2015

Using Music and Applied Behaviour Analysis to Introduce an Adaptive Mobility Device to a Student with Multiple Disabilities: A Case Study

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Introducing an adapted mobility device (AMD) to a child with multiple disabilities can be especially challenging. In this descriptive case study, an AMD is introduced to a six year old boy with congenital blindness, speech impairment, and an intellectual disability. Observational data were collected via A-B-C documentation resulting in a strategic intervention design plan to improve grasping and independent travelling skills. Over the course of 16 weeks, data indicated that Joey (pseudonym) met his IEP goal of holding his AMD consistently for 50 feet. Music treatment was applied as a positive reinforcer to change Joey's behaviours.

Introducing the long cane to a child with an intellectual disability, speech impairment, and vision impairment can be especially challenging. Careful attention must be paid to the child's level of cognitive functioning to determine what environmental information is understood. Expressive and receptive communication skills, sensory skills, and fine and gross motor skills must also be considered when planning O&M training. For example, does the child understand verbal directions and ask questions? Does the child have the fine motor skills necessary to hold a long cane? If the child is walking, but has combined disabilities that preclude safe travel with a long cane, then an adapted mobility device (AMD) might be recommended. AMDs are specifically designed devices to provide environmental information to people who might not be able to use a long cane. An AMD can also be a bridge to increasing independence until a child is capable of using a long cane (Pogrund, Sewell, Anderson, Calaci, Cowart, Gonzalez, Marsh, & Roberson-Smith, 2012). AMDs are usually made out of PVC pipe, and prescribed by O&M specialists (Sapp, 2004).

Requisite Skills for Cane Travel

Successful cane travel requires a child traveller to move and hold the cane automatically so that the child can focus on interpreting other sensory input from the environment. According to Pogrund and Fazzi (2002) instruction may begin even if the child has only a limited awareness of objects

in the immediate environment. Expressive language abilities are not necessary because such nonverbal communication as modelling and physical prompting may be used for cane instruction. Understanding of object permanence, cause-and-effect relationships, spatial concepts, and function of the cane as a bumper can actually be facilitated through cane instruction. Therefore, a child traveller with an intellectual disability might be enabled to successfully use a cane to gain a developmentally appropriate level of independence.

The first step in using a cane is grasping and holding the cane. Typically developing infants with vision begin grasping and "coordinating objects with both hands" at the age of 4-5 months (Berk, 2007, p. 140). These infants reach and grasp often motivated by a visual stimulus such as a caretaker's face. However, a child with congenital blindness will be delayed in grasping for several reasons. First, the child is not able to see faces or objects and, therefore, not motivated to reach. This lack of movement and reaching may result in underdeveloped muscles that in turn, make reaching even more difficult. Second, without vision, infants have no visual models for reaching or grasping. They must be intentionally taught these skills and are not likely to have as many opportunities to practice them as their sighted peers. Third, the concepts related to object permanence is not developed in children with vision until 8-12 months old (Berk, 2007), and is delayed longer in children who are blind. As a result, a child with congenital blindness who learns to reach and grasp objects such as a cane during planned activities will not search for objects within the environment until much later. All of these developmental milestones may be further delayed if the child also has an intellectual disability with congenital blindness. Additionally, some children with intellectual disabilities have tactile defensiveness and engage in stimming behaviours, both of which interfere with holding. Obviously, cane skills will have to be intentionally taught to a child with both congenital blindness and intellectual disability.

Applied Behaviour Analysis

Researchers have successfully used interventions based on applied behaviour analysis, to improve motor skills (Alstot, et al., 2013; Donahue et al., 1980; Lee, 1993; Ward & Barrett, 2002). By manipulating the stimuli immediately preceding and/or immediately following the occurrence of a target behaviour, practitioners can increase or decrease the target behaviour. According to Cooper, Heron, and Heward (2007) "specifically within physical activity settings, practitioners can alter the stimuli preceding a behaviour (e.g., giving instructional cues) and after the occurrence of the behaviour (e.g., reinforcement through verbal praise or tangible reward)."

