THE ART OF TRANSITION: A DESIGN STUDY FOR EFFECTIVE TRANSITION INTERVENTIONS IN AUTISTIC KIDS

by

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ABSTRACT

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This study is concentrating on the transition process in autistic disorder kids. Transition is characterized as shifting between activities and also in an ongoing task. This transformation appears to be very hard to accomplish for many autistic individuals. The tendency towards sameness and resistance towards any alters in the routines leads to tantrum behaviors, such as kicking, shouting, punching, … The tantrum behaviors that are the outcome of a transition to a non-preferred activity affects the child's learning process and brings a lot of pressure and anxiety for both parents and the ASD individual.

The current thesis has focused on obtaining practical ways to facilitate this process and incorporating them into a system design. To fulfill this goal, a precise understanding of the users need was necessary, in addition to choosing the best suitable intervention models and employing them into a design. In the end, a corresponding app, along with a supporting smartwatch, was accomplished through various rounds of usability testing and user studies.

CHAPTER 1. INTRODUCTION

I became aware of autism in my early teenage years when my little cousin was diagnosed with severe autism. For many years autism was a very painful concept for me. I could not comprehend the fact that it appeared to be incurable. As my cousin got older, the autistic signs became more significant, to the point that he missed all years of school and was never able to be left alone by himself even for the shortest time.

The first time that I professionally studied autism was in my graduate studies, as a project for one of my courses. It was then that I discovered the importance of interventions and their vital part in an autistic person's life. I realized an early diagnosis and professional interventions could cure an individual up to ninety percent.

Years past and I became more aware of autism, and I decided to play my part in the intervention programs. This study is an excellent opportunity for me to explore ways that I can help these individuals and to make their lives a bit easier. Being a close observer in one ASD individual's life and working with many more autistic kids, I realized the difficulty that they face while they are asked to take part in a new activity or the challenges, they face to finish an ongoing task. The disruptive behaviors, along with extreme resistance at times, enlightened an idea in me to facilitate this process. I am focusing mainly on this transition process and ways that could facilitate this within a functional system design.

Transition, in general, is referred to shifting from one activity to another. More precisely kids tend to transition harder when there is not a precise understanding of the next activity, therefore providing a clear picture of the expecting activities and plans, by different methods will help to make the transition more straightforward (Flannery & Horner,1994).

In this study, I am focusing on the transition between the activities and in an ongoing activity. Autistic children tend to be resistive towards any change in their routines. This is referred to as emphasize on "sameness" and "resistance towards change." This characteristic usually makes it hard for both kids and caregivers to engage in new activities and learning new skills. It is necessary to state that autism is a vast spectrum, and almost all individuals are different. However, there are some shared personalities that researches have pointed, and I am going to make the design system based on these shared characteristics. In addition to this, I

would like to customize my design so that all the individuals could take advantage of this system.

I am planning to achieve this goal through proven interventions and designing a system that would digitally support this idea. My goal is to explore high-tech technologies and to implement the existing interventions into a compact design.

I plan to review related articles, study the existing methods in order to build a strong foundation for my design. I am planning to interview the caregivers, observe my main user group (autistic kids), study online sources such as YouTube channels, and perform usability testing on my users so that I could make related adjustments to my final design.

I want to pursue the following goals in this design:

- How to avoid disruptive behaviors in transition times (both in activities and in between the activities)?
- How to encourage dedication in an ongoing activity?
- How to facilitate the stress of the changes in routine tasks?
- What kind of design could be more accessible for ASD persons?
- What age group should I work with?
- How to make a design that attracts targeted users?

CHAPTER 2. LITERATURE REVIEW

2.1 Autism Spectrum Disorder

Autism has been categorized as a neuro-developmental state that is correlated with deficiencies in communication (verbal and non-verbal) and repetitious behaviors (American Psychiatric Association [APA], 2013).

ASD was initially mentioned by psychiatrist Kanner (1943) while examining a group of children in which he, later on, described them as been preoccupied with things more than people. He also suggested that resistance towards change was part of their behavior. Kanner adopted the “Autistic," word which stems from the Latin word "Autismus" meaning autos or self that was previously introduced by Bleuler a Swiss psychiatric in 1910. Kanner (1943), in his study, reported that these kids tend to require to be left alone with no interest to interact with others. He further mentioned they tend to have little to no intention to communicate spontaneously with the outside world. One year later Hans Asperger (1944) another psychiatric stated that he has been witnessing similar behaviors as Kanner had stated before in a group of children that he was working with, the symptoms that he pointed to was later known as Asperger's Syndrome (AS).

Autistic children are overall described as having varying levels of complications in motor skills, behavioral and emotional difficulties, and attention insufficiency (APA, 2013).

Because there are many various cases on the spectrum, some of the autistic persons obtain independence, and others may entail assistance and care for their whole life. One significant problem that multiple individuals with ASD encounter are lack of productive performance towards change. The tendency towards repetitive behavior leads to many difficulties when facing a change, or in other words, "transition." Whether we are talking about changes in daily activities or places or even more specifically during an activity transition is inevitable. This change should occur naturally; however, in autistic individuals, this transformation of attention might appear to be problematical.

There are various methods that scientists have proposed to simplify the transition process; predictability is a proven technique of making this happen (Flannery & Horner,1994), hardship in following the up-coming activity (Mesibov, Shea, & Schopler, 2005), or challenges when a particular model of behavior is interrupted.

Studies have designed several strategies to assist these individuals before the transitions occur, during the process of transition, and after the transitions have been completed to prepare them for the next upcoming change. The outcome of a successful transition could be as following:

- Reducing the amount of time in transition
- Enhancing appropriate response during transitions
- Promoting more independence on the individual and less dependence on the adult

Many strategies have been proposed to assist with a more productive transition. Studies have recommended both high-tech and low-tech techniques; however, both of these procedures have their unique advantages for individuals. The importance of employing these strategies is to implement a suitable platform for autistic individuals in order to build positive habits and to enhance the predictability in an adaptive framework for the individuals.

More precisely kids tend to transition harder when there is not a precise understanding of the next activity, therefore providing a clear picture of the expecting activities and plans by different methods will help make the transition more straightforward (Flannery & Horner,1994).

In this thesis, we are trying to review different proposed ideas that have been proven to simplify the transition process in individuals with ASD. I have to mention transition in this thesis was considered before and in between the activity and during an activity. These strategies might be practical for all individuals, but we are solely focusing on ASD individuals.

2.2 Early Interventions

2.2.1 Preferred to Non-preferred Activities

Individuals with ASD frequently resist any changes while occupied in a preferred activity; this even gets harder if the next expecting activity is a non-preferred one. (Fritz et al. 2004) Reviewed two individuals who were revealing challenging behaviors towards changes while engaging in a preferred activity. The data received by functional assessment recommended that resistant behaviors in autism are a way to avoid demands. Additional studies showed that destructive behaviors were maintained while involving in a continuous preferred activity. The

study concluded that shifting in a different activity itself did not turn into a problem unless a preferred activity was terminated in the process.

2.3 Timing

One way to help autistic individuals is to use visual timers so that they would have a better sense of a timeframe they require to have to accomplish an activity since time is somewhat an abstract concept.

"You have a few minutes, "Just a second," "You need to go to bed in a minute," are usually difficult to interpret and are confusing for ASD individuals. One way to make this more understandable is to visualize time information. Research on an autistic student (Dettmer, 2000) showed that visual timer could assist transitioning while shifting from computer time to the next activity several times during the day. One main issue here is that caregivers must realize that embedding the timer in the schedules should not interfere with the completion of a preferred activity.

Miltenberger (2006) mentioned that the individuals might show less resistance while shifting from an activity if we adjust the timing of a transition task to the completion of a reinforcing task. As an example, it is most likely to see better cooperation if a request takes place when the desired television show is over compared to the time that the transition request is made amid the TV program. The paper also mentions that creating a sense of completion for a specific task, especially for the preferred activities may appear to reinforce a more cooperative behavior by the individuals.

One notable transition strategy that has been widely suggested by clinical practitioners and nowadays is a widespread practice is notifying the individual in advance to an activity shift. This method has been a popular strategy in many case studies and has been mentioned to facilitate the transition process. Allowing sometime before any transition and making a clear signal before a shift in activities can benefit individual during the transition in a more cooperative way.

An example would be (Tustin, 1995) research, he used an A–B–A–B treatment (in A-B-A design the "A" phase is effecting a change to the "B" phase. The next step will be removing the change to see whether if it returns to the initial condition "A" phase), to examine the impact of the requesting methods on an autistic man allegedly with a stereotypical behavior with a relatively

mild learning disability, repetitive behavior, and stimming. The researcher performed two different methods in order to ask for a change in an ongoing task: one being an advance notice before the change, and the other was an immediate change. In the immediate shifting technique, the participant was requested to engage in the new task and was quickly presented with the new materials for the requested task. In the warning technique, he was requested to change the task, and the materials were given while the researcher left, enabling the him to transit to the new task two minutes after. The reported results showed that transitions in the immediate change happened in much lower rates, in which the participant was engaged in the transition activity within ten minutes after the request. Additionally, in the immediate change, the individual only got involved in the transition 60% of the time compared to the 90% engagement with the prior notice.

In another study (Flannery and Horner,1994) high school students showed disruptive behavior after being asked to shift to a novel or unexplained task. Functional assessment was performed to measure the variabilities in the required tasks. Resistive behavior in the unexplained variability caused unwillingness in transition and led to disruptive behaviors. In the first experiment, which had a singles participant, A–B– A–B method was included. During the (A) phase, which was defined as a baseline, resistive behaviors were reported to be enhanced when previously unexplained tasks were presented. Through (B) phase predictability was included in the schedule, so that all steps were explained individually for the next tasks and were explained in detail, including the previous familiar tasks as well. Addressing prior notice and providing detailed instructions considerably reduced the tantrum behavior. In the second study a different method was introduced: an A–B–C–B–C strategy: A was defined as a "Constant Schedule", the usual routine tasks regarding the duration and the series of tasks, this led to lower disruptive measures; B was defined as a "Random", here the scenario was to alter the duration and series of the tasks which ultimately resulted in excessively disruptive behavior; C was described as being random as well as predictable. In this scenario, both the duration and the series of activities were modified, however, a written script that explained the series of activities was given to the participant, for excessive support participant were notified with a timer in advance of the beginning of the next activity. This led to a decrease in disruptive behaviors compare to the first phase. The study concluded that a predictable environment will, in almost all cases, assure the participants, and would lead to lower rates of challenging behaviors.

2.4 Visual Schedules

One very successful intervention that is facilitating the transition, specifically in ASD individuals, is incorporating visual frameworks such as photographs, images, and drawings. Visual schedules have been proven to have a positive effect as a mean to enhance the predictability of a specific task or situation as well as positively affecting the learning process Hodgson (1995), Schopler et al. (1995), and McClannahan and Krantz (1999) have highlighted that visual planning helps ASD children in various ways. One noticeable effect of this strategy has been facilitating the transition process by presenting predictable schedules for the kids.

In a study that was conducted by MacDuff et al. (1993) employed regulated guidance in presenting photographic lists to promote ongoing task performance and improve the task-completion with four kids, aged between 9–14, that were autistic and had severe communication delays. The experimented group of children were showing disruptive behavior involving aggression, kicking, and stereotypical behaviors. The study applied several baselines in the experimental design. Dependent variables covered the percentage of time-on-assignments, including the orientation and manipulation of activities and percentage of the amount of time spent on the assignment, which showed the engagement in the activity. The experiment was created in a home setting. The supervisor provided a set of six visual tasks which was presented in a three-ring binder. The plan in this study was to see how the individuals perform in a non-verbal- guidance environment solely depending on the visual presentation of the activities. The binders were given to the participants from the behind. The supervisors then shadowed the procedure, and after a few minutes, they started to slowly leave the room in order to see the reactions of the participants. All through the experiment, there was no verbal guidance or any other non-verbal prompts. The students were then monitored to see if they could follow the tasks independently. According to the reported results, the tasks and the ordered schedules were positively increased for all the three students also the use of manual prompt decreased for all of them towards the sixth task. The visual tasks were altered so that the students were not just following their usual consistent tasks by habit.

This research indicated that the visual prompts could positively increase task-following in students, and positively displaying the ability to follow the transition process independently. However, children showed a lengthier response in the transition between the activities compare to the time that the supervisors were present.

In a slightly similar study conducted by Bryan and Gast (2000) step by step visual schedules guidance was presented to a group of children aged between 7-8 years old, which was conducted in a classroom setting. All the participants had significant cognitive impairments and were all autistic. This study was differentiated by the latter in presenting drawings to the participants instead of photographic schedules. The A-B-A-B method was applied, and an activity booklet was delivered to the participants (four kids) in the B phase and taken away from them in the next A phase. Similarly, both task following and schedule following were increased for all the participants, and the independence of the supervisor was notably reported. However, in MacDuff et al. (1993) study more problematic behaviors during the transition between the activities were reported.

Dettmer et al. (2000) tested the effect of visual planning to measure the time spent in between the activities during the transition phase. The study was conducted on two autistic children aged seven and five years old who were reportedly displayed problematic behaviors during the transition between the activities. The A-B-A-B design that was incorporated in this study involved physical prompt in addition to the direct supervision. The participants were provided one-minute alert before making a transition to the upcoming activity. If the transition did not happen the verbal cues would continue up to ten minutes at one-minute interval alerts.

In the next phase (B), there were two different complementary visual prompts. One visual schedule was attached to the car's dashboard in a string form that contained the sequence of the following tasks and another identical book that was presented to the kid before getting to the car. The tasks were analyzed before going to the car in the visual book. To indicate the completion B-finished was announced. Both with the use of visual prompts and verbal prompts the average transition timing in between the tasks were lowered from 6 minutes to 1.8 and 1.6 minutes in both phases. The physical prompt usage was lowered to zero in the second phase. For the second child, the same kind of drawing was used. The tasks were reviewed by the supervisor verbally prior to the initiation of the activity. In this scenario, index cards were used, which had step by step visual instructions. Each time one task was completed, the child would drop the card into a B-finished box.

