A SUNNY DAY: Ann and Ron's World an iPad Application for Children with Autism

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Abstract. As autism becomes a more widely-understood medical field, so do therapeutic implications. With the recent development of these methodologies in mind, "A SUNNY DAY" aids the therapeutic treatment of children with autism by providing simple and structured tasks while awarding children with praise in the form of an electronic iPad application. Every task in the game takes into consideration the emotional, social, and sensory disabilities autistic children struggle with and utilizes new teaching methods to remedy them. This paper includes the research prior to developing the application and the design and objectives of the application.

Keywords: Autism; autistic disorder; iPad; application; therapy; rehabilitation; game; a sunny day; interactive behavior training; text-to-speech; communication.

1   Introduction

The 1988 film, Rain Man, depicts the life of a person with the developmental disorder known as autism. Raymond Babbitt, played by Dustin Hoffman, had extraordinary mathematic capabilities that rival calculators, as well as a photographic memory. Although he has these gifts, he lacks social abilities to effectively communicate with others. Raymond's struggles are common to many individuals in the real world who also have autism.

Autism, also known as "Autistic Disorder," is a developmental disorder caused by a malfunction of the nervous system, with symptoms including defective social awareness, the inability to communicate effectively, and abnormal interests and behaviors. Although autism has been known to occur in approximately five in ten thousand people [5], there has been an increase in reported diagnoses of children and older people alike with milder forms of autism. Individuals with autism may cause mental and economic burdens for their families, as autism is a relatively new medical field which contains many mysteries yet to be solved.

"A SUNNY DAY" seeks to aid the therapy of autistic children. This iPad application is a product of the widespread goal of the Tencent Foundation and the Digital Media Lab of the Central Academy of Fine Arts in helping autistic children "live in sunshine," improving the lives of children with autism and their families and friends. This tool can help remedy effects of autism by challenging users with tasks,

based on the corresponding research. Additionally, it educates families, friends, and caretakers of autism and aids in the therapy of their loved-ones. "A SUNNY DAY" utilizes technology not previously available or user-friendly to children with autism in order to provide effective means of education and therapy in the home without the presence of expensive medical or professional aid.

The purpose of this paper is to present the research conducted in discovering the best method to accomplish this goal. Through interviewing and investigation of existing therapeutic methodologies, we are able to establish our own based on technological advantages offered by the iPad and effectively change the manner in which autism is treated. Although games are previously thought to be purely for entertainment, through research and implementation of multiple therapeutic methodologies, it is possible for serious game technologies to act as a medical tool for children with autism.

We shall begin by discussing the discourse of the background investigation involved prior to the design stage. In the three stages of investigation, we will visit and interview institutions who work with autism in order to design a game correctly catered towards children with autism and help them improve learning skills. Section 3 will discuss the game concept and factors implemented pertaining to the research on autism followed by Section 4 which describes the test process with allowing children to play the game, and adjusting the game design to more effectively meet the needs of the children.

2   Initial Research

Prior to developing a therapeutic game for children with autism, it is imperative that we gain the appropriate knowledge of autism: what is it, how can it be treated, and how can we treat it in a single iPad application? We address these questions in the following three stages of investigation.

Our research will be conducted in three phases. The first stage of investigation will be directed towards learning about autism as a whole. We do this by interviewing hospitals, clinics, and other institutions related to the treatment of autism. Doing so will allow us to understand the basis for the game design and establish clear goals about the goals of the game. Stage 2 of the investigation will continue to closely interview clinics and observe current practices for the remedy and treatment of autism. These practices consist of several methods and training strategies which help children improve various skills. Studying current treatment methods will allow us to form our own treatment techniques while incorporating other existing techniques. Stage 3 of the investigation will continue to observe training methods and interviewing parents, teachers, and children in order to discover effective ways to incorporate training methods into an electronic application. We will focus on finding out what elements best captures the attention of a child with autism. The research of autism is vital to the game design. Every element of the game is designed to train children effectively in various areas and cannot digress in lieu of possible adverse affects.

