of *Recognize* is an abuse/no-abuse activity that shows two images: one pertaining to the type of abuse from the current topic (preferably an image from the slides in the static learning content) and another image showing a non-abuse situation. Users would be asked to tap the image that shows abuse. Appropriate encouraging feedback (suitably narrated and captioned) could be provided to the users, based on their choices, to explain why the depicted situation does or does not constitute abuse.

8.4 The Grounding Activities should be Diversified and Provide a Check-in Feature

The consolidated prototype included only one form of grounding activity in each topic. However, the way in which people deal with sensitive content varies from person to person [15]. Consequently, in order to be useful to a larger group of individuals with I/DD, the app should offer a variety of grounding activities. These activities need not only include those that can be performed digitally (e.g., guided breathing or playing a video game). They should ideally also include activities in the physical world (e.g., talking a walk). Therefore, we believe that an app such as *Recognize* should provide multiple digital and offline suggestions for grounding activities.

Further, in the consolidated prototype, a grounding — or *self-regulation* — activity was presented only once per topic, immediately after the static content. We did this because we had designed the grounding activity to be accessible at all times from the emoji menu (always visible at the bottom of the screen). However, during the user study, we noticed that none of the participants used it even though it could be accessed in two taps. Expecting users to seek activities that are located in another part of the app could place too much of a cognitive burden on users. Thus, we concluded that it would be better to include suggestions for multiple self-regulation activities after every type of learning content in a topic in addition to making these suggestions available from the emoji menu. That being said, several consolidated user study participants reported not finding the material to be emotionally difficult. Giving such individuals unwanted suggestions for

self-regulation may be unnecessary and could even result in reducing their engagement with the app. One way of showing self-regulation activity suggestions only to those who need it could be with a check-in screen. Self-regulation activities could then be suggested only to those individuals who indicate that they need them. Such a check-in screen can also be repurposed to keep track of the user's emotional state while using the app over time.

8.5 The Language within the App Needs to Be Simplified and Made More Direct

When people with I/DD are expected to use an app, it is important that the language within the app be easy to read, clear and direct, and avoid euphemisms and idiomatic language. Some language issues in the prototype were mentioned by participants during the consolidated user study, for example, the suggestion to use the term *prize* instead of *emojis*. We had called our topics "lessons" during the consolidated user study. However, the term *lesson* can connote a tedious obligation and could make the app sound preachy, school-like, and boring. The word *topic*, however, is much more neutral. Moreover, conversational language, when possible, would help to clarify what is meant and how the user is expected to respond, for example, "how are you feeling?" for a check-in screen. Overall, it is necessary to perform a thorough review of the language used within the app to ensure that the content is much more direct and easily comprehensible.

9 LIMITATIONS

There are a few limitations of this work, which we describe next. In our user study, the participants were asked to join the Zoom session using the device of their choosing. Unfortunately, we found that when a participant joined the Zoom call with a smartphone or a tablet computer, it prevented us from ceding control of the emulator to the participant. This was definitely an issue with the private parts identification activity, in which participants felt uncomfortable telling the researcher to click on specific private body parts. Further, the fact that the technical limitations of Zoom prevented certain participants from controlling the emulator (and, therefore, the prototype) directly 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 the right directional arrow button to move the screen forward. However, the participant could have meant something different, such as scroll down, but never corrected the researcher. Finally, it can be seen that the large majority of the quotations incorporated within the findings section came from a subset ($N = 6$) of the participants. This was because the participants were generally of two types: those who were very talkative and those who consistently gave short, succinct answers and who, even when prompted, did not explain their actions and/or decisions regarding the prototype. We do not believe that this affected the observations in this article. However, if all participants had explained their thinking, it perhaps could have provided additional perspectives that we might have missed here.

10 CONCLUSIONS

Facilitating the recognition of abuse among individuals with I/DD is essential to improve the likelihood that members of this population are able to recognize abuse on their own and that the abuse is reported in a timely manner. To these ends, we presented the design and prototype of a mobile computing device-based app called *Recognize* for independent learning by individuals with I/DD. We co-designed *Recognize* with self-advocates from the community who teach other individuals with I/DD about various types of abuse in a multi-step process. After an initial co-design session, we then created three initial prototype variants of *Recognize*, which were compared and evaluated by six experts who were individuals with I/DD and also instructors of the material covered in the variants. Based on the results of this study, we consolidated the features of the three variants into

one *consolidated prototype* of *Recognize* and performed a second qualitative user study of it with 11 individuals with I/DD who represented the eventual users of *Recognize*. Our findings demonstrated that the consolidated prototype is viable to teach people with I/DD about abuse and keep them engaged, given the sensitive content of the learning material. Based on our findings, we further identified several design implications for the development of a deployable version of *Recognize* and similar apps.

ACKNOWLEDGMENTS

We would like to thank all of our reviewers and participants for their invaluable help with this article. We would also like to thank Pauline Bosma, John Mullaly, Brian Kelly, Melissa Beauregard, Grant Yosenick, Deb Lloyd, Laney Bruner-Canhoto, Brian Kremer, Thomas Howard III, Priyankan Kirupaharan, Thomas Balistreri, and Jennefer Raymond for their help with this work.

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Received 28 June 2022; revised 13 October 2022; accepted 20 October 2022