Evaluation and Design Improvement of an Augmentative and Alternative Communication Tool for Children with Autism

by

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Abstract

Title: Evaluation and Design Improvement of an Augmentative and Alternative Communication Tool for Children with Autism

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Autism Spectrum Disorder treatment is a real challenge in our society. In an attempt to manage this, Augmentative and Alternative Communication devices became more and more prevalent in the form of software installed on portable devices such as tablets. These mobile applications help individuals with autism to enhance their communication capabilities. Some of the concerns pertaining to the success these systems are the efficacy and the capability, the ease of use, and the user engagement.

The research described in this thesis focuses on the usability of a particular application named Livox. This usability evaluation consisted of a threefold approach: (1) a heuristic evaluation, (2) a usability testing with users, and (3) an evaluation survey distributed to parents of 6 autistic children after they had used the application for 6 weeks. The issues identified from the combination of the different usability evaluations were mainly related to
the user interface and information architecture. Based on the gathered data, design improvements have been prototyped and additional features have been proposed.

This thesis begins by first introducing autism and the projects context. Second, different types of Augmentative and Alternative communication systems are presented. Third, a literature review about usability in general and the methods used in this project in particular are explained. Then, the results from the usability evaluation have been detailed and potential improvements generated. Afterwards, design improvements have been proposed and prototyped before finishing by a conclusion and future work.
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Dedication

To my mother; No words can express my gratitude for all her love, support, and faith in me.
Chapter 1
Introduction

1. About Autism

Autism Spectrum Disorder (ASD) is a disorder in the development of a child, characterized with deficiencies in communication (verbal and non-verbal), social interaction and repetitive behavior [1]. Autism is usually first detected in childhood. According to the Centers for Disease Control and Prevention (CDC), approximately 1 in 68 children has been diagnosed with ASD during the surveillance year of 2014 [2]. Additionally, it is approximately 4.5 times more common among males (1 in 42) than among females (1 in 189) [2]. The number of children diagnosed has increased in the last decade. Diagnosis can be accurate from an age as young as 2 years old [3]. As indicated by its name, autism has a spectrum. Thus, the disorder manifests itself differently from one individual to another [4]. Not only do they display a different range of deficiencies, but also the severity of each impairment varies. Some demonstrate more behavior in excess (e.g. vocal and motor stereotypes, echoic speech, rigidity, etc.), others show behavior in deficit (e.g. delay in communication, relationships, independent functioning, etc.) [5].

ASD symptoms can be reduced and treated [6]. The earlier the diagnosis takes place, the greater the chances for the child to have a better quality of life [7]. Autistic individuals find
it very hard to integrate themselves in society; in fact, they show difficulty interacting with and understanding other people’s feelings and situations [8]. Several research efforts have been undertaken to understand how to treat this disability; there is unfortunately no medicine to cure ASD. However, the field Applied Behavior Analysis (ABA) has contributed greatly in improving the skills of people with autism [9]. ABA is a scientifically proven approach that studies behavior, how it is affected by the environment, and manipulates the environment to affect behavior. This alteration of the environment engenders the enhancement of the individual’s learning process: therapists use well-defined procedures and protocols to foster the occurrence of wanted behaviors [5]. Principles such as positive reinforcement – giving a type of reward right after a behavior occurs in order for the patient to reproduce it – are used to teach children new skills.

This thesis focuses, in particular, on the communication impairment in children with autism. Many of these children do not develop verbal communication at a level that allows them to express their day to day needs and wants and to interact properly with their family members [10]. Having communication problems creates frustrations that can ultimately lead to unwanted behaviors (e.g. tantrums) [11]. Consequently, one of the most important aspects of autism treatment is teaching the patients how to communicate. It is to fulfill this goal that Augmentative and Alternative Communication (AAC) has been developed (chapter 2 will provide further details).
2. Human-Centered Design

Human-Centered Design (HCD) is a multi-disciplinary problem-solving approach that takes into account the human in all the design phases – finding the right problem and answering human needs [12]. HCD plays a major role when it comes to innovation. In fact, by placing the human being at the center of the design process, we can design usable and truly useful products and services that satisfy the needs of various stakeholders.

Applying HCD means working hand in hand with the user through what is called participatory design. Some of the most important fundamentals of modern design include insight, observation, and empathy [13]. It is only when the user is truly understood that the real requirements are gathered and, thus, the best designs are created. The best product is not necessarily the most technologically sophisticated product, rather it is the one that best responds to people’s needs. The HCD process revolves around methods such as field observation, brainstorming, prototyping, and modeling & simulation. When coupled with the integration of the user from the early phases of design, these techniques allow for creative design thinking.

Numerous products have failed miserably in the past despite featuring state of the art technology. The reason for these failures is the disconnection between engineering and users. If designers had thought about involving the user since the early phases of the design, they could have gathered fundamental insight necessary to generate a more effective solution. When the user input is solicited only after the product is made, it is usually too late and costly to change the design and redo everything from scratch. To avoid these shortcomings, the
HCD approach relies on the iteration of: observation, idea generation, prototyping, and testing [12]. Design reiteration is key, especially when it is performed before major technical decisions and investments have been made. HCD is then a perpetual wheel of continuous improvement until the optimal possible solution is found.

### 3. Project’s Context

If the popularity of HCD nowadays comes from its effectiveness when designing for humans, healthcare is a natural fit for HCD and a passion for the author. This project was then conceived from a collaboration between the Human-Centered Design Institute, The Scott Center for Autism Treatment [14], and MindsUntapped [15].

#### 3.1 The Scott Center for Autism Treatment

The Scott Center for Autism Treatment (TSC) has a facility located at Florida Institute of Technology. Edward and Cheryl Scott funded the creation of the center in 2009. TSC “pursues a three-fold mission of clinical service, research and training” [14].

TSC incorporates state of the art knowledge from Florida Tech’s School of Psychology and Applied Behavior Analysis to provide training, supervision to graduate students. The center is top-ranked internationally thanks to its contribution to research in ABA [14].

TSC’s facility is well suited for children with autism and equipped with observation rooms, small group exposure rooms, behavior therapy rooms and much more [16].
3.2 MindsUntapped

MindsUntapped is a company that serves as a platform to integrate communication and learning technologies to enhance the human mind and empower people with disabilities to integrate, participate, and flourish in today’s society.

One of the companies that MindsUntapped is currently collaborating with in the USA is Livox, whose product is an AAC mobile application.

3.3 Project Description

Many AAC tools exist today on the market and they each have their own strengths and limitations. Livox is a relatively new AAC tool (mobile application) that is still in the process of being validated by practitioners. As a leader in autism treatment, TSC strives to explore cutting-edge solutions to enhance its clients’ quality of life. In this thesis project, the usability of the Livox app is evaluated – involving clients from TSC – and potential improvements are designed. Testing the app with families from TSC allows us to have quality feedback about the app from real users.
Chapter 2  
Technology and Health

With the level of technological advancement today and its ubiquity in our life, it is no surprise for the healthcare domain to turn to technology in order to enhance performance and/or the quality of service. We are observing more and more mobile health (mHealth) systems and platforms that rely on mobile devices such as smartphones, tablets, smartwatches, and wearables to optimize health provision to patients. For example, individuals with chronic health diseases, such as heart disease, can rely on such systems to collect data periodically and send it to their doctor [17]. The doctor can then analyze this data and order additional tests of prescribe medication accordingly.

Another area in which mHealth is very prevalent is fitness and wellness. Individuals can now use their mobile devices to monitor their sleep, heart rate, burned calories, amount of exercise, and follow specific and personalized diets [18]. This allows users to follow steps and keep track of their progress toward a healthy lifestyle.

Our research focuses on the relationship between technology and a specific type of disability which is ASD.

1. Technology and Autism

One of the aspects that makes autism very difficult to deal with is obviously related to communication and social interaction impairment. One of the goals of ASD treatment is to
allow for integration within the society [8]. Enhancing communication abilities is key in achieving this goal. That is where assistive technology comes into play in the form (AAC).

In the world of psychology and behavior analysis, AAC can be aided or unaided [19]. This distinction is not related to how advanced the technology being used is, but whether or not there is an actual external device used. Unaided AAC systems refer to the use of gestures (e.g. sign language), whereas aided AAC relies on the use of a vast array of external devices ranging from the technologically sophisticated such as Speech Generating Devices (SGD) to simple pictures. Depending on the severity of the disability and the diagnosis results, therapists choose which type of AAC is the most adequate for the patient.

Two of the most used approaches for AAC are Picture Exchange Communication System (PECS), and Speech Generating Devices (SGD) [20].

1.1. Picture Exchange Communication System (PECS)

PECS is a structured system that revolves around the use of pictures in order to teach functional communication skills. These pictures or symbols are organized in grids in a binder (book). The learner then hands out the picture of the desired item in order to get it [21]. Figure 2-1 shows an example of a PECS binder.
PECS follows a protocol that has six phases. The phases are designed to increase in communication complexity. The child progresses to the next phase only after achieving satisfactory results in the previous phase.

PECS’s six phases are as follows [23]:

- **Phase 1**: Focuses on *how* to communicate by teaching the physical exchange of the picture.
- **Phase 2**: Focuses on “distance and persistence” by putting the communicative partner farther away and makes the child initiate and seek communication
- **Phase 3**: Focuses on discrimination between items according to preference
- **Phase 4**: Focuses on sentence structure
• **Phase 5:** Focuses on teaching the children to answer the “What do you want?” question

• **Phase 6:** Focuses on teaching the children how to comment on subjects.

Trained therapists apply behavior analysis techniques such as reinforcement to teach children with ASD how to properly use their binders.

PECS is considered to be a low-technology AAC system. Nonetheless, it has proven its effectiveness in enhancing functional communication skills [24]. Some of the disadvantages might include the tediousness of elaborating the PECS book and having it available at all times when portability can be an issue.

### 1.2. Speech Generating Devices (SGDs)

Technology advancement has allowed the development of another approach for AAC which is the Speech Generating Device (SGDs) – also called Voice Output Communication Aids (VOCA). In the past, SGDs were portable, dedicated devices equipped with clickable buttons. Each button is labeled by a picture (e.g. a favorite food) and/or message. When the button is pressed, a pre-recorded message plays as audio output [25]. With the improvement of technology, SGDs are evolving from dedicated hard-wired devices to software that can easily be installed on tablets or smartphones. Advantages of using tablets include the reduced cost in comparison to buying a dedicated SGD device, as well as the portability and the availability of such devices. Finally, speech is naturally understood by the information receiver with less cognitive load [26].
In a study conducted in 2012, Flores et al. compared using the iPad for communication and a picture-based system; interestingly, it was found that communication behavior did not decrease when using the iPad. In fact, it either increased or stayed the same compared to using the picture cards [27]. These findings represent a good basis to further research as to whether or not SGDs can be a good replacement for picture-based systems.

The user interface architecture design of the SGD mobile applications is very similar to PECS. It uses pictures arranged in the form of grids with labels. When pressed, these pictures generate speech.

1.2.1. Proloquo2Go

Proloquo2Go is an iPad-based application that has been developed by AssistiveWare [28]. Like PECS, Proloquo2go uses pictures displayed in a grid and are color-coded to differentiate between the types of buttons. For instance, whether it is a “subject” (e.g. I, you, it, etc.), “actions/verb” (e.g. want, do, see, etc.), “directional words” (e.g. up, down, etc.), or “descriptors” (e.g. good, bad, etc.), the framing colors of the pictures are different. Also, the interface offers numerous customization possibilities such as the size of the grid, the size of the buttons, the colors and the labels. Figure 2-2 shows a screenshot of Proloquo2go.
Figure 2-2 Screenshot of Proloquo2Go [28]

It is argued that Proloquo2Go can be used to achieve the four first phases of the PECS protocol [29].

Many studies have been undertaken to assess the effectiveness of Proloquo2go app as an SGD device because it represents a relatively cost effective alternative to the more expensive dedicated SGD devices that can cost up to thousands of dollars. The results so far concerning the use of the app have been encouraging and positive [30]

1.2.2. GoTalk NOW

GoTalk NOW is a mobile AAC app developed by Attainment Company [31]. In the past, GoTalk used to be dedicated SGD devices. Nowadays, the company took advantage of the
iPad’s abilities and made the AAC more accessible. GoTalk NOW is similar to PECS in its use of pictures on grids as shown in Figure 2-3. The user navigates through the pages and chooses the desired picture and the device generates the according speech.

Customization is also available in this app. The pages can be categorized and the number of icons on each page can be changed. Although GoTalk NOW is less sophisticated and less capable than Proloquo2go, its price point is very accessible and makes it a great candidate to start with AAC.

![Figure 2-3 Screenshot of GoTalkNOW app][31]

### 1.2.3. Scene Speak: A Visual Scene Display (VSD)

A Visual Scene Display is a type of SGD that consists of showing images of real world scenes that give context to the different communication elements and concepts [32]. The elements in the picture are transformed into hotspots that produce sound when they are
selected on the screen [33]. The largest contribution of VSDs is a more contextualized content, rather than isolated symbols that are displayed out of context [34].

