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## Evaluating the Effectiveness of the Travel Assistance Device on the Bus Riding Behavior of Individuals with Disabilities

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Evaluating the Effectiveness of the Travel Assistance Device on the Bus Riding Behavior  
of Individuals with Disabilities

by

Arica J. Bolechala

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Arts  
Department of Child and Family Studies  
College of Behavioral and Community Sciences  
University of South Florida

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## Dedication

I dedicated this manuscript to my family, for all their love and support during my academic career. Without their constant encouragement and patients my goal would have gone unreached.

## Acknowledgements

I would like to acknowledge and thank my advisor, Dr. Raymond Miltenberger for providing me with guidance and encouragement throughout my thesis and throughout the two years I have spent under his advisement. I would like to thank Sean Barbeau, Nevine Georggi, and Marcy Gordon for all their valuable information and ideas throughout my thesis. I would also like to thank Mark Sheppard for teaching me all about the local transit system. Lastly, I would like to acknowledge my research assistance, of which there were many. Without them my data would have gone uncollected.

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ABSTRACT

Independence for individuals with disabilities can be facilitated through the use of devices that have been created and adapted for these individuals. Research regarding the use of technology to afford independence to those with disabilities is growing as new devices are being created. One such device is the Travel Assistance Device (TAD) which has undergone conceptual tests to assess if the individual components of the device work as intended. The purpose of this research study was to determine whether the prompts given by the TAD would exhibit stimulus control over the participant's behavior of pulling the cord to stop the bus at the appropriate time and exiting the bus at the appropriate stop. Results show favorable outcomes for the 3 participants who were able to pull the bus cord at the appropriate stops and exit the bus only when the TAD delivered prompts. Future implications in parent training are discussed.



## Introduction

Many individuals who have disabilities are no strangers to having care providers as constant fixtures in their everyday lives. Care providers are necessary for individuals with disabilities due to an array of physical or cognitive impairments that they experience. These individuals may face a variety of potential dangers throughout their day due to a lack of knowledge or ability to stay home without supervision, leave a building if it were on fire, cross the street safely when traffic is present, or use public transportation without getting lost (Sohlberg, Fickas, Hung, & Fortier, 2007). However, with the technological growth that has been seen in the last 20 years, a wide array of devices have been adapted, created, and utilized with the potential to create independence for individuals with disabilities. Virtual reality, pagers, hand held computer devices, and cellular phones have all been used to assist those who require assistance in their day to day lives (Padgett, Stickland, & Coles, 2006; Riffel, et al., 2005; Self, Scudder, Weheba, & Crumrine, 2007; Taylor, Hughes, Richard, Hoch & Coelo, 2004). These devices and others have been utilized across settings including in the home (Cheslock, Barton-Hulsey, Ronski, & Sevcik, 2008; Hersh & Treadgold, 1994; Lancioni, et al., 2008), in the work place (Davies, Stock, & Wehmeyer, 2001; Davies, Stock, & Wehmeyer, 2002a), and in the community (Taylor, et al., 2004; Zaruba, Kamangar, & Huber; 2003) to facilitate such behaviors as, task initiation (Wade & Troy 2001), task completions (Davies, Stock, & Wehmeyer 2002b), and indoor travel (Lancioni, Gigante, O'Reilly, Oliva, & Montironi, 2000; Lancioni, Mantini, O'Reilly, & Oliva, 1999; Lancioni & Oliva, 1999;

Lancioni, Oliva, & Bracalente, 1995a; Lancioni, Oliva, & Bracalente, 1995b; Lancioni, Oliva, & Ten Hoppen, 1997; Lancioni, O'Reilly, Oliva, & Bracalente, 1998).

Assuring safety within the community is one of the most challenging aspects of providing individuals with disabilities the chance to be independent. This independence includes accessing the community, navigating safely when in the community, and returning safely to the original starting point. However the challenges faced by individuals with disabilities are great, especially when talking about accessing and using public transportation. Yet according to Rosenkvist, Risser, Iwasson, Wendel, and Stahl (2009), training individuals with disabilities to use public transportation is one of the least researched areas. Individuals with disabilities may have a difficult time being able to find suitable transportation to complete their desired task and, once in the community, these individuals may forget why they have come out and how to get to their destination, and may get lost or disoriented (Rosenkvist et al. 2009).