2.1   Stage 1 of Investigation

Following the investigation with the Beijing Association for Rehabilitation of Autistic Children, Sixth Affiliated Hospital of Peking University, Capital Pediatrics Institution and Children's Hospital, and visiting with Professor Wang Yufeng, the Vice President of Sixth Affiliated Hospital of Peking University, Vice President of Beijing Association for Rehabilitation of Autistic Children, and the pediatric doctors of Children's Hospital affiliated to Capital Pediatrics Institution, we have discovered several findings regarding autism. Contrary to popular belief, autism is a developmental disorder, not a psychological disease. The difference between the two is that autism is inherent to the individual, while disease is caused by a more direct, external, biological agent. As forms of autism differ, it can also be caused by different physical, social, or mental factors. Additionally, autism changes with the maturing of both the body and minds of children. According to the Chinese Autism website [4], the occurrence curve for mental retardation is opposite to that of autism, with autism being significantly higher. This is largely due to the lack of related studies and diagnostic tools that differentiate the two. There are no commonly known guaranteed therapeutic correctional methods related to autism. With the release of the Apple iPad, we seek to introduce new correctional methods that incorporate this technology. The iPad is a simple means of interaction with an intuitive display and interface for children with autism. John Gruber, on his blog addressing autism applications, states that "A SUNNY DAY" has "results [that] are seemingly miraculous…the lack of indirection — fingers [are] touching screen elements directly, rather than pushing hardware buttons or manipulating an on-screen pointer using a mouse or trackpad" [7]. Indeed, the simplicity of a direct interface of the iPad proves to be, by far, the simplest form of interaction for children with autism.

2.2   Stage 2 of Investigation

The purpose of this investigation was to assess the viability of "A SUNNY DAY" in comparison with other rehabilitation methods. Upon interviewing teachers and parents, and the data derived from questionnaires, we have found that there were many types and subtypes of autism treatment, both orthodox and unorthodox. In order to produce an effective learning software for children with autism, it is imperative to implement teaching methods that are known to be effective. This is to avoid implementing education elements that are irrelevant and may possibly confuse the children.

According to popular discourse, autism is a biological defect and language is the foundation of the disorder. However, studies indicate that its core symptoms do not, in fact, stem from language problems [9]. Thus, methods which derive therapeutic processes from solutions based on language may not necessarily be helpful. The foundation of symptoms in autism is the social response, which incorporates language among other communication skills.

In addition, autism patients are susceptible to the connotation of respective cultures. A common definition of autism is the incapability of communicating within a certain culture. While it is true that the capacity to communicate on the premises of language may be lacking, it is the capability to communicate to the standards of the

culture which is difficult. Of course, this does not imply that a child can be autistic in one culture and not another, but that certain cultures may contribute, to a certain extent, to the development of autism, as it is a social disorder and is relevant to social contexts and situations. Based on these assumptions and findings, we aim of "A SUNNY DAY" will target the core disorder of autism – the malfunction of social functions.

As case studies of current methods of autism therapy are vital in developing new teaching methods, we have examined therapy sessions in the Sunshine & Friendship Rehabilitation Center. In each session, there are four sections: the cognitive lesson, interactive behavior training, a game simulation to help provoke healthy learning habits, and sensory integration activities which stimulate the children's sensory capabilities. Of these lessons, the interactive behavior portion is to remedy the damage of social functions. The following is the methodology of one of these sessions.

Lesson name: Interactive Behavior Training
Duration: 45 min
Participants: 5 autistic children, 1 teacher, 5 accompanying parents
Training Methodology: Train and encourage healthy daily activities such as putting on clothes, brushing teeth, and eating breakfast. The importance of these tests is to teach children structural habits by encouraging step-by-step repetition.
Training Steps: Demonstrating the movements and actions involved in each activity while explaining them, having parents assisting the children to emulate the activity as instructed by the teacher, analyze the performance of the children and repeat the repeat the steps again, and finally, the issuance of reward to promote future positive behavior.

