USABILITY TESTING OF GUIDED INTERNET-BASED PARENT TRAINING FOR CHALLENGING BEHAVIOR IN CHILDREN WITH FETAL ALCOHOL SPECTRUM DISORDER (STRONGEST FAMILIES FASD)

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ABSTRACT

Background

In order to meet the need for accessible interventions and support for families affected by fetal alcohol spectrum disorder (FASD), we have developed an Internet-based, distance intervention for caregivers of children with FASD between the ages of four and twelve, called Strongest Families™ FASD.

Objectives

To evaluate the usability of the Strongest Families FASD program content and website in terms of learnability, efficiency and acceptability.

Methods

A remote usability testing approach was conducted in two iterative cycles of participants. Synchronous online usability testing sessions were conducted, followed by asynchronous testing. A total of 18 participants were included, comprised of both health care professionals with expertise in FASD and caregivers of children with FASD. The data collected in each cycle was examined for commonalities and results were used to inform changes to the website and content after each cycle.

Results

Participants rated the website as appealing and relatively easy and fast to use. Nevertheless, several usability problems were identified such as difficulty navigating between sections of content on the website, displaying too much content per page, and the relevance and appropriateness of the content as it related to FASD.

Conclusions

The identification of usability problems was an important step in refining the Strongest Families FASD program before its effectiveness is evaluated in a randomized controlled trial.

Key Words: *Fetal alcohol spectrum disorders, distance treatment, psychoeducation, usability, Internet, ehealth*

Maternal alcohol consumption during pregnancy can adversely affect fetal development, leading to birth defects in the offspring.[1] Fetal alcohol spectrum disorder (FASD) is a term that encompasses the continuum of birth defects and neurological deficits resulting from prenatal alcohol exposure. FASD includes the diagnostic categories of fetal alcohol syndrome (FAS), partial FAS (pFAS), and alcohol related neurodevelopmental disorder (ARND).[2] Associated with FASD are a broad range of cognitive and behavioural deficits in areas such as executive functioning, visual-spatial ability, motor function, and attention.[3-5] These deficits result in high rates of psychiatric comorbid disorders, difficulty with academic achievement and problems with alcohol and drug abuse.[6,7] In severe cases, individuals may be unable to live independently and require support throughout their lifetime.

Prevalence of FASD in the general population is difficult to quantify and most statistics are believed to underestimate the true extent.[8] Extrapolating on data from the US and Europe, the prevalence of FASD in Canada has been estimated at 9 per 1,000 live births.[9] In the Province of Alberta, FASD prevalence has recently been estimated at 12 per 1,000 individuals, based on provincial health records.[10] The costs associated with FASD are significant. In Canada the minimal population cost of FASD in 2013 was estimated at $1.8 billion, including direct and indirect costs.[11,12]

Given the estimated prevalence and costs associated with an FASD diagnosis, early childhood interventions are critical to mitigating chronic physical and mental health problems. Children with FASD often present with multiple comorbidities, necessitating the development of interventions that target the multiple needs of this population.[13,14] Unfortunately, there is currently a lack of evidenced-based, empirically-supported interventions for FASD.[13,15,16] To date, only 12 clinical intervention studies examining efficacy and effectiveness of interventions for children with FASD have been identified involving pharmacological and behavioural strategies.[15,16] However, small sample size and poor study design were common, making the findings difficult to interpret.[15,16]

In addition to inadequate and unavailable resources for families affected by FASD, barriers such as difficulty qualifying for and maintaining services, and a general lack of knowledge regarding FASD have been frequently reported.[13] The Internet has the potential to make interventions more accessible. The Internet is an effective method for delivering psychoeducational interventions due to its capacity to reach underserved families, increase engagement and be cost effective for both families and the health care system.[17-19] As of 2012, 83% of Canadian households had access to the Internet, with 97% of those having access to high speed service.[20] Additionally, based on input gathered by members of this research team through a needs assessment, caregivers of children with FASD most frequently reported the Internet as their preferred method for receiving assistance.[21]

In an attempt to address the need for accessible early childhood interventions that can support children and families affected by FASD, we developed an Internet-based, distance intervention for caregivers of children between the ages of four and twelve with FASD. The intervention is designed to teach caregivers evidence-based strategies which promote the positive development of their child and improve the parent child relationship. Content is delivered online and accompanied by weekly telephone sessions with a trained coach. The content is modelled on the current, effective Strongest Families™ intervention for disruptive behaviour.[22] As children with FASD share many behavioural characteristics such as hyperactivity, defiance and learning deficits with those with disruptive behaviour. [23] The findings from the needs assessment of both caregivers and health care professionals with FASD expertise was used to inform development of the content to make it appropriate for the FASD population.[21]

When developing an online intervention, the platform must be easy to use and to understand, error free, and aesthetically pleasing. Intervention software which fails to meet the needs of users can result in decreased adherence and satisfaction, potentially leading to reduced effectiveness.[24-26] As a result, an iterative usability evaluation is an essential part of the development process. As it applies to an online intervention, usability is a qualitative attribute which assesses the ease of use and acceptability of an interface.[27] Usability testing is critical for identifying problems with the user interface and content prior to conducting large scale studies.[26]

The goal of this study was to evaluate and improve the usability of the Strongest Families FASD program website in terms of 1) learnability, 2) efficiency and 3) acceptability of the content and interface based on user feedback from caregivers and health care professionals with expertise in FASD.

METHODS

Strongest Families FASD Development

Strongest Families FASD includes 11 sessions which each introduce a parenting skill. For a list of each session title and the corresponding parenting skill, see Table 1. Each session is delivered online and includes written material, interactive exercises and instructional video and audio clips. Content is designed and written at a fifth grade reading level. Within each session, example situations are used to demonstrate the skills. Each session is planned to contain: an introduction to the session, a skill section where participants learn a new skill, a media section including videos and questions on the skill, a troubleshooting section including common problems when implementing the skill and how to solve them, a review section summarizing the skill, and finally a tryout section where users create a customized tryout exercise based on the skill to practice throughout the week.