Although research in this area is scarce, some research on independence in the community is beginning to emerge in the literature. Understanding the navigational patterns and needs of individuals with disabilities has been the first step in developing tools to be utilized by individuals with disabilities. Sohlberg, Todis, Fickas, Hung, and Lemoncello (2005) conducted several focus groups with individuals with disabilities, care providers, and transit workers to determine the travel patterns for individuals with disabilities, how they access the community, with whom they access the community, how often they access the community, for what purposes, and what type of device could be designed to aid individuals to decrease barriers to independent travel.

The first part of the study focused on documenting the navigational patterns of 6 individuals and for what purposes the individuals went out into the community. After

tracking these individuals for 4 months, researchers found that errands such as going to the mall, grocery shopping, and banking were the most frequent trips taken into the community. Other trips into the community included going to church, medical appointments, work/ school, neighborhood trips, family visits, and restaurants. They also found that if trips into the community were taken independently, participants were more likely to walk or take the bus. When assisted by care providers these individuals walked, used a chauffeur such as taxi or other car, used the bus, or were taken in the facility van. Interestingly, researchers found that participants did not generalize the use of one mode of transportation across different tasks. For example if an individual habitually took the bus to go to the mall every Wednesday but walked to the store every Thursday the same individual would not take the bus to the store or walk to the mall.

In the second part of the study Sohlberg et al. (2005) conducted focus groups with individuals with disabilities, care providers, and transit workers. The aim of these focus groups was to determine some of the challenges that individuals with disabilities, specifically individuals with traumatic brain injuries, face when they go out into the community, strategies that are used to minimize errors when out in the community and suggestions the groups might have for an assistive device. Some of the challenges faced by the individuals were fear of getting lost, getting separated from a travel companion, forgetting the destination, fear of asking strangers for help, expenses associated with taxis, concerns about safety, and following written directions. Some of the strategies used by individuals with disabilities were getting written directions, showing the directions to bus drivers, avoiding/ limiting travel, going with family, using landmarks, staying in one place if lost, and getting directions on palm pilot or cell phone. The groups also gave suggestions to researchers on what features they would find helpful in

an assistive device. These features included a beeper to locate a companion, the ability to personalize directions with landmarks, repetition of audio directions, the ability to back track, a save option for repeat trips, a help button, the provision of training for device use, options for low vision, the provision of location updates, a link to bus GPS, and the ability to track riders who are in the system and make route corrections mid-route. This study showed how the independence of individuals with disabilities is affected by their difficulties traveling and how their difficulties could be overcome through assistance from a travel device.

Further research by Sohlberg, Fickas, Hung, and Fortier (2007) used the findings from Sohlberg et al. (2005) to develop and test the effectiveness of using a PDA to deliver four different prompting methods and to see which prompting method was most effective. The four prompting methods were an aerial map, a point of view map with arrows superimposed on the picture, text based step-by-step instructions, and verbal step-by-step instructions. Participants of the study were given four different routes to follow on foot with the four different prompting methods. The researchers found that the best prompting method for these individuals was verbal step-by-step instructions.

According to Rosenkvist et al. (2009) some people with disabilities often do not even consider using public transportation or only consider using public transportation in the distant future due to factors such as the advice from other individuals around them not to use the bus because of potential dangers, the inability to handle performing complex series of tasks that are high paced, and forgetting how to use the bus. By investigating issues such as the navigational patterns of individuals with disabilities, modifications to the current system, and the development of prompting devices that can assist these individuals, researchers can afford independence to individuals with disabilities within

the community that was not available before. Some research by Fischer and Sullivan (2002) focused on understanding the barriers experienced by people with cognitive disabilities, designing a user friendly model to reduce the cognitive load for individuals with cognitive disabilities within public transportation, and implementing their design in the real world.

Fischer and Sullivan (2002) found that a) mistakes made by familiar and unfamiliar users fall into 2 categories, system errors (mislabeled buses, buses not running on time, detours from bus routes), and user errors (falling asleep, failing to hear or understand announcements, forgetting to signal for the appropriate stop, and getting off at the wrong stop) and b) even familiar users of public transportation made mistakes when using traditional navigational prompts such as maps, schedules, signs, landmarks, and clocks. These findings led the researchers to propose two strategies for developing a user friendly model for individuals with disabilities. The first was to simplify the current navigational prompts used by the public transportation system and the second was to design and develop a technology-based device to deliver individualized prompts at the appropriate time. The authors decided that the second option would be better given that existing navigational prompts already use simplification measures such as the color coding of maps. The outline given for such a device included a schedule and activity management system, a system to share schedules with caregivers, and automated error detection with performance feedback, recovery, and care giver notification.