The methodology that the interactive behavior training incorporates is called "Treatment and Education of Autistic and Related Communication-Handicapped Children," also known as "TEACCH Therapy," which involves close interaction with children and teachers, and rewarding the positive responses of children.

We have made several conclusions after observing and analyzing these therapeutic sessions. People live in tangible, structural social environments; they are foundations of our future behaviors which are products of the responses we receive from the environment. We form cognitions around responses that are to be expected of the environment. Autistic children lack the ability to form cognitions and assumptions of their respective environments, requiring outside assistance in order to effectively do so. It is important to note that it is not impossible for autistic children to overcome the difficulties of forming a structured cognitive system – it is important to implement an effective learning environment which can consistently provide the environmental responses that autistic children require, when normal environments do not.

2.3   Stage 3 of Investigation

After referring to several autobiographies of people with autism, we have discerned that according to personal accounts of autism, these following factors are emotions people with autism feel, and the situations that cause these responses:

• The surrounding environment is usually filled with unintelligible and intolerable noises
• Feel pain and anxiety when touched
• Feel uncomfortable and do not know what to say around others
• Feel delighted and happy when they experience rhythm
• They will not know the meaning of the words they speak out if they do not repeat them
• Are confused when in crowded environments
• They attempt to stop this confusion by acting out

"A SUNNY DAY" contains several features which are sensitive to those feelings described in the above points. First, "A SUNNY DAY" contains background music which is soothing and has a predictable rhythm to induce a calming atmosphere for the player. Additionally, there are several alternatives for voices and music which can be adjusted. Second, the structured step-by-step process is easy for the player to understand without overwhelming or confusing him/her. Third, there are several forms of praise to reward players for completing tasks to encourage effective behaviors and increasing concentration. Fourth, there are a small number of tasks which have real life applications such as finding food and taking baths. These tasks are designed to exercise and improve multiple brain functions including concentration, imaging capacity, and communication skills. Colors implemented in the game are chosen as simple and obvious with strong contrast. Characters are easy-recognizable cartoon figures.

3   Game Concept

The basic interface of the game is simple, making it easy for players to choose the activity by simply touching the object that the player is most interested in. The title screen, shown in Fig. 1, shows a pleasant animated scene with the two main characters of the game, Ann and Ron. Selecting either one will utilize the corresponding character as the assistant who will help the player in achieving tasks. Voice assistance not only aids the player in completing tasks to avoid use of extensive texts for instruction, but it also helps with communication skills. Touching other objects such as the sun or clouds will trigger small animations. There are seven small games in total, five of which are correlated with basic daily life skills such as getting up, brushing teeth, eating, bathing, and going to sleep. These five games are determined by the time of day which include, daytime, school time, and night time. During school time, there are two games which stimulate the child's sense of perception, shapes, concentration, among other abilities

After a character has been selected from the main screen, the player will be prompted to select one out of three scenes: daytime, school time, or nighttime, as shown in Fig. 2. In the daytime, there are three tasks a player must complete: get up, brush teeth, and eat breakfast. During school time, the player must find food with an animal helper and complete a tangram puzzle. At nighttime, the player must take a bath and go to bed.

Fig. 1. "A SUNNY DAY" Title Screen

Fig. 2. Selecting the Time of Day

In the food-finding mini-game, the player has an option of picking a variety of different animals. Upon choosing an animal, it will rotate its eyes until it stops on an icon for a certain kind of food. The player is to remember the type of food chosen by the animal and select it. Upon successfully picking the right food item, the player will be rewarded with praise and a special animated sticker. This exercise will help the child with concentration and memory, familiarization with animals and foods, and develop more effective social communication skills from the interaction and eye contact with animals.