Sessions are designed to be completed weekly and supplemented by a weekly telephone call with a trained coach to reinforce the skills, answer questions and provide support. The coach uses a customized interface which interacts with the end user interface so that session exercises and content are informed by the weekly coaching sessions. The content is delivered online using the Intelligent Research and Intervention Software (IRIS) platform that allows for the creation of a smart site which includes personalization and customization features, as well as multiple workflows and social supports.[28] For screenshots of the program website after usability testing was completed, see Figure 1.

TABLE 1 Strongest Families FASD: parenting skills

Session	Skills taught to caregivers
Notice the good	Noticing good behaviour as a way of rewarding their child. Positive communication and verbal techniques for noticing good behavior.
Spread attention around	Learning how to share attention between more than one child.
Ignore whining and complaining	Learning to ignore whining and complaining, to stay calm, to change negative thoughts to positive and to walk away if needed.
Preparing children for change	Learning change warnings and cues to prepare their child for transitions.
Plan ahead inside	Learning to make a plan with their child using the SOLVER (situation, options, listen, venture, evaluate, reward).
Reward system	A reward system is a customized visual schedule that a child uses to earn points or stickers for doing daily tasks and good behaviours.
Plan ahead outside	Learning five steps for successful planning (1. Select the situation; 2. Listen to the child's ideas; 3. Try the plan; 4. Evaluate; 5. Reward).
Working with the school	A daily report card as a way for the teacher to share their ideas about the child's behaviours while in that environment.
Calming down	Using SOLVER for calming strategies with their child.
Problem solving	Learning how to help their child plan ahead for difficult situations.
Putting it all together	Reviewing the program and practice integrating the skills.

FIG. 1 Two examples of the content of Session 1: Notice the Good on the Strongest Families FASD website, after usability testing

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Things You Can SAY to Notice the Good

Let's review some examples:

1 Name It

2 Comment or Ask Questions

3 Say It Back

Comment or Ask Questions

Situation: Bob is looking at a picture book.

Which 'Comment/Question' would Notice the Good in Bob's behaviour?

○ "Bob, I hope you put away the toys you were playing with earlier."
● "Bob, I'm so proud of you for reading all on your own."
○ "Remember not to bend the pages, Bob."
○ "Why don't you read the new book you got for your birthday?"

Click to hear how Bob's dad **Noticed the Good** by **'Commenting and Asking a Question'**.

Bob's dad uses 'Commenting'

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Study Design and Procedure

A remote, blended (synchronous and asynchronous) qualitative usability testing approach was selected, consisting of a synchronous online usability session, followed by asynchronous access to the website, and a questionnaire. In synchronous testing, the facilitator (researcher) and participant communicate in real time, this is in contrast to asynchronous testing where the participant has no real-time interaction with the researcher.[29] The study was performed in two iterative cycles of participants. After each cycle, changes were made to the intervention content and website interface based on the feedback from participants. The study evaluated the caregiver interface of the website and the content from session 1 through 4. Given the time constraints, it was not feasible for participants to review the content of all 11 sessions. As a result, findings from the first four sessions were generalized to the content of the remaining sessions. The usability testing also did not include the coaching component. The study protocol and procedures were reviewed and approved by the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board and the IWK Health Centre Research Ethics Board.

Initial contact and demographic information

Information including age, sex, mailing address, education, employment, and diagnosis of the child with FASD (if applicable) was collected over the phone after obtaining consent. Headsets with microphones were mailed to participants who required them to ensure high quality audio during the online session.

Synchronous usability testing

Sessions were conducted at a distance, online, using Blackboard Collaborate web conferencing software.[30,31] The software enabled participants to speak and share live video of their computer screen. The software then generated a video file of the recorded screen and audio for offline review and analysis. All sessions were conducted by one member of the research team (ASH). The sessions began with a brief explanation of the Strongest Families FASD program and then participants were asked to share their computer screen with the facilitator. They were prompted to log on to the Strongest Families FASD website and give their initial impressions. Participants then completed session 1: notice the good (including completing all exercises and listening to the video and audio clips). Participants were prompted using the think-aloud method, to say what they were thinking, doing and feeling as they worked through the content.[32,33] Upon completion of session 1, participants were prompted for additional feedback by the facilitator using a semi-structured interview guide. Finally, participants were asked to complete a series of basic navigational tasks on the website while continuing to think-aloud. Participants navigated to each tab of the website (home, library, sessions, messages, community) and were asked to describe the purpose of the tab and complete tasks such as checking the messages inbox and sending a message. Throughout the session the facilitator took notes while observing. The recorded video file of each completed session was also reviewed in order to supplement the field notes with additional information.

Asynchronous usability testing

Following the synchronous usability session, participants were given ten days to complete sessions two through four on the website on their own time and at their own pace. Asynchronous testing was used in order to test more content than would be feasible in a synchronous session alone due to time constraints and also to allow participants to use the website independently.

Upon completion of session 4, participants were prompted to complete a questionnaire through the Strongest Families FASD website to collect feedback. The questionnaire included 21 5-point Likert items from 1 (strongly disagree) to 5 (strongly agree) and 8 open-ended questions regarding the content in sessions 2, 3 and 4. The Likert items were adapted from the Systems Usability Scale and the Standardized User Experience Percentile Rank Questionnaire.[34,35] Questions on computer use habits, proficiencies and attitudes were also included for descriptive purposes. Participants were specifically asked to rate their computer skills proficiency from very bad to very good, as well as rate their attitudes towards receiving health care services online from very negative to very positive. Questions on frequency of computer use and for what purposes, as well as comfort level with online interactive activities (from very bad to very good) were also included.

Participant Selection

Two different samples were used: a sample of health care professionals with expertise in FASD and a sample of caregivers of children with FASD. Separate samples were recruited for each cycle. The same procedure was used for both samples. Usability testing is typically performed with end users, in this case the caregivers. However, health care professionals in contact with families affected by FASD were also included to provide input based on their expertise regarding how caregivers would respond to the program. Previous studies have revealed that more than 80% of usability problems are discovered by the first five participants.[26,36,37] As a result, a sample size of five health care professionals and five caregivers per cycle was sought. Caregivers were required: 1) to be or have been the primary caregiver for a minimum of six months of a child diagnosed with FAS, pFAS, ARND, or suspected of having a FASD; 2) to speak English, 3) and to have access to a computer with high speed Internet and a telephone. Health care professionals were required: 1) to be physicians or allied health professionals such as nurses, physiotherapists and occupational therapists with experience working with the FASD population; 2) to speak English, 3) and to have access to a computer with high speed Internet and a telephone.