The free times in between the activities the child was asked to get back to the task by the time the color-coded timer reached the red color. The results were reported that the latency in transitions was lowered to under one minute from over two minutes. The child was also

cooperating and vocalizing during the tasks and asked to reintroduce the activity during the second phase.

Dooley et al. (2001) also explained the effect of image boards based on the Picture Exchange Communication System (PECS). They employed Functional assessment to measure a three-year-old autistic child with stereotypical behavior (Kicking, stimming, hitting) that were reported to be initiated prior to the beginning of the next transition. The child was also showing resistive behavior when there was a change in routine tasks. The PECS design treatment consisted of a board schedule and with visual designs. The children were presented by drawings of the expected activities on the board which would be wiped away after the introduction of the task and then they would see a matching picture on another side waiting to be accomplished. After the completion of the activity, they were asked to drop the image into a box, and as a treat, an edible was handed to them. Quickly after the consumption, they would go back to the next activity. The study reported that 50% of the disruptive behaviors were reduced and the transition between the activities was increased upon the verbal description and visual cues. The study showed that after three days of this schedule using, the transition problems dropped to zero. Also, the edible reinforcements were stopped and did not affect the transitions. Parents reported that tantrum behaviors had lowered significantly by using the same methods in the home setting, which included both the routines and the changes in daily activities.

Mechling and Savidge (2010) opened a new discussion for visual design boards: the digital presentation of the images or as they referred to "Personal Digital Assistant (PDA). The digital assistant had several visual promptings (images, image and auditory, video). They incorporated this to measure the effectiveness of the device in both transitions in between the activities and in the ongoing activity in three autistic middle school students. The founding's show that students accomplished more tasks with the PDA, but the transition between the activities was extremely significant compared to the non-tech visual cues. However, students were reported to accomplish more transitions between the activities when using the PDA.

Whether it is safe to generalize this finding for all autistic children, there should be more studies and research conducted, but the use of digital devices opens many doors towards opportunities for autistic kids to act more independently while transitioning in between activities and in the same ongoing activity. Other researchers such as Banda and Grimmett (2008), Lequia et al. (2012) and Koyama and Wang (2011) have found positive results in the incorporation of

the digital technologies to further assist the autistic individuals in reducing tantrum behaviors and resistance towards changes. However, it is essential to note that the severity of autism and age could play an essential role in the effectiveness of this method.

2.5 Priming Strategies

Studies have investigated the effect of priming in autistic individuals. Priming is explaining a future task before the actual occurrence. It could be appearing in the same setting as the actual activity or a different setting. Sevin et al. (2001) practiced this method to help an adult who had a hard time going through different levels of a hygiene task. She would get confused in the whole procedure and could not accomplish the whole task. She reportedly needed a verbal assistant to accomplish each step. In order to clarify the activity for her an analyzed step by step task were prepared and presented to her to accomplish the morning hygiene routine. This priming had three stages, including reading from the list, verbal explanation, and practicing the steps through the hygiene activity. She was also allowed to have the list with her while the activity was taking place.

In order to measure the effectiveness of the task, multiple baselines were incorporated to see which steps of the task is accomplished without the help of the caregiver. The result was very outstanding, and she was able to perform the steps thoroughly first without any prompts from the caregiver and then by not taking the list with her while performing the hygiene task. Schreibman et al. (2000) reviewed the outcomes of priming in ASD children showing problematic behaviors to teach them new skills. They managed to build a video from the child's perspective to explain the whole procedure, resulted in a significant difference. It positively affected the performance of changes in routines and task completion.

The study included three children who showed extreme resistive behaviors during a particular targeted transition state. Towards helping the situation, three different videos were intervened. The children were asked to see the video immediately prior to the activity. Upon watching the video, they were rewarded with a reinforcement. The first child's video intervention consisted of breaking the steps of different tasks before getting to the car. The second child who showed disruptive behaviors while going to the mall was presented with a video that showed a different entry and different stores in the mall before getting to his favorite store in the mall. The third child showed tantrum behaviors while going to Target. The video showed different departments in the store

before getting to the toy section. Several baseline evaluations assessed the design. The technique demonstrated positive changes and extreme reduction in tantrum behaviors in two of the children, and for the third child, the video had to be played a couple more time in order to help him in the transition process. But in all cases, the outcome was positive, which was reported to be maintained in a follow-up.This study is noteworthy since the child was presented with a natural, personalized, relevant situation which increased the predictability and provided an essential help for a more cooperative transition.

Zanolli et al. (1996) suggested that priming should take place before the actual task. Priming should explain the up-coming situation and should not consist of high demands. Potential reinforcements should be included in the priming sessions.

2.6 Modeling

Modeling is usually used in instructional strategies which have been practiced as a theme in order to practice a set of skills for autistic individuals and persons with developmental disabilities.

Stahmer (1995) practiced modeling along with positive reinforcement for an autistic kid who showed stereotypical behavior while playing with his favorite toys. Variations of modeling are used to teach different aspects of behaviors to persons with developmental disabilities such as social and language skills. The application of modeling is widely reported to deal with tantrum behaviors in multiple procedures. By enhancing abilities, limited characteristics and persevative behvaiors are usually positively affected. Modeling strategies assists transitions which have been examined by scholars and may serve hopeful outcomes for future studies.

Taber-Doughtry et al. (2013) studied the effectiveness of video models to teach new skills and tasks. They incorporated a multiple-baseline which was conducted on four adults with mild intellectual disability. The videos were conducted by graduate students to show novel tasks which were broken into several steps. The results demonstrated an increase in the transition durations and successful performance of the tasks.

Buggey (2005) emphasizes on the self- monitoring video application in order to teach novel skills to autistic persons. In this method, the individual is recorded over and over again till the expected response is captured. The individual is assisted in imitating the expected behavior in which he would, later on, use as a targeted form of behavior for himself. This method might

come to be troublesome, especially if the individual is having a hard time to role play or imitate others. Buggy (2005) displayed a desired form of behavior to students who were showing problematic attitude towards a specific situation in a video recorded of themselves. All the participants which included ASD children aged between 5-11 were studied in a set of several baselines. The insistence on the sameness was targeted in the videos. This included preservations in conversations, tasks, and obsessions with a specific TV show, which resulted in aggressive behaviors towards transitioning and new activities or any changes in the routine in general. The utilization of these videos in which the kids observed themselves handling unknown situations, showing no tantrum behaviors decreased the disruptive behavior to 90%. Another benefit of this method was to teach students novel communication skills and language skills.

Cihak (2011) conducted an interesting study on four autistic kids aged between 11 and 13, which had deficits in adaptiveness in transitioning in between school tasks. He wanted to make a comparison between a self-monitoring video and non-tech image usage. All of the children were reported to show disruptive behaviors and some non-cooperative tendency in transitioning phases. They presented the children with two different designs, the first version was to show five different images of themselves accomplishing a task, and in the self-monitoring video version, they were presented with five different videos which showed the targeted tasks were accomplished. The results indicated that all students were benefitted from both designs; however, two of them did better after the video presentation, one performed more efficiently after the image presentation, and one did similar during both designs.

CHAPTER 3. METHODOLOGY

3.1 Individual case studies

After reviewing the literature in chapter two, I planned on analyzing and utilizing these practical interventions that lead to a better transition in a system design. The initial model will be exploring two areas;

1. Face recognition
2. Transition (in between activities and in the same activity)

For the first part, many ASD individuals are scheduled to be studied and reviewed; during these sessions, their facial expressions in different situations will be recorded and analyzed. Several data scientists and computational psychologists would provide this project with their professional insights in addition to expert designers' views, on the practicality of the performance.

I have also planned several case interviews with the caregivers and would prefer to observe the intended audience while they are occupied with their daily schedule. Considering that I am going to work with special case kids, I am anticipating the restrictions that I might face during the planned sessions. Therefore, as a back-up plan, I intend to incorporate other sources of information into this research. Based on the papers that have been reviewed so far, I am expecting to encounter some non-cooperative individuals, as well as time and space constraints. I may also face communication barriers, and parental restraints (some parents/caregivers may not feel comfortable talking about their child).

3.1.1 Video Observations

Another productive way to further expand this study with productive data is to find relevant videos that contain detailed information about cases of autism. These videos would be reviewed over three months, which would help to collect a broader set of data. These YouTube channels have unique contents that are filled with personal experiences, live videos, kids' challenges on daily life and may include from very personal to more general information related to the kids and their families. This medium also allows me to contact the families and in some

cases, the individual itself, in order to communicate and ask questions about specific behaviors or attitudes that the individuals are pertaining.

3.2 Data Collection

The data collection will start after the interviews and the direct observation of the ASD persons, in addition to the interviews and cases of video observations. I will then start to draw a pattern of behaviors and try to incorporate my findings along with the strategies and models that I have already obtained for the second chapter.

Here I will connect the identified issues to the design's possible solutions, and after further evaluations, the final direction will be documented. I will then decide on potential directions in various brainstorming sessions, before finalizing the precise design solution for my system design. The following topics will be answered for the final design direction:

- How to avoid disruptive behaviors in transition times (both in activities and in between the activities)?
- How to encourage dedication in an ongoing activity?
- How to facilitate the stress of the changes in routine tasks?
- What kind of design could be more accessible for ASD persons?
- What age group should be considered?
- How to design an attractive system to draw targeted users?

3.3 Design Solution

After obtaining the required data from the information sources, and finalizing the brainstorming session, several design directions based on the targeted audience needs will be obtained. The ideation process is expected to fulfill the purpose of the transition process. Since the design is focused on a particular group of individuals, empathy, and a complete understanding of the best iteration will be highly considered. This goal will be obtained through so many different testing and professional consultations. The final aim is to build a high functioning system that will further help the individuals to facilitate the transition process. I am determined to work on a high-tech model which corresponds to the related needs and to provide a platform in which both kids and the caregivers would easily interact with.

In order to collect the data more efficiently, clinical advisors in an autism institution will be assisting this project. The method that I am planning to practice is to classify the info into various settings and designate the best interventions that would be a potential help to promote the transition.

3.3.1 Intervention Categorization

I will be incorporating the strategies reviewed in chapter two that are essential to my design. These strategies are as following:

- Priming strategies
- Predictability
- Modeling, Timing
- Preferred to non-preferred activities
- Visual schedules.

For the sake of the design, there will be two panels one for the targeted user (ASD persons) and one for the caregiver (adults' panel). This would enable the caregiver to have full authority over the kids' panel as well as tracking their progress accordingly. This panel should be an independent entry.

3.4 Usability Testing

After finalizing the design, testing the model would be a great opportunity to see its performance and to understand the users' direct input towards the system. The planned method is to design several interfaces and display the printed version to the participants. Direct observation and think aloud method will be applied and after the evaluation, changes will be made based on the feedback received.

The usability testing process will most likely go through several different rounds before finalizing the design. Expert insights of both designers and clinical advisors will also be employed to the model in addition to the users' direct feedback.

The testing will be performed in a specialized autism clinic and the clinical advisors will present the interfaces to the kids. The aim was to avoid any kind of change or stress of having a new face (myself) performing the testing so that the users will feel more comfortable and accept

this challenge as part of their daily routines. I will directly observe the whole process and will take corresponding notes.

Both verbal and physical cues are going to be used in usability testing. The supervisors will be shadowing the process after the first task is accomplished. They will set the interfaces for each activity and will explain the scenario with the images. The images would then be rearranged, and the kid would be asked to set the scene in the right order. In this phase, the teachers would not help the kids directly, and the kids are required to set the scene based on the previous explanations successfully. The second round of the storyboards will be handed to the children quietly and after they have perceived the story for a few minutes, the supervisor will rearrange the sequences and waits for the participant to set them in the right order.

3.5 Data Analysis

The systematic analysis of this model will be based on the information discovery in testing sessions, clinical consultations, and expert evaluation of the design. After considering all the existing factors, the finalized model will be designed.

The same process will take place for the adults' entry. By pertaining to this systematic approach, a functional design will be presented.

CHAPTER 4. DESIGN STUDY

4.1 Design Objectives

For the sake of time and existing tools for this project, I decided to narrow down the research to only exploring the transition process. Following the reviewed studies and personal research, the transition process in ASD persons became a working topic for this thesis. The tantrum behaviors that are the outcome of a transition to a non-preferred activity affects the child's learning process and brings a lot of pressure and anxiety for both parents and the ASD individuals. Caregivers struggle a lot to cope with these behaviors. However, autism involves a broad spectrum of behaviors that are all known as an autistic disorder. There are many unexpected behaviors that should be considered, the severity of the disorder, age group, family's educational background, and their social status are all affecting points that should be noticed before the actual design process. Caregivers usually complain about the changes in the routine and the child's resistance towards adjusting to this change. Some of these individuals need a direct supervisor all through the day; therefore, the level of independence in some individuals, mostly, severe cases, are very low. During the interviews, a lot of the caregivers mentioned they would like to have indirect supervision and to promote self-dependence in the child.

Based on the findings I decided to divide the app into two separate panels for this design: kids' panel and adults' panel. The kids' entry is dependent on the adults' panel and could easily be modified by the caregiver. The advantage of separate entries is that the caregiver could easily personalize the scenes based on the users' age and skills and also by inputting the kids' image, further customizes the scenarios. This resolution also promotes independence in the child. Self-monitoring method has been used by the researchers for a few years. However, although there are many proven advantages in this method, it is not always easy to make the child role play or imitate a specific act in order to show them the targeted behavior in the future. One of the main goals in this design is to make the transition as easy as possible both for the kids and the caregiver and to bring a sense of playfulness as well as presenting many illustrations that usually attract ASD persons.

4.2 Existing Products

I reviewed many existing digital and non-digital devices that had, directly and indirectly, helped the child in the transition process.