Scene Speak is a VSD app on the iPad that allows the user to add images, set sound areas and even link interactive scenes with one another [35]. Users can either upload their own picture or take pictures through the iPad’s camera. The pictures are then editable, e.g. crop and resize. There is also the possibility to group visual scenes together and create interactive stories [35]. Figure 2-4 shows a screenshot of a Scene Speak screen.

![Figure 2-4 Screenshot of Scene Speak](image-url)
2. Livox Application for Tablets

Livox is an AAC application for Android tablets that was developed by Carlos Pereira in 2010, when his daughter was diagnosed with cerebral palsy. Livox can be used as an AAC for other disabilities as well, including autism – which is the focus of this research.

2.1. Features

Similar to the other applications mentioned above, Livox relies on the use of pictures and symbols to allow students to communicate as shown in Figure 2-5. When an icon is selected, a pre-recorded voice output is generated, and new items related to that icon appear. For example, when the button “I want to…” is pressed, icons such as “Play…”, “Eat…”, “Drink…” will appear.

![Livox Interaction Home screen](image)

Figure 2-5 Livox Interaction Home screen
2.2. Content Addition

The user has customization options in Livox such as adding an unlimited number of items within each screen (whether it is the home screen or a specific item like “I want to…”). The pictures can be chosen either from the internal database of pictures and symbols or can be uploaded from the device’s gallery or camera. Also, the text displayed with the image can be typed and placed above or below the picture. Additionally, the background color of the picture can be changed as well. Finally, the users also set the speech output by either typing a message or recording their own voice. Figure 2-6 shows the item creation interface.

Every item created can be edited, deleted, moved in position, and hidden – making it disappear without having to delete it, and putting it back whenever wanted.

![Item Creation: Livox Item Creation screen](image)

Figure 2-6 Livox Item Creation screen
2.3. Setup

Livox allows for the creation of several separate profiles for different patients. According to the patient’s level of disability, it is possible to customize the screen setup and the way to interact with the app. When a profile is first created, diagnostic questions are presented. The caregiver then has the choice to either let Livox do a preliminary set up of the app (according to the disability and its level) or perform the setup manually.

In the User Parameters (shown in Figure 2-7) the user can, for example, modify the size of the grid by choosing the number of columns and lines, the speed of the speech to be spoken, and more.

![Livox User Parameters screen](image)

Figure 2-7 Livox User Parameters screen
Depending to the severity of sight impairment (if any), it is possible to enable a “Black and White” option (Figure 2-8) or “High Contrast” option (Figure 2-9).
In order to navigate between pages, it is possible to use the navigation buttons – the arrow shown in Figure 2-8. In case the child has good motor skills, there is also the option to swipe left and right instead (by disabling the navigation arrows) as shown in Figure 2-9.
Chapter 3
Methodology

To evaluate Livox as an AAC tool, insights on its performance with the users have to be gathered. This information can then be used as a basis for improvements and enhancing user experience. To do so, it was fundamental to perform a usability evaluation of the app.

This chapter first covers the literature on usability before detailing the approach taken to evaluate the usability of Livox is described taking into account different constraints.

1. Usability Evaluation Literature

Usability was born with the Human-Computer Interaction field in the 1980s [36]. When personal computers were no more solely made for people who had a strong technical background, designers began to pay more attention to make the computer “usable” by the average consumer. Over the years, usability evaluation has seen influences from many other fields such as cognitive psychology, behavioral psychology, systems engineering, and computer-science [36].

Nowadays, good usability for products and system is an expectation and not an option anymore. In fact, it is an important factor in the race between competing companies to dominate different markets. Products have to be easy, effective and satisfying to use.

There are many components and metrics used in usability. Nielsen, for example, defines usability through five quality components [37]:
• Learnability: The degree to which it is easy for first-time users to accomplish their tasks.

• Efficiency: The speed with which frequent users can accomplish their tasks.

• Memorability: The extent to which proficiency is affected after not using the product for a certain period of time.

• Errors: The amount of errors that are made and the easiness of recovery from them.

• Satisfaction: The extent to which using the product is pleasurable.

Usability is an integral part of HCD. It completely blends in the iterative nature of HCD and heavily contributes to it. By employing different methods and techniques for usability evaluation, it is possible to get insight in every step of the design which is crucial when it comes to taking the human into account. In fact, it is possible to test from high-level concepts stage to low/high fidelity prototypes [38]. Usability testing can also be applied on finished products in order to be redesigned and improved [39]. The earlier one proceeds to test their design – with the right usability methods and people – the more chances they have for design improvement.

We can distinguish two usability practices; usability inspection and usability testing.

1.1. Usability Testing

Usability testing is an empirical methodology that consists of observing users while they are using the design [36]. The observation component is of the utmost importance because it allows to see not only how the tasks are performed from a user perspective, but also get
insight on the frustrations and obstacles that users feel while using the product. The facilitator records – by taking notes and/or by performing actual audio/visual recording – everything from the sequence of the activity to the body language and facial expressions of the user [40]. These observations are later analyzed to generate improvements for the next design iteration.

Usability testing requires a thorough preparation. It is very important that the task presented to the user is realistic in order to have qualitative input. It is usually advised to write the tasks in the form of scenarios in order to engage the participant by providing context [41]. The scenario should not only be realistic but also avoid providing clues to the user as to how exactly the task should be performed [41]. By only expressing the goal of the task, and not how to do it, the facilitator minimizes bias and obtains better insights on how the users are expecting the system to work according to their own understanding. Furthermore, the tasks have to be clear (without ambiguity) in order to derive measurements for metrics such as rate of completion, critical execution-errors, time on task, etc.

Usability testing can be performed in different phases of the design, whether it is early prototypes or a functioning product as long as the system is in a testable phase. Also, usability testing can take place following different configurations. Depending on the needs, the type of product (website, mobile application, etc.), and the resources, the evaluation can be performed one on one (in person), remotely or even automated by software [42].

The data collected from usability testing can be qualitative or quantitative:
• *Qualitative usability testing:* Focuses on the identification of the problems that a user faces while using the system through observation [43]. Knowing why the user is struggling allows to generate precise design insights as of what to improve in the next design iteration. In a qualitative testing a small number of users are sufficient. Testing with many users would result in an excess of resources (time, money, etc.). The reason being that testing with only 5 users can identify 85% of the usability problems [44]. Thus, it is better to test with a small number of users, fix the problems and reiterate as much as possible rather than test with a high number of users and have redundant results [44].

• *Quantitative usability testing:* Focuses on metrics such as task completion rate, time on task, success rate, number of errors, etc. [43]. Therefore, in contrast with qualitative usability testing, the higher the number of participants, the better the statistical data. Hence the high cost that quantitative testing generates. This type of evaluation is generally used to 1) compare new design iterations to the previous one or 2) compare one design with a competitor’s, and 3) compare one design performance with industry standards – if any [43].

### 1.2. Usability Inspection Methods

Usability Inspection methods are informal in nature. They are “based on rules of thumb” and the evaluators’ own experience and knowledge [45]. Thus, participants in an evaluation using one of the usability inspection methods should be experts in the field of usability. Usability inspection methods were born when designers realized that recruiting real end-users for usability testing can be hard, expensive, and late in the design phases [45].
compensate for those constraints, a small number of experts (ideally five) is used iteratively [37]. In other words, it is preferred to run several tests with a limited number of experts than run few tests with many evaluators.

Usability inspection methods are not meant to completely replace empirical data collected through usability testing. Each of the two approaches can overlook usability issues that the other approach can find. Therefore, for optimal results it is better to use different methods, when appropriate, and combine usability testing and usability inspection [45].

Usability inspection methods include but are not limited to:

**Heuristic Evaluation:** This method consists of having experts evaluate the interface dialogues in regards to following 10 general usability principles introduced by Nielsen. Following is the list of the heuristics as presented by Nielsen [46]:

1. **Visibility of system status**
   
   “The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.” [46]

2. **Match between system and the real world**
   
   “The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.” [46]

3. **User control and freedom**
“Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.” [46]

4. Consistency and standards

“Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.” [46]

5. Error prevention

“Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.” [46]

6. Recognition rather than recall

“Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.” [46]

7. Flexibility and efficiency of use

“Accelerators – unseen by the novice user – may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.” [46]
8. Aesthetic and minimalist design

“Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.” [46]

9. Help users recognize, diagnose, and recover from errors

“Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.” [46]

10. Help and documentation

“Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.” [46]

Few evaluators undertake the evaluation individually. After everyone has finished their own evaluation, they meet to debrief and agree on the issues that are more important to fix firsts.

_Cognitive Walkthrough:_ This method consists of giving a list of tasks to experts (usability experts or software engineering experts) to evaluate a proposition of a design [47]. The proposition is an interface’s detailed design description. It can even be in the form of a paper prototype. This allows for the possibility to have an evaluation early on in the design phases that is quick, cheap and effective. Along with the prototype itself, the evaluator is
given a list of tasks, context of use, information about the user, and the sequence of actions that the user is supposed to take to accomplish the task. The participant then proceeds to the walkthrough by answering a set of 4 questions for each task: “1) Will the users try to achieve the right effect? 2) Will the user notice that the correct action is available? 3) Will the user associate the correct action with the effect trying to be achieved? 4) If the correct action is performed, will the user see that progress is being made toward solution of the task?” [47]. After the evaluation of all the tasks is complete, a list of problematic tasks and the cause of these problems is established.

*Pluralistic Usability Walkthrough*: This method has the particularity to gather at the same time end users, usability professionals and developers [48]. It is a method that was created to answer questions about design in a very early phase with minimal development. Paper prototype panels are presented to the users who will write precisely the sequence of tasks they would take. When everyone finishes, discussions of different results begin. Pluralistic usability walkthrough relies heavily on collaboration and participation. In fact, identified issues are discussed between end-users, developers and usability experts on the spot and improvement suggestions are generated. One of the strengths of this method is the availability of three different points of view at the same time collaborating to reach a better solution.

### 1.3. Qualitative vs. Quantitative Surveys

Surveys constitute a very important tool to get feedback and collect data from people. Especially today with the internet, sending surveys and receiving answers can be very fast. In usability evaluation, surveys can be used to collect quantitative and/or qualitative data.
The main difference between the two is the way questions are asked. Quantitative surveys look essentially for numbers. Therefore, the questions are close-ended and can be answered by checkbox [49]. The data is then used to establish statistics that would answer the survey’s main goals. Thus, the larger the number of representative people to respond to a quantitative survey, the more precise are the statistics and therefore the more pertinent the interpretation.

Qualitative surveys on the other hand use open-ended questions that allow the answerers to express themselves. They are particularly helpful when we want to get useful insight without being sure what the array of answers might include [49]. It is an opportunity to ask for feedback, comments and suggestions. Qualitative surveys need fewer people than quantitative surveys. However, the type of answers that it requires is usually long, which can tire the respondents and make them quit. Therefore, surveys should be short and have easy to answer questions to maximize the response rate. [50].

2. Usability Evaluation for Livox

In order to have insights about Livox’s usability it has to be put it in the hands of users. This study was divided into three parts: one was an evaluation with clients from TSC, another with usability experts, and an individual evaluation performed through use, exploration and inspection of Livox.

2.1. Testing with The Scott Center’s Clients

2.1.1. Participants

In total, 6 children and their families from TSC were recruited to test Livox and use it for a period of approximately 6 weeks.
• GiMa: GiMA was a 6 years old male diagnosed with ASD. He started attending at TSC in March 2017 which provided early intensive behavioral intervention. At the onset of the study, GiMa did not show any functional vocal utterances. He was not able to mand for items or activities and he did not initiate interactions with others. Language such as vocal play and vocal imitation was absent. GiMa has used PECS for about a month before the study.

• AiWa: AiWa was a 4 years old male diagnosed with ASD. He started receiving behavioral services at TSC in June 2017. On the onset of the study, AiWa was able to show a certain extent of cooperation with adults and request items. He could vocalize sounds with varied intonations and repeat few specific sounds or words. He also readily asks adults for reinforcers. Aiwa has used PECS for 2 months before the study.

• MaSa: MaSa was a just over 3 years old male diagnosed with ASD. He began receiving intensive behavioral services at TSC on November 2017. At the beginning of the study MaSa could show limited cooperation with adults and ask for reinforcers. He also could vocalize understandable words as well as repeat many words when asked. He physically approaches others to initiate an interaction. MaSa has never used PECS before.

• NiMi: NiMi was a 5 years old male diagnosed with ASD. He began receiving intense behavioral services at TSC on January 2015. NiMi was able to exhibit good cooperation with adults and ask for reinforcers. He vocalizes frequently and says many understandable words – on occasions he would say non-understandable words. He can repeat words and some simple phrases.
NiMi never used PECS before.

- WiMi: WiMi was a 5 years old male diagnosed with ASD. He began receiving intense behavioral services at TSC on January 2015. WiMi showed cooperation with adults and is able to use some words to ask for reinforcers. He utters few speech sounds at low rate and can repeat few specific sound or words when prompted. He mainly uses Proloquo2Go app to ask for reinforcers.

  WiMi Never used PECS before.

- AlMi: AlMi was a 5 years old male diagnosed with ASD. He began receiving intense behavioral services at TSC on January 2015. At the beginning of the study, AlMi could cooperate with adults and say few words to ask for reinforcers, although he uses Proloquo2Go as his main communication mean.