Data Analysis

Caregivers and health care professionals were analyzed separately per cycle. Data was compiled for each sample and cycle from the notes taken from the synchronous usability sessions and from the responses to the open ended questions administered at the end of the asynchronous usability testing. For each sample and cycle qualitative data was examined for common themes to identify usability problems and suggestions for improvement. In addition, the median and range for the quantitative data was calculated.

Health care professionals who were also caregivers of children with FASD were categorized as health care professionals during data analysis because of the insight their clinical knowledge provided. Results presented were categorized into major themes, defined as problems that were identified by at least three participants in a cycle. Minor website errors identified during testing were not included.

RESULTS

Participant Characteristics

Cycle 1 was completed during August and September of 2013 and cycle 2 during October and November of 2013. Cycle 1 consisted of four caregivers and six health care professionals. In cycle 1, one of the six health care professional completed the synchronous usability session, but did not complete the asynchronous usability testing. In cycle 2, ten participants consented, however two (one health care professional, one caregiver) withdrew due to personal reasons before beginning the study. Therefore, the sample for cycle 2 consisted of four caregivers and four health care professionals. See Figure 2 for a flowchart of participation in both cycles.

FIG. 2 Participation of caregivers and health care professionals in cycles 1 and 2

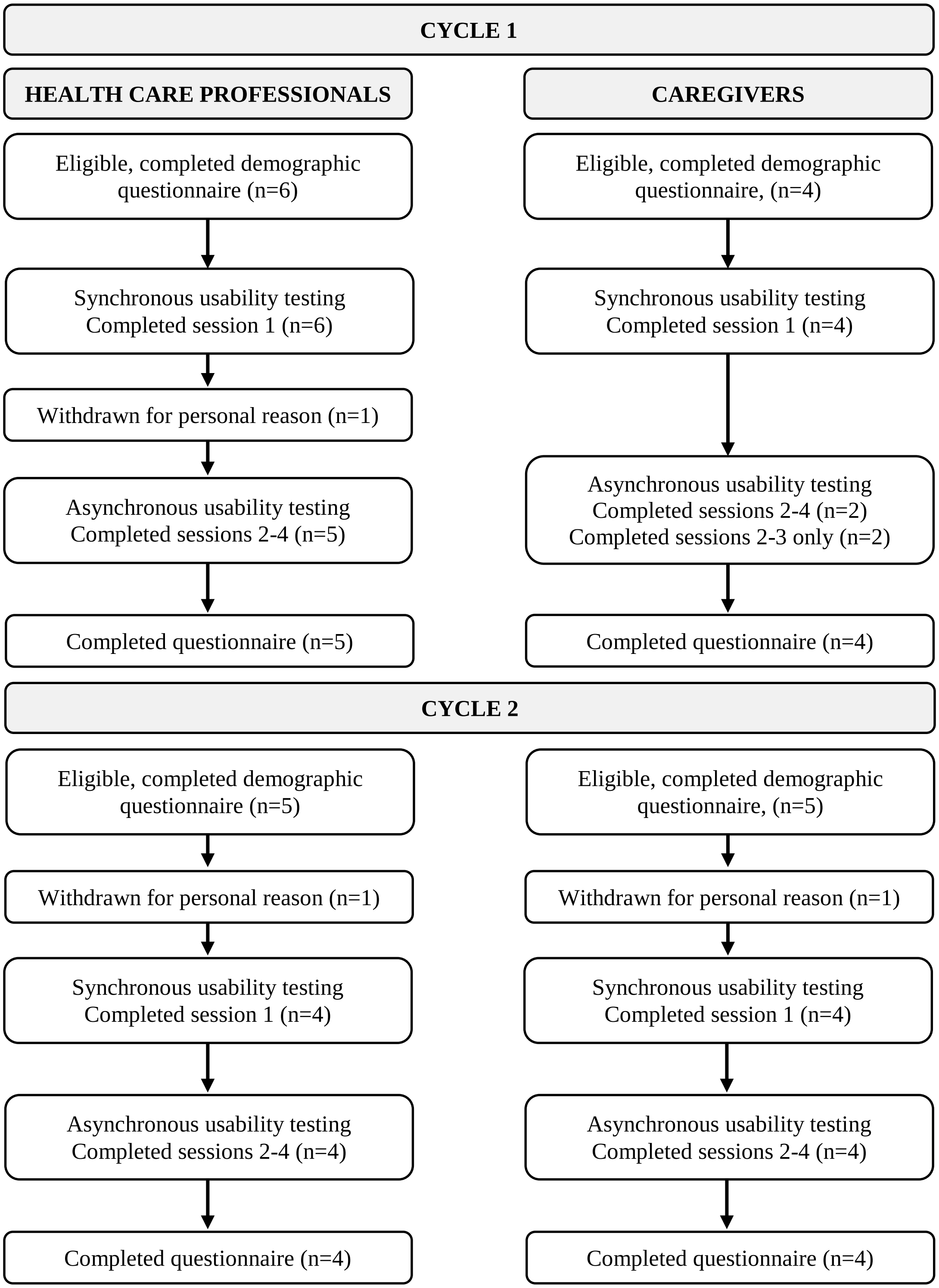


TABLE 2 Characteristics of caregivers and health care professionals in cycles 1 and 2 (N=18).