Many apps that were focused on different aspects of communication and did not mainly focus on transition as a separate feature. An essential approach that provides a useful perspective for the upcoming schedules were mostly not maintained in the apps as much as it is required for the users. The following figure presents customized apps that have displayed some aspects of transition; however, they all have their pros and cons:

Proloquo2Go

Full-featured communication solution for people who have difficulty speaking. It brings natural sounding text-to-speech voices, up-to-date symbols, automatic conjugations, vocabulary of over 7000 items, and extreme ease of use.

- Communication
- Available on iPad, iPhone
- No age restrictions
- $250

Benefits
It combines research-based vocabulary levels, (activity) templates to support motor-planning, in order to express yourself and full bilingual support, minimal customization effort, growth the communication skills, easy to work with, covers all users, from beginning to advanced and enhances motor, visual and cognitive skills.

Disadvantages
Expensive, the interface seems a little crowded for the users specially for the new users.

First Then

First-Then allows schedules to be created on the go and customized to the needs of the individual.

- Organizer
- Available on iPad, iPhone
- $9.99

Benefits
Affordable user-friendly (easy to follow) app, provides positive behavior support through the use of visual scheduling. It covers communication needs and developmental delays. Allows schedules to be created on the go and customized to the needs of the individual. Easy to follow and simple interface. Involves task analysis, social stories and choice boards.

Disadvantages
It works better on iPad, some of the users mentioned while using it on iPhone the "drag" option doesn't work well.

Stories2learn

Animated app that practice fine motor skills such as pinching, expanding, dragging and shaking motions.

- Social Skills
- Available on iPad, iPhone
- $13.99

Benefits
Affordable powerful app to promote positive social skills. It's among the top ten apps for autistism among users. Provides many social stories, as well as giving the opportunity to build the new ones. costomization in pictures being uploaded. very staraight forward interface (simple and easy to follow)

Disadvantages
The titles for the stories (the default ones) were very irrelevat and hard for the user to understand the theme of it, also the icons seemed very small.
It's not for all user groups in autism since it uses word format a long with audio and pictures.

iPrompts

Create & modifies visual schedules, countdown timer with pictures.

- Social Skills
- Behavioral Intervention
- Communication
- Functional Skills
- Available on iPad, iPhone
- $39.99

Benefits
Uploading images with image library, simple interface, customizing the schedules, colorful, picture base, visual countdown timer, presenting choice making, easy to follow for the autistic children.

Disadvantages
It might need a help of a caregiver to set the schedule in front, It doesn't break down the tasks for the kids who have difficulty completing a task.

Choiceworks Calendar

Powerful picture-based calendar that helps children learn what is happening day-to-day. Choiceworks calendar helps children organize their lives as well as understand sequence and time.

- Functional Skills
- Organizer
- Available on iPad
- $4.99

Benefits
Picture based, enables uploading image, colorful, it's very educational, cheap. It's easy to follow and provides time warnings. It enhances the organization skills and helps to improve memory by reminding the user at times.

Disadvantages
The interface is a bit crowded and seems like there should be a caregivers help is needed to organize the schedules.

Figure 1. App comparison chart

4.3 Data Analysis

I am planning to gather the data through five separate steps:

1. Interviews with the caregivers
2. Interviews with clinical advisors
3. Indirect observation of ASD kids
4. YouTube Channels
5. Direct interactions with ASD kids

There were some restrictions while collecting data from targeted users. I encountered hardship while obtaining approval for my research most of the times, and most caregivers and institutes that were working with the ASD children were not open to researchers, often to protect the child. Since I experienced the same problems in the past while working with the ASD kids, I explored other approaches to gather the essential info. Caregivers usually spend much time with ASD individuals throughout the day. They are excellent resources of specific pieces of information which provided many insights towards the design.

Also, I talked to clinical advisors who were trained for years and were expertise in dealing with ASD individuals that later on became a reliable source of data for this design. Observing the kids while they are working on their daily schedules were another useful approach to enhance the research process further. Observing the kids and learning how they deal with different aspects of their daily schedules allowed me to have a more in-depth perception of their challenges and behaviors. YouTube was another reference in the design since YouTube has become a very well-known, medium for people to talk about their experiences to the point that it is an actual job for some. Nowadays hearing the word "YouTuber" as a person's profession is prevalent. I found many channels that are uploading daily videos about their autistic child. Many of these channels have both the caregiver and the child's daily views on their videos. The problems, everyday challenges, child's reaction to different things or situation, caregiver's suggestions or explanations, and many more could be found on these videos. However, I only used YouTube to understand the main challenges and the daily routines of ASD individuals and their caregivers, to provide insights for the ideation process. My finalized design was solely based on the users' feedback, professional clinical advisors, and designers.

Several Rounds of testing were conducted after the initial design was achieved. The main goal of this design is to make the child naturally accept the transition. This should become a

lifestyle and should not be a big challenge for most parts. The features of the design are categorized into five major parts:

4.4 App Design

I intended to design an app for this intervention. An app is accessible, convenient, cheap (mostly), and a portable digital design. While reviewing the existing product, I discovered thousands of positive feedbacks on effectiveness and life-changing aspects of many apps, especially the ones that were designed for special need individuals.

4.4.1 Playfulness

Since my sample population has already been narrowed down into 3-11 years old (also for kids that are mentally at this stage), a playful characterization could be an additional motivation to interact with the app.

4.4.2 Illustration

For many years' researchers have stressed on the fact that ASD persons have their distinctive ways of perceiving the world, therefore discovering and employing these differences, is the key to a useful intervention. In chapter two, while reviewing different articles, I came across many techniques that involved pictures, videos, and illustrations that were used to help the autistic individuals. Mostly all the outcomes indicated that ASD persons responded very well to the interventions that involved pictures, images, videos, ...

4.4.3 Customization

After reviewing the positive effects of video modeling from Taber-Doughtry et al. (2013) and other scholars, considering their research on using customized videos on children, I thought about using customized videos, and images with the user being the leading figure in different scenes. The idea is to let the child compete with their image of a successful transition. The way I am planned this is to either use their actual image or animated image which would be designed through their parents.

4.4.4 Storytelling

After reviewing the collected data, I was assured that storytelling is one effective way to interact positively with the child. This helps them to predict the following unknown situation and to visualize themselves in the scenario, so that disruptive behaviors that are caused by unexpected situations will be controlled. I came across several reports about improved behaviors that were the result of satisfied predictability in chapter two.

4.4.5 Two Different Panels

Caregiver's panel and the kids' panel are two separate panels that work through one app space. There are multiple reasons behind this, parent’s authorization upon the child's performance is one prominent reason behind this design. The idea about parent’s intervention is mostly indirect and mostly as shadowing. The child needs to be tracked so that their progress rate could be followed. The caregiver should only intervene unless needed. The way I have this design planned is to have the stories explained and then have them be part of the whole scenario and examine themselves afterward.

CHAPTER 5. IMPLEMENTATION OF DATA

After the data gathering stage, the implementation of the data started. From the beginning stages of the design, I planned on consulting the design models with the clinical advisors as well as the experienced designers. Many adjustments were implied during different stages of the design based on the users need. These stages included:

1. Brainstorming the ideas

In this stage, the planned features were categorized and were implement into the design later on. The ideas were narrowed down and improved through different sessions. Eventually, the features were summarized into three main features in the kids' panel and four main features for in the caregivers' panel.

2. Hierarchical Task Analysis (HTA) Chart

This chart was designed based on ideations and visual designs. HTA (Lee & Reigeluth, 2003; Reigeluth, 1999) explains, elicits, analyzes, and signifies proficiency into a complex network that represents cognitive tasks. The HTA chart for this design involves the constructed data for the whole design, which would be a guideline for the interventions that are built in the designed levels. The corresponding ideas were also built in the chart. The adjustments were incorporated based on the users and the experts' feedback, that lead to the finalization of the design.

3. Wireframing

Wireframing was the next step to visualize the corresponding ideations. The finalized session indicated the complete design system. The conceptual structure defined the interaction mode of the system and the user configuration. The demonstrated system was designed in detail to represent all aspects of the visual design, instructed steps, and the prototyping.

4. Usability Testing

Three rounds of usability testing for each of the panels was conducted and incorporated in the design later on to assure the best performance for the final model.

5.1 Digital Device Brainstorming

Brainstorming took a few rounds based on the feedback that was collected from the expert clinical advisors and user observation and other collected data. The initiative round had two

separate directions; Recognition and transition. After more rounds of brainstorming, this was narrowed down to only exploring the transition interventions. Overall the sessions lead to three main features.

5.1.1 First Brainstorming Session

The brainstorming started by analyzing two separate features: Face recognition and transition intervention. The aim was first to recognize the child's feelings towards an upcoming transition and then make a corresponding intervention to make the child transfer easier to the next activity.

After going through more details, I found out that there would be many limitations in covering the face recognition direction. Based on the findings, more ASD kids were not prone to show their feelings in their facial expression, which would make this even harder to code. Also, there was not enough time to explore all aspects of facial expression in ASD kids, that would have been reliable enough to make proper corresponding transition interventions. To solve this, I decided to make the child express their feelings in the form of animated smiley faces.

This method has been adopted in some apps, and according to the users, it was helpful at some points when the child was cooperating. The problem I came across with this method was that the smiley faces would not correspond to the actual human expressions in real life, this would even make it harder for some individuals to interact with the system design.

Throughout the sessions that I had with the experts, they emphasized on the fact that this method might bring more difficulties for the kids unless it has done through advanced machine learnings and data scientists' coding, which I did not have any access to. So, I focused on the transition process solely.

5.1.2 Second Brainstorming Session

In this round, only the transition process was mainly focused on. I concentrated on the features that were found to be more adjusted to the needs of the intended users. The transition process was categorized into the features that were found to be valid for this process. The following features were chosen as the main parts for the system design.

- Predictability
- Time scheduling

- Video modeling
- Visual representation
- Priming
- Storytelling

In order to accomplish the best outcomes, two more features were added to the whole system design. During the consultation sessions with the clinical advisers, the importance of testing the learning session was discussed. In order to promote better experience, awards and testing features were added to the main components of the design. Also, the caregiver's panel was broken down to more detailed features. Each of the features was individually processed, and potential ideations were developed.

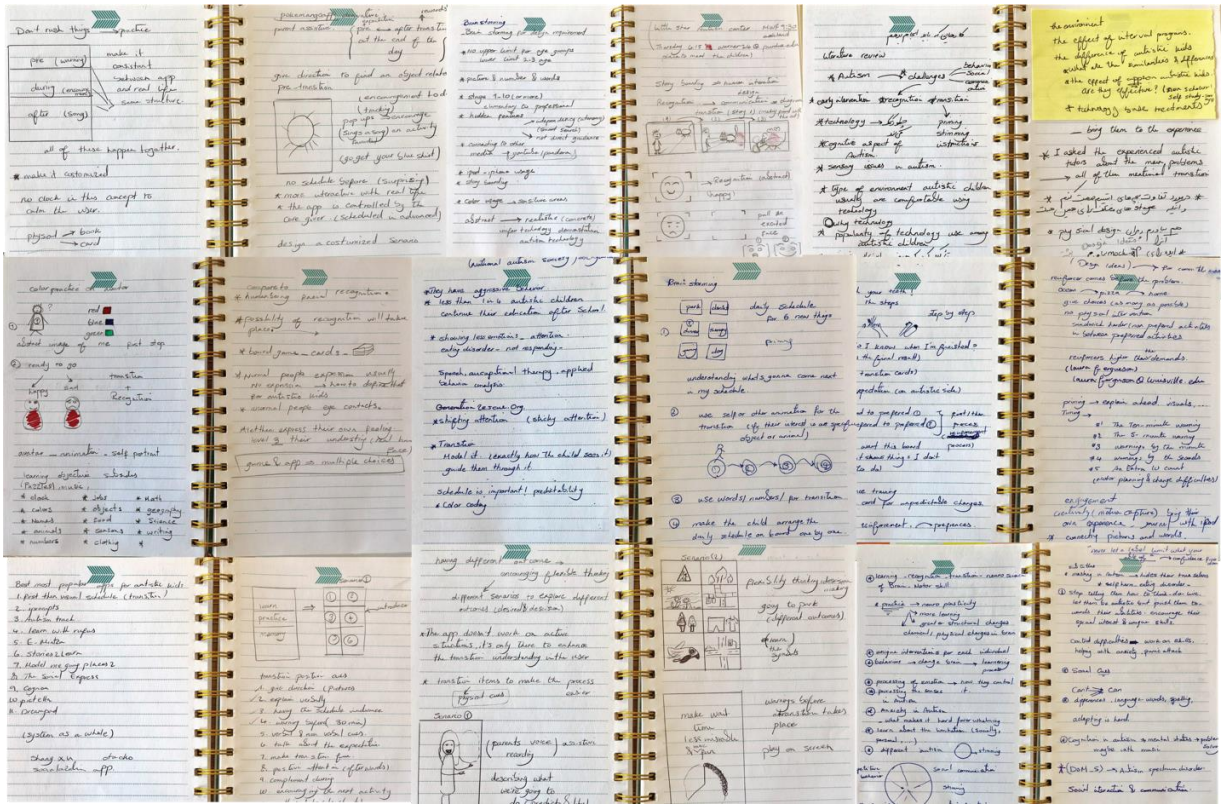

Figure 2. Early stages of brainstorming

5.1.3 Physical Design Brainstorming

I wanted to connect the digital design with a suitable physical device that would further help the individual to promote the transition process. During the brainstorming sessions, several ideations were explored.

- Pressure kits
- Smart friend
- Digital schedule boards
- Smartwatch

Figure 3. Physical design ideation

5.1.4 Finalized Design Direction

After finalizing the brainstorming sessions, I decided on two designs that were most representative of both my research process and ideations. I decided to design an app along with a smartwatch. The reason that the smartwatch was picked was that it is small, portable, easy to work with, and could come in different forms or colors to fit different tastes. The design had to be connected to the app so that the desired stories could be synced easily anytime, anywhere.

The synced images were less illustrated, only showing the actions that were required to be taken in the next activity. Other features such as next-before button, volume, and on/off buttons were part of the design.

