Inclusion

How Do I Get to the Student Union? Developing Independent Navigation Skills in Students with an Intellectual or Developmental Disability

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Abstract:	About one-fifth of students attending postsecondary education have an identified disability. Navigating campus and the surrounding community may pose barriers to student matriculation, engagement, and quality of life. Therefore, it is imperative that transition-age youth learn skills and strategies to traverse their surroundings. One way postsecondary education programs for students with an intellectual or developmental disability can teach students to navigate a college campus and its community, is through pedestrian navigation using the university smartphone map application. This intervention uses the student's smartphone device and a university map application to guide students as they navigate to specific destinations around campus (e.g., library, classroom buildings, restaurants, student union, and recreation centers). A single-case experimental withdrawal design (ABAB) was used to collect data, demonstrating the intervention's effectiveness in supporting independent navigation to designated locales across a large college campus. This potentially feasible intervention for secondary and postsecondary educators is easy to use because it requires little time, few resources, and only one staff member to implement the intervention. Social validity and implications of this intervention, including application in other settings such as communities surrounding campus, are discussed.

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Author Note

We have no known conflict of interest to disclose.

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Abstract

Navigating campus and the surrounding community may pose barriers to matriculation, engagement, and quality of life for students with disabilities. This intervention uses the student's smartphone device and a university map application to guide students as they navigate to specific destinations around campus (e.g., library, classroom buildings, restaurants, student union, and recreation centers). A single-case experimental withdrawal design (ABAB) was used to collect data for two participants. There was an immediate level change upon introduction of the intervention for both participants indicating a functional relation. Results are suggestive that the presentation and application of wayfinding skills through technology can be successful and have the potential to support more independent lifestyles for persons with an Intellectual or Developmental Disability.

Key Words: Postsecondary Education Programs, Transition, Navigation, Independent Living, Transportation, Intellectual Disability, Single Case Design

How Do I Get to the Student Union? Developing Independent Navigation Skills in Students with an Intellectual or Developmental Disability

A greater number of students with disabilities are pursuing higher education than ever before. As many as one-fifth of students attending college identify as having a disability (National Center for Education Statistics, 2019). This is an ever-expanding percentage as more educators, parents, family members, and students are finding college and other postsecondary education settings to be accessible and realistic options after high school (Shaw et al., 2010). Additionally, legislation such as the Americans with Disabilities Act (ADA, 1990) and The Higher Education Opportunity Act (HEOA, 2008) have facilitated an increased number of students with disabilities attending college. These acts have broken down physical barriers to attendance, opened financial aid supports, and mandated both academic and non-academic accommodations.

Current experimental literature suggests students with disabilities who have college credits, associate degrees, or bachelor's degrees are more likely to be employed than those with only a high school diploma (Cornell University, 2022). Yet, postsecondary education retention and completion rates for students with disabilities are far below their counterparts without disabilities (Murray et al., 2000; Newman et al., 2011; Wessel et al., 2009). One of the greatest advances in making college accessible to individuals with disabilities is the creation of inclusive postsecondary education programs (IPSE) for students with an intellectual or developmental disability (IDD). IPSE programs provide a college experience to students through a variety of academic, social, and independent living activities. These programs provide students with certificates of completion rather than a traditional college degree. Research has shown students who attend IPSE programs are more likely to be employed than students with disabilities who have bachelor's degrees (Cornell University, 2022; Domin et al., 2020). Further, retention rates for IPSE programs exceed traditional degree-seeking programs (National Core Indicators, 2022).

In the last ten years, the availability of IPSE programs for individuals with IDD has increased significantly (Grigal et al., 2021). There are currently 311 IPSE programs across the United States, with at least one in all 50 states (Think College, 2022). While enrolled in IPSE programs, students participate in college coursework and are provided with training in vocational skills through participation in a variety of experiences such as workshops, volunteer work, and internships. These focused vocational experiences often result in more secure employment (Grigal & Hart, 2010; Grigal et al., 2021; Lee & Taylor, 2022; Moore & Schelling, 2015) and greater opportunities for social inclusion (Moore & Schelling, 2015; Qian et al., 2018). Additionally, IPSE programs have the potential to positively impact not only students with IDD but also the campus community at large (Lee & Taylor, 2022). In a recent systematic literature review, 10 of 21 studies reported the positive impact of IPSE programs on the university campus (Lee & Taylor, 2022). These included more positive attitudes toward disability and an increase in disability knowledge and skills for mentors, peers, and instructors (Lee & Taylor, 2022).

