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Toy for Preschoolers with Deaf-Blindness

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Toy for Preschoolers with Deafblindness



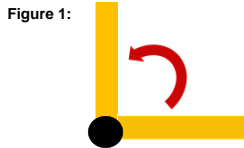
Introduction

There are approximately 70,000-100,000 people living in America today diagnosed as deaf-blind. Deaf-blindness is a condition where a person has little to no hearing in addition to little to no sight. This limited sensory input can cause severe communication deficits. If the condition is present from birth, individuals may additionally have developmental delays that can affect them for the rest of their lives. For blindness or deafness alone, toys are available for children to help with any developmental problems that may occur because of their condition. Unfortunately, children with deaf-blindness are an extreme minority, limiting the availability of toys that can stimulate their development from an early age.

Our project aims to create a product that would help in the motor, cognitive, and social development of a child with deaf-blindness between the ages of three and six. Our goal is to address this problem by developing a toy that will prepare these children for school by catalyzing their progression in learning and in societal interactions earlier than current tools allow. According to the Virginia Department of Education's standards of learning for preschoolers, physical development, development of mathematical concepts, development of a sense of self, and a surrounding environment are core requirements to move on to Kindergarten. Each part of our toy targets these areas of development.

Physical Development

Physically, those who are deafblind have a limited understanding of correct posture. Teaching them to sit properly can be difficult, and teaching them to walk is near impossible. Without the use of certain muscles from a young age, mobility can be severely limited in the future. Our chair targets motor development of deafblind children by encouraging them to sit upright with their head back through positive feedback mechanisms.



When presented with any type of stimulus, deafblind children have the tendency to bring their face close to the source of the stimulus. This could be problematic with toys targeting solely cognitive development. In our toy, we have incorporated two major components to encourage upright sitting. We have added vibrating speakers into the headrest of the chair; these will resonate low frequency sounds (Figure 2). The child will be attracted by the stimulus and choose to keep their head upright. We have also developed a table for the toys to rest on that can move from a horizontal position to a vertical position directly in front of the child's face (Figure 1). When the table is vertical, the child's natural position will be to sit upright to play with the toys.

Cognitive Development

Concept Development and Braille Exposure:

One struggle for children with deafblindness is giving meaning and definition to objects in their environment. From an early age it is important for parents to relate an object to a task or concept; that way when the child touches the object, they understand what action is about to happen next. For instance the rougher feel of a wash cloth means it is time to take a bath. By age three most children should have this ability, we took it a step further so that they could relate that common object to a Braille word. Early exposure to Braille is essential to develop proper reading techniques. We designed a Braille matching game (Figure 3), where the child must match a braille word to an object that relates to a known concept.

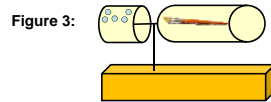
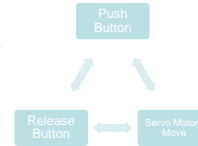


Figure 4: The process is very simple, so the child can learn the game quickly



Pattern Recognition:

To develop the child's pattern recognition skills, our team created a Simon game (Figure 5) that produces a numerical pattern that the child replicates. Not all deafblind children have complete loss of hearing and sight; therefore, our team incorporated two colored buttons that give off light and sound simultaneously with the vibrational pattern that is to be replicated.



Figure 6: The child begins to respond in a manner to achieve success



Social Development

Social Interaction

During the use of this toy, a parent or guardian will interact with the child by providing positive feedback when they feel that the child is successful. These positive feedback mechanisms include personal touch and control over the vibrational speakers in the headrest. These interactions will help the child to develop socially through learning to be comfortable with interaction from other people.

Exploration

Another challenge for preschoolers with deafblindness is the fear of their unknown surrounding environment. To target this problem, we created a hanging apparatus that consists of familiar everyday objects that the child interacts with (Figure 7). This hangs over the child's head while they are using the game, so if the child reaches out to explore their environment they will feel a familiar object. This will help the child to feel more comfortable with his or her environment, encouraging exploration.

Materials and Methods

A prototype toy for children with deafblindness was constructed using the following materials:

Base – Designed and constructed from lumber and screws

Chair – Graco Car Seat with vibrational speakers in the head rest

Table – White board that is adjustable 0-90° using a custom fit hinge joint

Braille Game – PVC piping turned by continuous rotating servo motors programmed using a BASIC Stamp 2 microcontroller, labeled with a Braille printer

Simon Game – 3D printed, programmed using a BASIC Stamp 2 microcontroller, with LEDs and piezo speakers.

Hanging Apparatus – Peg board and a hinge joint with releasable zip ties

The materials and design considerations of the final product were based off of consultations with Julie Durando Ed.D, and Dianne Pawluk Ph.D. concerning their individual work with the deafblind community in Virginia. The Graco car seat was selected based on its size accommodations and fit for a preschooler. Team members were certified to use the machine shop in order to properly design and build the base, table, and braille game for this prototype. The microcontrollers for the Simon and Braille games were coded using BASIC Stamp Editor software, and a MakerBot® 3D printer was used to print the SolidWorks® 3D CAD design of the Simon Game buttons.

Final Product



Figure 7: Assembled prototype consisting of the wooden base, adjustable table, car seat, game on the table, and hanging apparatus

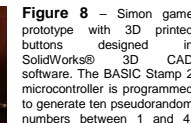


Figure 8 – Simon game prototype with 3D printed buttons designed in SolidWorks® 3D CAD software. The BASIC Stamp 2 microcontroller is programmed to generate ten pseudorandom numbers between 1 and 4. One button will vibrate, flash, and produce a 2.5k-3k tone according to the number the program selected. The user must repeat the associated number of button presses.



Figure 9 - Braille game prototype. One side contains Braille words, and the other side contains tangible symbols that represent those words. Each side is attached to a continuous rotating servo motor programmed with a BASIC Stamp two microcontroller. Additionally, each 3D printed button rotates one side of the cylinder, when pressed. The user must match the correct word and symbol using the buttons to rotate the respective sides.



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