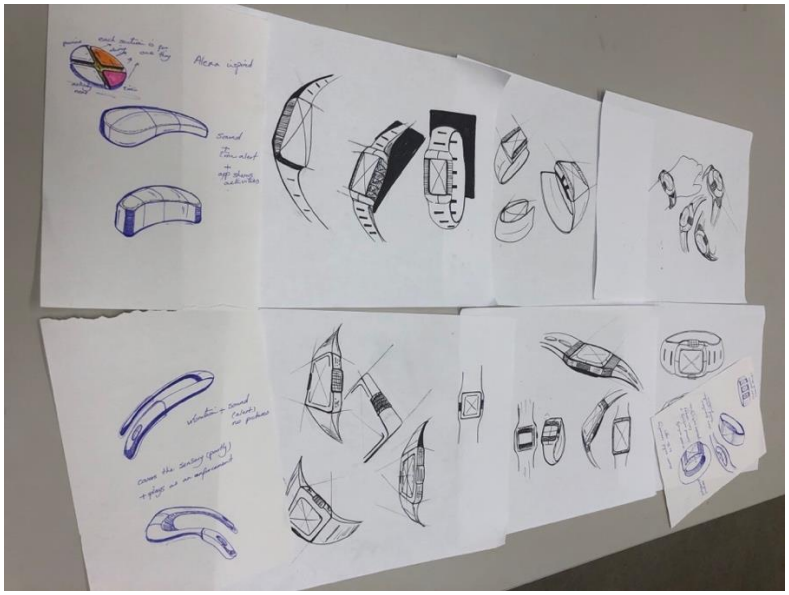

Figure 4. Iterations of smartwatch

Figure 5. Final brainstorming session

This design consists of:

1. An app
    1.1 Kids panel
    1.2 Adults Panel
2. Smartwatch

Three main features were incorporated into the main layout: Learning, Stories, and Awards panel. Storyboards will encompass the underlying intervention methods such as priming, visual timing, and predictability. These elements are visually illustrated and customized according to the child's age, cognitive abilities, and personal experiences.

5.1.4.1 Caregiver/Adult Panel

This entry is entirely different and solely built for the caregiver to authorize and track the kid's panel and also to connect with other users with similar states. Socializing and expert feedbacks were also planned to be in the finalized design for further help. Based on the brainstorming sessions, I came up with four main features that consist of the following: Home, Feed, Activities, and Profile page.

During the interviews, I came across a point that was repeatedly mentioned by the people; the lack of socialization, and updated news about new effective interventions that were valid and accessible at all times.

Adults entry enables the individuals to access the most updated autism-related news through live videos, top stories and the favorite feature (which could be categorized), socialize through the profile feature and track the progress of the kids through the activity feature. They can Also get professional advice by reading other users' problems, or they can ask the professionals their own questions.

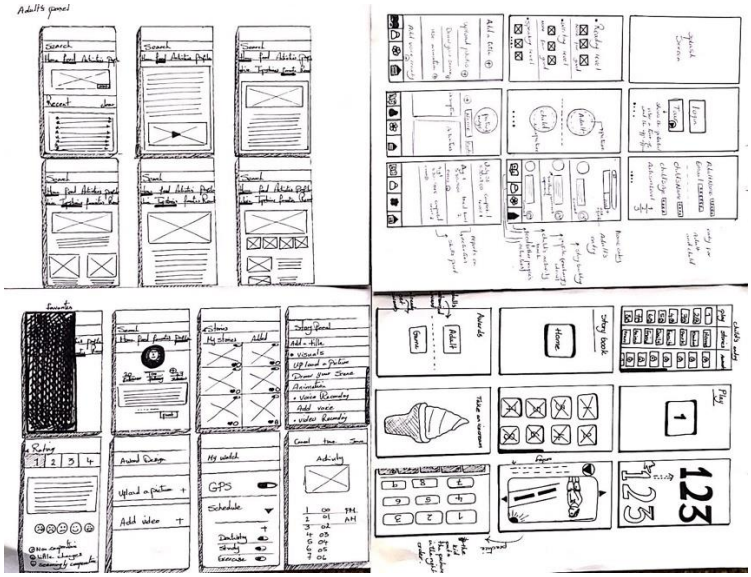

Figure 6. Iterations of the app interface, adult’s panel

5.1.4.2 Kid/targeted User Panel

The kids' panel has three main features: Learning, Stories, and Awards.
This system design was based on the needs of all autistic individuals on the spectrum. However, the considered age group is 3-11, yet other ages can still take advantage of the various features that this app presents. One of the main benefits of this design is the fact that it is entirely customizable.

Users can customize the stories, awards, and even the learning skills that they are planning to teach the kids. The kid plays the central part in each story and will, go through any planned schedule before it occurs. To ensure the kids understanding of the boards, the testing panel has been incorporated. As the child works with the storyboards and the planned lessons, he/she will gradually develop the skills to become more independent in different settings, and as a result, there would be more controlled behaviors and less disruptive actions that result from the unknown situation.

5.1.4.3 Physical Design

The physical design is a customized complementary to the digital design. It is specifically designed for autistic kids. The smartwatch can operate independently after the desired stories have been synced. It can generate time alerts as well as announcing the up-coming activity on the screen. The child can decrease, or increase the volume level, and turn the screen off in any undesired circumstances. The smartwatch comes in different colors and is made of soft rubber material for the wrist band and a hard digital screen.

5.2 Hierarchal Structure

Below is a hierarchal structure of the app design

5.2.1 Adults Panel

1. Home
    1.1 Live
        1.1.1 Top lives
        1.1.2 Saved lives
    1.2 Top Stories
    1.3 Favorites

3.5.2.2 Sync a new activity

3.5.2.2.1 Add title

3.5.2.2.2 Upload image

3.5.2.2.3 Set time alerts

3.5.2.2.4 Set time

3.6 Profile

3.6.1 Following other users

3.6.2 Followers of your own network

3.6.3 Existing stories

3.6.4 Added stories

5.2.2 Kids' Panel

1. Sign up

1.1 Tour

1.2 Sign in

1.3 Sign up

1.3.1 Adults Name

1.3.2 Email address

1.3.3 Child's name

1.3.4 Autism level

1.3.4.1 Choose level

1.4 Image upload

1.4.1 Build a child's customized animation

1.4.2 Upload your own picture

1.4.3 Upload the child's image

1.5 Child's reading level

2. Storyboards

2.1 Choose story

2.1.1 Video

2.1.2 Book

2.2 Test yourself

2.3 Color completion, the indicator of finishing levels

3. Learning panel

3.1 Choose learning option

3.1.1 Test yourself

4. Awards

4.1 Color the next cloud

4.1.1 Explore the gift

5.3 HTA Chart

After finalizing the design direction based on the brainstorming sessions, and classifying its distinct features, a correlating HTA chart was designed. This chart platforms my design directions, and it's corresponding steps. The finalized HTA chart was drowned after reviewing the essential components of the design and the problem identifications that were already covered in the brainstorming stage.

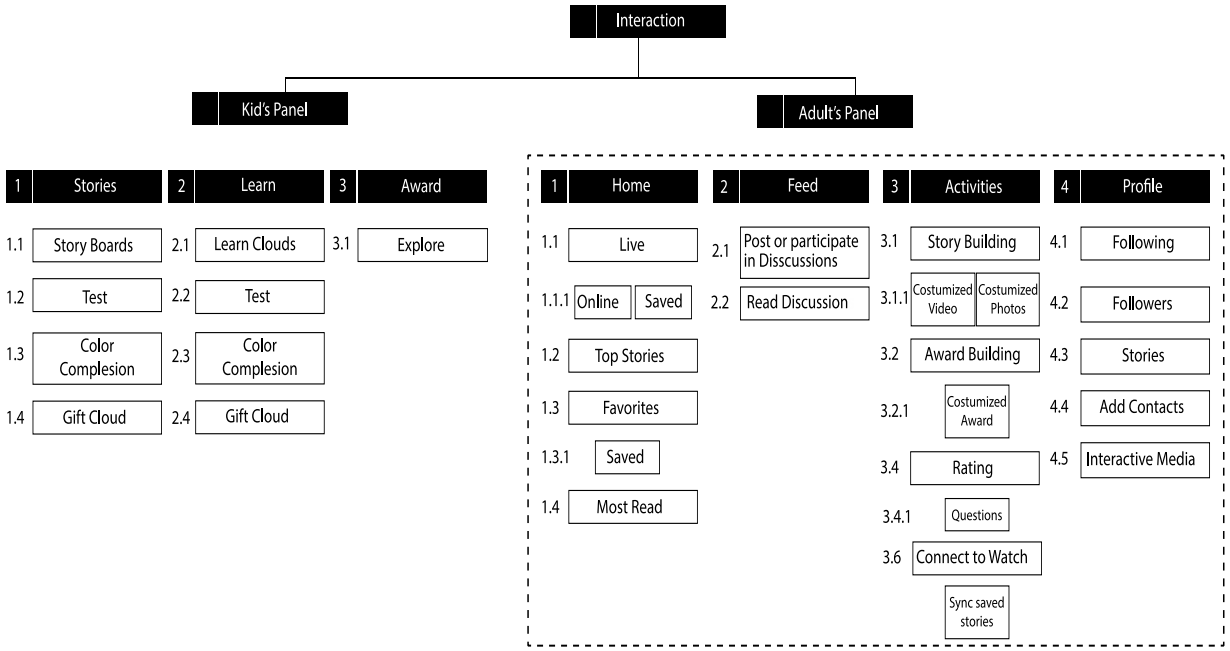

Figure 7. HTA chart, kids' and adults' panel

5.4 User Navigation

The following chart represents the user's path while in the app.

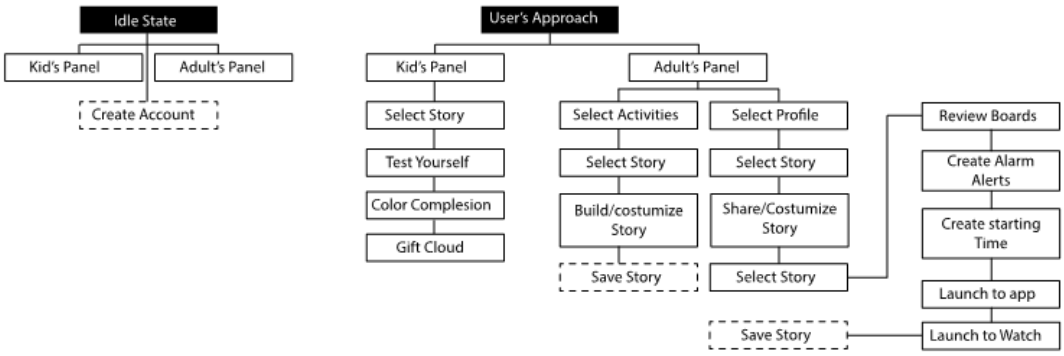

Figure 8. User navigation path

5.5 The Visual Design Steps

5.5.1 Storytelling

The initial attempt was to establish this feature as the main component of this design system. To achieve this end, three topics had to be covered.

1. What kind of a visual presentation serves the user in the best way?
2. How many storyboards are required to have the scenarios fully comprehended by the users?
3. Is it possible to incorporate written language in the design along with the visual presentations?

I decided to arrange the structure of the design based on my understanding of the users and according to the collected data and the brainstorming sessions. I began with designing mainly illustrated interfaces and incorporating fewer written parts (only for those users that had the reading abilities). At this stage, the illustrations were elementary, and storyboards were mainly 3-4 pages.

After the first round of design, I had the expert evaluation and also had clinical advisors' point of view on the design.

5.6 Usability Testing

The way the usability testing was set up was, the teacher would display a set of stories in front of the kids and would explain the sequence and the stories in each of the slides, the child

would have an active role in the slides and would look or touch the slides as long as they desire. Both physical and verbal cues are used to guide the participants throughout the process. After the sequences were explained for the kids, the storyboards were rearranged. At this point, the kids were asked to set the boards into the right order. The supervisor would be shadowing the kids at this stage and would not interact or help them. If the participant encountered much trouble arranging the sequences in the right order, the supervisor would interfere and set the first slide and again steps back so that the kid would figure the next slide. This process will continue until the kid finishes the slides. In cases of extreme confusion, the whole storyboards will be explained in detail again, and the advisor will repeat the testing.

5.6.1 Kid'sPpanel

5.6.1.1 First Round

Considering the limitations of working with the ASD kids directly (I had the clinical supervisors perform the testing while I was silently observing the children and taking notes of their action) I only worked with one institute and performed the testing there.

After the finalization of the first round of testing, in addition to professional feedback from designers and clinical advisors, the designs were adjusted respectively to be more fitting to the intended audiences. We also decided to get some feedback from the kids by displaying only two of the storyboards. Two kids, eight and none years old took part in the testing. At this stage, we only wanted to see the kids' reaction towards the printed interfaces. The plan was that if the kids did not respond well to the printed version, I would change the displaying settings.

Both kids had a basic understanding of alphabets and could read at a basic level and were considered as high functioning autistic persons. Both of the children appeared to have no problem following the sequences and the beginning pages that lead to the storyboards.

The formal usability testing was scheduled for the day after so that I could include the suggestions into the design before we have the kids tested.

5.6.1.1.2 Outcomes of the First Round of Design

Several changes were inserted within the design based on the feedback I received from mainly the users, clinical advisors, and the expert consultations:

- There should be less written words and more illustrations.

- The visual elements should be more consistent and further customized
- The storyboards should differ for different users (younger and less functional kids needed fewer storyboards, compare to more functional children).
- The visual timer presentation should be part of the illustrations
- The overall visuals had to be more precise and reflect a specific theme (such as nature, specific characters, etc.)
- More colors should be incorporated
- The storyboards should be in more details
- The storyboards should be printed in larger sizes for more natural interaction

Based on the feedback I received, I made many changes to the design. I decided to make nature as the central theme of the design and create more storyboards, making the child the theme of the scenes. I also removed the words for most parts and enhanced the visual presentation so that images play the most parts. I then scheduled another round of usability testing to review the results with the kids again.