Behavioural assessment inclusive of "direct and repeated observations in the natural environment" is one of the classic principles of applied behaviour analysis and is considered the preferred assessment method for the translation of recorded data into behavioural strategies for instruction (Cooper, Heron, & Heward, 2007, p. 53). Descriptive direct behavioural data in the form of A-B-C recording can used to determine what is causing behaviour and how to manage it. Noting behavioural observations and environmental issues

surrounding it can provide a structurally sound description of a child's pattern of behaviour (Cooper, Heron, & Heward, 2007).

In A-B-C descriptive behavioural analysis, the A stands for antecedent, B for the behaviour to be modified, and C for consequence (Barbera, 2007). Identifying the antecedent (A) preceding the behaviour (B), enables the person working with the student to either eliminate or modify the antecedent (A). The consequence (C) occurs after the behaviour and may either reinforce or discourage the behaviour. Evaluating the results of A-B-C data collection recordings allows single subject intervention development to support a child in need of behavioural intervention.

In this case study, a six year old boy named Joey (pseudonym) with congenital blindness, multiple disabilities, and intellectual disability learned to hold an AMD. After A-B-C evaluation and the collaborative efforts of Joey's teachers, orientation and mobility (O&M) instructor, and family, reinforcers were identified and appropriate learning goals were set. Over the course of 16 weeks, Joey's Individual Education Plan (IEP) goal was to hold an AMD consistently for 50 feet. Music was used as a positive reinforcer until the skill was acquired after which the music was faded out. This study documents the progress Joey made during intervention by analysing data collected at that time. Ethics clearance was obtained from the Institutional Review Board (IRB) of Stephen F. Austin State University (SFA).

Method

Participant and Setting

Joey was six years old when he started kindergarten in a life skills classroom in a public school setting. He qualified for special education services as a student with congenital blindness and intellectual disability. Joey had the gross motor skills necessary for walking but had skipped crawling entirely which made transitional movements very difficult for him. Protective reactions that children typically master in their first year had yet to develop. Joey engaged in a great deal of self-stimulatory behaviour, such as rubbing and patting his face and body, waving his hands in the air, and clapping them together.

At the beginning of this study, Joey was not motivated to engage in independent tactile exploration of objects or his environment. If he encountered an object, then he would either ignore it, mouth it, or throw it. He required extensive hand-over-hand support in order to use objects in their designated manner, for example stacking blocks or placing them into a container. He did not exhibit tactile defensiveness and frequently brought an adult's hands to a specific part of his body he wanted rubbed. This indicated that he had some body awareness. A multi-sensory approach that incorporated concrete object symbols, with no delay between auditory information and presentation of action or object was recommended by the assessment, review, and dismissal (ARD) committee.

Joey was assigned an O&M instructor who spent a great deal of time building rapport with him, and assessing his preferences, strengths, and sources of anxiety. Though

Joey received many services at school, he only attended on a part-time basis because of the additional therapies he received outside of school hours. As is often the case with students who have multiple impairments, Joey's frequent illnesses led to even more absences from school. His initial O&M lessons focused on room familiarisation and learning the simple route from the classroom door to his seat. He used trailing with his right arm as a means of locating landmarks. Joey's team confirmed that he responded to music and soothing voices, and that repetition and consistency yielded results. It became apparent that loud noises led to anxiety and more frequent and severe self-stimulation. Through consultation with the occupational and physical therapists, a simple movement routine synchronised to music was developed to reinforce Joey's body awareness. It was noted that these music sessions helped relax Joey to a large extent.

An important topic discussed at Joey's IEP team meeting was the need for independent travel which would begin with learning to grasp an AMD. The supportive verbal prompt objective for everyone who worked with Joey was to incorporate the same simple vocabulary, "reach" and "hold" into their respective activities. During O&M lessons, Joey was told to "reach" as he trailed the wall. Additionally, a piece of PVC with cane grip material was presented during lessons so that he could become accustomed to holding it.