Although the study described above did not provide an actual device that could be tested, such a device would be the next step in providing independence to individuals with disabilities. The Travel Assistance Device (TAD) is a device that has been developed by a team in the engineering department at the University of South Florida. This device is a

navigation software program designed to prompt individuals via a cell phone to exit the bus at a pre-scheduled location. Once the software is downloaded to the cell phone, parents, travel trainers, or other authorized individuals can access the web management page to schedule bus routes to be transmitted to the cell phone. The TAD offers real time tracking of the cell phone via the web management page, phone alerts for the user on the bus, an alarm that triggers when the user deviates from the pre-scheduled route, and arrival times for the bus the individual is waiting for. Two separate conceptual tests have been performed to assess whether each of the different components of the TAD works consistently and adequately (Winters, Barbeau, & Georggi, 2010). These tests showed that when the TAD was active each of the features of the device worked as it was intended. Because these two conceptual tests were designed only to test whether the TAD's features worked as intended, tests were still needed to see if the TAD had the ability to gain stimulus control over the transit rider's behavior. The purpose of this research study was to determine whether the prompts given by the TAD would exhibit stimulus control over the participant's behavior of pulling the cord to stop the bus at the appropriate time and exiting the bus at the appropriate stop. Stimulus control refers to the increased probability that a behavior will occur in the presence of a particular stimulus because that behavior was reinforced in the past when that environmental stimulus was present (Miltenberger, 2008).

## Method

### *Participants and Setting*

Participants were three individuals with moderate mental retardation. The participants were ambulatory and had previous travel training on how to use public transportation but were unable to travel a novel route on the bus independently. Travel training for each of the participants was tailored to their individual need. The travel trainer establishes one to three locations that the trainee travels to or wishes to travel to and then provides the trainee with pictures of each location to act as a visual prompt when riding the bus. He then accompanies the participants to each of these locations, teaching the trainees how to deposit their money or show their bus pass, select a seat near the door, recognize the bus stop before the location in their picture, pull the bus cord when they pass the stop before their stop, and exit the bus.

Mark was a 22 year old male diagnosed with moderate mental retardation and Benign Congenital Hypotonia. Mark was travel trained in 2008 and used the bus approximately 5 times a week using the same bus and route each time. Paige was a 20 year old female diagnosed with Down syndrome and moderate mental retardation. Paige was travel trained in 2004 and used the bus approximately 5 times a week using the same bus and route each time. Clark was a 25 year old male diagnosed with Down syndrome and moderate mental retardation. Clark was travel trained in 2004 and did not use the bus to access the community at that time. The observations for baseline and intervention phases were conducted on the city transportation system in a metropolitan area. Training for the

Travel Assistance Device (TAD) took place by providing participants with behavioral skills training (BST) in a classroom setting.

### *Target Behaviors and Data Collection*

The target behaviors marked for increase when utilizing the TAD were pulling the bus cord to signal the desired bus stop within 5 seconds of passing the bus stop before the appropriate stop and exiting the bus at the appropriate stop. Participants received 1 point if they pulled the bus cord signaling their stop at the correct location and within the time limit. Participants received another point if they then exited the bus at the correct location. If participants failed to pull the cord at the appropriate location and time then they automatically received a 0 for the assessment, even if they exited the bus. The score was assigned in this way because a person first has to pull the cord to get the bus to stop before exiting.

Data were also collected on whether the participant looked at TAD when it vibrated, whether the TAD provided the prompts at the appropriate locations, whether the participant asked people for directions to his or her location, and any observational data on what the participant was doing while on the bus. The bus routes chosen for assessment were different on every assessment. The routes were chosen based on the participants' current and past travel patterns. Bus routes that the participants traveled on more than once a week were excluded from assessments due to the possible confounding variable of practice effects. Also, any bus stop that provided a connection to another bus route was excluded because at these bus stops the names of the streets are announced for riders; however the bus passed through these bus stops on the way to the participant's appropriate stop.



### *Interobserver Agreement*

Interobserver agreement (IOA) was assessed for 33% of the trials in each phase of the study and was calculated by dividing the number of agreements by the response opportunities. A small hand held video camera was used to record the participant and was viewed separately by a research assistant. During the first baseline IOA was calculated to be 83%. During the first post-training phase IOA was calculated to be 100%. During the second baseline phase IOA was calculated to be 100%. For the final post-training phase the IOA was calculated at 100%. The overall IOA for all phases was calculated at 95.8%.