Here are the interfaces that was prepared for the first round of usability testing for the kids panel:

Figure 9. Initial kids' panel design, storyboarding

The following interfaces include the path in the learning panel, which is an independent panel:

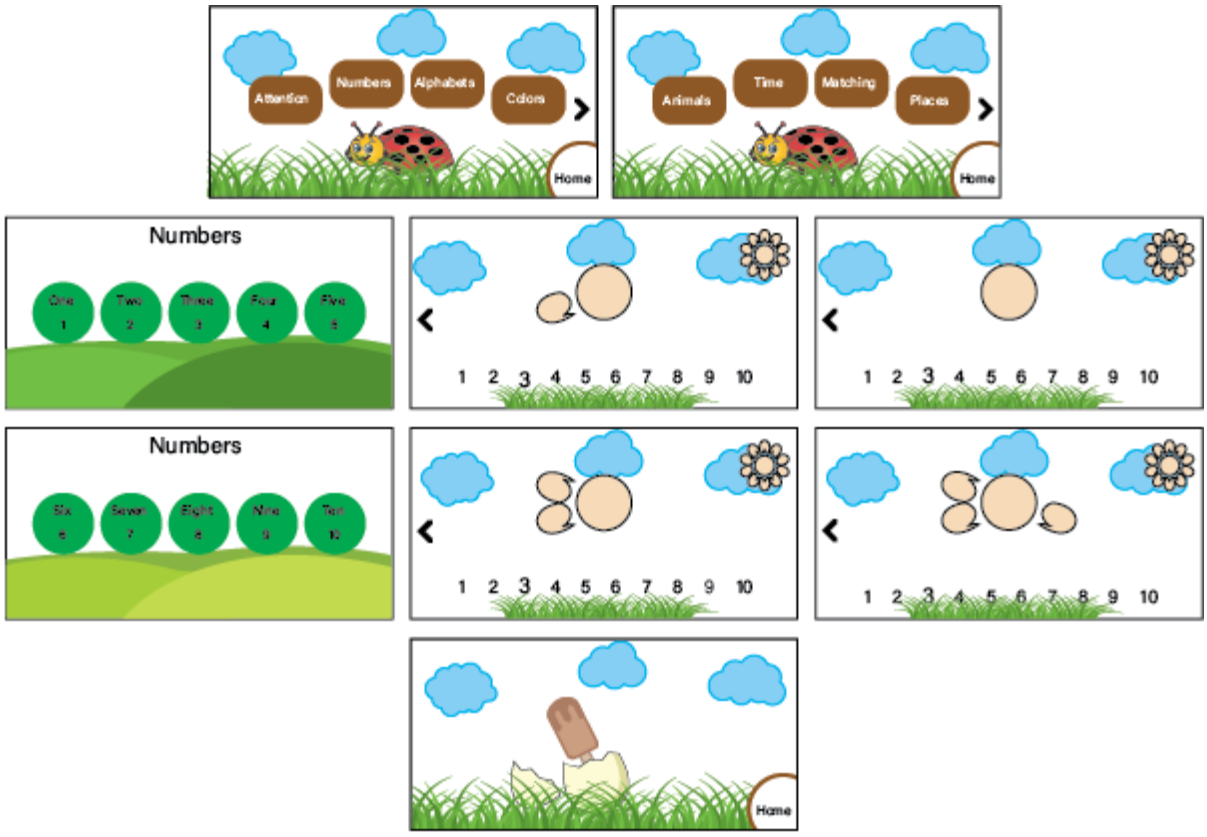

Figure 10. Initial kids' panel design, Learning feature

5.6.1.2 The Second Round of Usability Testing

In the second round, both physical and verbal cues were applied again. Four participants aged 4-8 took part in the study. By the time the teacher was done explaining the sequence, the child was given a few minutes to interact with the slides. At this point, the teacher would rearrange the slides and would ask the child to set the slides in the corresponding order. The child was expected to accomplish this stage without the help of the supervisor.

Three out of four children managed to set the three slide storyboards in the correct order. The teacher would interfere at this point and would explain the sequences again. The child managed to set the slides into the right order after the second explanation.

The second storyboard was consisting of 4 slides. The procedure was the same, and the teacher would ask the kids to arrange the slides into the right order. At this point, two of the

children got the slides right at the first time, and the remaining two needed further explanations to set the sequences in the right order.

The same method was done for 5 and six slide storyboards. According to the results, the children had an easier time understanding the sequences if the storyboards were visually explained in more details. For example, one of the children who had a slightly more difficult time arranging the storyboards in the right order in the four slides successfully finished a different six slide storyboard, which was visualized in a more detailed setting.

5.6.1.2.2 Outcomes of the Second Usability Testing

- More detailed storyboards
- The visual timer modifications
- Preferred to non-preferred activities
- Award setting modification

After testing the interfaces, I added the feedbacks within the current design. One of the keynotes that were discovered during the usability session was that younger kids (7 years or younger) responded better to fewer slides. The same problem was not seen in the older group of children.

The visual timer seemed a bit distracting at some points for two participants. So that part was modified so this would not be the main targeted attention for some.

After the usability testing was over the clinical advisors made some productive points about the arrangement of preferred to non-preferred activities. The way I resolved this issue was to modify the storyboards in a way that a preferred activity occurred following a non-preferred one so that the child would look up to the completion of the task. I also added a reward panel right after the completion of every task.

The below interfaces determine the revised path of all three learning, storyboards, and awards features. I have redesigned most of the interfaces since I wanted the users to have a consistent path as well as their choice of animal character to go through the various paths. Depending on what kind of an animated animal they choose, the selected animation would be the main character for storyboards along with an animation of the kids her/himself. I have also removed the words in all most all the interfaces. However, that part is left for the user to decide to work with (they will have the image base, and words and image base options, in this particular

path I used the image path for the users). Below is the improved interface of the entry part of the design:

Figure 11. Revised entry stages, kids' panel

The following interfaces determine the award panel. After having accomplished several steps, the user is rewarded with a customized gift. The caregiver is in charge of choosing, and making the awards, depending on the users need.

Figure 12. Reward feature, kids' panel

Below are some added features that show the completion. As mentioned in chapter two, indicating a finishing point for the ASD children will determine that they have accomplished the task and no more action is required. They sometimes tend to have a harder time realizing an ending point for a task they are involved in. Every time they accomplish a task, they will color one part of their selected animated animal. After they finish all of the animal parts, they will go to the cloud

interface and white-color the next cloud in line. This process continues until they reach the gift cloud.

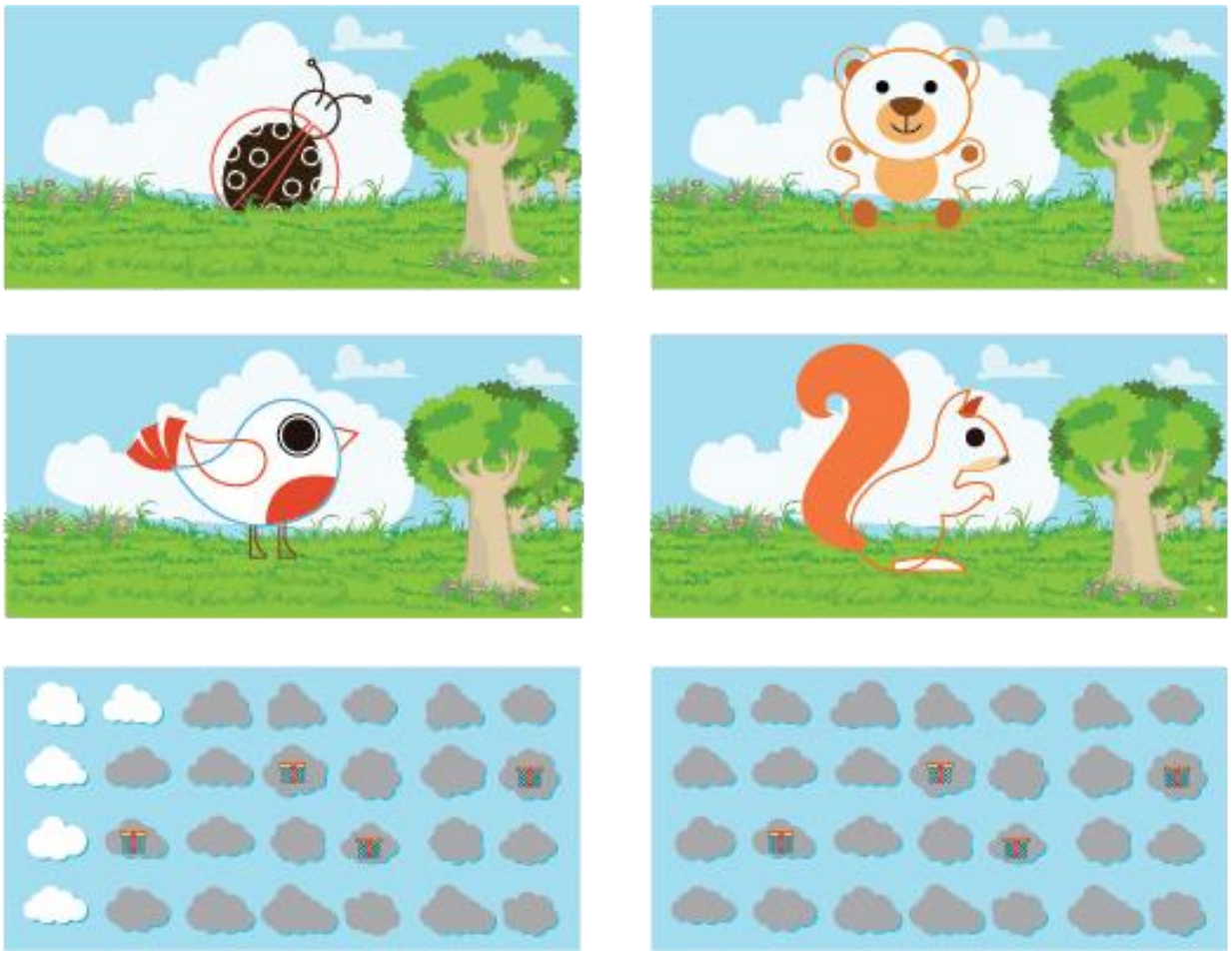

Figure 13. Completion mode in kids' panel

The following interfaces are the most significant part of the design, which is the storyboarding. After the usability testing was conducted, I realize seven years old and younger ASD individuals need fewer interfaces since it is hard for them to follow the sequences for four slide storyboards and more this way they would follow the whole scenario easier. However, the stories are customized by the caregiver, and there are a few already existing scenarios that the adults can take advantage of. The adult will use the same sequences to make newer scenarios. The stories can get more elaborated as the user gets more familiar with the whole procedure.

Below are three storyboards that have the main character (the adult designs through the library panel in the app). This young boy is accomplishing different stages of an identified task. I choose the preferred to non-preferred activity method. In this method, the child would be delivered

with a preferred activity (swimming, eating a sandwich, or playing in the garden) before or after the main task. In some cases that the child is exceptionally resistive towards any non-preferred activity, they will be given a slightly preferred activity in prior, and after they have accomplished the task, they would be rewarded with another preferred activity.

During the interviews that I had with caregivers, they pointed to another interesting fact. They mentioned that sometimes or a lot of the times the child will resist leaving a preferred activity. They have been reported to show tantrum behaviors after they were asked to give up the task and move on to the next one. One example is when the child is occupied with video games. They tend to spend much time on similar activities.

My approach towards this problem was to prepare a smaller preferred activity with a time alert. The user is expected to finish playing with the tablet after a targeted time; at this time, the app will show an alert. These alerts can be more than just one final alert. They could set ten minutes prior alert, five minutes alert, two and one minutes alerts before the final one. These all depend on the child's attitude towards the change, and the caregivers can easily customize this part. When encountering resistive cases, we can add an extra preferred activity after a preferred activity. In the below scenario, the child was given a ten-minute time to play with his favorite car. The second preferred activity should involve a short time to make the child ready to move on to the non-preferred activity.

The same scenario was designed for studying time. The child was resistive towards studying, so a swimming activity was prepared with an already selected time and time alerts. Since the child was resisting to give up swimming, a fun sandwich (or any other food) was designed to encourage them to leave the pool. In the end, they will change and start the studying sessions.

In the dentist scenario, the same procedure was shown. The user goes through all the steps before the actual event and will be rewarded with customized presents before the dental appointment, after or both before and after the appointment.