Characteristic	**Caregivers**		**Health care professionals**	
	Cycle 1 (n=4)	**Cycle 2 (n=4)**	**Cycle 1 (n=6)**	**Cycle 2 (n=4)**
Age, median (range)				
Age in years	46 (39-64)	57 (48-66)	53 (37-57)	46 (41-56)
Gender, n (%)				
Male	0	1 (25)	0	0
Female	4 (100)	3 (75)	6 (100)	4 (100)
Province of residence, n (%)				
Alberta	0	0	1 (16.7)	0
British Colombia	1 (25)	1 (25)	1 (16.7)	1 (25)
Manitoba	1 (25)	0	0	0
New Brunswick	0	0	1 (16.7)	1 (25)
North West Territories	0	0	1 (16.7)	0
Ontario	2 (50)	3 (75)	1 (16.7)	0
Saskatchewan	0	0	1 (16.7)	1 (25)
Yukon	0	0	0	1 (25)
Education, n (%)				
University degree	1 (25)	4 (100)	5 (83.3)	4 (100)
College or trade certification	2 (50)	0	1 (16.7)	0
Some post-secondary	1 (25)	0	0	0
Relationship to child[1], n (%)				
Birth parent	1 (25)	0	0	0
Adopted parent	2 (50)	3 (75)	2 (100)	0
Foster parent	1 (25)	1 (25)	0	1 (100)
Child's diagnosis[1], n (%)				
FAS	3 (75)	1 (25)	1 (50)	0
ARND	1 (25)	1 (25)	1 (50)	0
Suspected FAS	0	2 (50)	0	1 (100)
FASD related occupation, n (%)				
Social/outreach worker	Not applicable	Not applicable	3 (50)	1 (25)
Occupational therapist			1 (16.7)	0
Nurse			0	1 (25)
Government consultant			0	2 (50)
Program manager			2 (33.3)	0

[1] Two health care professionals in cycle 1 and one in cycle 2 were also caregivers for children with FASD.

Of the eight caregivers who participated, one was male and the median age was 52 (range 39-66 years). Of the ten health care professionals, all were female and the median age was 50 (range 37-57 years). Caregivers resided in three different provinces and health care professionals resided in a total of seven different provinces and territories across Canada. All participants had at least some education beyond high school. Three health care professionals were also caregivers of children with FASD in their home. The most common relationship to the child with FASD was adopted parent (7, 64%), followed by foster parent (3, 27%) and one caregiver (9%) was the birth parent. Characteristics of the health care professionals and caregivers by cycle are depicted in Table 2. Participant self-rated computer use, competency and attitudes are reported in Table 3. All participants had a computer at home and rated their computer skills as average or higher.

TABLE 3 Computer use, competency and attitudes of caregivers and health care professionals in cycles 1 and 2 (N=17)

Computer use, competency, and attitudes[1]	Caregivers, n (%)		Health care professionals, n (%)	
	Cycle 1 (n=4)	Cycle 2 (n=4)	Cycle 1 (n=5)[2]	Cycle 2 (n=4)
Own a home computer				
Yes	4 (100)	4 (100)	5 (100)	4 (100)
Computer user[3]				
Daily	3 (75)	4 (100)	5 (100)	4 (100)
Weekly	1 (25)			
Computer skills[4]				
Very good	1 (25)	1 (25)	1 (20)	2 (50)
Good	2 (50)	2 (50)	1 (20)	1 (25)
Average	1 (25)	1 (25)	3 (60)	1 (25)
Comfort level with online interactive activities[4]				
Very good	2 (50)	1 (25)	2 (40)	3 (75)
Good	1 (25)	3 (75)	1 (20)	1 (25)
Average			2 (40)	
Bad	1 (25)			
Attitude towards receiving health care services over the internet[5]				
Very positive	1 (25)		2 (40)	
Positive	3 (75)	4 (100)	1 (20)	3 (75)
Neutral			2 (40)	1 (25)

[1] Only answer options which were selected by participants are displayed in the table.
[2] One health care professional in cycle 1 did not complete the computer competency and attitudes questions.
[3] Options: never/almost never, less than once a month, monthly, every weekly, every day.
[4] Options: very bad, bad, average, good, very good.
[5] Options: very negative, negative, neutral, positive, very positive.

Learnability of the Website

Learnability refers to how easy it is for new users to learn the interface and perform tasks on the website. The use of the tryout section was the most common problem identified. The tryout section consisted of three pages: the first was instructions; the second page was a setup page, allowing users to generate a custom worksheet; and the third was the final user-created tryout worksheet. In cycle 1, four caregivers and five health care professionals found navigating the tryout section to be difficult. Both groups had trouble learning the buttons on the setup page and how to move forward or back to the home page once they finished the tryout worksheet. They also found the written instructions unclear. As a result of the feedback after cycle 1, the "generate" button on the tryout setup page was replaced with a "create new" and an "update" button. In addition, a "save" button was added to the tryout worksheet, which saved the work and redirected users to the home page. Written instructions on the tryout page were also edited for clarity. In cycle 2, no participants identified the tryout navigation or buttons as difficult to use. However, the written directions were again identified as confusing by all four caregivers and all four health care professionals in the cycle. As a result, we further refined and simplified the written instructions after cycle 2.

The second most common problem identified was navigating between different sections within a session, such as moving between the skill section and the media section. Four health care professionals and three caregivers in cycle 1 found it unclear what to do at the end of a section. For example, one caregiver reached the end of the introduction section and said, "What do I do now? This looks like the end." Based on this feedback, text directions were inserted on the last page of each section instructing users what section was ending and to click "next page" to access the next section. In cycle 2 no caregivers or health care professionals identified moving between sections as an issue.

Other issues frequently identified relating to the learnability of the website were problems with the multiple choice questions. In cycle 1, three caregivers and three health care professionals found they did not know if multiple choice questions had one possible correct answer, or multiple possible correct answers. This concerned one health care professional as they said, "If you don't select all the right answers then you assume the ones you didn't select are wrong" and a caregiver said, "How many can I select, they all sound right." As a result, after cycle 1, text was added next to multiple choice questions which said "you may select more than one response" when appropriate. In cycle 2, no caregivers or health care professionals identified this as an issue. Also relating to the multiple choice questions, two caregivers and two health care professionals found they did not know if they had answered a multiple choice question right or wrong. As a result, after cycle 1, additional feedback was added. Once a user selected an answer to a question, feedback would appear immediately below the question informing them if the response was right or wrong. In cycle 2, no participants identified this as a problem.