### *Social Validity*

Social validity was assessed by giving parent social validity surveys before baseline and after the completion of the study. The surveys were intended to capture how parents felt about their child using public transportation with and without an assistive device, and to capture how the parents feeling changed from before to after their child was able to use the TAD. The surveys asked questions focusing on how often each participant used the bus system, how confident the parents were in their child's ability to use the bus system to access familiar and novel locations, how confident would they be if their child had an assistive device, and how confident they were in their child's ability to access new locations when their child used the TAD. These surveys can be seen in appendices A and B.

### *Travel Assistance Device*

The Travel Assistance Device (TAD) is a computer software program for cell phones that prompts a transit rider using audio, tactile (vibration), and visual prompts to pull the bus cord when the bus is approaching the appropriate bus stop. Users of the TAD

system can access and download the TAD mobile phone software from a web site developed by researchers in the engineering department at USF. Desired trip itineraries can be planned by users via the TAD website and saved for future travel purposes on the phone as well as on the web. Once the users have planned their trips on the web, they can then access their pre-planned trips on their phone.

The TAD delivers two sets of prompts to the participant during a given trip. The first prompt is delivered once the bus comes within 300 meters of the desired bus stop. The prompts consist of the TAD vibrating and providing an audio prompt, “Get ready.” The second set of prompts occurs once the phone passes the bus stop prior to the desired bus stop. The prompts consist of the phone vibrating and then providing the audio and visual prompt, “Pull the cord now.” The phone continually vibrates and provides a visual and audio prompt to “Pull the cord now” until the participant responds to the prompts by pressing a button on the phone.

### *Procedure*

The effects of the TAD were evaluated in an ABAB research design (A = baseline and B = post-training). If the TAD was not effective, in-situ training would be provided and evaluated in a reversal design. As previously mentioned each participant had received travel training focusing on using public transportation. The travel training program for each of the individuals was custom designed to fit the ability and needs of the participant. All programs addressed how to use public transportation to access trips frequently taken by the participant at that time, such as to and from work and to and from home.

*Baseline and post-training.* For the purpose of this study there were two types of research assistants (RA), an RA who was familiar to the participant (familiar RA) and an

RA who the participant did not know (inconspicuous observer or unfamiliar RA). During all phases participants were observed by inconspicuous observers on the bus to gather data and to ensure the safety of all participants. During assessments, participants met two familiar RAs at a local transit center. Transit center start locations for the first baseline assessments were chosen by each participant. Transit center start locations for further assessments were randomly assigned and were limited to 4 transit centers. The familiar research assistants introduced themselves to the participant when they arrived at the transit center. The primary researcher instructed the participant to follow him or her to X bus. The primary researcher then told the participant that he or she was going to take a short trip on X bus making sure to point to the appropriate bus. The primary researcher then told the participant that this bus trip would be new for him or her and the participant would exit the bus at a new location too. The primary researcher told the participant to try his or her best to get off the bus at the new bus stop. The primary researcher told the participant that even though the bus stop was new and might be difficult to find, the researchers will make sure the participant gets off the bus and he or she would be safe. The primary researcher then told the participant that he or she would take the bus to the bus stop at X location and asked the participant to repeat the bus stop location. If the participant repeated the correct location the primary researcher delivered verbal praise which again stated the bus stop location. For example: "Good job remembering you need to get off the bus at the corner of Fletcher and Nebraska." If the participant did not state the correct location, the primary researcher restated the location of the bus stop and then asked the participant to state the location once again. The location was repeated to the participant until he or she stated the correct location. The primary researcher then told the participant that the bus would leave at X time and he or she should get on the bus.

The participant and the inconspicuous observer were observed boarding the bus by the primary researcher. The second familiar RA observed the primary researcher delivering the directions to the participant then left the transit center to go to the appropriate bus stop to wait for the participant's bus. The inconspicuous observer boarded the bus after the participant in order to sit near enough to the participant to hear and directly observe the participant. The primary researcher observed the bus leaving the curb before going to her car to follow behind the bus.