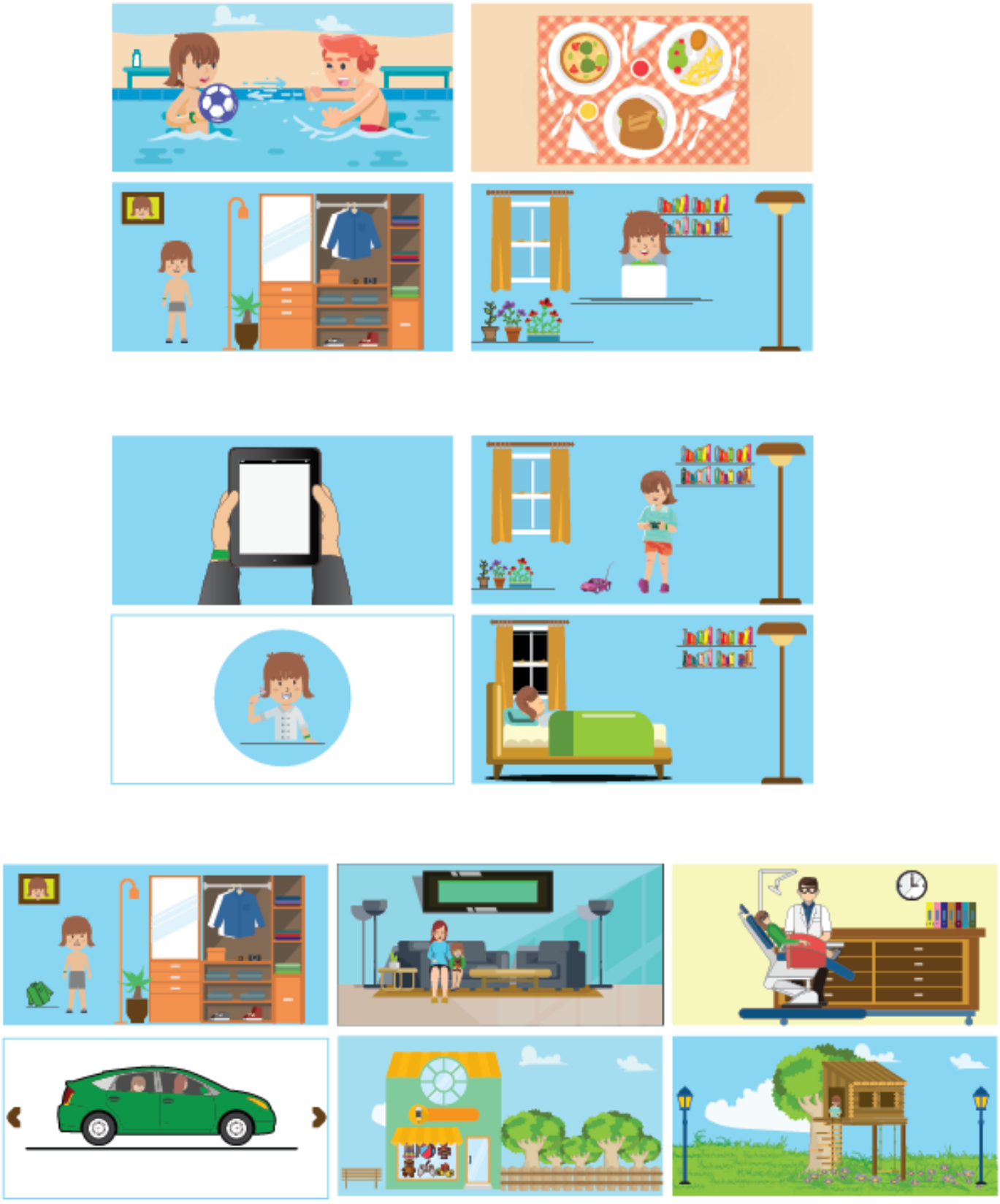

Figure 14. Storyboards for different scenarios

One way to make sure that the child had understood the whole scenario is to test them after they have been reviewed.

In the second round of usability testing, the testing part was designed based on the selected animated theme. The child should arrange the storyboards that they have already reviewed in the right order. However, the animal-shaped storyboards were changed afterward to simple rectangles so that it won't be distracting to the user.

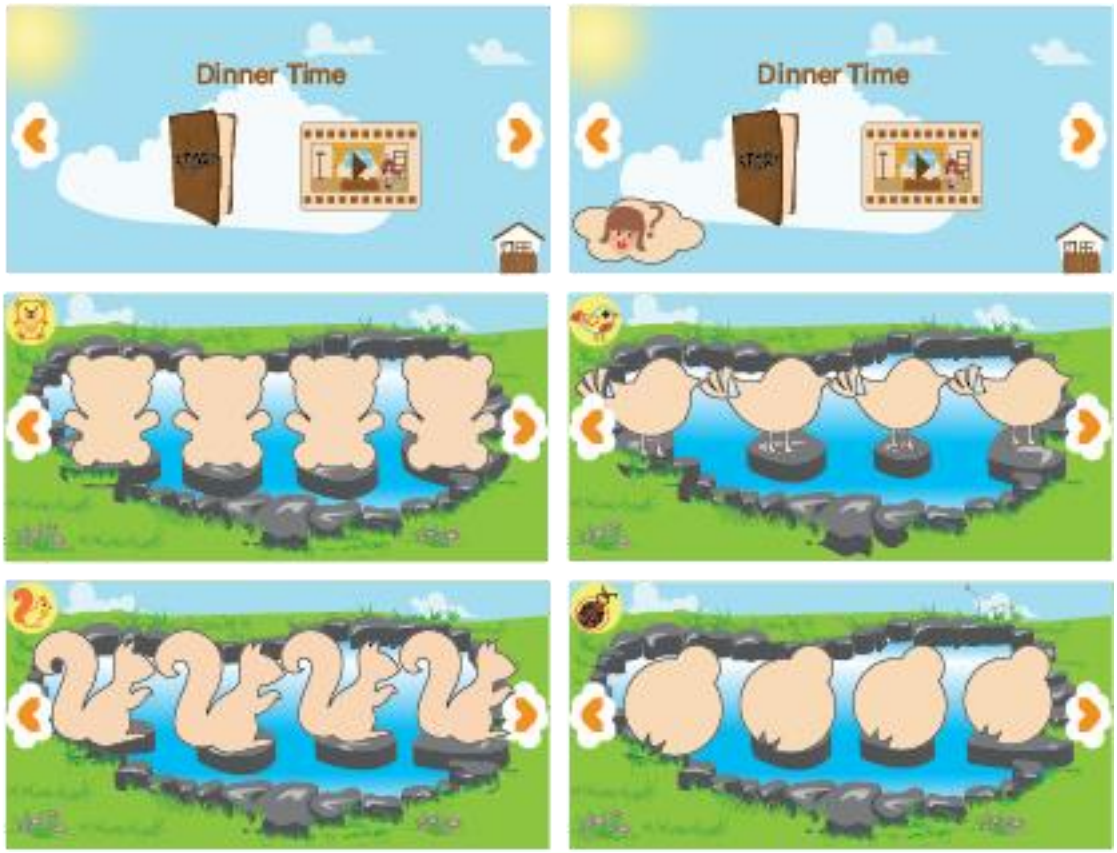

Figure 15. Testing feature for the kids' panel

The learning panel was designed to enhance the child's cognitive and logical intuition. They are customized according to the child's age and involve several different activities. The child will click on one of the clouds and a learning lesson will appear.

The following interfaces show the number learning activity. The child will first learn the numbers through the ladybirds, and later on, will be tested to see how well they have learned the lesson.

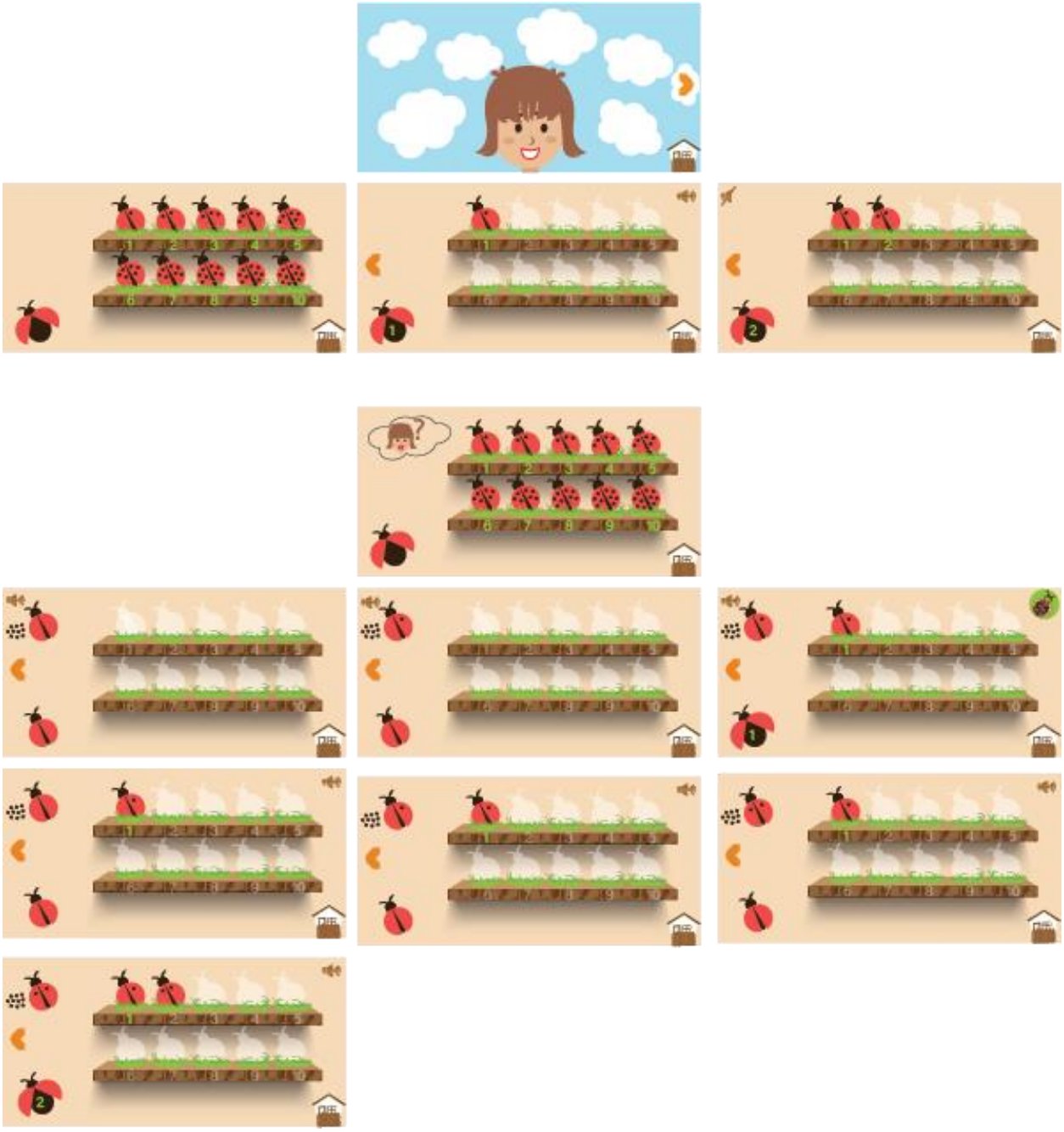

Figure 16. Number learning in learn panel

5.6.1.3 The Third Round of Usability Testing

Three different kids aged 6-10 were asked to participate in this final round of usability testing. The procedure was the same as the second round, however, to make sure that this design was practical for most ASD kids we decided on working with a different group of children that had no idea about the slides and the procedure. Both physical and verbal cues were used, and the

teacher would interfere in case the child did not respond well. All three successfully comprehended the sequences in the three slides and four slide stories. However, one needed some assistance while they were working with the six slide storyboards.

The only changes that were incorporated into the design after this round was to modify the testing boards to make it even easier for the children to understand.

Figure 17. Usability testing printed interfaces

5.6.2 Adults' Panel

Adults panel was designed to have the caregiver authorize and track the child's progress. This panel is entirely different in both settings and designs from the kid's panel. I had fewer restrictions on testing my models for this panel since regular adults could take part in the testing. This panel also went through various stages of usability testing and was modified accordingly.

5.6.2.1 The First Round of Usability Testing

The usability testing was performed on two designers, and the interfaces were printed and displayed in front of them. The participants were asked to use the think-aloud method and to go

through the different pages without any help, entirely independently. They would talk about whatever they felt was right, wrong, confusing, redundant, or useful. In case they needed assistance with a particular slide and could not figure out the functionality of the same slide, I would give them a slight hint.

5.6.2.1.2 Outcomes of the First Usability Testing

- The entry panel for the kid and the adult should be more descriptive
- The live feature in the home panel should have the save option
- The add option should exist for other live podcasts
- In the top stories feature in the home button, highlight the successful cases
- Favorites should be categorized according to the topics
- Background color
- The correlation between the child's progress and the rating should be more representative

I incorporated the feedback into the design and changed the design accordingly.

Below are the interfaces for the first round of design, which involves all the main features. In the profile menu is an option to share stories from the users and their followers. In this case, the user either needs to customize some parts of the storyboards or use them as they are. This feature enables the users to get ideas from others as well as having a broader library that they can enrich with their stories.