Based on the Likert items administered during the asynchronous usability test, both caregivers and clinicians in cycles 1 and 2 found the website easy to learn how to use, and did not find it confusing. See Figures 3 and 4 for a summary of responses by health care professionals and caregivers, respectively.

Efficiency of the Website

Efficiency refers to how quickly users can perform tasks and navigate the website. Based on the Likert items health care professionals and caregivers agreed that the website was easy to navigate and use. The speed of the website and how fast pages and video clips loaded varied considerably between participants, as seen based on the range of responses in Figures 3 and 4. Participants used either home or work computers to conduct the tests and differences in the Internet connection likely explained the variability. Website speed was upgraded after cycle 1 and overall the caregivers and health care professionals in cycle 2 reported improved speeds based on the Likert responses.

FIG. 3 Median response by health care professionals to the Likert item (1 strongly disagree to 5 strongly agree) questionnaire in cycles 1 (n=5) and 2 (n=4), error bars indicate range of responses

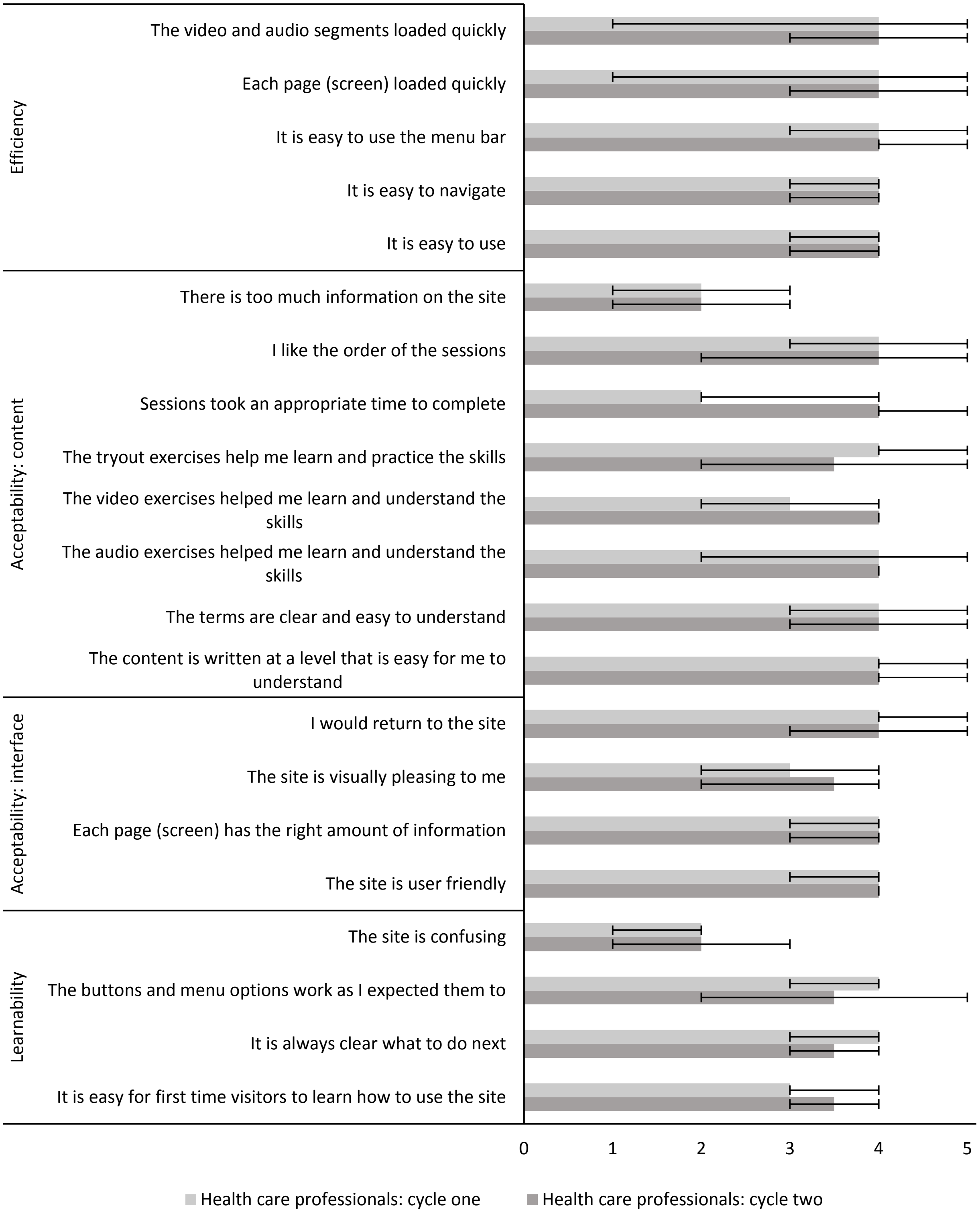
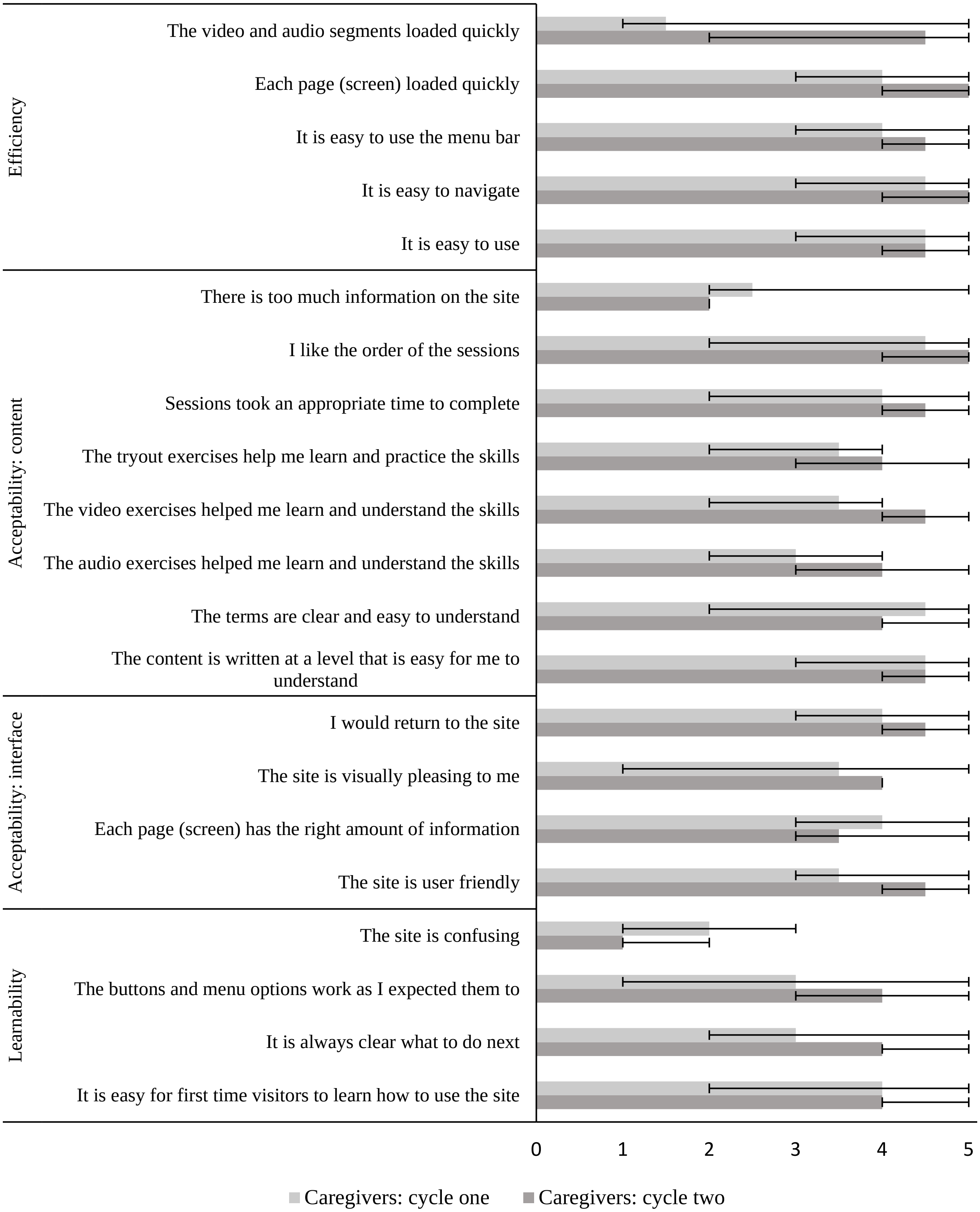