In the tangram puzzle game, the player is to utilize a series of shapes and as-semble them into a pattern outlined on the screen. Players complete the puzzle by touching the shapes and dragging them into the correct locations. They also have the ability to zoom in by touching the screen accordingly. There are four puzzles which players

can repeat. This game contains simple shapes and colors that are easy for the player to distinguish. Skills that are involved include shape and color recognition, creative thinking skills, analytical skills, concentration, and memory.
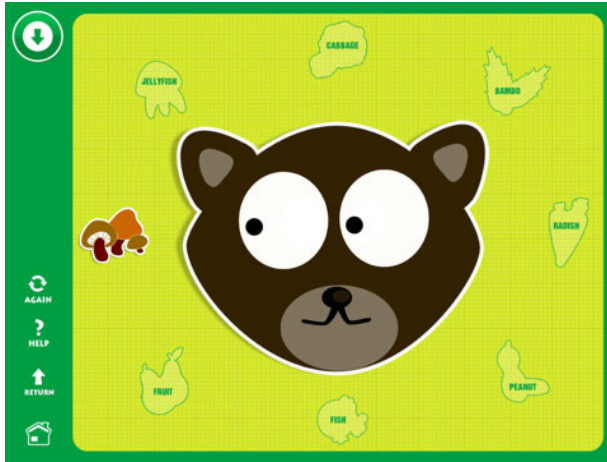

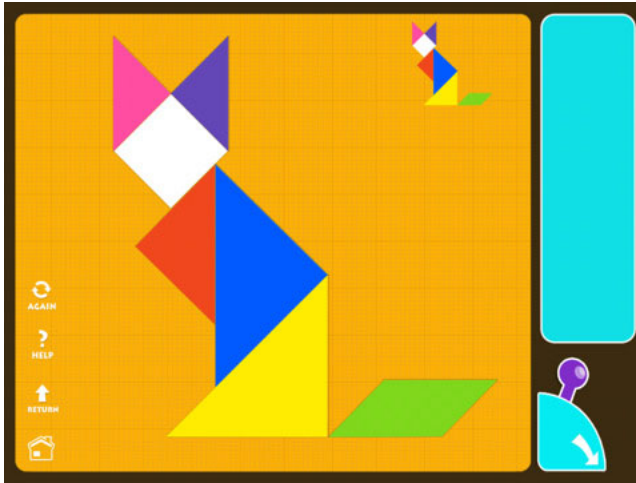**Fig. 3.** Finding Food Mini-Game

Fig. 4. Tangram Puzzle

Other games follow suit with similar format and styles. Each game seeks to remedy the problems children with autism struggle with in a structured fashion without the use of extensive medical and professional facilities. It also provides an entertaining environment for the children which encourages them to continue therapy, an element that may or may not be present in other therapeutic methods.
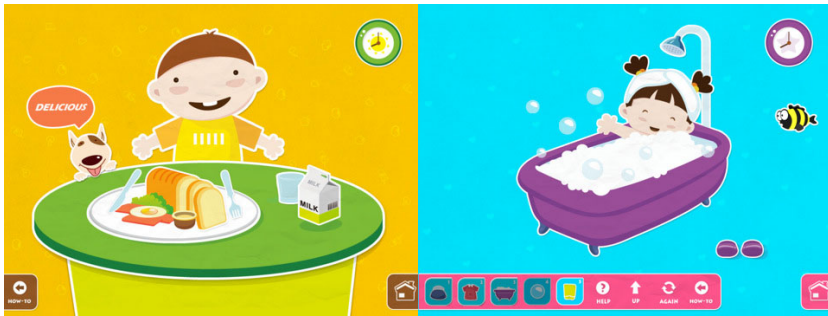
Fig. 5. Eating Breakfast and Taking Bath Mini-games

3.1 Comparison of Applications for Autism

Indeed, there are several existing electronic applications intended for children with autism. However, most applications exercise only one skill such as communication, social abilities, emotions, and language. Some applications train communication by associating text with images and sound to help the children memorize them in a fashion similar to flash cards such as iAssist, iComm, and MyVoice Commuication. Text-to-speech applications help children learn words by associating audio clips with text displayed on the screen.

