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BRIEF PRACTICE

Teaching Young Adults with Intellectual and Developmental Disabilities Community-Based Navigation Skills to Take Public Transportation

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Abstract Facilitating the use of public transportation enhances opportunities for independent living and competitive, community-based employment for individuals with intellectual and developmental disabilities (IDD). Four young adults with IDD were taught through total-task chaining to use the Google Maps application, a self-prompting, visual navigation system, to take the bus to locations around a college campus and the community. Three of four participants learned to use Google Maps to independently navigate public transportation. Google Maps may be helpful in supporting independent travel, highlighting the importance of future research in teaching navigation skills.

- Learning to independently use public transportation increases access to autonomous activities, such as opportunities to work and to attend postsecondary education programs on large college campuses.
- Individuals with IDD can be taught through chaining procedures to use the Google Maps application to navigate public transportation.
- Mobile map applications are an effective and functional modern tool that can be used to teach community navigation.

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Community inclusion and integrated employment are common but often difficult-to-achieve goals for adults with intellectual and developmental disabilities (IDD). To increase successful outcomes, transition programs should focus on developing functional life skills that prepare adults with IDD to live and work independently. Transportation is one of the largest barriers hindering individuals with IDD from achieving independence and maintaining employment (McMahon, Smith, Cihak, Wright, & Gibbons, 2015; Mechling & Savidge, 2011; Mechling & Seid, 2011; Stock, Davis, Hoelzel, & Mullen, 2013). The current study was designed to teach young adults with IDD to use the Google Maps application to take the bus around a college campus and in the community.

In addition to having difficulties with accessing transportation, individuals with IDD often require direct teaching to read bus schedules and paper maps and to make transfers. Such skills require comprehension, memory, attention, time management, literacy, multitasking, and problem solving (Davies, Stock, Holloway, & Wehmeyer, 2010). The availability of smartphones with map applications (apps) that use Global Positioning System (GPS) technology may help to circumvent these cognitively loaded skills (McMahon et al., 2015).

Previous research indicates that adults with IDD can independently navigate a public bus route using a GPS-based software program (Davies et al., 2010; Stock et al., 2013). The GPS-based program led not only to more successful navigation attempts (compared to in vivo teaching using a paper copy of a map; Davies et al.) but also to faster skill acquisition and generalization to a novel route (Stock et al.). Although promising, this program required customization, limiting opportunities for spontaneous independent travel to novel locations. More recently, McMahon et al. (2015) examined successful walking navigation using three different navigation aids (printed map, Google Maps on a mobile device, and an augmented reality navigation app). Students were more independent using the augmented reality and Google Maps app compared to the paper map.

Given the positive outcomes for following walking directions and the automation of the Google Maps app, this might be a promising new technology to teach independent navigation of public transportation. Thus, by combining the methods of previous research, the current study assessed whether young adults with IDD could be taught to use Google Maps to navigate the public transportation system. Specifically, because the Google Maps app uses GPS technology to determine the user's location and to provide the best travel route for public transportation and then provides directions through mobile, visual, and auditory prompts, this app could increase opportunities for independence.

Method

Participants and Setting

One man and three women attending a school-to-work transition program on a large public university campus participated. Joe[1] was a 24-year-old man diagnosed with autism spectrum disorder (ASD). Molly[1] was a 25-year-old woman with Down syndrome. Arielle[1] was a 17-year-old young woman with mild intellectual disability (ID). Sarah[1] was a 19-year-old woman with mild ID. All participants could follow multiple-step directions. The study was conducted on campus, before and after participants transitioned to and from their internship sites. Informed consent was obtained from participants and their guardians.

Experimental Design

A multiple-probe design across participants was used to assess skill acquisition, maintenance, and generalization across settings (Gast & Ledford, 2014).

Procedure

Data Collection

A 15-step task analysis was developed of the essential steps for using Google Maps to take the bus from a starting location to an assigned destination (see the appendix). The dependent variable was the percentage of steps completed independently. The number of prompted and independently completed steps was scored for each probe. Because every step in the task analysis was essential for participants to successfully travel independently, mastery criterion was set at 100% of steps completed independently for 2 consecutive days.

Baseline

During baseline, the researcher presented the vocal instruction "You are going to take the bus to _____" and then observed and documented the number of steps in the task analysis that the participant completed independently. Once the participant indicated that he or she did not know what to do next or when he or she made a mistake in the task analysis, the probe was terminated. The remaining steps were marked as incorrect, and the participant was sent back to the classroom. No subsequent instruction or reinforcement was provided for that session.

Intervention

Students were taught to take the bus using the Google Maps app through a fading procedure that consisted of three phases. In the pretraining phase, implemented prior to the first baseline probe, participants were introduced to the Google Maps app on their smartphones. In a group, participants were shown the tools within the app, including (a) the icons for current locations and destinations, (b) the icons for the five modes of transportation, (c) the visual prompts to determine applicable routes and directions, and (d) the "blue arrow" button to initiate a directional prompt. Students then practiced opening the app, entering their current and desired locations, and pressing the "Bus" icon for three on-campus locations. They did not take the bus during the pretraining session.