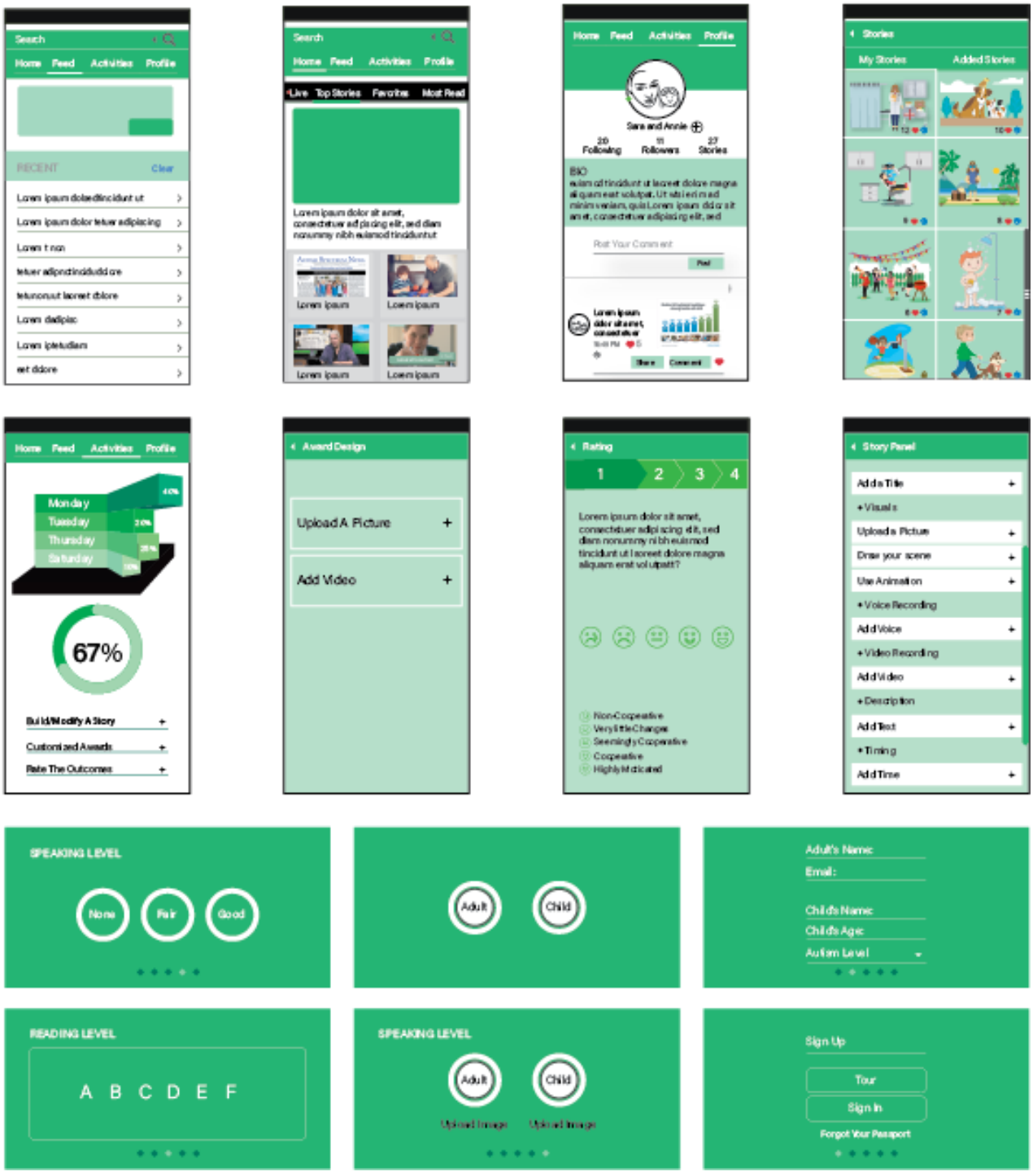

Figure 18. The initial design for the adult's panel

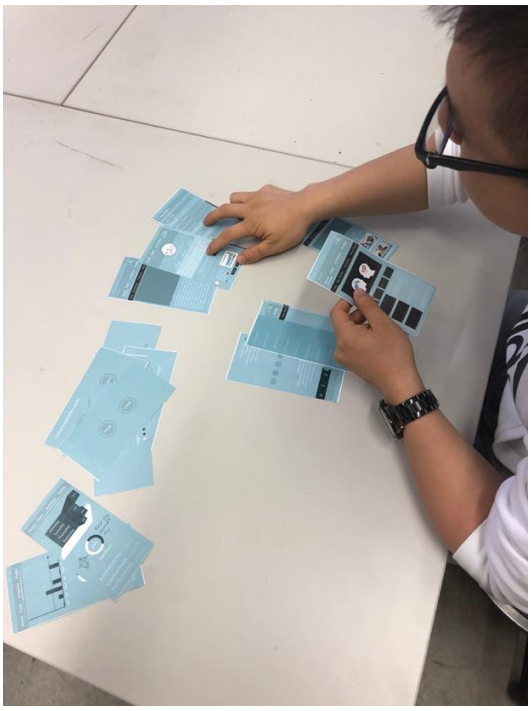

Figure 19. Usability testing for the first round of design

5.6.2.2 The second round of usability testing

In this round, I asked both the clinical advisors and designers to work with the design and used the same method in the first round.

5.6.2.2.2 Outcomes of the Second Usability Testing

Two main points were highlighted in the usability session.

- Feed section (user’s questions) should involve a professional clinical advisor to make sure the solutions were practical and accurate
- In the activity section, the caregiver should have the ability to compare the kid's progress during the past few weeks.

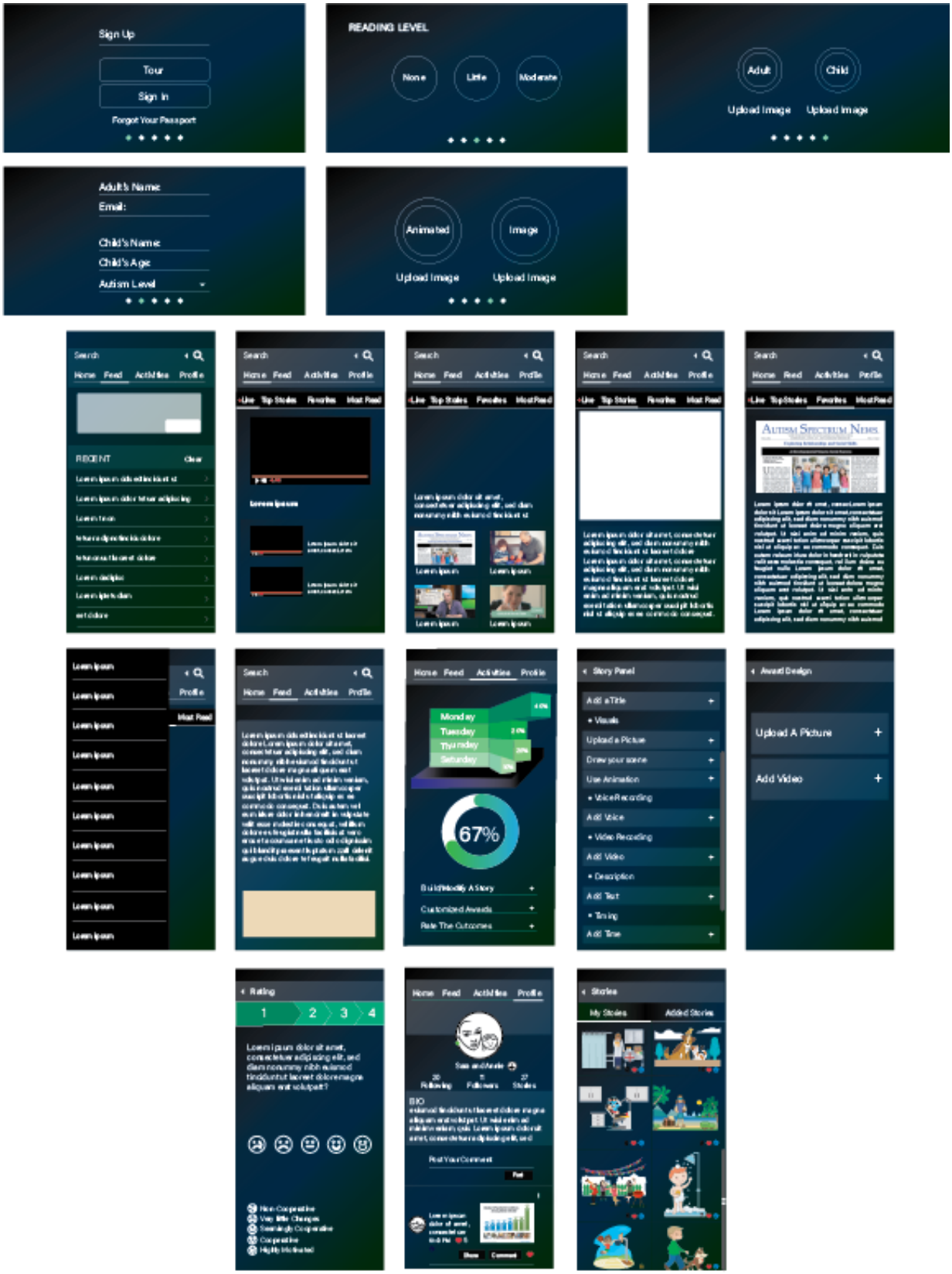

Figure 20. Revised interfaces for adult's panel

Figure 21. Usability testing for the second design

5.6.2.3 The Third Round of Usability Testing

In the final round of usability testing, I asked both the clinical advisors and the designers to work with the printed interfaces in the same manner.

The overall interaction with the app was much more satisfying, but a few points came to notice.

5.6.2.3.2 Outcomes of the Third Usability Testing

- The background colors
- Showing the library for the storyboards
- Minor changes in the app and the watch's syncing process

The final design involves many changes that were collected from the user’s feedback and further studies. The following interfaces are the different stages that the user goes through in the app, from the sign up interfaces to all the other features.

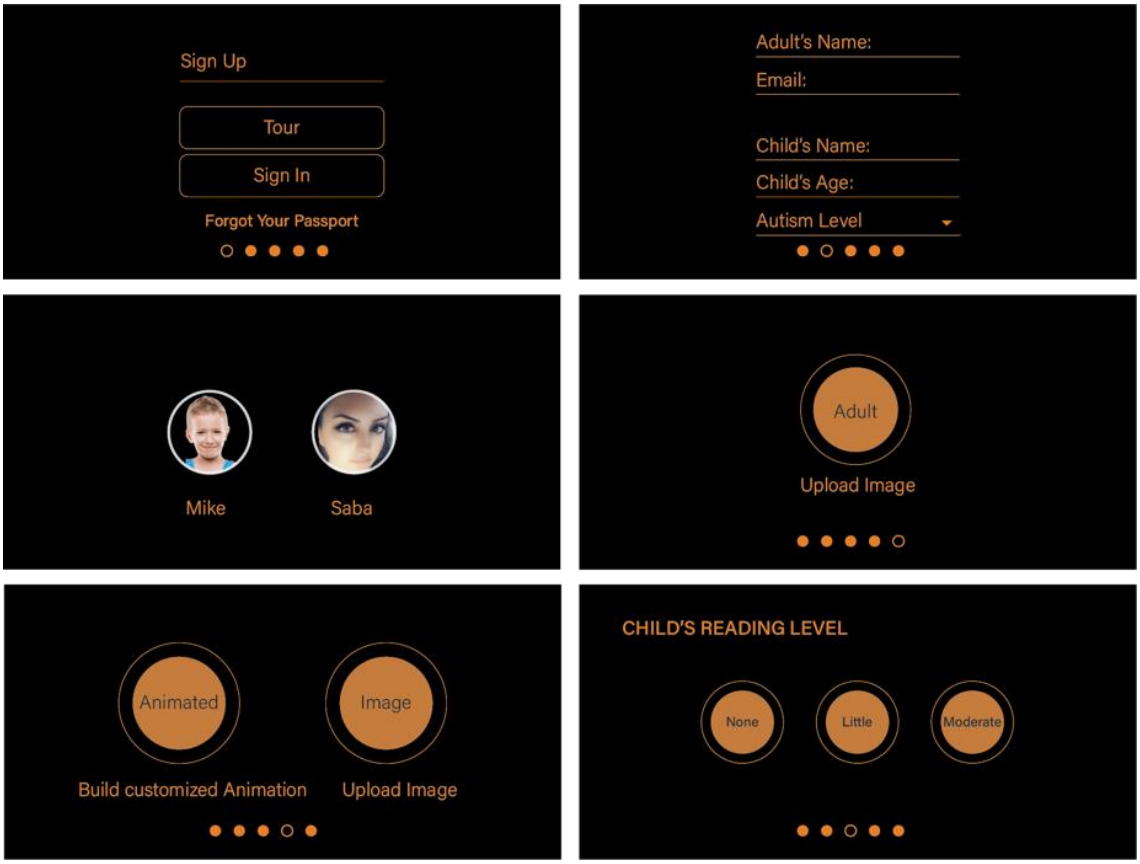

Figure 22. Entry interfaces for finalized design

The following interfaces are the finalized design of the caregiver's app.