An AMD called the T-Wheeler cane was custom built for Joey because it provides additional feedback and protection when walking (Figure 1). A traditional long cane has a single tip that touches the ground at one point of contact, whereas the T-Wheeler

Figure 1. Joey's T-Wheeler cane: 36" (91.44cm) long and 14" (35.56cm) wide.

cane's wide base provides a higher probability of making contact with objects which addressed one of Joey's objectives. The heavier base of the T-Wheeler cane also decreased the likelihood that Joey would lift the cane off the ground and wave it in the air. The accompanying IEP goal was "to improve Joey's walking skills by walking

with an assistive device and supervision (with only verbal cueing) on smooth level surfaces, at least 50 feet." Joey began his lessons by simply holding the T-Wheeler cane in front of his body every time he exited his classroom with his O&M instructor.

Procedure

There were several factors to consider when planning O&M lessons for Joey. First, Joey did not grasp objects continuously unless a pleasant stimulation resulted. For example, he liked to touch things that vibrate. Second, Joey's stimming behaviours were also interfering with holding items such as the cane. Joey constantly craved sensory input and his hands were the most convenient source. Finally, while he had a basic understanding of cause-and-effect, it was unlikely that he would understand the purpose of holding a cane or receive any pleasant stimulation from doing so.

Music was a soothing positive reinforcer for Joey and used to encourage him to hold his cane. Lim (2010) noted that music stimuli can function as antecedent variables and automatic reinforcement. In this case, various songs were played for Joey so that his reactions could be noted. A favourite walking playlist was collected for Joey using an iPhone. These walking songs differed from the movement routine music so as to not confuse Joey.

A simple O&M routine was developed and implemented at the beginning of the spring semester which continued over 16 weeks comprising 13 weekly sessions (Joey did not attend school during weeks six, seven, and eight). Each lesson began with Joey retrieving his AMD from the same location by the door with the instructor's support. The two exited the classroom holding the AMD using the hand-over-hand teaching method. Once outside, the instructor said, "time to hold" and started Joey's playlist. Using hand-over-hand the instructor supported Joey to hold the cane during the first 3 – 5 seconds of the music while repeating the word "hold." Then the instructor released Joey's hand. If Joey opened his hand, then the instructor immediately stopped the music. The music reinforced the grasping of the cane. In this way, the antecedent, A, the need to self-stimulate, was minimised by soothing music. If the behaviour, B, opening the hand occurred, then the consequence, C, stopping of the music, was applied. Each time the AMD was dropped, Joey, with the instructor's physical assistance, bent down to pick up the AMD, and the pattern was repeated. In order to minimise fatigue and boredom, only a portion of each O&M lesson focused on AMD use. The lesson followed an I-route (return) which is a straight line of travel with no turns that began outside the classroom door. The endpoint was determined based on student stamina. Relaxing and fun activities for example, spinning with support or songs were completed at the end of the I-route. Then the AMD was used to return to the classroom door.

Results

Thirteen O&M sessions were completed over16 weeks. Data were collected that revealed the (i) frequency Joey opened his hand and released the AMD (ii) duration of the O&M session (iii) duration of the AMD session and (iv) distance between each release (in feet) (Table 1).

During the first session Joey walked less than two feet before opening his hand. It took a long time to physically guide him

Table 1. Data collected over 16 weeks.

Session number	Duration (mins) of O&M routine	Duration (mins) of AMD portion of routine	Number of AMD releases	Distance covered between releases (ft)	Max # ft covered
1	30	15	9	<2 9 times; then 8	8
2	30	18	5	3; 3; 5; 10; 20; 20	20
3	30	25	3	3; 10; 20; 25	25
4	30	25	5	3; 10; 10; 20; 25	25
5	30	25	5	3; 3; 5; 10; 10; 20	20
6	30	20	6	3; 10; 20	20
7	45	25	1	10; 10; 20	20
8	45	30	2	20; 10; 30	30
9	45	30	2	20; 10; 30	30
10	45	30	2	15; 15; 30	30
11	45	35	?	40; 40	40
12	45	35	?	40; 40	40
13	45	35	2; 3?	50; 50	50

to bend down and pick up the AMD. The routine was repeated two more times and the longest distance covered between AMD releases was only nine feet. Less than 15 minutes was spent on the AMD routine and the remaining O&M time was spent in engaging in the familiar, relaxing movement routine.