"A SUNNY DAY" combines several types of training methods into one app. Real life situations require children to be able to utilize different types of skills. While one application can help with one skill, it is difficult for children to learn many things at once in the form of different applications. "A SUNNY DAY" avoids this by incorporating several skills into separate games which train every skill naturally without the need for excessive memorization or attention, but to the player's own enjoyment. Additionally, excessive text can have adverse effects on a child's attention span. The replacement of text with pictures, colors, and simple symbols creates a fun and simple atmosphere for the child.

While many existing iPad applications for children with autism have extensive features catered towards specific skills, they can be excessively complex and due to the variety of skills required for children to learn, purchasing the required applications and devices can be expensive and requires guidance from a teacher or parent. "A SUNNY DAY" is available to children free of charge, and parents or teachers only need to aid the child in purchasing the program without continual attention on helping the child learn how to use the application. This application utilizes the technological capacities of the iPad to maximize the simplicity of the user interface. It eliminates the use of text and instructions and allows the child to touch pictures they like, allowing the child to learn independently without aid from others. The tasks presented to the player are directly related to real-life activities and by training mental and social skills, they become more adept at daily tasks and schedules. The simplicity, fun characters, animations, and rewards create the feeling that they are playing a game, not learning.

In addition to learning mental and social skills, children are also taught, by repetition and the background story of the game and tasks, to perform tasks timely on a daily basis. "A SUNNY DAY" presents tasks which always occur on schedule and

are attributed to specific times of the day. As the child plays through the tasks, they will discover that it is normal for other children (Ron and Ann) to participate in these activities and will want to do so as well. Helping the characters accomplish these tasks will encourage doing the same in real life by positive reinforcement from rewards and praise granted in the game. Ron and Ann serve as both assistants in helping the children accomplish tasks as well as role models by promoting positive behavior. "A SUNNY DAY" demonstrates to children that simple, daily tasks can be fun and rewarding.

4   Design Test

Following the development and completion of the game, several tests were conducted to assess the applicability and overall effectiveness of the game. The goal of these tests was to determine if the new methodologies implemented in the game were indeed effective in treating autism. The following steps were taken:

> 1. Allow a child with autism to play the game
> 2. Receive feedback from doctors, teachers, parents who observe effects of the game
> 3. Allow parents and teachers to play the game and receive feedback accordingly

Following the test, we discovered that children with autism retain the following difficulties when using the application:

- Difficulty in dealing with signals – can only deal with one signal at once.
- Visual stimuli are received more readily than audio stimuli.
- Effective communication of instructions is difficult – only hear parts of the instruction.

According to the suggestions proposed by doctors, teachers, and parents, the interface should be simpler and more distinctive to clarify objectives. Rewards should also be awarded more quickly after completing tasks. This is to more effectively associate success with tasks completed.

We have also discovered that the game is meant as an individual learning tool. With the participation of a parent, they can cause confusion and uncertainty in the child. The game itself provides minimal emotional and visual stimuli to avoid overwhelming the child. The presence of a parent can overwhelm the child's emotional capacity. Additionally, frequent contact with the parent can deter the child's concentration and thought processes. Much like the real world, feelings of success should be produced by the individual, not by an outside source because outside sources are unreliable and inconsistent. Changes to the game have been made accordingly as per the proposed suggestions.

5   Summary of Project

Due to the positive feedback we have received from individuals who have tested "A SUNNY DAY," we have concluded that it is indeed possible for games to have

medical uses as well as entertainment purposes. Specifically, the entertainment aspect of games can be used as a means to increase the attention spans of players is widely beneficial in addition to the simplicity of the user interface. While the causes of autism cannot be treated easily biologically with medicines, technological advances in interface devices have indeed aided clinical therapeutic methods. "A SUNNY DAY" has successfully implemented multiple therapy methodologies in one, simple interface application for children to use as an alternative for more complex and expensive therapeutic methods with the aid of game technology. This new methodology using technology as leverage is valuable alternatives to often-times complex or expensive medical treatments when otherwise unobtainable vis-à-vis conventional means. We are hopeful for the future utilization of game-related technologies for other medical (and other fields of) applications.

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