  AlMi used PECS for about 3 months when he was 3.5 years old.

2.1.2. **Constraints**

The study within TSC presented some challenges. The main one was the inability to introduce Livox to use during the children’s sessions within the institute. Therapists judged that they had specific procedures to apply during the sessions at the TSC. The study was not allowed to have clinical/therapeutic aspects in it. This means that: (1) Therapists involvement would be minimal (inability to evaluate the Livox’s clinical effectiveness through professional scoring) and (2) it was not possible to observe the children directly when they are using Livox. It was agreed that all the parents who accepted to participate in the study would use the tablet during hours that would not interfere with their sessions (e.g.
at home, school, parks, etc.). The data collected concerning usability had to come from parents’ observations.

Another constraint is related to the parents’ very busy schedules. It was difficult to call a meeting for usability testing or interviews.

Finally, the time allocated for the study was limited (6 weeks). Therefore, parents had to be taught how to use the app quickly in order to efficiently take advantage of the time allotted. The Internal Review Board (IRB) approval is in Appendix A.

### 2.1.3 Communication Skills Inventory

In order to get a baseline for the participating children’s communication skill level we distributed a Behavioral Language Assessment (BLA) (in Appendix B) to the case managers to fill. The BLA is a quick way to assess different behavioral aspects related to language (e.g. mands, echoics, interverbals, etc.). Table 3-1 presents an explanation for each aspect assessed by the BLA.

**Table 3-1 Communication behaviors assessed by the BLA (extracted from BLA)**

<table>
<thead>
<tr>
<th>Operant</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperation with adults</td>
<td>The extent to which the child is willing to work with adults</td>
</tr>
<tr>
<td>Requests (Mands)</td>
<td>How the child expresses his needs</td>
</tr>
<tr>
<td>Motor imitation</td>
<td>The ability of the child to copy actions</td>
</tr>
<tr>
<td>Vocal play</td>
<td>The extent to which the child spontaneously says sounds and words</td>
</tr>
<tr>
<td>Vocal imitation (Echoics)</td>
<td>The ability of the child to repeat sound and words</td>
</tr>
<tr>
<td>Matching-to-sample</td>
<td>The ability of the child to match objects, pictures, designs to presented samples</td>
</tr>
<tr>
<td>Receptive (Listener behavior)</td>
<td>The ability of the child to understand words and follow directions</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Labeling (Tacts)</td>
<td>The ability of the child to label or verbally identify items or actions</td>
</tr>
<tr>
<td>Receptive by feature, function and class (RFFC)</td>
<td>The ability of the child to identify items based on information given about those items</td>
</tr>
<tr>
<td>Conversational skills (intraverbals)</td>
<td>The ability of the child to fill-in missing words or answer question</td>
</tr>
<tr>
<td>Letters and numbers</td>
<td>The child’s knowledge of letters, numbers and written words</td>
</tr>
<tr>
<td>Social interaction</td>
<td>The extent to which the child initiates and sustains interactions with others</td>
</tr>
</tbody>
</table>

The purpose for using this assessment was to have an idea about the extent – if any – to which the type and level of skills play a role in the application’s adoption as a communication tool by the children. Also, comparing the BLA results before and after the use of Livox might provide insight on the application’s ability to enhance communication skills.

2.1.4. **Technology Attitude Probing Survey**

During the first meeting with each parent, I administered a survey (Appendix C) about their affinity with tablets as well as how comfortable are their children with using tablets and for what purpose. It was also asked if the children have used a tablet for communication in the past. If yes, which software was used, and what were the positive and negative aspects. Additionally, the parents were asked whether or not their children have used PECS before and for how long, in order to have an idea if the children were trained to have a grid of pictures in front of them to choose from.
2.1.5. **Evaluation with Parents**

Parents used Livox with their children for a period of 6 weeks, after which an online evaluation survey was sent to them. This survey was a mean to collect qualitative data given that the number of participants was relatively small. Consequently, the questions were open-ended in order to have richer feedback. Given that answering a series of consecutive open-ended questions can be annoying for the respondent and might reduce the quality of the feedback, some closed-ended questions were introduced in between the open-ended questions to break the pattern and avoid discouraging the respondents.

The goal of this evaluation questionnaire (Appendix D) was to gather feedback about different aspects of Livox such as: the child’s level of engagement, effectiveness, ease of use, features, and overall satisfaction.

2.2. **Usability Testing with Usability Experts**

Usability testing, whenever possible, is the best way to get insight from users [41]. A total of 6 people knowledgeable in usability were recruited to test Livox. The list of tasks for this test (Appendix E) were carefully selected to make the user go through all the types of actions possible in the app (i.e. choosing wanted items, set parameters, and edit/create items). The users were not trained to use the app prior to the testing; It was only explained that Livox is a communication tool that relies on a grid of pictures that when selected, generates a speech of the wanted item. The reason for choosing not to train the user is to have an idea about the learnability of the app and see how intuitive it is to use. If first time users are able to navigate through the app without any training, it means that the app has, a priori, a good
usability. If the users are not able to navigate through the app, then the types of problems they are facing can be observed and recorded.

Scenarios were used to create context in order to engage the user and make the task realistic. Moreover, the complexity of the tasks was incremental. For instance, users were asked in the beginning to open the app and select the profile, then to choose a type of food just like the person that has communication impairment would do. This would allow the participant to familiarize themselves with how the app is supposed to work. Later, tasks about changing some parameters and creating/modifying pictures were given, which would represent more complicated tasks that a caregiver would perform. During the tasks execution, no help is provided to the user on how the task is supposed to be performed, unless there was a misunderstanding of the instruction itself.

Along with the tasks list, Think Aloud method was also used, which consists of asking the users to think out loud while they are performing the tasks [51]. Knowing what the user is thinking and feeling in addition to observing how they perform the task is a great way to identify the pain points and confusion.

In addition, the evaluators were video recorded while they were testing the app. This is a great way to gather important Think Aloud sentences as well as to get insight about facial expressions and body language that might express frustration, pleasure, satisfaction, etc. Video recordings allowed me to focus on writing down the task sequencing that the user executed in order to compare it later on with the right task sequence that is supposed to be executed.
Once the user finished all the tasks, we proceeded to a session of feedback where they summarized their opinions on the positive and negative aspects they encountered.

It is important to note that usability testing is usually applied with representative real users. One might argue that this test should have been administered to the children’s parents. There are two reasons why the test was done with usability experts:

- One of the important aspects of the test is the use of the app prior to receiving any training. Since the opportunities to meet with the parents were very limited and the duration of the study was also limited, it was decided to quickly train the parents during the first encounter. This enabled them to start using the application as soon as possible and not be discouraged because they don’t know how to use the app and/or did not have time to learn.

- The app in itself is not domain dependent. Which means that everyone who has a child with autism can become a user. Therefore, I believe any user should be able to use the app without necessarily having a deep knowledge about autism. Since the author had access to usability experts, tests were conducted with them because their feedback about the usability itself might be more pertinent than a regular user without knowledge in usability.

### 2.3. Individual Usability Inspection

The Heuristic Evaluation is one of the most efficient and widely used methods to identify usability issues in a user interface (UI). Being an inspection method, it can be done by a small number of expert evaluators (Nielsen recommends 3 to 5 evaluators). Nothing really
prevents a single evaluator to perform a Heuristic Evaluation, but experience has shown that it is nearly impossible for only one person to identify the entirety of the usability problems [46]. With that being said, Heuristic Evaluation still brings value even when done by one person.

With the heuristics in mind, the author proceeded to use and investigate Livox in search of usability problems.
Chapter 4  
Results

This chapter illustrates the detailed results of the different surveys and usability methods employed to identify problems that should be fixed in Livox.

1. Heuristic Evaluation Results

The Livox application does not contain a high number of screens. Therefore, to depict the different issues identified in Livox’s user interface, it is convenient to take each screen separately and detail all of the violations related to it according to the heuristics. Each screen has been captured and is presented in figures below with the associated issues (framed and numbered in red). Each issue is then described in a following table that includes the description of the issue, which heuristics it violated and a severity score. Additional screenshots, if needed, are included to better explain the issue. The severity scoring that is used is subjective and has been defined by the author; Minor reflects problems that do not heavily impact the user experience and that users can easily overcome. Major reflects issues that heavily impact the user experience resulting in user frustration and demanding high cognitive effort to overcome. Critical are issues that literally make the user unable to proceed.

When the application is first opened, the user is asked to create a new profile or to choose from the profiles already created as shown in Figure 4-1. The usability issues for the selection screen according to the heuristics are illustrated in Table 4-1.
Figure 4-1 Profile Selection screen

Table 4-1 Profile selection screen usability issues

<table>
<thead>
<tr>
<th>N°</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Error prevention</td>
<td>When setting a Pin code, the application allows the user to put as many digits as wanted. However, once the password is saved, the</td>
<td>Critical</td>
<td><img src="image" alt="Screenshot" /></td>
</tr>
</tbody>
</table>
Once the profile is selected, the app takes the user to a “Menu screen” where a user can choose to either start using Livox or go to other options as shown in Figure 4-2. Table 3-1 describes the usability problems found in the Menu screen.

| and recover from errors | user is asked to put a Pin code of only 4 digits. This situation leads the user to be unable to modify anything in the system because they are unable to type the saved password, and there is no way to revert this situation by themselves. |

![Figure 4-2 Menu screen](image)
Table 4-2 Menu Screen usability issues

<table>
<thead>
<tr>
<th>N°</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
</table>
| 1  | • Recognition rather than recall  
  • Consistency and standards                                                          | The instruction to start using Livox is written in small font that can make users wonder how to start. | Minor    |                       |
| 2  | • Match between system and real world  
  • Consistency and standards                                                            | The icon used for settings is not an image representative of settings. There exist standard images for settings that are used across several different platforms and that users can easily recognize. | Minor    |                       |
| 3  | • Aesthetic and minimalist design                                                      | The “About” icon takes unnecessarily a large space for something that is not often accessed by the user. Also, since the start icon is not necessarily recognizable as start icon, the user might mistake the big green Livox logo for the start button. | Minor    |                       |

The Settings screen, shown in Figure 4-3 is where the user can change parameters, create new items/symbols, and receives items from another tablet and/or therapists. User interface issues are depicted in red and detailed in Table 4-3.
Table 4-3 Settings screen usability issues

<table>
<thead>
<tr>
<th>№</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Match between system and real world</td>
<td>The icon used for parameters might be misunderstood by users.</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Consistency and standards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>• Match between system and real world</td>
<td>“Edit Screens” takes the users to a screen where they can add/edit items.</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There is a misuse of the word “screens” that can confuse the user.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When the user selects “Edit Screens” it is possible to modify, delete, and hide the items as well as to create new ones as shown in Figure 4-4. The usability issues are detailed in Table 4-4.

<table>
<thead>
<tr>
<th></th>
<th>Match between system and real world</th>
<th>“Most accessed” is an incomplete wording. The user might wonder if it is most accessed items or settings.</th>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Match between system and real world</td>
<td>“Receive sets” might be misunderstood by the user as configuration settings, whereas in reality it is items (pictures) to save in the profile.</td>
<td>Minor</td>
</tr>
<tr>
<td>5</td>
<td>Consistency and standards</td>
<td>The use of the terms “fields”, “screens” and “sets” are inconsistently referring to the same thing (items/pictures).</td>
<td>Major</td>
</tr>
</tbody>
</table>

Figure 4-4 "Edit Screens" screen
Table 4-4 "Edit Screens" usability issues

<table>
<thead>
<tr>
<th>N°</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
</table>
| 1  | • Recognition rather than recall  
• Consistency and standards | Although the items shown here are the same as the ones in the interaction home screen (see Figure 2-5), the size and the position of the icons is not the same. This can be annoying for the user to retrieve the item to edit or retrieve the folder in which they wish to add an item. | Minor    | ![Minor Screenshot](image1) |
| 2  | • Aesthetic and minimalist design | The “+” button is used to create a new item. The location of this button hides the delete icon of the last item in the page at the bottom right. Which makes it impossible to delete whichever item is located at that position (see additional screenshot). | Major    | ![Major Screenshot](image2) |
| 3  | • Visibility of system status  
• Recognition rather than recall | There is no visual indication that an item is actually a folder that contains other items. For example, “I want to…” contains “Play…”, “Eat…”, “Drink…”, etc. When users want to modify “Eat…” or add a type of food in Livox, they have to click on “I want to…” then “Eat…” to access all the food and then press the “+” button to add a new one. If there is no indication that | Major    |                    |
When it comes to the creation of a new item, a new screen appears that allows the user to choose the picture, the label and the text for the speech generation as shown in Figure 4-5. The usability issues are detailed in Table 4-5.