Progress was relatively consistent. The AMD portion of each lesson increased to about 25 minutes in the seventh session. This was broken down as follows: 10 – 12 minutes AMD usage in one direction; 10 minutes of relaxing and/or fun activity at midpoint; 10 – 12 minutes AMD usage back to classroom; 10 minutes of a relaxing activity. The midpoint fun activities could be spinning, familiar movement routines in standing positions, or clapping and singing. The maximum distance covered between AMD releases also increased consistently. In the sixth session, there was no change in the number of feet between releases and an increase in the number of releases during the session.

Joey did not attend school for three weeks between the fifth and sixth sessions. The O&M instructor noted that there were several false starts in session six, but ultimately, the number of feet between the last two releases was back to the previous maximum of 20 feet. During session six, a condition was altered to support Joey's independence. A strap was added to the cane grip to prevent the AMD from falling to the ground upon release. Joey started working on re-grasping the cane independently and was successful in session 11. This made it more difficult to discriminate how frequently releasing occurred in future sessions. During session seven, the music started to be faded out. Upon return from the midpoint, music only played until Joey had the strap around his wrist and the AMD in his grasp. The tenth

session was the first session where music was not used during the entire route, but only at the midpoint and endpoint activities. Joey met his IEP goal during the thirteenth session.

Discussion

Applied behaviour analysis in the form of descriptive A-B-C observation data was successfully used to change behaviour in the student with disabilities. When introducing an AMD to a student, it is important to identify individual behaviours and whether or not these need to be increased, like grasping, or decreased, like releasing. Understanding the student's temperament and preferences is crucial for determining optimal lesson times and appropriate reinforcers. Joey was able to meet his IEP goals of holding an AMD for 50 feet with only verbal prompting. Manipulating the self-stimulation antecedents Joey enjoyed encouraged positive behaviours in cane holding and travelling with the consequence of increased independent travelling.

Study limitations

Single-case experimental designs can be useful for individual students with disabilities in educational environments, though may be criticised for lack of generalisability to other members of the same disability population (Gay, Mills, & Airasian, 2009). It is important in single-case design studies that all conditions remain constant over the time of the study so that observer and intraobserver reliability can be maintained (Gay, Mills, & Airasian, 2009). In this case study, the only observer and data collector during the study was the O&M instructor. Though Joey successfully learned the skills taught in the study, another observer collecting data with Joey during his instruction might have increased the study's internal validity.

Implications for Practitioners

Teachers of students with vision impairment (TVIs), O&M instructors, and special education teachers are often called upon to recommend interventions to change student behaviours. The method used in this study is one that can be replicated relatively easily by school personnel. Once behaviour is identified and operationally defined, the school personnel can determine appropriate reinforcers, interventions, procedures, and data collection methods. It is important to determine who can implement musical reinforcers in ABA approaches. If the student has multiple disabilities, including intellectual and vision impairment, then collaboration among all of the child's specialists is critical to determining who will oversee these types of interventions and the ways that everyone on the team may reinforce the skills in order to ensure successful generalisation.

Practitioners must always be respectful of the individual needs of the child and vary lengths of lessons accordingly. In this study, several months allowed the student time to be comfortable in his school and classroom, and to build rapport with teachers and specialists. This ensured that potential anxiety experienced by the introduction of a new activity would not be compounded by lingering anxieties from being in an unfamiliar setting with unfamiliar people. In addition, careful documentation is critical to ensure that unusual shift of data trends are tied into related extraordinary situations.

As was evident in Joey's case, a three-week absence resulted in a dip in the rate of improvement.

More research using quantitative data from a large sample size are needed to examine the effect of ABA with music as a reinforcer for students with intellectual disabilities learning O&M. Residential schools for students with vision impairment are potential sources of participants in larger studies. They may have the added benefits of consistent environment and instructors across participants to ensure results are not skewed by these factors.

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