Each trial began once the participant and the inconspicuous observer were both on the appropriate bus. The trial was ended once the participant and inconspicuous observer exited the bus. The bus rides were no more than 20 minutes in length for each trial as dictated by optimal travel time provided on the HART website. The average bus trip taken by participants was 11.8 minutes in length with a range between 6 minutes and 20 minutes. Once on the bus, the inconspicuous observer offered no feedback or aid to the participant unless the participant was being given in-situ training. If the participant failed to pull the cord after the bus had passed the bus stop immediately before the appropriate stop, the inconspicuous observer pulled the cord to ensure that the bus stopped at the appropriate location. During baseline it was unnecessary for the inconspicuous observer to pull the cord because another familiar research assistant was visibly waiting at the stop. Having a second RA standing at the bus stop ensured the bus would stop at the appropriate stop. If the participant did not exit the bus once the bus stopped at the appropriate location, the familiar RA at the bus stop entered the bus and informed the participant that this was his or her stop and the participant needed to exit the bus. The primary researcher followed behind the bus during all phases of the study. Following the bus served two functions, it allowed the primary researcher to provide transportation back

to the starting location for either the participant or the inconspicuous observer, and in the event that the participant exited the bus at the wrong location it allowed the primary researcher to pick up the participant without the inconspicuous observer having to reveal him or herself. Due to the limited numbers of RA's for this study, this was a great benefit in that it retained the anonymity of inconspicuous observer. Once the participant exited the bus the familiar research assistant who was waiting at the bus stop provided transportation back to the transit center. The primary researcher then provided transportation for the inconspicuous observer to the transit center. In the event that the participant pulled and exited the bus before the appropriate location was reached the inconspicuous observer exited the bus with the participant. The researcher who followed the bus then stopped and picked up the participant. The inconspicuous observer did not reveal him or herself to the participant but ensured that the participant was safe while not on the bus.

*TAD training.* Training for the TAD consisted of behavioral skills training (BST) which consisted of instructions, modeling, rehearsal, and feedback (Himle, Miltenberger, Flessner, & Gatheridge, 2004). Each participant was trained individually as he or she moved from the first baseline phase to the first post training phase. Training was only done once with no booster sessions in between trips or phases. The verbal instructions described how the TAD operates, what prompts would be given by the TAD, and how to respond to the prompts. The modeling consisted of allowing the participant to hear the prompts, and showing the participant how to respond to the prompts. Rehearsal consisted of the participant hearing the prompts given by the TAD and following the prompts given by the TAD in a simulated setting. Verbal praise was provided to the participant as well as corrective feedback as needed. The training for the TAD was carried out in a

classroom setting using a simple simulated bus set-up. This set up consisted of chairs lined up to simulate bus seats and a string attached to the wall that simulated the cord that needed to be pulled on the bus. Following training, participants participated in at least 3 assessments designed to evaluate the TAD. The length of training for each of the participants ranged from 3 minutes to 5 minutes.

*In-situ training.* In-situ training was never needed for this study; however it would have been conducted by the inconspicuous observer following three incorrect trials during the assessments. During the in-situ training the inconspicuous observer would board the bus after the participant and would sit behind him or her. Once the prompt to pull the cord had been issued to the participant, the inconspicuous observer would have allowed 3-5 seconds to pass with no response from the participant. The inconspicuous observer would then pull the bus cord, tell the participant he or she did not respond to the prompt given to by the TAD, and then instruct the participant to pull the cord.

## Results

Figure 1 shows the results from each participant. Trials are presented on the x-axis and steps completed are presented on the y-axis. In baseline all participants scored a zero on all assessments, indicating that they did not pull the cord or exit the bus at the appropriate time. After intervention, all participants scored a 2, indicating that they pulled the cord and exited the bus at the appropriate bus stop. During the reversal to the second baseline, all participants scored a zero and during the second intervention phase, all participants scored a 2 in all assessments. Further data taken during assessments found that the TAD provided all prompts at the correct locations. In addition none of the participants looked at the TAD when the phone vibrated and provided the audio prompt of “Get Ready”. Mark asked the bus driver where his bus stop was on the very first baseline trip. For further baseline and post training trips he did not ask anyone any questions. Paige called her mother on the very first baseline trip to ask her mother where her bus stop was but made no more calls after that first trip. Carl made no attempts to ask for directions from anyone while on the bus.

It should be noted that the time between the first post training assessments and the second post training assessments differed for each individual. For Mark there were 23 days in between trial 2 and 3 of the first post training phase. From the end of the first post training phase and start of the second post training phase there were 6 days. For Paige there were 14 days in between the completion of the first post training phase and the beginning of the second post training phase. For Carl there were 8 days in between the

completion of the first post intervention phase and the beginning of the second post training phase.

The social validity results showed the mean confidence level for parents pertaining to their child's ability to travel to new locations before using TAD equaled 1.3 (1 = not at all confident, 5 = very confident). The mean confidence level for parents pertaining to their child's ability to travel to new locations when using TAD equaled 4.3. Table 1 provides the full results from the social validity surveys for each participant before and after the study.