Figure 4-5 Item Creation screen
<table>
<thead>
<tr>
<th>No</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
</table>
| 1  | • Recognition rather than recall  
• Match between system and real world  
• Aesthetic and minimalist design | The space usage is not optimal for the different elements of the screen. Also, the sequence of actions to do is not clear and intuitive. Do we begin by choosing a picture? A label? The flow is not specified visually. This confuses the user as to what to do. | Major    |                      |
| 2  | • Aesthetic and minimalist design                                                | The pictures are smaller than their labels and are displayed in a small area. When choosing a picture, it is more important to see the picture than the label or the white spaces. Also, there is a redundancy in the labels. | Minor    |                      |
| 3  | • Visibility of system status  
• Error prevention | There is an image by default that will be automatically selected if the user does not choose another one.                                                                                                           | Minor    |                      |
| 4  | • Error prevention  
• User control and freedom | If a user chooses a primary picture (positioned on top) and then decides to try another picture, it goes automatically as a secondary picture (on the bottom) – as shown in the additional screen. From then on, each time another picture is selected from the library, it replaces the second picture. | Major    | ![Additional Screenshot](image_url) |
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 5 | • Recognition rather than recall  
• Match between system and real world  
• Consistency and standards | There is text in a small font telling the user there is a possibility to choose from Gallery or Camera. There are universal standard icons easily recognizable for these actions. Also, the same text changes depending on the situation:  
1) In additional screenshot 1, we can see that if a picture is selected from the library, the user has to long-press it in order to delete it. This is an unintuitive and non-standard way to delete pictures, especially when there is a standard “trash icon” for this action that has been used in other screens of Livox.  
2) The text under both images also changes if the item is saved and re-accessed to be edited (see additional screenshot 2). In this case there is no instruction concerning how to delete a picture at all. | Critical |

!(screenshot 1) Add a note  
!(screenshot 2) Keep the first image pressed to delete  
!(screenshot 2) Click to choose an image from the camera or from the gallery or drag an
The other sub-option under settings in addition to “Edit Screens” is “Parameters”. This section allows the user to modify the screen layout, the audio options, navigation options, and more. Figure 4-6 illustrates a screenshot of “Parameters” screen. The usability problems are detailed in Table 4-6.

<table>
<thead>
<tr>
<th>#</th>
<th>Sub-option</th>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
</table>
| 6 | • Recognition rather than recall  
• Match between system and real world | If a user, for example, decides to record their own voice instead of typing a text to be spoken, they have to enable media options to find the desired option (see additional screenshot). There is no visual clue to tell the user that this option is hidden under another option. | Major |
| 7 | • Error prevention | If a user creates a new item without selecting any picture, text to be displayed and text to be spoken, the system allows them to save the item and assigns the default picture for the item without asking for confirmation beforehand. | Minor |
Table 4-6 Parameters screen usability issues

<table>
<thead>
<tr>
<th>N°</th>
<th>Violated Heuristics</th>
<th>Usability Problems</th>
<th>Severity</th>
<th>Additional Screenshot</th>
</tr>
</thead>
</table>
| 1  | • Recognition rather than recall  
• Aesthetic and minimalist design                                                      | The way the information is presented overwhelms the user. There are no visual    | Major    |                       |
|    |                                                                                     | directions and clues as to where to look to find specific settings. The font     |          |                       |
|    |                                                                                     | is small and the different settings are scattered and not categorized.            |          |                       |
Nielsen’s heuristics are not related only to visible problems; they are also related to the omission of applying good practices. What is presented above are usability problems that can be fixed. What is presented below in Table 4-7, are some of the design elements missing so far, that should be added to improve the usability.

<p>| 2 | • Recognition rather than recall | When the user decides to choose swiping as a navigation method between pages instead of the navigation arrows, they have to disable “enable navigation button” then a new setting appears that has to be enabled: “User has a good motor coordination” – which might be a jargon that the user is not using in everyday life. | Major |
|   | • Match between system and real world | | |
| 3 | • Match between system and real world | Many text formulations of settings (marked with no. 3 on Figure 4-6) can be improved and optimized. For example, there is no need to write “Enable navigation button?” when there is a toggle button in front of it that indicates whether or not it is enabled. Another example is “use switch control”. Where is the switch? Is it in the tablet? Is it an external switch that can be plugged? | Minor |</p>
<table>
<thead>
<tr>
<th>Violated Heuristic (by design omissions)</th>
<th>Usability problems description</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>User control and freedom</td>
<td>1) In the “Parameters”, there is no option to reset the default settings or to confirm or cancel the modifications that are in progress. The user might change something and forget how to undo it. This creates a frustration and a wariness to try out things by fear of not being able to undo it afterwards. 2) In “Item creation” there is no possibility to enable or disable the option to add a secondary picture. The users find themselves having to delete pictures – in an unusual and unintuitive manner – that they might not have chosen to have in the first place. This increases the level of frustration.</td>
<td>Major</td>
</tr>
<tr>
<td>Consistency and standards</td>
<td>1) In general, the wording of the options and the use of icons can be improved in quality and consistency 2) There is no software back button. The application heavily relies on the physical back button of the tablet which might be unusual for users that come from iPad and are used to having only one home button.</td>
<td>Minor</td>
</tr>
<tr>
<td>Error prevention</td>
<td>1) There are no warnings or reminders for the users when they forget to fully create a new item. 2) There are no confirmation/cancellation dialogs with the user.</td>
<td>Major</td>
</tr>
<tr>
<td>Recognition rather that recall</td>
<td>Generally, in the settings the users have to rely on their memory and thinking process to find out what to do: • Some options are unnecessarily hidden. • Settings not grouped in a logical fashion that is visually identifiable. • Small and long labels.</td>
<td>Major</td>
</tr>
<tr>
<td>Flexibility and efficiency of use</td>
<td>There are no shortcuts to modify items.</td>
<td>Minor</td>
</tr>
<tr>
<td>Help users recognize, diagnose, and recover from errors</td>
<td>System errors and crashes do not come with information for the user concerning what happened and what is being done.</td>
<td>Major</td>
</tr>
</tbody>
</table>
2. Usability Testing Results

Usability testing was performed with six participants that were given a list of tasks (Appendix E) to perform on Livox. The observations, supported by audiovisual recording were helpful to get insight about the problematic tasks and the confusing aspects in using the application. Also, a discussion with every participant has been carried out in order to gather their feedback.

The detailed results of the usability test observations can be seen in Appendix F. The results consist of the following information:

- A specification of the expected sequence to be performed for each task
- A transcription of what has actually been done by the participants for each task
- Various observations about the execution of some of the tasks
- Highlights of participant’s expressions generated from the Think Aloud method
- A score for each task going from 1 to 4 (1: Could not accomplish the task, 2: Inaccurate, 3: Mostly accurate, and 4: Accurate)

Table 4-8 illustrates a ranking of the most problematic tasks according to the inaccuracy of the execution, the confusion and the frustration that the participants showed. The ranking
has been established by adding up the scores of the participants for each task. The lower the score is, the more problematic it has been. For the tasks that have the same score, they have been ranked according to the complexity of the task even if they have been executed correctly.

Table 4-8 Tasks ranked by usability issues' emergence

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Task</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Changing the picture of an already existing item</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Creating a new item</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Changing the navigation between pages method (arrows vs. swiping)</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>Changing the speech generated from the default method to voice recording</td>
<td>21</td>
</tr>
<tr>
<td>8</td>
<td>Changing the grid size for items display</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>Creating a new item that has 2 pictures</td>
<td>24</td>
</tr>
<tr>
<td>10</td>
<td>Modifying the speed of the speech generated</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>Using the app to ask for a drink</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Using the app to ask for food</td>
<td>24</td>
</tr>
<tr>
<td>1</td>
<td>Opening Livox, choosing a profile, and starting to use it</td>
<td>24</td>
</tr>
</tbody>
</table>

It is important to note here that even though task #7 is more complicated than task #4, the success rate of task #7 is superior. We can conclude that this is due to the learnability curve that the participants experienced. Their first encounter with the Edit/Create item screen happened with task #4 and therefore, the problems were more observable and more difficult to overcome. The difficulty to accomplish task #4 is also due to the absence of any clue on how to delete a picture when editing an item that is already created.
Interesting insight about the confusion and frustration of the participants has been recorded when they were thinking aloud. Table 4-9 highlights some of the remarks and expressions that participants stated concerning different tasks.

**Table 4-9 Participants think aloud expressions highlights**

<table>
<thead>
<tr>
<th>Task N°</th>
<th>Participants expressions while executing the tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“I don’t see a start button”</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>“There is no home button to take me to the first screen”</td>
</tr>
<tr>
<td>4</td>
<td>“What am I supposed to do exactly?”</td>
</tr>
<tr>
<td></td>
<td>“I go to “Edit Screens” and the item I am looking for is not here”</td>
</tr>
<tr>
<td></td>
<td>“I can’t accomplish the task”</td>
</tr>
<tr>
<td></td>
<td>“Why does the picture keep appearing there [as a second picture]?”</td>
</tr>
<tr>
<td></td>
<td>“The picture can’t be deleted, when I press on it, I am asked to choose a picture from the gallery or take a picture.”</td>
</tr>
<tr>
<td></td>
<td>“It is the first time that I have to keep pressing a picture to delete it!”</td>
</tr>
<tr>
<td></td>
<td>“I can’t accomplish this task”</td>
</tr>
<tr>
<td></td>
<td>“There is no visible scrolling bar in the library, unless I start scrolling”</td>
</tr>
<tr>
<td></td>
<td>“What is this “+” button for? [in the second picture spot]”</td>
</tr>
<tr>
<td>5</td>
<td>“Oh I forgot to put the label!”</td>
</tr>
<tr>
<td>6</td>
<td>“What am I supposed to click on?”</td>
</tr>
<tr>
<td></td>
<td>“There is no visual clue on this interface”</td>
</tr>
<tr>
<td></td>
<td>“Why is the option to record sound hidden?”</td>
</tr>
<tr>
<td></td>
<td>“Well… Let's try this [enable media options]!”</td>
</tr>
<tr>
<td></td>
<td>“I can’t accomplish this task”</td>
</tr>
<tr>
<td>7</td>
<td>“The &quot;+&quot; symbol located at the spot for the second picture is confusing because it usually prompts us to click on it”</td>
</tr>
<tr>
<td>8</td>
<td>“I forgot how to use the app”</td>
</tr>
<tr>
<td></td>
<td>“There is too much information displayed”</td>
</tr>
<tr>
<td></td>
<td>“There is no button to save so I guess I will just press return and go check if it changed”</td>
</tr>
<tr>
<td></td>
<td>“I gave up”</td>
</tr>
<tr>
<td>9</td>
<td>“The labeling text size is too small!!”</td>
</tr>
<tr>
<td></td>
<td>“Why does &quot;user has good motor skill&quot; appear when &quot;enable buttons&quot; is disabled?”</td>
</tr>
<tr>
<td></td>
<td>“There is too much information”</td>
</tr>
<tr>
<td></td>
<td>“Why isn’t it simply written enable swiping?”</td>
</tr>
<tr>
<td></td>
<td>“What does switch control mean? Does it mean change the controls? Let’s try that.”</td>
</tr>
</tbody>
</table>
Valuable feedback was also gathered from the participants that covered various aspects of the user interface and the system. The details about the feedback from each participant are presented in Appendix F. Many points have been mentioned by more than one participant. Thus, for the sake of clarity and to avoid redundancy, the following is a list that includes issues commonly highlighted by multiple participants:

- There is not a visually clear start button.
- Many labels in the settings menu can be improved (example: pronunciation speed).
- Editing/creating items is not intuitive and needs to be reworked.
- Lack of cues for action (example: delete action).
- Absence of visual signifiers (clues) to differentiate folders – items that contain other items – from single items.
- Text and labels are small in size, long and not very accurate.
- Lack of use of standard icons and inconsistency in using icons.
- There are icons that are not at all representative (settings icon, parameters icon).
- There is too much information displayed. The parameters should be organized by type (navigation, display, speech, etc.).
• Some options are unnecessarily hidden and do not have strong signifiers to be discovered.

• Deleting an image can simply be replaced by a trash icon instead of writing with small sized text that the user should long-press a picture in order to delete it.

• In "Item Creation", the text under the image (actions instructions) changes according to whether or not an image has been selected.

• A back button should be displayed on the screen.

• I see no reason to have an image by default when adding a new item. Additionally, when one forgets to add an image, that image is selected by default.

• Why not simply put a microphone icon to record sound? Having hidden options that only appear when enabling media options is confusing.

• Enabling swiping method is confusing and unclear.

• The look and feel of the parameters is not good; Labels are small and unclear. I also don't need what is presented on the left part of the screen.

• The system should verify if there is an external switch control connected to the tablet before activating the function and making the app completely unusable with gestures. I personally thought there was a glitch.

• The menu should not change when I make an action. Additional options should appear in dialog boxes or new screens.
The nature of the feedback from the test users was a mixture of functional and user interface problems.

3. Testing with The Scott Center’s Clients Results

Before handing over the tablets to use Livox, parents filled out a survey (Appendix C) that had the purpose to mainly assess their comfort, as well as their child’s affinity, with using tablets. All the parents are accustomed to using tablets and mobile devices. Except from GiMa, caregivers reported that all the other children are also able to use tablets by themselves. GiMa, AiWa, and MaSa, use tablets only for entertainment (i.e. watching cartoons). NiMi uses the table mainly for entertainment but sometimes uses it for communication, if he is misunderstood. WiMi and AlMi use tablets for entertainment and communication through Proloquo2go application.