FIG. 4 Median response by caregivers to the Likert item (1 strongly disagree to 5 strongly agree) questionnaire in cycles 1 (n=4) and 2 (n=4), error bars indicate range of responses



Acceptability of the Website

In cycle 1, two health care professionals and one caregiver felt some pages contained too much content. A caregiver in cycle 1 pointed out, “I don’t like having to scroll on some pages”. Based on this feedback large pages were divided in to multiple smaller pages where possible. In cycle 2 no participants commented on the content of pages being too long. Overall, in both cycles caregivers and health care professionals did not feel that the site needed more visuals (graphics, pictures, colours). A caregiver in cycle 1 said, “No more pictures, you are looking for information. I like to read and know what I am reading is important.”

As seen in Figures 3 and 4, based on the Likert item responses health care professionals and caregivers in both cycles indicated they would return to the website and that the site was visually pleasing. Participants also agreed that each page (screen) had the right amount of information.

Acceptability of the Content

The most frequently identified problem related to the reading level and complexity of the content. However, health care professionals and caregivers had different opinions. In cycle 1, two health care professionals expressed concerns that the content would be too difficult for many of their clients to complete. One health care professional said, “Half the families I work with I don’t think could do this on their own, because of the caregivers own cognitive level.” At the same time, two caregivers in cycle 1 said the content was too simplistic and mostly information they already knew. No changes were made after cycle 1 as a result of the feedback. In cycle 2, results were similar. One health care professional believed the content was too complex for some caregivers, while another believed it to be too simple, saying, “The content is simplistic, an educated parent will not see value in it.” All four caregivers gave similar opinions in cycle 2. One caregiver said, “I think you can’t hear what it teaches often enough, even if I know all of this. Most parents have already received it, it is good and information that is easy to forget.” No changes to the content were made based on this feedback. The relevance and appropriateness of the content as it related to FASD was another common problem. In cycle 1, two health care professionals and one caregiver thought that the content was not sufficiently specific to FASD. For example, one health care professional said, “I expected the topics to be a little bit more FASD specific, but the strategies are FASD friendly for sure.” While a caregiver said, “I did not relate to the examples, they are not extreme enough.” Also in cycle 1, two caregivers found that many examples of how to use the skills were too lengthy to use with children with FASD, who would not be able to focus because of short attention spans. In order to address this feedback, after cycle 1 the session content was reviewed and modified where appropriate to have example situations that more closely resemble the types of behaviours exhibited by children with FASD. For example, one situation was originally written as, “Bradley is building a tower out of blocks”; it was modified to, “Bradley is building a tower out of blocks. He is making loud noises, is running around the room and knocks the tower over. Unfazed he starts making another tower.” Example situations were also modified to shorten responses given by caregivers. For example, in an example situation where a caregiver notices their child’s good behaviour, the caregiver response was changed from "Johnny, you are playing very nicely with Laura. It's good of you to be so much fun with your sister" to a shorter "Johnny, you are playing very nicely with Laura." Despite these changes, feedback that the content was not sufficiently specific to FASD was again suggested in cycle 2 by two health care professionals and one caregiver. After cycle 2 the content for all sessions was put through another round of revisions in order to address the concern and insert more FASD specific examples, as well as to better highlight differences between FASD and typically developing children.

The troubleshooting section also resulted in some concerns. In cycle 1, two caregivers and five health care professionals were concerned with the troubleshooting section name or confused about the purpose of the section. However, they believed it contained useful information. As a health care professional in cycle 1 said, “I think because parents think if something doesn’t work really quickly, then it’s not worth it and so emphasizing over time it can work is important."