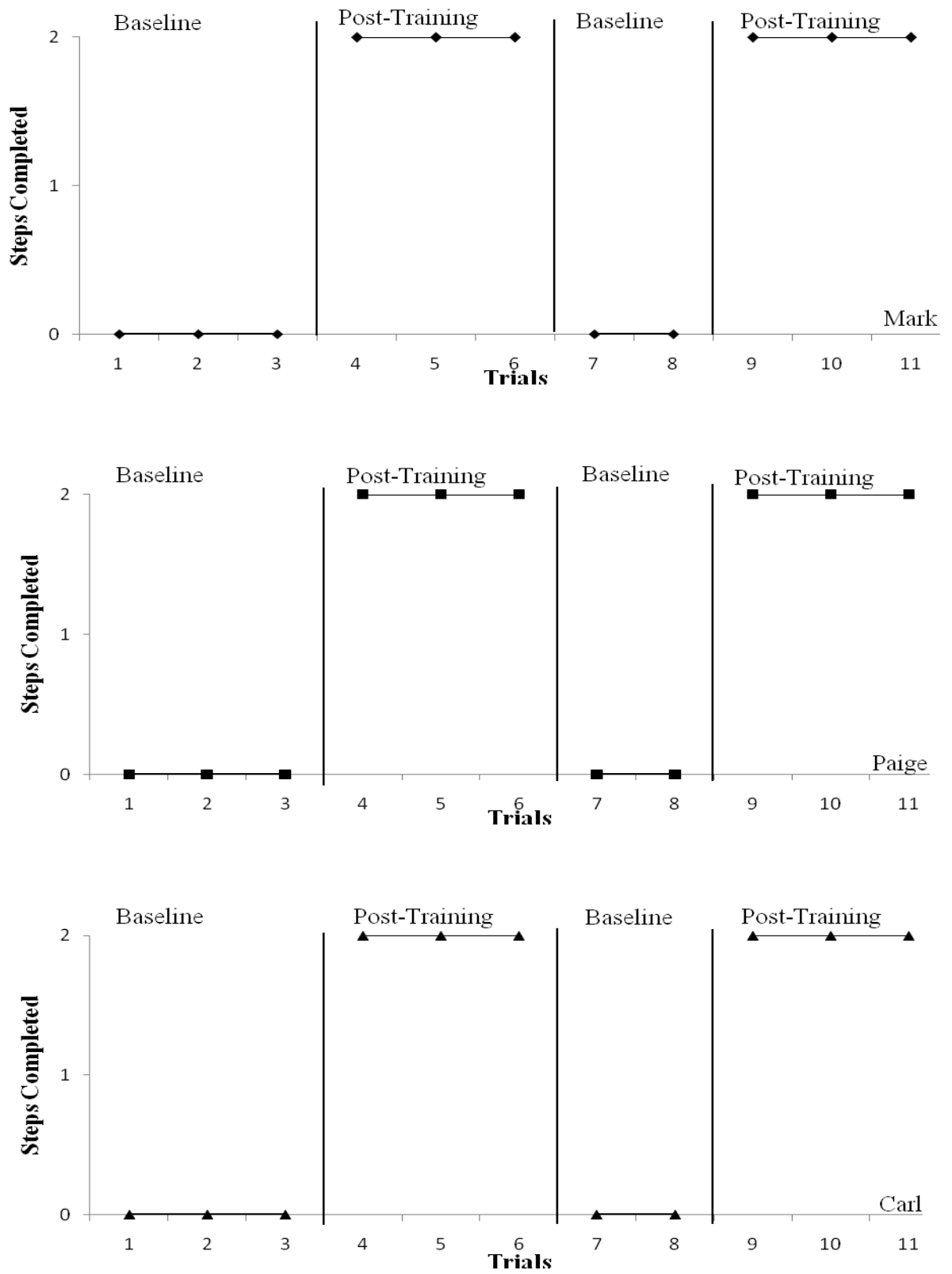


Figure 1. shows steps completed on the y-axis and trials on the x-axis for each participant.

*Table 1.* Results from the social validity surveys pertaining to the parent’s attitudes and beliefs about their child’s ability to access the community using public transportation.