3.1. Online Survey Responses

Once the testing period is over, an online survey has been sent to the parent (see Appendix D). For clarity purposes, the feedback specific to each participant is summarized in paragraphs.

1. GiMa’s caregiver feedback:

GiMa used Livox every day at school and at home. Unlike for the other participants, his therapist also encouraged the use of the tablet at TSC. He believed that the study began at a perfect time for GiMa because he was looking to work with an SGD device. According to the parents, GiMa initiates interaction more frequently. The interest that he shows for the tablet has increased over time. However, he is not completely relying on it for
communication and chooses to pull people towards what he wants. He still needs a lot of assistance to use the app and cannot yet navigate through pages by himself – the caregiver prepares the screens and items for him to choose from. The grid size is therefore 2 x 1 since GiMa is still in the process of learning to discriminate between objects. When it comes to the pictures, the caregiver did not appreciate what came with Livox library and thought they were not very representative, were too abstract and not colorful enough. Therefore, he preferred to use the camera to take photos and assign them to the items. Even though GiMa’s parents think that the Livox capabilities match their child’s skill levels, their opinion about “Item Creation” and “Parameters” is not positive. In fact, they reported that they had to go to the user manuals several times to learn how to use it and lots of trial and error. They thought, not only the screens were quite overwhelming and condensed, but also some actions were not obvious such as deleting a picture and starting Livox.

Finally, the parents were overall satisfied with using Livox (5/5) because they think their child is beginning to vocalize some sounds and improve his level of skills. They think it is very well suited for a beginner like their child. Additionally, when asked about the likelihood of recommending the app to a friend they answered with a 5/5.

2. AiWa’s caregiver feedback:

AiWa used the tablet at home after TSC hours and during the weekends. His caregiver had difficulties teaching him how to use the tablet because AiWa showed no significant interest in using it for communication and it was hard for him to understand the pictures that came with Livox. He can swipe between pages but needs a lot of assistance to use the app for communication purposes. AiWa could not reach a level of meaningful communication
with the app, it was more of curiosity to press items and to generate sound than asking for
items. The caregiver rated the overall satisfaction 3/5 because there were no results in the
period of time it was used, however she said she would recommend it to a friend with a
likelihood of 5/5.

3. *MaSa caregiver feedback:*

MaSa showed a little bit of interest only in the beginning to explore the app, the kind of
interest a child shows when he sees a new device. However, he quickly lost all interest in the
app and all he wanted to do was exit Livox and explore other parts of the tablet such as clock
and calculator. The study with MaSa did not go through and his mother gave up trying to
teach him to use Livox for communication as he completely refused to adopt it.

4. *WiMi caregiver feedback:*

WiMi used Livox only when prompted. He has been using Proloquo2Go on iPad for a
year and a half and continued to rely on it for communication. According to his mother,
WiMi does not really show interest in communication in general. Even with the
Proloquo2Go app, he usually needs encouragement to use it. Constant assistance in using
Livox has to be provided because it was difficult to teach him how to navigate between the
pages. Not only were the arrows (left and right) different from the ones he is used to with
Proloquo2Go, but also if the arrows are removed, there is no indication for the existence of
other pages to swipe through. The caregiver then rated the difficulty to teach him Livox at
3/5. WiMi’s parent disliked the pictures that came with Livox and opted to either assign
pictures taken with camera or upload her own pictures.
Since WiMi’s level is relatively advanced – he is able to read and his other device is already rich in vocabulary – his caregiver found the task of loading Livox very cumbersome. She had wished it was easier to add and modify pictures on the spot instead of going back and forth between the “Edit Screens” and the interaction screen.

Finally, the overall satisfaction reported was 3/5. When asked how likely would she recommend this app to a friend, WiMi’s mother answered 4/5 and specified that this would be great tool for someone starting out with AAC.

5. AlMi caregiver’s feedback:

AlMi used Livox out of curiosity and did not rely on it for communication. He is accustomed to using Proloquo2Go for a year and Livox did not engage him enough to replace his old device as a primary communication mean. Although he did not really need assistance to use Livox – navigate between pages and different items – he was using it more to play and hear different sounds than to communicate.

AlMi’s caregiver finds the preloaded pictures in Livox abstract and not enough representative. She also could not find pictures for many items she was looking for in the library. Thankfully, AlMi is able to read and can identify the items through text anyway. In addition, AlMi’s mother complained about the fact that she had to go back and forth between the “Edit screens” and the interaction screen.

Livox did not perfectly match AlMi’s level of skills. In fact, he is used to a more complicated software that allows him to satisfy his communication needs, and thus, he was over skilled. Consequently, AlMi’s mother rated her satisfaction by 3/5 and said she would
definitely recommend this app for someone who is starting out or someone who has limited motor skills.

6. **NiMi caregiver’s feedback:**

NiMi enjoyed using Livox although he was capable of verbal communication. However, it was not necessary for communication. He liked the app so much that he was participating in its setup and was asking for specific items to be uploaded.

When NiMi speaks and is not understood, he sometimes uses the virtual keyboard of the app to communicate.

NiMi’s caregiver pointed out that there was no help section or “contact us” sections to ask for support. She also disliked the fact that once the pin code was set up, it had to be entered every time she needed to add or edit an item. This was particularly frustrating when she had to type it several times while going back and forth between the “Settings” and the first page.

NiMi’s Mother is likely to recommend Livox to someone who is non-verbal or beginning with AAC devices.

### 3.2. **Communication Skills Inventory (Before vs. After the study)**

The level of communication skills of the children was measured before and after exposure to Livox. Scores for each item of the BLA ranges between 1 and 5. Table 4-10 illustrates the BLA scoring for each of the participants. Colored in green are the areas of progress. The areas of decline are in red.
Table 4-10 BLA results before and after exposure to Livox

<table>
<thead>
<tr>
<th>Operant</th>
<th>GiMa Before</th>
<th>GiMa After</th>
<th>AiWa Before</th>
<th>AiWa After</th>
<th>MaSa Before</th>
<th>MaSa After</th>
<th>NiMi Before</th>
<th>NiMi After</th>
<th>WiMi Before</th>
<th>WiMi After</th>
<th>AlMi Before</th>
<th>AlMi After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperation with adults</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Requests (Mands)</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Motor imitation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Vocal play</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Vocal imitation (Echoics)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Matching-to-sample</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Receptive (Listener behavior)</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Labeling (Tacts)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Receptive by feature, function and class (RFFC)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Conversational skills (intraverbals)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Letters and numbers</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Social interaction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
It can be seen from the BLA results that there is a slight improvement. It cannot be determined with certainty whether or not Livox is the reason of this improvement because the children were receiving therapy sessions during the same period. Except for GiMa, whose therapist was using Livox also within TSC, all the other children had access to Livox only outside TSC hours. Besides, from these results we cannot conclude whether or not the level of skills has an impact on the client’s adoption of the app. GiMa whose communication level was the most severe, accepted the app better than MaSa and AiWa. Also, NiMi, WiMi and AlMi, who were at a more advanced level than the rest of the group, showed more interest in Livox than Aiwa and Masa – They just were just used to another application.

3.3. Results Summary

From the Heuristic Evaluation, the usability testing, and the responses received from the parents, weak points have been identified and improvement opportunities have been generated. First, the three evaluations demonstrated that the “Settings” menu – “Parameters and “Item Creation” – are cumbersome and indicate several usability issues related to the UI and information architecture. Second, Livox, as is currently, is more suited for beginners than for more advanced levels of communication skills. In fact, the app does not scale to accommodate more skilled users. Third, visual clues are also lacking in interaction screens presented to the children – screens that do not involve settings but rather the actual interaction with the application. Finally, the images available in the image library have been heavily criticized.
Chapter 5
Design Improvements

The design improvements focus on two different aspects. The first one concerns the tasks that the parents/caregivers would perform, which are: setting up the parameters and adding/editing items. The second aspect concerns the patient’s interaction with the app, namely visual cues in the main interaction screen and scalability of the application. For the prototyping of the solutions, Axure RP 8 [52] was used on a MacOS El Captain version 10.11.6.

1. Design Patterns Used

Whether it is designing user interfaces for desktop, web or mobile devices, there are dozens of design patterns that have proven their efficacy throughout the years. With the evolution of the technology and device capabilities, many have evolved and some have been created. In this section are presented design patterns that are useful for Livox UI improvement.

- Visual Framework: The different elements of the design (page layout, colors, font, and overall style) should be consistent and visually related, with a reasonable amount of flexibility [53].

- Breadcrumbs: when the information is organized in a hierarchy, it is useful to list all the pages or folders that lead to the point where the user is [53].
- **Center Stage:** The most important part of the UI should take the largest portion of the screen. The secondary elements should be smaller and placed around it. The center stage does not necessarily need to be in the middle of the page. This helps to guide the users towards the main stage to accomplish a task, and spares them the frustration of searching for where to begin [53].

- **Titled Sections:** A clear title should be given to the different chunks or sections of information. Unrelated content should not be put in the same section [53].

- **Module Tabs:** Using module tabs allows to show one chunk of information at a time. In order to see different modules, the user clicks on the appropriate tab [53].

- **Diagonal Balance:** Chunked content placed asymmetrically should be balanced by putting visual weight on the upper-left corner and bottom-right corner of the screen. This is especially appealing for users who read from left to right. It allows the flow of content to be smooth when the page has a title on top and ends with a OK/Submit/Apply buttons in the bottom. The content in the middle should follow the same direction, however one must pay attention not to put too much white space on one side or the another of the screen [53].

- **Thumbnail Grid:** Images of same size and importance are placed near each other in a grid. Metadata (i.e. label) can also be displayed along with the images without taking much space. The thumbnail grid a visually appealing and attracts the focus of the user. The shape and size of the items are big enough to be used in mobile devices by being easily selectable with the fingers [53].
The list of design patterns presented above is by no means exhaustive. They are patterns that are particularly important to the improvements brought to Livox UI.

2. Design Improvements for Caregivers

The two elements that were criticized the most in the usability study are the “Item creation” and “Parameters”. These are tasks performed by parents and not the children.

2.1. Items Creation

In chapter 4, usability and design issues for item creation were detailed. The screen was said to be confusing and unintuitive. The use of the screen real estate was not optimal. And there were no visual clues about the possible actions.

The prototype for item creation is presented in Figure 5-1.
Table 5-1 highlights the main differences between the old design of “Item Creation” screen and the new one.

**Table 5-1 "Item Creation": before/after comparison**

<table>
<thead>
<tr>
<th></th>
<th>Old design (Figure 2-6)</th>
<th>New design (Figure 5-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The pictures library was presented in a thumbnail-and-text list, in the right side of the screen. The labels were taking most of the space and they were redundant. Also, the scrolling bar is only visible when the user starts scrolling.</td>
<td>A Thumbnail grid was introduced on the left side of the screen with a minimal design that shows more pictures at a given time and clear concise labels. Also, a scrolling bar is clearly visible to show there is more content and give an impression about its size.</td>
</tr>
<tr>
<td>2</td>
<td>The content chunking followed a logic from right to left as follows: pictures library -&gt; selected pictures -&gt; everything else. Many users did not know where to begin.</td>
<td>A chunking that goes from left to right and from top to bottom with clear titled sections. The order is as follows: picture selection -&gt; speech to be played -&gt; additional media (if the user chooses so) -&gt; displaying options. The picture selection is the most important task and therefore occupies the center stage (in size and position) of the page.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>Some media options where hidden and appear only when the user selects “enable media options”.</td>
<td>All the media options are available and are grouped together in a coherent fashion. Each element belongs to a group of related elements.</td>
</tr>
<tr>
<td>4</td>
<td>No visual clues as of how to perform different actions such as: delete picture, add picture from library/camera/gallery. Also, the instruction under the selected picture changes depending on whether the screen was accessed in edit mode or creation mode. The text also changes depending on whether a picture has already been added or not. Finally, if a user has selected a picture and wants to try another one, it is automatically assigned as a second picture without asking the user beforehand.</td>
<td>Icons for deleting, accessing gallery, and camera have been introduced under the selected image. Also, the primary and secondary picture in different module tabs so there is no confusion. Given that assigning a secondary picture is not a frequent action, it is disabled by default (tab colored in gray). If the user wishes to enable it, there is a toggle just on top to do so. The user now can try as many pictures as she wants without having them automatically assigned as secondary. The selected picture simply goes to the selected tab.</td>
</tr>
<tr>
<td>5</td>
<td>No contextual help.</td>
<td>Help buttons have been added in specific titled sections to give more information to the user about what the options are for.</td>
</tr>
<tr>
<td>6</td>
<td>No software back button.</td>
<td>A back button has been added at the top left of the screen.</td>
</tr>
<tr>
<td>7</td>
<td>Long and small text.</td>
<td>Shorter and bigger text.</td>
</tr>
</tbody>
</table>

It is very important to use white space effectively when chunking content. Gestalt theory explains how people perceive elements as a whole and in a relationship with their environment as opposed to individual stand-alone items [54]. By grouping related content
and isolating them from other groups of content, Gestalt principles of proximity and closure were applied [53].