In the second phase of intervention, participants were taught to use the Google Maps app through total task chaining and constant time delay prompting procedures. To begin each probe, the researcher presented the vocal instruction "We are going to go ride the bus to _____" and then waited 3 to 5 s for the participant to complete the first step of the task analysis (e.g., pull out his or her phone and open Google Maps). If the participant did not initiate the first step within 3 to 5 s, the researcher provided a verbal and gestural prompt (e.g., "Take out your phone and open Google Maps"). This procedure then continued through each step of the task analysis, with the researcher waiting 3 to 5 s for the participant to complete each step independently before providing a prompt. Students completed this phase when they met the criterion of independently completing 100% of the steps in the task analysis across two consecutive sessions.

In the final phase of intervention, proximity to the participant was faded; participants traveled on the bus alone and the researcher met them at the predetermined location. The researcher only intervened if the participant walked to the

[1] This is a pseudonym.

incorrect starting bus stop, at which time the researcher prompted the participant to check his or her accuracy and walk to the correct bus stop (and scored that step as prompted). Once the participant boarded the bus, one researcher followed the bus by car, and another met the participant at the destination's bus stop. If the participant did not get off the bus at the destination bus stop, the researcher continued to follow the participant until he or she got off at a stop. The researcher then told the participant that he or she did not get off at the correct stop and discussed the mistake. Participants met criterion for this final phase when they independently completed 100% of the steps across two consecutive sessions.

Generalization and Maintenance

Using the procedures described for the proximity-fading phase, generalization probes were conducted to assess whether participants could use the Google Maps app to travel to novel locations on and off campus. All generalization locations were new destinations to which the participants had never before taken the bus. Maintenance probes were conducted once every 3 weeks to assess whether students could use the Google Maps app to travel to previously visited locations.

Mass Trials

Mass trials were implemented for two participants for whom data suggested a lack of skill acquisition for a specific step(s) within the task analysis. For each mass trial session, the participant was provided with 10 opportunities to describe how to use Google Maps to take the bus to a specified location (locations varied each session). Criterion was met when the participant accurately described all of the steps within the task analysis for nine out of 10 trials for two consecutive sessions.

Reliability

Interobserver agreement (IOA) was collected for 53.5% of data collection sessions. IOA data were taken using the task analysis by both an observer and a data collector; the number of agreements was divided by the number of agreements plus disagreements multiplied by 100. Mean agreement of independent responses on the task analysis was 99.7% (range of 79%–100%).

Results

During his first baseline probe, Joe independently completed 93% of the essential steps. Because it was apparent that he was able to use Google Maps to take the bus and only needed instructions on a few steps within the task analysis, Joe was immediately moved into the intervention condition. Joe met mastery criterion of independently completing 100% of the steps for 2 consecutive days within seven sessions across four different campus locations. After researchers faded their proximity for the final phase, Joe met mastery criterion within three sessions across three locations. He achieved 93% or higher across all 12 generalization or maintenance probes, including seven novel locations on and off campus.

During three baseline probes, Arielle independently completed a mean of 7% of steps. After 15 sessions of variable responding in intervention, a mass trial condition was introduced. She met criterion for the mass trial condition within 4 days and subsequently displayed the ability to use Google Maps to take the bus with 100% accuracy. When proximity was faded, she met mastery criterion within 2 days across two locations. Arielle independently completed 100% of the steps during the single generalization probe to a novel off-campus location.

After pretraining, Molly independently completed 33% of the steps during baseline. Because she displayed knowledge of several steps and the classroom teacher wanted the students to begin riding the bus immediately, the researchers began intervention with Molly after one baseline probe. She reached mastery criterion within 19 sessions across seven campus locations. After researchers faded their proximity, she met criterion within five sessions across four locations. Molly independently completed 93% or more of the steps within the task analysis during all five generalization or maintenance probes across three novel locations.

Finally, Sarah independently completed an average of 9% of steps across three baseline probes. Despite prompting, her performance was variable across 16 sessions of intervention, so she was moved into a mass trial condition. Sarah met mastery for the mass trial condition within 4 days and was then moved back into intervention. Unfortunately, her performance continued to be variable, with an average score of 62% of steps independently completed across three locations. Due to time constraints and because Sarah began to complain about the training and expressed disinterest in any further learning to take the bus, intervention was terminated (see Fig. 1).

Discussion

Three of the four participants with IDD learned to use the Google Maps app to independently navigate public transportation. These results extend the research on the effectiveness of using GPS-based technology to teach public transportation navigation (Davies et al., 2010; Stock et al., 2013) and using Google Maps to teach walking navigation (McMahon et al., 2015). This research also provides three important contributions to the literature.

First, because the intervention included training to various locations on and off campus, skills generalized across settings (Stokes & Baer, 1977). The inclusion of generalization probes helped to ensure that participants were able to effectively navigate the public transportation system beyond the university setting. This skill generalization enhances opportunities for independence because public transportation is available in most locations, allowing participants to travel beyond their local community.