	Mark	Paige	Carl		Mark	Paige	Carl
	Before	Before	Before		After	After	After
To what extent does your son/ daughter/ client want to travel independently?	5	5	4	To what extent does your son/ daughter/ client want to travel independently?	2	5	5
To what extent do you want your son/ daughter/ client to travel independently?	4	4	4	To what extent do you want your son/ daughter/ client to travel independently?	5	5	4
How confident are you in your son/ daughter/ client’s ability to get off the bus at the correct bus stop?	2	5	3	How confident are you in your son/ daughter/ client’s ability to use public transportation to reach new locations using the TAD?	4	5	5
How confident are you in your son/ daughter/ client’s ability to use public transportation to reach new locations?	2	1	1	In general how confident are you in your son/ daughter/ client’s ability to use public transportation when using the TAD?	4	5	5
How confident would you feel if your son/ daughter/ client had an assistive device when using public transportation?	4	5	4	Would you like your son/ daughter/ client to use the TAD again when using public transportations?	Yes	Yes	Yes

Note: 1 = no desire or not at all confident, 5 = very confident or strong desire

## Discussion

The current literature shows that with the advancement of technology, devices can be created to assist individuals with disabilities to increase their independence. The least researched and developed area is independent travel in the community. This study provides supporting evidence that, following one brief behavioral skills training session, the TAD was an effective device for prompting individuals to pull the cord indicating their stop and exit the bus at the appropriate location. During both baseline phases without the TAD, participants did not pull the cord indicating their stop at the appropriate times and without the safety measure put into place for this study, the bus would not have stopped. Failing to pull the cord at the correct time would increase the possibility that an individual would have missed his or her stop and ultimately could have gotten lost. With the prompts given by the TAD the participants were pulled the cord and exit the bus at the appropriate locations. During assessments it was observed that if the participant had the phone closed when the prompt to “pull the cord now” was delivered, they did not open the phone to look at the visual prompt. All participants waited to deactivate the vocal prompt until they had exited the bus. Although the use of the TAD might seem unnecessary as an individual riding the bus might just ask the bus driver for assistance as a way to ensure exiting at the correct stop, such a strategy is not always successful. This point was illustrated by one participant in particular, Mark. On the very first trip during baseline Mark asked for assistance from the bus driver, which was permitted because in the natural environment it is highly likely that people ask for assistance while on the bus. When asked for assistance the bus driver told Mark the wrong bus stop. Due to this information Mark got off the bus at the wrong stop and had to be picked up early,

therefore showing that asking for help, although a seemingly sensible travel assistance strategy, does not always lead to successful completion of a bus trip for individuals. This device has the potential to afford independence for individuals with disabilities who desire to travel independently by giving these individuals a tool that will assist them in finding the places they want to travel. It also provided the individuals in the study with security during their trips. During baseline assessments all of the participants expressed anxiety or concern when traveling without the TAD to the unknown locations. One participant, Paige started every baseline trip by saying, “I don’t know where that is at.” However, once she was given the TAD she did not express any concern about the location she was asked to ride the bus to. Social validity surveys collected from the parents of the participants before and after the study show that before using the TAD parents were not confident to somewhat confident in their child’s ability to get off the bus at familiar and novel bus stops. Surveys given to the parents after the study showed that, when the participants used the TAD, parents were confident to very confident in their child’s ability to get off the bus at familiar and novel bus stops. Parents also stated that they would like their child to use the TAD again when using public transportation. None of the participants for this study expressed their concern that the TAD was in any way stigmatizing when they were using it; however the authors recognize that there is potential for this to occur. This potential is somewhat counter balanced with the volume control of the phone. Furthermore, if headphones can be used, then they might reduce any concern of being stigmatized while using TAD.

When beginning this study the researchers experienced a setback that requires mentioning. Once researchers and participants were ready to begin assessments the cell phones that the developers of TAD had been using had to be switched with new phones.

The software then had to be down loaded onto the new cell phones and then had to be modified to be compatible with the phones. The modifications that were required pushed back the start dates of the study. Although this delay did not affect the data collection for this study, it brings up a related issue with the reliability of cell phone service and the TAD system. There is the possibility that the cell phones used during the assessments would lose service connection when in operation. Because the TAD software relied on GPS and the service connection of the cell phone, if for some reason the phone lost service, the TAD software on the phone would not connect with the GPS coordinates required to prompt the individuals to pull the cord and exit the bus at the correct location. Hypothetically, if the cell phone lost service while the TAD application was running and, depending on how long the interruption lasted, the TAD could fail to deliver the prompts necessary for the individual using the TAD. Fortunately, the developers of the TAD built in a safeguard that would protect individuals in case the above scenario did occur. The TAD software has the ability to notify a third party that the individual using the device has failed to respond to the TAD or failed to get off the bus at the correct location. This safeguard would lessen the probability that an individual would get lost while traveling in the community.