2.2. Parameters

Complaints about “Parameters” (chapter 4) came mainly from a bad information architecture. All the parameters were dumped together in the same page and written with small and long text.

For the new design I decided to breakdown the one screen of parameters and regroup the items into different sections. Figure 5-2, Figure 5-3 and Figure 5-4 show the new design for “Parameters”.

![Figure 5-2 Design prototype of "Parameters" screen: Display setting](image)
Figure 5-3 Design prototype of "Parameters" screen: Audio Settings
Table 5-2 "Parameters": before/after comparison

<table>
<thead>
<tr>
<th></th>
<th>Old design (Figure 2-7)</th>
<th>New design (Figure 5-2, Figure 5-3 and Figure 5-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All the parameters are mixed together in the same screen. The left side of the screen takes too much space and also presents beta feature that are very rarely interacted with.</td>
<td>Module tabs were created on the left for each type of parameters (Display, Audio, Navigation, and Beta features). It is visually clear which tab is selected at any given moment. Within the tabs, Gestalt principles have been applied to gather elements into titled section to increase information retrieval.</td>
</tr>
<tr>
<td>2</td>
<td>The text was long, small and badly formulated.</td>
<td>Improvement of the size, length and structure of the text.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>Some options appear only when others are disabled (example, to enable swiping as a navigation method, the user has to disable “Enable navigation buttons?” and enable “User has good motor skills?”), which is supposed to imply that swiping has been activated.</td>
<td>Elimination of all convolution and clearly states what each option does. In each tab, all the options related to that particular tab are present and do not disappear.</td>
</tr>
<tr>
<td>4</td>
<td>There is no “Save” nor “Cancel” buttons. Whatever change is made in the parameters is applied without the user’s confirmation.</td>
<td>Introduction of a “Cancel” and “Apply” buttons. Also, a “Preview” function has been added in order for the user to visually see the impact of the changes on the interface before she confirms it.</td>
</tr>
<tr>
<td>5</td>
<td>No clear start button. A smiley face is used for that purpose.</td>
<td>A clear “Use Livox” button is added to go back to the interaction home screen.</td>
</tr>
<tr>
<td>6</td>
<td>No reset default settings button.</td>
<td>A “Reset Default Settings” button has been added for the convenience of the user.</td>
</tr>
<tr>
<td>7</td>
<td>Back button.</td>
<td>Addition of a software back button.</td>
</tr>
<tr>
<td>8</td>
<td>No help.</td>
<td>Contextual help has been added for option that might need explanation.</td>
</tr>
</tbody>
</table>

The new design increases clarity and the overall look and feel of the parameters. The old design not only visually confuses the user but also textually. For example, to activate swiping the interface forces the user to interpret having good motor skills, which is a technical term, as necessarily wanting to swipe between pages instead of using left/right arrow buttons. As Alan Cooper says: “Most people would rather be successful than knowledgeable” [54]. Therefore, it is very important to employ simple and straightforward instructions, rather than counting on the user to understand how the designer’s mental model is. It is common to have a gap between the mental models of the designers and the users [55]. This is explained by the fact that the designer is a product expert, what might seem simple and evident to her, might not be the same for the user.
2.3. Other Improvements

Generally, the icons and labels were improved all over the UI. As shown in Figure 5-5, a clear start button has been added ("Use Livox"). The “Settings” icon was changed to a recognizable icon. Also, the icon that was used for “About Livox” was showing the application’s Logo which was big and green, which would conflict with the start button. Therefore, the icon was changed to a minimalist and discrete icon. Finally, the “Virtual Keyboard” icon was changed to match the style of the other icons.

![Figure 5-5 Design prototype for the General Menu](image)

The “Parameters” icon in the “Settings” menu has been changed to a universally recognized icon as shown in Figure 5-6.
3. Design Improvements for The Patients

The only part of the software that the children have access to and interact with is the main Interaction Screen. Feedback from the caregivers had also brought insight on how the children’s experience can be improved.

3.1. Interaction Screen

The most criticized aspects of the interaction screens are the lack of visual clues and the style of the pictures that was said to be too abstract. In the old design, the user could not visually discriminate between items that play the role of folders – and contain other items
within them – and items that do not. Also, there was no indication about the existence of other pages right and left from a given screen when navigation is set on “swiping mode”.

Interactions feedback is very important. The user should always be aware of when and what has been done. For instance, the user should know what item has been selected from the screen and be informed of what message has been created [34]. Livox produces already an auditory feedback each time an item is selected. However, it does not keep track of what has been previously selected at any given time. Having such visual feedback can help the child learn the arborescence employed in the grouping of different items and also memorize an approximate length of the path that has to be taken to reach a desired item. For example, if the child wants a glass of water, after a few trials, he would know that it takes 3 steps to reach the desired item. He would not stop at the second screen looking for the glass of water whereas it is actually one step further.

Changes made to the interaction screen are presented in Figure 5-7.
Figure 5-7 Design prototype for the "Interaction Screen"

Two white arrows (left and right) have been added to each side of the screen. On the first page, the left arrow would not appear. Similarly, on the last page, the right arrow would not appear either. Also, at the top of the screen, a visual reminder of all the items that have been selected so far was added. Finally, the shape of the items that play a role of folders has been modified. Three indentations have been added to the right side of those items, to mimic the design of a booklet.
3.2 Scalability

Based on the feedback received from caregivers of children that have relatively advanced communication skills, Livox was described as great for beginners. The children that have been using Proloquo2Go for 1.5 to 2 years, saw Livox as a new gadget to have and play with, however, they go back to Proloquo2Go for their communication needs. This may be simply because they were already used to their old devices or truly because Livox cannot, as is, fulfill all their communication needs.

The AAC device has to be able to evolve with the development of the patient’s level of communication skills [56]. As far as vocabulary is concerned, Livox is able to expand as needed. The number of items that it is possible to add is very large and only limited by the device’s memory. This might still not be enough. Let’s take a hypothetical scenario to illustrate a limitation:

A child wants for example to wear his blue shirt. If the specific item for that blue shirt has not been added to the array of items to select from, the child will not be able to express that demand using Livox. In this case, the parent would have to add every item in the child’s wardrobe in Livox.

Livox, as is, does not allow for sentence formulation. If their communication skills allow it, the users should be able to combine verbs, colors and objects using his AAC. This would give them the ability to extend the precision and richness of their communication, but also to spontaneously comment on things and events. Therefore, in order for Livox to serve a wider range of users, it is imperative to introduce an intermediate and expert version. This
could be done by releasing a separate software or by including the options in one software.

Figure 5-8 shows an example of a layout for a more advanced version of Livox.

![Figure 5-8 Layout proposition for an advanced version](image)

By visually separating the different types of items according to their types (subjects, verbs, items, etc.) and give them different color background, it is easier to know where to look in order to retrieve the elements of a sentence. This idea should be further developed and tested to make decisions about the interaction design. Should each section be scrollable to show more items? Should it be expandable in pop-up windows? Should the user swipe
between different pages? The answer to these question needs more prototypes, testing and design iterations to be performed.

### 3.3 Additional Propositions

1. **Incorporating animated GIF image format:**

   It is easier for individuals with ASD to handle visual and spatial information [57]. If AAC devices take fully advantage of this ability, it is safe to assume that results can be improved. The feedback from the usability study showed many complaints about the pictures used in Livox. Although this style of pictures is used in many other SGD applications [58], they were described as abstract and sometimes not representative.

   In general, the symbols differ in the level of complexity. For example, symbols for verbs, adverbs, and questions are more difficult to interpret than the symbols used to depict nouns [34]. Moving visuals may improve the engagement of children with the device [59]. Therefore, it would be interesting to investigate the idea of using animated GIF format pictures to represent action verbs. These images behave like repetitive short videos showing a specific action.

2. **Extending communication beyond face-to-face**

   Being able to communicate with a child using an SGD device on a tablet is already a good achievement. But what if communication could be taken beyond a face-to-face setup? High functioning children with autism can use a tablet at a high level of autonomy. And with today’s devices it is easy and fast to send pictures and text. Therefore, it might be useful to develop a feature that allows parents to ask simple questions to their children – when they
are not together – using images and get a response. Let’s use a hypothetical scenario as an example:

A parent is going to the autism treatment center to pick up his son. On the way he remembers that he has to buy cereals for tomorrow’s breakfast. However, he would like to know what kind of cereal his son wants this time. So he goes to the store, picks up his phone, accesses the new feature in Livox. He then types a question: “Which cereals do you like?” and takes 3 pictures of 3 different cereal brands and sends them to his son. The son then receives a notification, opens it and chooses the desired item.

Figure 5-9 shows how the screen would look like in the child’s end.

![Design prototype for distance communication](image)

**Figure 5-9 Design prototype for distance communication**
3. **On-the-spot image editing**

During the usability study, participants complained about the number of clicks they had to make in order to go back and forth between the “Interaction Screen” and the “Item Creation” screen. It would be more convenient to be able to access “Edit Items” directly from the “Interaction Screen”. However, if such a button exists, not only might it confuse the children as an intrusive item, but also they might select it and edit/delete items. Therefore, the button should be hidden and password protected. The idea is to incorporate a gesture, that is very improbable for the child to execute accidentally, that would make the button appear. Once the button appears and is pressed, the caregiver would be prompted to enter a password.

After considering a number of gestures and hardware buttons combination, the choice settled to a diagonal swipe of 3 inches beginning exactly from the bottom left corner of the screen.

Figure 5-10 depicts the edit button appearance. The blue circles illustrate the beginning and ending of the swiping gesture. The button appears once the finger reaches the second point.
Figure 5-10 Design prototype of the hidden edit button
Conclusion & Future Work

The effectiveness of SGD devices in improving the communication of individuals with autism has clearly been demonstrated by research [30]. However, there is a component, that might potentially be a potential obstacle, which is the usability of the device.

At first, the heuristic evaluation allowed for the identification of UI issues related to all the aspects of the application (layout, interaction, use of icons, instructions, etc.).

The usability testing with users that are experts in usability allowed for a richer input. In fact, people might have different mental models and might think of performing tasks differently. Observing the users while they perform the tasks allowed for the identification of the confusions caused by the lack of simplicity and clarity. These pain-points were taken into consideration in the design improvements.

The final piece of the usability study was the qualitative feedback gathered from parents after they used Livox with their children for a period of 6 weeks. The survey allowed to assess the overall satisfaction from using the application and contributed in the generation of additional ideas for design. Although the parents liked Livox as a tool, they all agreed that it might not be adequate, in its current state, for more advanced users.

The most criticized aspects of the user interface were “Parameters” and “Item Creation”, which are core components of Livox and remain the two most important functions of the application. They were reported to be particularly overwhelming, unintuitive, not
categorized, and difficult to discover. To fix the issues, several design patterns were applied to the UI for the purpose of providing a clearer and more enjoyable experience.

For future work, more iterations of usability testing and validation should be performed on the new design propositions and the new features to continuously refine them. For instance, it is of the utmost importance that the scaling of Livox to accommodate more skilled users is done right by taking into account all their needs such as the ability to spontaneously create sentences by combining subjects, verbs, and nouns. Furthermore, it would be interesting to experiment with new features such as distance communication that will allow children to answer simple questions, sent by the parents, by selecting options displayed on the screen. Another promising addition would be the use of animated GIF pictures that could be more representative than symbols (especially for action verbs) and might increase the children’s engagement along the way.

Finally, Livox’s effectiveness should be evaluated in a therapeutic set up. Although the before/after comparison of the BLA results showed that there was improvement in certain areas of communication, it cannot be concluded that it was due to the use of Livox. Not only was it used for a relatively short period of time (6 weeks), but also the children were given treatment at the same time that was dissociated from Livox with no interference between the two. With the exception of GiMa whose therapist opted for the use of SGD for his treatment and allowed for Livox use during sessions at TSC.
References


Appendix A
IRB Approval

Notice of Expedited Review Status
Certificate of Clearance for Human Participants Research

Principal Investigator: Moez Lidinallah Fessi
Date: February 14, 2018
IRB Number: [Redacted]
Study Title: Evaluation and improvement of an alternative communication tablet app for patients with Autism

Your research protocol was reviewed and approved by the IRB Chairperson. Per federal regulations, 45 CFR 46.110, your study has been determined to involve no more than minimal risk for human subjects. Federal regulations define minimal risk to mean that the probability and magnitude of harm are no more than would be expected in the daily life of a normal, healthy person.

Unless you have requested a waiver of consent, participants must sign a consent form, and the IRB requires you give each participant a copy of the consent form for their records. For online surveys, please advise participants to print out the consent screen for their files.

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Access to data is limited to authorized individuals listed as key study personnel.

Prompt reporting to the IRB is required in the following conditions:
• Procedural changes increasing the risk to participants or significantly affecting the conduct of the study
• All adverse or unanticipated experiences or events that may have real or potential unfavorable implications for participants
• New information that may adversely affect the safety of participants or the conduct of the study.