Second, rather than simply fading the vocal and gestural prompts, proximity fading was also implemented. Because the presence of the trainer can serve as an unintentional prompt, it was imperative to assess whether participants could still perform all steps of the task analysis in the absence of the trainer. Because we used proximity fading, the participants were able to demonstrate true independence with navigating public transportation.

Finally, the use of Google Maps on the participants' smartphones introduced a nonstigmatizing visual aide within the intervention. This adds to the social validity of the intervention, as it is common practice in the general population to use a smartphone application to navigate public transportation.

Despite the positive results, certain limitations must be considered. First, pretraining sessions were conducted prior to the baseline condition; therefore, some learning may have occurred. This could explain the high percentage of steps completed during baseline for two of the four participants. Despite the lack of extended baseline, the results highlight a steady increase in skill acquisition following start of intervention. Additionally, it is important to note that despite Joe's high baseline, it was still critical for him to complete training because missing even one step would lead to ineffective travel. Future research should consider conducting the baseline probes before pretraining. Still, three of the four participants did not have Google Maps on their phones prior to pretraining; the student who had the app did not know how to operate any of the system's components. Further, only two participants had reported riding the bus prior to training (not independently), and none of the participants had been explicitly taught the steps of navigating public transportation.

Second, two participants displayed variable skill acquisition and required a mass trial training condition. Despite this training, Sarah was not able to meet criterion. Although Sarah was able to take the bus to her work site without prompts, she was inconsistent when riding to novel locations. When asked about this discrepancy, Sarah indicated that she did not want to follow the prompts provided by Google Maps and was instead using visual environmental cues to know when to get off the bus. Future research should examine whether other forms of reinforcement and establishing operations may increase and maintain skill acquisition and overall willingness to participate. Finally, training was restricted to a large university campus; future research should consider implementing the training in a community-based setting. Training from various community locations may help with subsequent generalization and maintenance of the skill across environments.

Despite these limitations, results indicate that Google Maps may be an effective tool to support individuals with IDD in independently navigating public transportation. Although previous research has demonstrated success at teaching individuals with IDD to use augmented reality or GPS-based applications, the use of Google Maps is a more functional and normalized skill. The participants can use their smartphones, something to which they almost always have access, to travel to desired locations. This reduces dependence on parents or others for rides and the need to find and read a hard-copy map or to purchase expensive augmented reality equipment. Teaching these participants to use Google Maps to take public transportation allowed them to

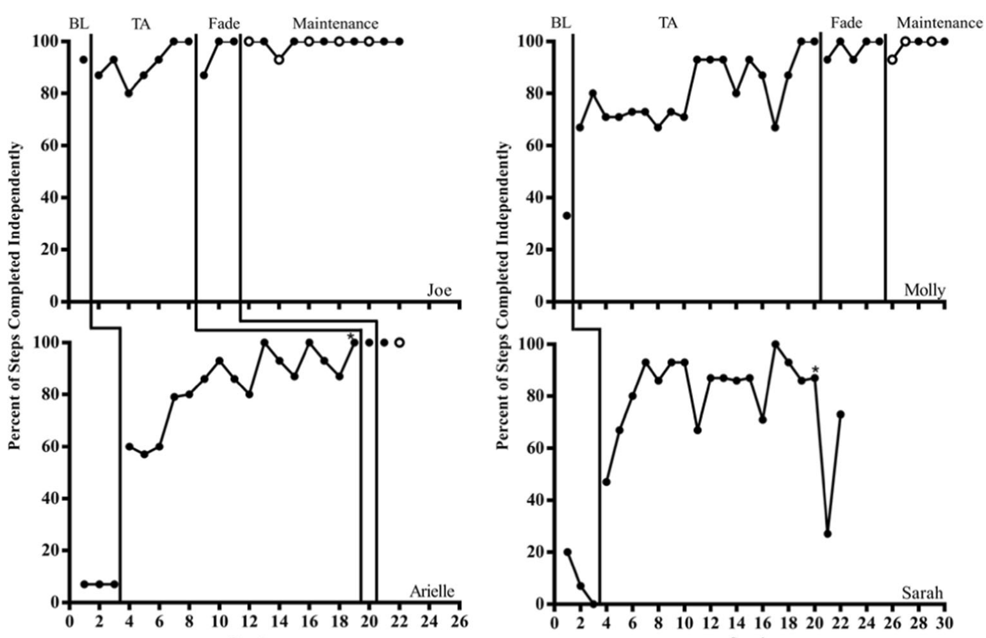

Fig. 1 Percentage of essential steps completed independently during navigation probes across baseline, chaining and constant time delay, trainer proximity fading, and maintenance. BL = baseline; TA = chaining and constant time delay prompting phase; Fade = trainer proximity-fading phase. Asterisks indicate all subsequent sessions conducted after mass trial training; open circles indicate a generalization probe

be more responsible for their own independence, especially when traveling to and from work. Additional research should consider how this skill generalizes and how it may translate to other modes of transportation over an extended period. Finally, it would be beneficial to examine the impact of acquisition of independent travel skills on opportunities for community participation and employment.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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