As a result, after cycle 1, troubleshooting was renamed as problem solving and included as part of the review section. In cycle 2, no participants identified this as an issue.

In cycle 1, three health care professionals and two caregivers felt they wanted more feedback and explanations on why the selected responses to a multiple choice question were right or wrong. As a result, more detailed feedback was added after cycle 1, such that the feedback appeared immediately below the question once a response was selected. No participants in cycle 2 identified the feedback as an issue.

Two health care professionals and two caregivers in cycle 1 were concerned with physical affection (e.g. hugging, kissing, touching) as a way to notice children's good behaviour. They were concerned that many children with FASD may not respond well to physical contact. After cycle 1, based on this feedback, content was modified to include information early in the first session informing users that it is important to understand what type of positive body language works best for their child and that some children with FASD process sensory information differently and may not like physical contact. Despite the changes, in cycle 2, two caregivers were again concerned that the use of physical affection was not appropriate for children with FASD. Additionally, one health care professional in cycle 2 said "Using physical affection can be difficult with boundaries, especially for foster parents." As a result, after cycle 2, content was modified further to include a greater emphasis on ways to notice the good which do not involve physical contact.

Based on responses to the Likert items in Figures 3 and 4 both caregivers and health care professionals agreed that the content was written at a level that was easy to understand. Participants also agreed that the tryout exercises and the audio and video content helped to understand the skills.

DISCUSSION

Current Study

This usability study identified important issues in user performance and acceptability of the site, as well as with the content itself. Modifications were made to correct the issues as appropriate. Conducting the study while the program was being developed allowed the content and website to be modified at low cost. Conducting usability testing online enabled recruitment from a wide geographical area, which included six provinces and two territories. Testing the intervention online also provided a real world testing environment, which allowed for evaluation across a variety of computer environments and Internet speeds. The online usability session reduced the time commitment for participants, allowing them to complete the study from a location convenient for them and at a time which suited their schedule.

In general, the caregivers and health care professionals identified similar issues throughout the study. However, the caregivers in this study were more likely to find the content simplistic, while several health care professionals were concerned the content was overly complex. This difference may result from the fact that all caregivers who participated had some education beyond high school, were older and possibly more involved in similar interventions. Additionally, participants reviewed only the first 4 of 11 sessions, which likely contained the most basic content. This feedback does suggest that some caregivers may be more likely to benefit from the program, while others, requiring more assistance and support may not find it meets their needs. However, highly educated caregivers who have already received similar training, may find some of the information redundant. In order to address the varying needs and abilities of caregivers, the intervention is customized for each family. For instance, the introduction to FASD offers two streams of information, one for caregivers who indicate they already have a strong knowledge of FASD, and one for those with a more basic understanding. The coach also plays an integral role in adapting the program to the needs of each family. The coach can assist caregivers who require more support in order to understand the content, and also focus caregivers with more advanced knowledge on the content which will benefit them the most.

Limitations

The study has several limitations. Our sample contained little heterogeneity, only one participant was male, only one participant was the birth parent of a child with FASD, all participants had some education beyond high school and all were over the age of 35. The study also excluded those who did not have access to Internet and telephone. In addition, interview data was not transcribed and formal content analysis was not conducted. The study did not reach the desired sample size of five participants in each sample and cycle, with only four caregivers and four health care professionals in cycle 2. Study participants reviewed content from session 1 to 4 only. However, content is delivered using the same interface in all sessions and is also written in the same format and style. The usability testing did not include the coaching interaction and instruction in advance of the users accessing and completing content, as will be the case when intervention is delivered. The coaching assistance may help users to understand the website and testing the website without coaching assistance helped ensure the website is as easy to use as possible.

Future Direction

Following completion of the usability study, the Strongest Families FASD program is now being evaluated in a two-arm randomized controlled trial (trial registration #NCT02210455) comparing groups assigned to receive either the Strongest Families FASD program (intervention group) or a static resource webpage (control group). Using a subset of participants in the trial intervention group, we are first evaluating the feasibility of the program, defined as user satisfaction, perception of burden, perceived utility, and levels of compliance with the program. Following this, using a sample of 200 caregivers of children with FASD aged four to twelve years we will evaluate the effectiveness of Strongest Families FASD in reducing externalizing and internalizing problems in children with FASD, and reducing parental distress in the intervention group compared to the control group. For additional information on the trial design, see the published study protocol.[38]

CONCLUSION

This study was designed as a feasible, cost effective method for improving the usability of the Strongest Families FASD intervention before conducting a randomized controlled trial.

The usability study provided valuable feedback which improved the website interface acceptability, learnability and efficiency, as well as the acceptability of the content.

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Conflicts of Interest

Strongest Families Institute (www.strongestfamilies.com) is a not-for-profit organization delivering services to Canadian families. Dr. McGrath is co-founder and CEO of Strongest Families Institute (SFI); he derives no financial benefit from SFI. Dr. Lingley-Pottie is co-founder of SFI and employed full-time as the President and Chief Operating Officer. Dr. Pottie provided her academic and clinical consultation to this study as an 'in-kind' contribution. Drs. McGrath and Lingley-Pottie will be co-founders of the IRIS company that is pending incorporation and may benefit financially in the future from IRIS and services sales.