This study is approved for one year from the above date. If data collection continues past this date, a Protocol Renewal Form must be submitted.
## Appendix B
### Behavioral Language Assessment (BLA)

**BEHAVIORAL LANGUAGE ASSESSMENT**

1. **Cooperation with adults**
   - How easy is it to work with the child?
   1. Always uncooperative, avoids work, engages in negative behavior
   2. Will do only one brief and easy response for a powerful reinforcer
   3. Will give 5 responses without disruptive behavior
   4. Will work for 5 min without disruptive behavior
   5. Works well for 10 min at a table without disruptive behavior

2. **Requests (Mands)**
   - How does the learner let his needs and wants be known?
   1. Cannot ask for reinforcers; or engages in negative behavior
   2. Pulls people, points or stands by reinforcing items
   3. Uses 1–5 words, signs or pictures to ask for reinforcers
   4. Uses 5–10 words, signs or pictures to ask for reinforcers
   5. Frequently requests using 10 or more words, signs or pictures

3. **Motor imitation**
   - Does the learner copy actions?
   1. Cannot imitate anybody’s motor movements
   2. Imitates a few gross motor movements modeled by others
   3. Imitates several gross motor movements on request
   4. Imitates several fine and gross motor movements on request
   5. Easily imitates any fine or gross movements, often spontaneously

4. **Vocal play**
   - Does the learner spontaneously say sounds and words?
   1. Does not make any sounds (mute)
   2. Makes a few speech sounds at a low rate
   3. Vocalizes many speech sounds with varied intonations
   4. Vocalizes frequently with varied intonation and says a few words
   5. Vocalizes frequently and says many understandable words

5. **Vocal imitation (Echoics)**
   - Will the learner repeat sounds or words?
   1. Cannot repeat any sounds or words
   2. Will repeat a few specific sounds or words
   3. Will repeat or closely approximate several sounds or words
   4. Will repeat or closely approximate many different words
   5. Will clearly repeat any word, or even simple phrases

6. **Matching-to-sample**
   - Will the learner match any objects, pictures, designs to presented samples?
   1. Cannot match any objects or pictures to a sample
   2. Can match 1 or 2 objects or pictures to a sample
   3. Can match 5–10 objects or pictures to a sample
   4. Can match 5–10 colors, shapes or designs to a sample
   5. Can match most items and match 2–4 block designs
7. Receptive (Listener Behavior) ____
   Does the learner understand any words or follow directions?
   1. Cannot understand any words
   2. Will follow a few instructions related to daily routine
   3. Will follow a few instructions to do actions or touch items
   4. Can follow many instructions and point to at least 25 items
   5. Can point to at least 100 items, actions, persons or adjectives

8. Labeling (Tacts) ____
   Does the learner label or verbally identify any items or actions?
   1. Cannot identify any items or actions
   2. Identifies only 1–5 items or actions
   3. Identifies 6–15 items or actions
   4. Identifies 16–30 items or actions
   5. Identifies over 100 items or actions and emits short sentences

9. Receptive by Feature, Function and Class (RBFC) ____
   Does the learner identify items when given information about those items?
   1. Cannot identify items based on information about them
   2. Will identify a few items given synonyms or common functions
   3. Will identify 10 items given 1 of 5 functions or features
   4. Will identify 25 items given 4 functions, features or classes
   5. Will identify 100 items given 5 functions, features or classes

10. Conversational skills (Intraverbals) ____
    Can the learner fill in missing words or answer questions?
    1. Cannot fill in missing words or parts of songs
    2. Can fill in a few missing words or provide animal sounds
    3. Can fill in 10 nonreinforcing phrases or answer at least 10 simple questions
    4. Can fill in 20 phrases or answer 20 questions with variation
    5. Can answer at least 30 questions with variation

11. Letters and numbers ____
    Does the learner know any letters, numbers or written words?
    1. Cannot identify any letters, numbers or written words
    2. Can identify at least 3 letters or numbers
    3. Can identify at least 15 letters or numbers
    4. Can read at least 5 words and identify 5 numbers
    5. Can read at least 25 words and identify 10 numbers

12. Social Interaction ____
    Does the learner initiate and sustain interactions with others?
    1. Does not initiate interactions with others
    2. Physically approaches others to initiate an interaction
    3. Regularly asks adults for reinforcers
    4. Verbally interacts with peers with prompts
    5. Regularly initiates and sustains verbal interactions with peers
Appendix C
Technology Attitude Probing Survey

Client name:
Caregiver name:

Technology Attitude Probing

1) How comfortable are you with using tablets?
   1  2  3  4  5

2) How comfortable is your child with using a tablet?
   1  2  3  4  5

Comment:

3) If your child uses a tablet on a regular basis, for what purpose is it usually used?

4) Has your child used a tablet for communication before? If YES, which software has been used?

5) If your child has used a tablet to communicate before, what are the aspects that did or did not work?

6) Is your child using PECS for communication? Did he/she used it before? For how long?
Appendix D
Evaluation Questionnaire

Livox Evaluation Survey
This survey has the purpose to get feedback from you after the use of Livox. Please take the time to provide us with answers to the questions below. Your input is greatly valued.

* Required

Email address *
________________________

Name *
________________________

1) How often does your child use the Livox app to express his/her wants and needs? *
________________________
________________________
________________________
________________________

2) Do you think that your child initiates interaction more frequently since he/she started using Livox than before using Livox? *
Mark only one oval.

☐ Yes
☐ No
☐ Maybe

Comment:
________________________
________________________
________________________
________________________
3) How would you describe the engagement of your child with Livox? (Does he show interest or disinterest, satisfaction, boredom, etc.)

4) When an item (example: food, drinks, etc.) is selected, Livox generates sound. What method did you use more for the sound output? *
Mark only one oval.
- Livox sound generation
- Recordings of your own voice

Which one of the sound output do you feel engages your child better? Why? *

5) How much assistance/help from you, if any, does your child need to express her/his needs through the Livox app? *

6) How easy/difficult do you feel teaching him to navigate between pages was? *
Mark only one oval.

1 2 3 4 5

Very easy 1 2 3 4 5 Very difficult
7) Which navigation method does your child prefer? *
   Mark only one oval.
   - Swiping
   - Using the arrow buttons (right and left)

8) What was the best grid size (Columns X Rows) for your child? *

9) What are your thoughts about the “Livox image library” available for pictures and symbols and how your child understands/learns them? *

10) To what extent do you feel that the Livox app matches your child’s level of skills? *
11) How efficient do you feel Livox is? (efficient = little time needed to reach desired item and limited practice time to familiarize with the system) *

12) What are your thoughts about the way information in the “Edit screens” and “Parameters” is displayed? *

13) What are the most difficult or complex aspects or tasks to accomplish in Livox? *

14) Do you feel your child gained vocalization of words after using Livox? *

*Mark only one oval.

☐ Yes
☐ No
☐ Maybe

Comment:

____________________

____________________

____________________

____________________
15) Does the Livox miss any feature you were expecting it to have? *  
*Mark only one oval.*
- [ ] Yes  
- [ ] No  
- [ ] Maybe  

Comment  

________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________  

16) What satisfied you the most in using Livox? *  

________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________  

17) How would you rate your overall satisfaction in using the Livox? *  
*Mark only one oval.*  

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very unsatisfied</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comment: *  

________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________
18) What improvements/suggestions do you think would improve the app? *

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

19) How likely is it that you would recommend Livox to a friend? *

Mark only one oval.

1 2 3 4 5

Very unlikely   [ ]   [ ]   [ ]   [ ]   [ ]   Very likely

If you have any comments or information you wish to share, please write them here
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix E
Usability Testing Task-List

1) Open the Livox app and choose to use “test test test” profile

2) Start using Livox to ask for a type of food you would want to eat.

3) After you ate you are feeling thirsty. Ask for water.

4) When you wanted to ask for water, you did not like the picture that was representing water. Change it for a picture that you think is more representative.

5) After you ate to your fill, you feel a little bit sleepy so you want to take a nap. However, the corresponding item does not exist. Create it and use it to let me know that you want to take a nap.

6) When you created the “take a nap” item, you did not like the voice of the default sound synthesizer that was generated upon selecting the item. Record your own voice instead.

Your friend’s child is named Owen. He is 6 years old and has autism. So you thought this tool (Livox) might have potential to help him communicate better. So you decided to set it up for him.

7) Livox has an option to assign two pictures for one item. In that case, each time the item is selected, the picture changes back and forth between the two assigned pictures. You had the idea to use this feature to teach Owen the number “3”. To do so, add a picture of 3 balloons, coupled with a picture of number “3”.

8) The screen’s grid size can be confusing for Owen. Change the grid size to 2 x 3 (row x column).

9) You noticed that the arrows that allow for navigation between pages are unnecessarily taking space on the screen. Change the method to navigate between pages from pressing arrows to swiping.

10) When you selected a time of food earlier, you noticed that the voice generated speaks a little bit too fast for Owen to assimilate it. Make sure to adapt it for him.
Appendix F
Usability Testing Detailed Results
<table>
<thead>
<tr>
<th>No</th>
<th>Expected sequence</th>
<th>Executed sequence</th>
<th>Observation</th>
<th>Think aloud</th>
<th>Score (1-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Livox logo -&gt; &quot;click to start livox&quot; button</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>&quot;I want to&quot; -&gt; &quot;eat&quot; -&gt; any option -&gt; any option</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Back button -&gt; back button -&gt; &quot;Drink&quot; -&gt; &quot;water&quot;</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; pencil icon on &quot;water&quot; to edit -&gt; long press on the picture to delete it -&gt; choose new picture -&gt; save</td>
<td>clicked on &quot;Water&quot; twice -&gt; long pressed on &quot;Water&quot; -&gt; back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit screens&quot; -&gt; scrolled down and up -&gt; went back and forth between &quot;Edit screen&quot; and the first page -&gt; Could not accomplish the task</td>
<td>The participant did not realise that, in the &quot;Edit screens&quot;, he had to select &quot;I want to&quot; to see all the screens related to &quot;I want to&quot;. Then press &quot;Drink&quot; to see all the screens related to &quot;Drink&quot;.</td>
<td>* What am I supposed to do exactly? * Did I misunderstand the question? * I go to edit screens and the item I am looking for is not here * I can’t accomplish the task</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;a&quot; button -&gt; choose a corresponding picture -&gt; write text to be displayed (&quot;Take a nap&quot;) -&gt; write text to be spoken (&quot;I want to take a nap&quot;) -&gt; save</td>
<td>clicked on &quot;Settings&quot; -&gt; &quot;Receive sets&quot; -&gt; back button -&gt; &quot;Edit screens&quot; -&gt; &quot;a&quot; button -&gt; wrote text to be displayed (&quot;nap&quot;) -&gt; saved</td>
<td>The participant did not put text to be spoken, did not add an image, and did not create the item in the &quot;I want to&quot; folder.</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; scroll to find &quot;Take a nap&quot; -&gt; pencil icon to edit -&gt; select &quot;enable media options&quot; -&gt; select &quot;record an audio for this item&quot; -&gt; select record/stop icon to speak -&gt; select record/stop icon to save</td>
<td>Went to keyboard -&gt; back -&gt; &quot;Edit screens&quot; -&gt; &quot;nap&quot; -&gt; pencil icon to edit -&gt; went back and forth between settings and first page -&gt; Could not accomplish the task</td>
<td>The participant did not guess that &quot;enable media options&quot; makes &quot;record an audio for the item&quot; appear. He thought that either he misunderstood the question or the option is hidden somewhere he cannot find</td>
<td>* What am I supposed to click on? * Did I misunderstand the task? * There is no visual clue on this interface * I can’t accomplish this task</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Back to &quot;Edit screens&quot; -&gt; &quot;x&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text to be displayed (&quot;3&quot;) -&gt; write text to be spoken (&quot;three&quot;) -&gt; save</td>
<td>correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; set &quot;Qty Columns&quot; to 3 -&gt; set &quot;Qty Rows&quot; to 2 -&gt; go to first page</td>
<td>correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills&quot; -&gt; go to first page</td>
<td>correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
### Participant 2