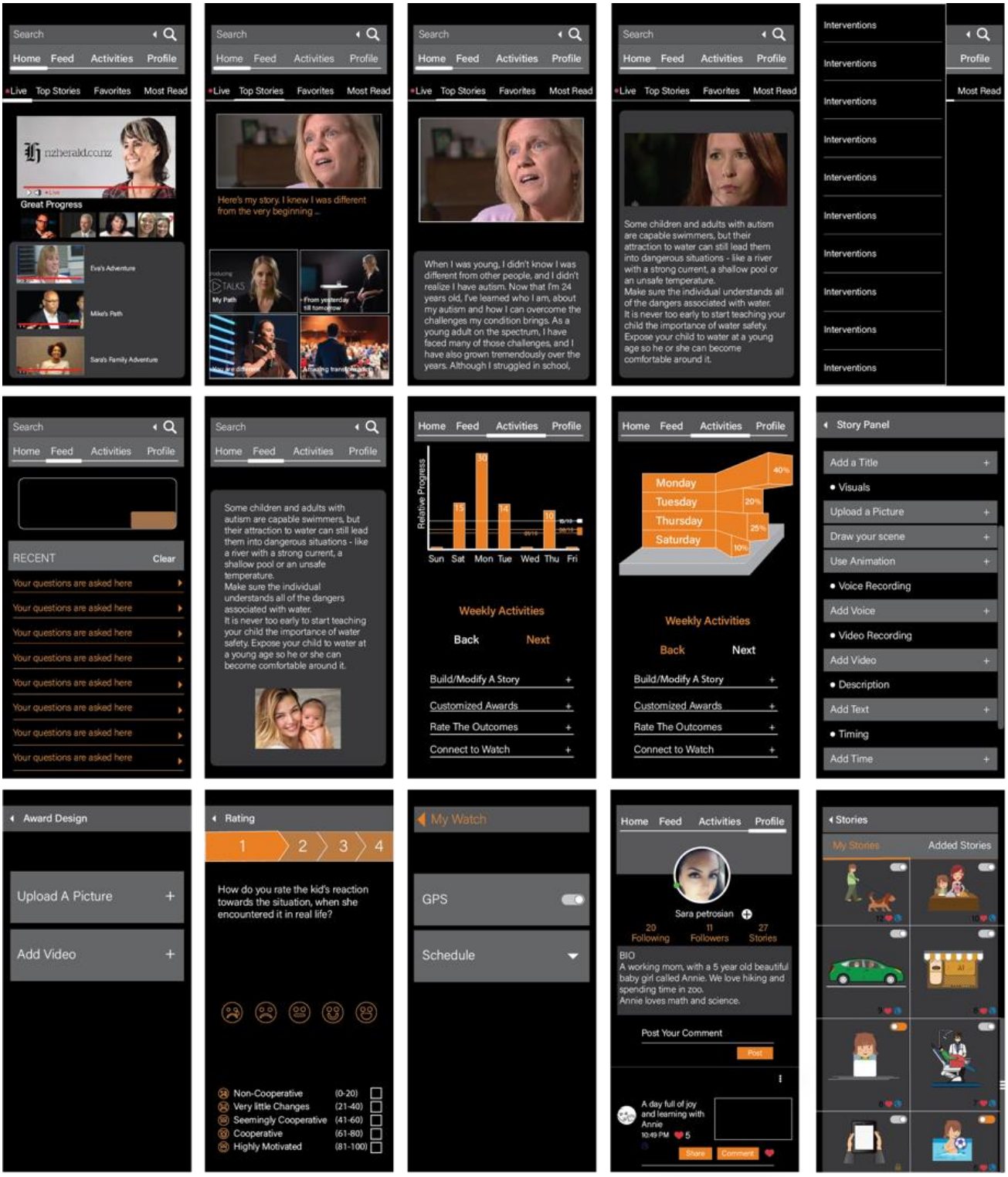

Figure 23. Finalized main features of adults' panel

Figure 24. Library for customized storyboards

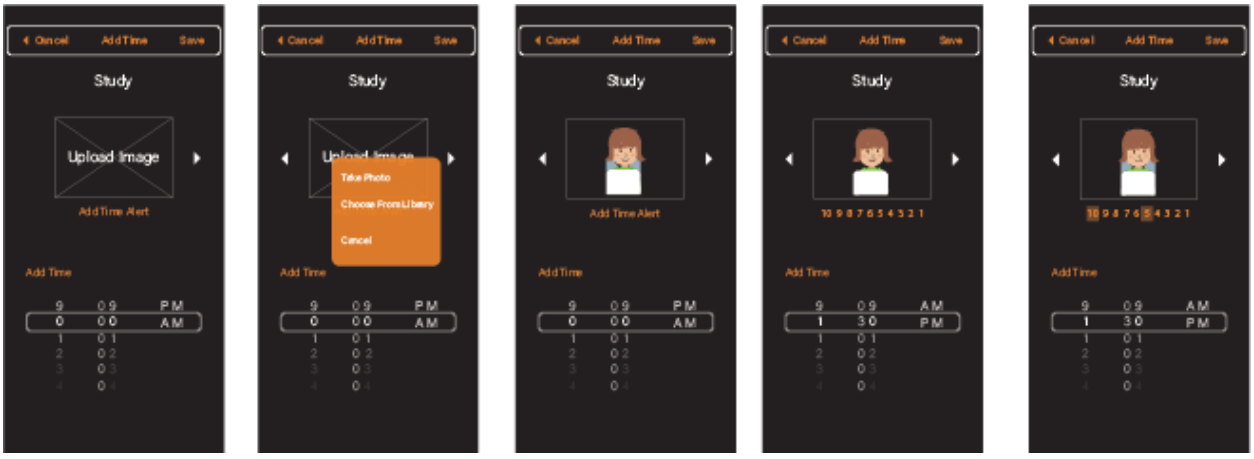

Figure 25. Syncing storyboards to the smartwatch

5.6.3 Physical Design

After going through many iterations of the smartwatch a customized watch was designed. This smartwatch has a very light flexible rubber band that comes in different colors. The screen has five buttons: On/off button, volume buttons, next and before buttons (for the storyboards)

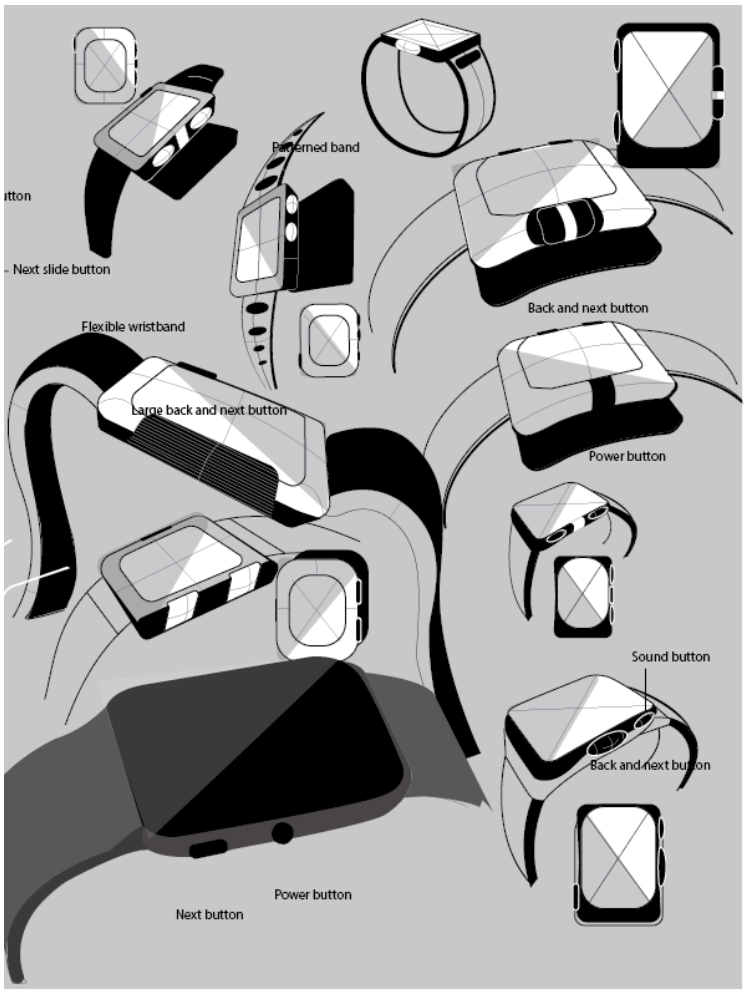

Figure 26. Iterations of smartwatch

Figure 27. Finalized exploded view of the smartwatch

Figure 28. Smartwatch and app working together

Figure 29. Final exhibition presentation

CHAPTER 6. CONCLUSION

6.1 An Overview

My previous works inspired the idea of working for ASD individuals. I had great working experience with these children in different areas and also felt the need to help them in the current research.

The idea of working on the transition process in ASD kids first came up after many sessions that I had with the language department professors at Purdue University. I had the opportunity to observe their labs and to witness some of the testings that they were performing. During these sessions, I realized that the children had a hard time understanding that they need to move on to the next activity or finishing the current one. I also saw the disruptive behaviors that were the result of changes in their routines. All of these, along with the further readings that I had in the relevant areas, lead to the idea of working in this specific field.

In the second chapter, I had the opportunity to get a broader perspective of transition difficulties. At the same time, I realized that I had to narrow my research. Initially, I wanted to incorporate face recognition technology into the design and utilize this method to get a more accurate perception of the kids' emotions before or while going through a transition. However, further research and readings revealed that accomplishing both transition and facial recognition in one study would require a longer time and much more facilities that I had access to for the sake of this research.

Transition difficulties do not just belong to ASD individuals, and it is a common problem in most of the kids. However, the transition from one activity to another, as well as in an ongoing activity might seem a bit more challenging in ASD persons considering that they tend to resist changes in their routine at most times.

Transition is part of every single activity and delivering innovative models that accommodates the needs of the individuals would open many possibilities for the individual. This research was entirely devoted to solving this issue, and to make a platform that provides useful techniques that would teach and help the ASD child to make a smoother transition and to avoid tantrum behaviors.

According to the articles I reviewed, several existing methods are proven to be effective by the researchers, and they had employed these techniques for several years. These techniques have been tested on ASD individuals and have shown to hold positive outcomes. I decided on choosing the most effecting methods and incorporating all of them in one design that is informative, straightforward, portable, and educational. These methods are; Priming, Predictability, Modeling, Visual Presentation, and Timing.

The idea of preferring an app over other existing digital devices was its accessibility most of all. Apps are convenient and easy to operate in addition to being affordable.

After developing the first system design, I tested the model with the intended audience and professional designers and clinical advisors. Throughout three usability testing, many adjustments were implied to the initial design. A similar procedure was replicated for the adults' entry. Following all the changes that were attributed to the design, a working prototype was constructed and presented in the final exhibition.

This app was accompanied by an interactive smartwatch to help the user in the transition process further. The caregiver managed the smartwatch through the adults' panel. This was easily achieved by syncing the targeted story from the app into the smartwatch.

While working on the digital design, a question was brought up concerning how the kid would cope with an unknown activity or environment if the app was not available. To handle this challenge, I went through different ideations that could potentially be a good supplement or at times, act as an alternative device to compensate the app. The concept of a smartwatch was chosen among other options since it was portable, very light (the child would not feel agitated or overwelled by it), and informative. I designed a customized watch that was specifically for the ASD kids and tested the results with two of the ASD children to assure that it was a perfect fit for them.

The final designs were exhibited in the Patti and Rusty Ruff Gallery. I presented all of my works along with prototypes and an informative video for the visitors.

6.2 Restrictions and Further Studies

I tried to cover the transition process in this study through an app and a supplemented smartwatch. I faced many restrictions during this study. There were not enough institutions that would agree to work with me as a researcher and therefore I faced many challenges in finding the

audiences I was looking for. I had to give up parts of the research that I was initially planning to work on because of not having access to some technologies and labs. However, future studies could work on emotion analysis in the transition process. This could be done through face recognition or even newer technologies that would involve similar realizations.

REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington: Author.

Asperger, H. (1944). Die 'autistische Psychopathen' im Kindesalter. *Archiv jut Psyehiatrie und Nervenkrankheiten, 117*, 76-136.

Banda, D. R., Grimmett, E., & Hart, S. L. (2009). Helping students with autism spectrum disorders in general education classrooms manage transition issues. *Teaching Exceptional Children, 41(4),* 16–21.

Bryan, L. C., & Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. *Journal of Autism and Developmental Disorders, 30(6),* 553–567.

Buggey, T. (2005). Video self-modeling applications with students with autism spectrum disorders in a small private school setting. *Focus on Autism and Other Developmental Disabilities, 20,* 52–63.

Cihak, D. F. (2011). Comparing pictorial and video modeling activity schedules during transitions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*, 433–441.

Dettmer, S., Simpson, R. L., Myles, B. S., & Ganz, J. B. (2000). The use of visual supports to facilitate transitions of students with autism. *Focus on Autism and Other Developmental Disabilities, 15(3),* 163– 169.

Dooley, P., Wilczenski, F. L., & Torem, C. (2001). Using an activity schedule to smooth school transitions. *Journal of Positive Behavior Interventions, 3*, 57–61.

Flannery, K. B., & Horner, R. H. (1994). The relationship between predictability and problem behavior for students with severe disabilities. *Journal of Behavioral Education, 4*, 157–176.

Hodgson, L. A. (1995). *Visual strategies for improving communication system training manual*. Troy: Quirk Roberts.

Kanner, L. (1943). Autistic disturbances of affective contact. *The Nervous Child*, 2, 217–250.

Koyama, T., & Wang, H. (2011). Use of activity schedule to promote independent performance of individuals with autism and other intellectual disabilities: a review. *Research in Developmental Disabilities, 32*, 2235–2242.

Lequia, J., Machalicek, W., & Rispoli, M. J. (2012). Efficacy of activity schedules on challenging behavior exhibited in children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 6*, 480–492.

MacDuff, G. S., Krantz, P. J., & McClanahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26*, 89–97.

McClannahan, I. F., & Krantz, P. I. (1999). *Activity schedules for children with autism: Teaching independent behavior*. Bethesda: Woodbine.

Mechling, L. C., & Savidge, E. J. (2010). Using a personal digital assistant to increase completion of novel tasks and independent transitioning by students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 41*, 687–704.

Mesibov, G. B., Shea, V., & Schopler, E. (Eds.). (2005). *The TEACCH approach to autism spectrum disorders*. New York: Springer.

Miltenberger, R. G. (2006). Antecedent interventions for challenging behaviors maintained by escape from instructional activities. In J. K. Luiselli (Ed.), *Antecedent assessment & intervention: Supporting children and adults with developmental disabilities in community settings*. Baltimore: Paul H. Brookes Publishing Co.

Ritz, J. N., DeLeon, I. G., & Lazarchich, W. N. (2004). Separating the influence of escape and access to preferred activities on problem behaviors occurring in instructional contexts. *Behavioral Interventions, 19*, 159–171.

Schopler, E., Mesibov, G. B., & Hearsey, K. (1995). Structured teaching in the TEACCH system. In E. Schopler & G. Mesibov (Eds.), *Learning and cognition in autism*. New York: Plenum Press.

Schreibman, L., Whalen, C., & Stahmer, A. C. (2000). The use of video priming to reduce disruptive transition behavior in children with autism. *Journal of Positive Behavior Interventions, 2*, 3–11.

Sevin, J. A., Bower-Stephens, C., Hamilton, M. H., & Ford, A. (2001). Integrating behavioral and pharmacological interventions in treating clients with psychiatric disorders and mental retardation. *Research in Developmental Disabilities, 22*, 463–485.

Stahmer, A. C. (1995). Teaching symbolic play skills to children with autism using pivotal response training. *Journal of Autism and Developmental Disabilities, 25*, 123–141.

Taber-Doughtry, T., Miller, B., Shurr, J., & Wiles, B. (2013). Portable and accessible video modeling: teaching a series of novel skills within school and community settings. *Education and Training in Autism and Developmental Disabilities, 48*, 147–163.

Tustin, R. D. (1995). The effects of advance notice of activity transitions on stereotypic behavior. *Journal of Applied Behavior Analysis, 28*, 91–92.

Zanolli, K., Daggett, J., & Adams, T. (1996). Teaching preschool age autistic children to make spontaneous initiations to peers using priming. *Journal of Autism and Developmental Disorders, 26*, 407–422.

APPENDIX A. SURVEYS

Case study interviews questions with the caregiver:

1. Describe your cild's daily activities
2. What kind of challenges do you face during a day with your autistic child?
3. What kind of resistive behaviors do the child show?
4. Do you face any kind of resistance while encouraging the child to the assigned daily activities?
5. How do you deal with resistive behaviors?
6. What are the child's favorite activities?
7. How do you encourage the child to shift to a less desirable task?