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REFERENCES

1. Sokol R, Delaney Black V, Nordstrom B. Fetal alcohol spectrum disorder. JAMA 2003;290(22):2996-9.
2. Chudley A, Conry J, Cook J, Loock C, Rosales T, LeBlanc N. Fetal alcohol spectrum disorder: Canadian guidelines for diagnosis. CMAJ 2005;172(5 Suppl):S1-S21.
3. Mattson S, Roesch S, Glass L, et al. Further development of a neurobehavioral profile of fetal alcohol spectrum disorders. Alcohol Clin Exp Res 2013;37(3):517-28.
4. Pei J, Job J, Kully Martens K, Rasmussen C. Executive function and memory in children with fetal alcohol spectrum disorder. Child Neuropsychol 2011;17(3):290-309.
5. Rasmussen C. Executive functioning and working memory in fetal alcohol spectrum disorder. Alcohol Clin Exp Res 2005;29(8):1359-67.
6. Streissguth AP, Aase JM, Clarren SK, Randels SP, LaDue RA, Smith DF. Fetal alcohol syndrome in adolescents and adults. JAMA 1991;265(15):1961-7.
7. Streissguth A, Bookstein F, Barr H, Sampson P, O'Malley K, Young J. Risk factors for adverse life outcomes in fetal alcohol syndrome and fetal alcohol effects. J Dev Behav Pediatr 2004;25(4):228-38.
8. May P, Baete A, Russo J, et al. Prevalence and characteristics of fetal alcohol spectrum disorders. Pediatrics 2014;134(5):855-66.
9. Public Health Agency of Canada. Fetal alcohol spectrum disorder (FASD): a framework for action. PHAC 2005.
10. Thanh N, Jonsson E, Salmon A, Sebastianski M. Incidence and prevalence of fetal alcohol spectrum disorder by sex and age group in Alberta, Canada. J Popul Ther Clin Pharmacol 2014;21(3):e395-404.
11. Popova S, Lange S, Burd L, Rehm J. The burden and economic impact of fetal alcohol spectrum disorder in Canada. Centre for Addiction and Mental Health 2015.
12. Stade B, Ali A, Bennett D, et al. The burden of prenatal exposure to alcohol: revised measurement of cost. J Popul Ther Clin Pharmacol 2009;16(1):e91-102.
13. Petrenko CLM, Tahir N, Mahoney E, Chin N. Prevention of secondary conditions in fetal alcohol spectrum disorders: identification of systems-level barriers. Matern Child Health J 2014;18(6):1496-505.
14. Caley L, Winkelman T, Mariano K. Problems expressed by caregivers of children with fetal alcohol spectrum disorder. Int J Nurs Terminol Classif 2009;20(4):181-8.
15. Kodituwakku P, Kodituwakku EL. From research to practice: An integrative framework for the development of interventions for children with fetal alcohol spectrum disorders. Neuropsychol Rev 2011;21(2):204-23.
16. Peadon E, Rhys Jones B, Bower C, Elliott E. Systematic review of interventions for children with fetal alcohol spectrum disorders. BMC Pediatr 2009;9(35).
17. Jones D, Forehand R, Cuellar J, et al. Harnessing innovative technologies to advance children's mental health: behavioral parent training as an example. Clin Psychol Rev 2013;33(2):241-52.
18. Barak A, Hen L, Boniel-Nissim M, Shapira N. A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. J Technol Hum Serv 2008;26(2-4):109-160.
19. Jones D, Forehand R, Cuellar J, et al. Technology-enhanced program for child disruptive behavior disorders: development and pilot randomized control trial. J Clin Child Adolesc Psychol 2014;43(1):88-101.
20. Statistics Canada. Canadian internet use survey 2012. The Daily 2013.
21. Green C, Roane J, Hewitt A, et al. Frequent behavioural challenges in children with fetal alcohol spectrum disorder: a needs-based assessment reported by caregivers and clinicians. J Popul Ther Clin Pharmacol 2014;21(3):e405-20.
22. McGrath PJ, Lingley-Pottie P, Thurston C, et al. Telephone-based mental health interventions for child disruptive behavior or anxiety disorders: randomized trials and overall analysis. J Am Acad Child Adolesc Psychiatry 2011;50(11):1162-1172.
23. Kooistra L, Crawford S, Gibbard B, Ramage B, Kaplan B. Differentiating attention deficits in children with fetal alcohol spectrum disorder or attention-deficit-hyperactivity disorder. Dev Med Child Neurol 2010;52(2):205-11.
24. Gustafson D, Wyatt J. Evaluation of ehealth systems and services. BMJ 2004;328(7449):1150.
25. Wichansky AM. Usability testing in 2000 and beyond. Ergonomics 2000;43(7):998-1006.
26. Brock D, Kim S, Palmer O, Gallagher T, Holmboe E. Usability testing for the rest of us: the application of discount usability principles in the development of an online communications

assessment application. Teach Learn Med 2013;25(1):89-96.
27. Nielsen J. Heuristic evaluation. In: Nielsen J, Mack RP, editors. Usability Inspection Methods. New York: John Wiley & Sons, 1994.
28. Wozney L, McGrath PJ, Newton A, et al. Usability, learnability and performance evaluation of intelligent research and intervention software: a delivery platform for eHealth interventions. Health Informatics J 2015. Jun 23. pii: 1460458215586803. [Epub ahead of print].
29. Hartson HR, Castillo JC, Kelso J, Neale WC. Remote evaluation: The network as an extension of the usability laboratory. Proceedings of CHI'96 Human Factors in Computing Systems 1996;228-235.
30. Wozney LM, Baxter P, Fast H, Cleghorn L, Hundert AS, Newton AS. Sociotechnical human factors involved in remote online usability testing of two eHealth interventions. JMIR Human Factors 2016;3(1):e6.
31. Blackboard Inc. Blackboard collaborate: Release 12.5. Washington, DC: Blackboard Inc. 2013.
32. Lewis C. Using the" thinking-aloud" method in cognitive interface design. IBM 1982;RC-9265.
33. Ericsson KA, Simon HA. Verbal reports as data. Psychol Rev 1980;87(3):215-251.
34. Brooke J. SUS: A quick and dirty usability scale. Usability Evaluation in Industry 1996;189-194.
35. Sauro J. SUPR-Q: A comprehensive measure of the quality of the website user experience. Journal of Usability Studies 2015;10(2):e68-96.
36. Virzi RA. Refining the test phase of usability evaluation: How many subjects is enough? Human Factors: The Journal of the Human Factors and Ergonomics Society 1992;34(4):457-468.
37. Nielsen J. Estimating the number of subjects needed for a thinking aloud test. Int J Hum Comput Stud 1994;41(3):385-397.
38. Turner K, Reynolds JN, McGrath P, et al. Guided internet-based parent training for challenging behavior in children with fetal alcohol spectrum disorder (strongest families FASD): Study protocol for a randomized controlled trial. JMIR Res Protoc 2015;4(4):e112.