Although this study shows good evidence supporting the use of an assistive device to gain independence in the community there are some limitations to this study related to generalization. First, all participants in this study were diagnosed with the same level of mental retardation. The results from the study show favorable outcomes for these three participants with moderate mental retardation; however more research needs to be conducted with a more diverse population to determine if the TAD is a device that can be used by individuals other than those with moderate mental retardation, particularly

individuals with more limited intellectual abilities. Other populations that could benefit from an assistive device when traveling are typically developing individuals who travel to new locations and do not know the area, elderly individuals, people with brain injuries, and those with visual impairments. Second, all participants had been previously travel trained to use the local bus system. One of the parameters for selecting participants for this study was that all participants had to have been trained to use the city bus. Although the years between when each of the participants was trained to the beginning of this study varied from participant to participant and the frequency of using the bus varied, they were all previously taught a specific set of skills to be able to use the city bus to access frequently taken trips on the city bus. This study did not look at whether individuals who were not travel trained would be able to use the TAD as successfully as those who had been travel trained.

Additional studies are needed to assess what level of independence individuals using this device will experience. The current study only assessed how the participants responded to TAD when the TAD application was already activated and the bus trip had been selected. In order for the TAD to provide prompts, the phone must be programmed with the bus stop locations, the application on the phone must be turned on when using the TAD, and each stop must be selected once the TAD application on the phone has been turned on. Future research should focus on whether individuals with disabilities can use the internet to access the TAD website to input bus trips into the system, access the TAD application on a cell phone, and select the desired bus trip. These studies would help clarify who will be able to use the TAD independently and how much assistance individuals might need to be able to use the TAD. Studies that focus on practice effects

should also be conducted to see how many times an individual must take a trip to a particular location before it is unnecessary to rely on the prompts given by the TAD.

Another area for future research would be to assess the effectiveness of the TAD for more complex bus trips, such as those that require a transfer. Because transfers from one bus to another to get to a location are common, research of this nature would be important. To conduct such research, the capabilities of the TAD would need to be enhanced and, once the fidelity of the TAD was established, researchers would need to establish the ability of the TAD to exert stimulus control over the behavior of the rider to navigate the bus transfer.

Further research on promoting independent travel in the community for individuals with disabilities might also focus on helping them navigate to a location once they exit the bus at the correct stop. Such research would require a hand held navigation device, perhaps akin to a GPS unit used by drivers, and the evaluation of behavioral skills training procedures to teach individuals to use such a device successfully.

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## Appendices

Appendix A

Parent / Guardian Pre-Study Social Validity Survey

Participant \_\_\_\_\_

1. How often does your son / daughter / client use public transportation?

- a) never
- b) 1–2 times a week
- c) 2-3 times a week
- d) 3-4 times a week
- d) Other: \_\_\_\_\_

2. Does your son/ daughter /client use public transportation independently?

- a) Sometimes
- b) All of the time
- c) Never

3. What locations does your son/ daughter/ client use public transportation to access?

\_\_\_\_\_

4. To what extent does your son/ daughter/client want to travel independently?

1	2	3	4	5
No desire		neutral		strong desire

5. To what extent do you want your son/ daughter/client to travel independently?

1	2	3	4	5
No desire		neutral		strong desire

6. How confident are you in your son/ daughter/ clients ability to get off the bus at the correct bus stop?

1	2	3	4	5
Not at all confident		neutral		very confident

7. How confident are you in your son/ daughter/ clients ability to use public transportation to reach new locations?

1	2	3	4	5
Not at all confident		neutral		very confident

8. How confident would you feel if your son/ daughter/ client had an assistive device when using public transportation?

1	2	3	4	5
Not at all confident		neutral		very confident

Appendix B

Parent/ Guardian post-intervention survey

Participant\_\_\_\_\_

1. To what extent does your son/ daughter/client want to travel independently?

1                      2                      3                      4                      5

No desire                                      neutral                                      strong desire

2. To what extent do you want your son/ daughter/client to travel independently?

1                      2                      3                      4                      5

No desire                                      neutral                                      strong desire

3. How confident are you in your son/ daughter/ clients ability to use public transportation to reach new locations when using the TAD?

1                      2                      3                      4                      5

Not at all confident                                      neutral                                      very confident

4. In general how confident are you in your son/ daughter/ clients ability to use public transportation when using the TAD?

1                      2                      3                      4                      5

Not at all confident                                      neutral                                      very confident

5. Would you like your child/ client to use the TAD again when using public transportation?

Yes

No