<table>
<thead>
<tr>
<th>No.</th>
<th>Expected sequence</th>
<th>Executed sequence</th>
<th>Observation</th>
<th>Think aloud</th>
<th>Score (1-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Livox logo -&gt; &quot;click to start Livox&quot; button</td>
<td>Correct</td>
<td>Thought a lot about how to start</td>
<td>* I don’t see a start button</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>&quot;I want to&quot; -&gt; &quot;est&quot; -&gt; any option -&gt; any option</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Back button -&gt; back button -&gt; &quot;Drink&quot; -&gt; &quot;water&quot;</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt;</td>
<td>clicked on &quot;Water&quot; -&gt; back -&gt; &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; &quot;Setup Livox</td>
<td>*Could not know that he had to delete the picture and choose</td>
<td>* Why does the picture keep appearing there?</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>pencil icon on &quot;water&quot; to edit -&gt; long press on the picture to delete it -&gt;</td>
<td>Recommendations&quot; -&gt; back -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; pencil</td>
<td>another one</td>
<td>* The picture can’t be deleted, when I press on it. I am asked to chose a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>choose new picture -&gt; save</td>
<td>icon on &quot;water&quot; -&gt; &quot;*&quot; button -&gt; scrolled -&gt; kept adding pictures as second</td>
<td>picture.</td>
<td>picture from the gallery or take a picture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>picture -&gt; deleted the two pictures -&gt; chose a picture -&gt; save</td>
<td>* Took time to notice that there was a database of pictures on</td>
<td>* It is the first time that I have to keep pressing a picture to delete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the right side.</td>
<td>it!</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;*&quot; button</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;*&quot; button</td>
<td>Did not add text label and speech to be spoken.</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>-&gt; choose a corresponding picture -&gt; write text to be displayed</td>
<td>-&gt; choose a corresponding picture -&gt; save</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>&quot;I want to take a nap&quot; -&gt; save</td>
<td>Cliked on the picture -&gt; back -&gt; pencil icon to edit -&gt; clicked on play icon</td>
<td>Spent a lot of time looking for the option to record sound</td>
<td>* Why is the option to record sound hidden?</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-&gt; select &quot;enable media options&quot; -&gt; select &quot;record an audio for the item&quot; -&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>select record/stop icon -&gt; speak -&gt; select record/stop icon -&gt; save</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Step</td>
<td>Action</td>
<td>Result</td>
<td>Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------------------------------</td>
<td>--------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Back to &quot;Edit screens&quot; -&gt; &quot;a&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text be displayed (&quot;3&quot;) -&gt; write text to be spoken (&quot;three&quot;) -&gt; save</td>
<td>Correct</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; set &quot;Qty Columns&quot; to 3  &gt; set &quot;Qty Rows&quot; to 2 -&gt; go to first page</td>
<td>Correct</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills?&quot; -&gt; go to first page</td>
<td>Correct</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Back button -&gt; decrease the number on &quot;pronunciation speed&quot;</td>
<td>Correct</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Feedback**

- Labels are long and small and sometimes meaning unclear
- Picture selection is confusing
- Editing/creating items is not intuitive and needs to be reworked
- Lack of use of standard icons and inconsistency in using icons

**Participant 3**

<table>
<thead>
<tr>
<th>Nº</th>
<th>Expected sequence</th>
<th>Executed sequence</th>
<th>Observation</th>
<th>Think aloud</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Livox logo -&gt; &quot;click to start Livox&quot; button</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>&quot;I want to&quot; -&gt; &quot;eat&quot; -&gt; any option -&gt; any option</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>back button -&gt; back button -&gt; &quot;Drink&quot; -&gt; &quot;water&quot;</td>
<td>Correct</td>
<td></td>
<td>&quot;The pictures in the &quot;Eat...&quot; have glasses filled with liquids. But I notice there is a specific folder for &quot;Drink...&quot;</td>
<td>4</td>
</tr>
<tr>
<td>Step</td>
<td>Action</td>
<td>Note</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; - &quot;Drink&quot; - pencil icon on &quot;water&quot; to edit -&gt; long press on the picture to delete it -&gt; choose new picture -&gt; save</td>
<td>Thinking about options, back and forth between options to add a photo in the appropriate place.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; - &quot;+&quot; button -&gt; choose a corresponding picture -&gt; write text to be displayed (&quot;Take a nap&quot;) -&gt; write text to be spoken (&quot;I want to take a nap&quot;) -&gt; save</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; - scroll to find &quot;Take a nap&quot; - pencil icon to edit -&gt; select &quot;media options&quot; -&gt; select &quot;record an audio for the item&quot; -&gt; select record/stop icon -&gt; speak -&gt; select record/stop icon -&gt; save</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Back to &quot;Edit screen&quot; -&gt; &quot;+&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text to be displayed (&quot;3&quot;) -&gt; write text to be spoken (&quot;three&quot;) -&gt; save</td>
<td>&quot;Edit Screens&quot; -&gt; &quot;+&quot; button -&gt; clicked on photo gallery -&gt; back -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text be displayed (&quot;3&quot;) -&gt; write text to be spoken (&quot;three&quot;) -&gt; save</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; set &quot;Qty Columns&quot; to 2 -&gt; go to first page</td>
<td>Did not know that the rows and columns numbers were scrollable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills?&quot; -&gt; go to first page</td>
<td>* The label text size is too small!!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills?&quot; -&gt; go to first page</td>
<td>* There is too much information displayed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The drag and drop text instruction is incomplete. * The only back button is the tablet’s physical button. It can cause confusion for people who are used to iPads (which does not have a physical back button).
<table>
<thead>
<tr>
<th>FEEDBACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drag and drop text labeling is incomplete</td>
</tr>
<tr>
<td>Text is small in size, long and not very accurate</td>
</tr>
<tr>
<td>There is too much information. The parameters should be organized by type (navigation, display, speech, etc.)</td>
</tr>
<tr>
<td>Some options are unnecessarily hidden and do not have strong clues to be discovered</td>
</tr>
<tr>
<td>There are icons that are not at all representative (settings icon, parameters).</td>
</tr>
<tr>
<td>Deleting an image can simply be replaced by a trash icon instead of writing with small sized text that the user should long keep pressing in order to delete and image.</td>
</tr>
<tr>
<td>In &quot;Edit screens&quot; the text under the image changes according to whether or not you selected an image.</td>
</tr>
<tr>
<td>When I choose to edit an item's image through the selection of the pencil, I do not have a clue as to how I can delete the image. Even the text that says I should keep pressing, is changed by drag and drop</td>
</tr>
<tr>
<td>The &quot;+&quot; button to add a new item is intrusive and hides options underneath it. It is unnaturally placed. There is space on top that would suite it.</td>
</tr>
<tr>
<td>There is too much information displayed at the same time.</td>
</tr>
<tr>
<td>A back button should be displayed in the screen</td>
</tr>
<tr>
<td>A lot of text can be replaced by icons that everybody knows</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>Step</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>
### Feedback

I see no reason to have an image by default when adding a new item. When one forgets to add an image, that image is selected by default.

The labels are very small.

Why not simply put a microphone icon to record sound? Having a hidden option that only appear when enabling media options is confusing.

Deleting a picture is tricky.

Enabling swiping method is confusing and unclear.

---

### Participant 5

<table>
<thead>
<tr>
<th>№</th>
<th>Expected sequence</th>
<th>Executed sequence</th>
<th>Observation</th>
<th>Think aloud</th>
<th>Score (1-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Livox logo -&gt; &quot;click to start Livox&quot; button</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;I want to&quot; -&gt; &quot;eat&quot; -&gt; any option -&gt; any option</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Back button -&gt; back button -&gt; &quot;Drink&quot; -&gt; &quot;water&quot;</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt;</td>
<td>Long pressed &quot;Water&quot; item -&gt; back -&gt; back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; pencil icon on &quot;water&quot; to edit -&gt; long press on the image to delete it -&gt; chose new picture -&gt; save</td>
<td>* I don't know how to go to the subsections... I guess I will click on it. Ok it worked. * Why does it ask me to go to gallery if I click on an image?</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Instructions</td>
<td>Feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;*&quot; button -&gt; choose a corresponding picture -&gt; write text to be displayed (&quot;Take a nap&quot;) -&gt; write text to be spoken (&quot;I want to take a nap&quot;) -&gt; save</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;*&quot; want to&quot; -&gt; scroll to find &quot;Take a nap&quot; -&gt; pencil icon to edit -&gt; select &quot;enable media options&quot; -&gt; select &quot;record an audio for the item&quot; -&gt; select record/stop icon &gt; speak -&gt; select record/stop icon &gt; save</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Back to &quot;Edit screens&quot; -&gt; &quot;*&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text be displayed (&quot;3&quot;) -&gt; write text to be spoken (&quot;three&quot;) -&gt; save</td>
<td>Correct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; back -&gt; &quot;Parameters&quot; -&gt; set Qty Columns&quot; to 3 -&gt; set Qty Rows&quot; to 2 -&gt; go to first page</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; back -&gt; &quot;Parameters&quot; -&gt; set Qty Columns&quot; to 3 -&gt; set Qty Rows&quot; to 2 -&gt; go to first page</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills?&quot; -&gt; go to first page</td>
<td>&quot;Parameters&quot; -&gt; disabled &quot;Enable navigation buttons&quot; -&gt; enabled &quot;switch control&quot; -&gt; went to test it -&gt; back &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; disabled &quot;switch control&quot; -&gt; went to test it -&gt; could not accomplish the task</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Back button -&gt; decrease the number on &quot;pronunciation speed&quot;</td>
<td>Back to home screen -&gt; &quot;Edit screens&quot; -&gt; back -&gt; &quot;Parameters&quot; -&gt; decrease the number on &quot;pronunciation speed&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FEEDBACK**

It is really overwhelming to go back and forth between the settings and the item's home page.

The look and feel of the parameters is not good. Labels are small and unclear, I also don't need what is presented on the left part.
I which I could edit the screens directly without having to go all that path. There is no visual feedback and clues to proceed.

There should be use of icons instead of all that small text
The system should verify if there is a switch control connected to the up. Before activating the function and making the app completely unusable with gestures. I personally thought there was a glitch

<table>
<thead>
<tr>
<th>No.</th>
<th>Expected sequence</th>
<th>Executed sequence</th>
<th>Observation</th>
<th>Think aloud</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Livox logo -&gt; &quot;click to start Livox&quot; button</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>&quot;I want to&quot; -&gt; &quot;eat&quot; -&gt; any option -&gt; any option</td>
<td>Correct</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Back button -&gt; back button -&gt; &quot;Drink&quot; -&gt; &quot;water&quot;</td>
<td>Correct</td>
<td>He accidentally discovered how to delete an image</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; pencil icon on &quot;water&quot; to edit -&gt; long press on the picture to delete it -&gt; choose new picture -&gt; save</td>
<td>Back to home screen -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; &quot;water&quot; -&gt; long pressed &quot;water&quot; item -&gt; back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;Drink&quot; -&gt; pencil icon on &quot;water&quot; to edit -&gt; clicked on the image -&gt; went to camera -&gt; back -&gt; changed background colors -&gt; searched for a picture -&gt; clicked on picture (that was selected as second picture) -&gt; Save -&gt; Clicked on &quot;water&quot; -&gt; &quot;*&quot; button -&gt; back -&gt; pencil icon on &quot;water&quot; -&gt; long pressed second picture to delete it -&gt; long pressed first picture to delete it -&gt; choose new picture -&gt; save</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; &quot;*&quot; button -&gt; choose a corresponding picture -&gt; write text to be displayed (&quot;Take a nap&quot;) -&gt; write text to be spoken (&quot;I want to take a nap&quot;) -&gt; save</td>
<td>Correct</td>
<td></td>
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<td>4</td>
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<tr>
<td>Step</td>
<td>Action</td>
<td>Correct</td>
<td>Notes</td>
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<td>6</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Edit Screens&quot; -&gt; &quot;I want to&quot; -&gt; scroll to find &quot;Take a nap&quot; -&gt; pencil icon to edit -&gt; select &quot;enable media options&quot; -&gt; select &quot;record an audio for the item&quot; -&gt; select record/stop icon -&gt; speak -&gt; select record/stop icon -&gt; save</td>
<td>Correct</td>
<td>Oh! So to record a voice I have to click on enable media options!</td>
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<td>7</td>
<td>Back to &quot;Edit screens&quot; -&gt; &quot;+&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; search for a picture of 3 balloons and select it -&gt; write text to be displayed (&quot;three&quot;) -&gt; save</td>
<td>Back to &quot;Edit screens&quot; -&gt; &quot;+&quot; button -&gt; search for the picture &quot;3&quot; and select it -&gt; Proceed on the &quot;+&quot; button on the second picture spot -&gt; back -&gt; search for a picture of 3 balloons and select it -&gt; write text to be displayed (&quot;three&quot;) -&gt; save</td>
<td>The &quot;+&quot; symbol located at the spot for the second picture is confusing because it usually prompts us to click on it</td>
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<td>8</td>
<td>Back to home screen -&gt; &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; set &quot;Qty Columns&quot; to 3 -&gt; set &quot;Qty Rows&quot; to 2 -&gt; go to first page</td>
<td>Correct</td>
<td>Isn't there any save button here?</td>
<td></td>
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<tr>
<td>9</td>
<td>Back button -&gt; disable &quot;enable navigation buttons&quot; -&gt; enable &quot;user has good motor skills&quot; -&gt; go to first page</td>
<td>&quot;Parameters&quot; -&gt; disabled &quot;Enable navigation buttons&quot; -&gt; enabled &quot;switch control&quot; -&gt; went to test it -&gt; back &quot;Settings&quot; -&gt; &quot;Parameters&quot; -&gt; disabled &quot;switch control&quot; -&gt; went to test it -&gt; enable &quot;user has good motor skills&quot;</td>
<td>* For a moment, thought that &quot;Use switch control&quot; changed the navigation method to swiping</td>
<td></td>
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<tr>
<td>10</td>
<td>Back button -&gt; decrease the number on &quot;pronunciation speed&quot;</td>
<td>Correct</td>
<td>* What does switch control mean? Does it mean change the controls? Let's try that.</td>
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</tbody>
</table>

**FEEDBACK**

- I dislike the presentation of the menus: Poorly designed and a lot of small text
- A lot of the text should be rephrased
- Some actions are not at all intuitive
- The menu should not change when I make an action. Additional things should appear in dialog boxes or new screen, not in the same screen