Navigation as a Barrier in IPSE Programs

The success of IPSE programs is promising, but barriers to attendance and successful completion exist. Examples of such barriers include a lack of knowledge of campus resources and procedures, inadequate independent travel skills, inaccessible campus landscapes, and lack of buy-in from faculty (Lee & Taylor, 2022; Sanderson et al., 2022). One of the most significant obstacles to the success of IPSE programming is lack of independent travel skills (Lee & Taylor, 2022; McMahon & Smith, 2012). The primary mode of transportation on most college campuses is pedestrian travel, yet navigating campus is a barrier many students struggle with across universities. McMahon et al. (2015) reported many students with IDD have never had the opportunity to navigate without assistance and supervision. Indeed, many have never crossed the street without supervision (Grigal & Hart, 2010). This lack of independence significantly limits campus accessibility, which is why some IPSE programs require independent pedestrian navigation skills as a prerequisite requirement to attendance (Grigal et al., 2012).

Independent travel skills are vital to leading an independent life and accessing the community for students with IDD on college campuses (McMahon et al., 2015; Salmi, 2005). Independent navigation skills enable students to lead full, purposeful lives, while increasing quality of life, facilitating social inclusion, encouraging healthy lifestyles, and enhancing chances of employment (Brown et al., 2011; Salmi, 2005). In addition, independently navigating to desired locations enables individuals to have confidence in learning and traveling to new routes (Brown et al., 2011) which heightens self-determination and community inclusion (Shogren et al., 2009). In short, developing and applying independent navigation skills are not only vital to postsecondary success but also beneficial in developing a variety of other skills.

Navigation Interventions

There are many advantages of teaching independent travel skills through the use of technology using global positioning systems (GPS), such as Google Maps (Cihak et al., 2010; Kelley et al., 2013; McMahon, 2015). Digital resources enable students to access more leisure and education opportunities while on campus and encourage them to explore new places off campus. One of the earliest published studies using technology to aid independent navigation used a handheld personal data assistant (PDA) device to deliver picture, auditory, and video prompts (Mechling & Seid, 2011). Results were encouraging and have led to additional experimental studies seeking to identify best practices and applications for using digital devices for independent navigation skills (e.g., Kearney et al., 2020; McMahon et al, 2015; Richter & Uphold, 2020; Smith et al., 2017). For instance, McMahon et al. (2015) compared effects of a paper map, the Google Maps application, or an augmented reality map on navigation skills. They found independent direction checks increased from 10.9% (paper map) to 46.8% (Google Maps) to 87% (augmented reality map). The technological advancement in McMahon et al.'s study parallels changes in methods and presentation as technology has become more accessible. Researchers have also successfully used digital photos delivered via video iPods (Kelley et al., 2013), specific communication devices like the Cyrano Communicator handheld electronic device (Mechling & Seid, 2011), and specific mobile applications such as the Heads Up Navigator augmented reality program (Smith et al., 2017) to increase independent navigation skills.

Several researchers, in addition to McMahon et al. (2015), have used variations of the Google Maps application to teach independent navigation skills. For example, Kearney et al. (2020) used a peer-mediated instructional package to successfully teach students with IDD how to use Google Maps. In addition, Price et al. (2018) used Google Maps to navigate the public transportation system for independent travel among youth with IDD. In a multiple probe across participants design study, Yuan et al. (2019) successfully used constant time delay on route planning using Google Maps. These previous studies are strong support for the efficacy of using technology with global positioning systems, such as Google Maps, to teach individuals with IDD how to successfully navigate large university campuses.

Purpose

Due to the growing number of IPSE programs, there is a need for interventions focusing on orientation and navigation training for students to enable them to attend coursework, social gatherings, and other community-based activities independently. Furthermore, many postsecondary education programs are staffed with a limited number of paid personnel (Plotner & Marshall, 2014), while other manpower needs are covered by volunteers like peer partners and graduate students. Some programs have 30 or more students needing to travel to three or more locations a day across a large campus. Therefore, teaching independent travel skills is necessary not only for student success but also to allow IPSE staff members time to focus on other barriers students may experience like academic struggles, participation in recreation and leisure activities, and self-care skills. Therefore, an intervention utilizing as little staff as possible to teach independent navigation and travel skills in and around campus is important.

Most research on independent navigation skills for youth with IDD has occurred on university campuses, yet none have used the university's map application to teach participants independent navigation skills. Therefore, our research sought to extend previous research (Kearney et al., 2020; McMahon et al, 2015; Richter & Uphold, 2020; Smith et al., 2017) by utilizing the university's map application from student's hand-held devices to independently navigate to new destinations. To this end, our research question is: What is the effect of direct instruction of a campus-wide map-based navigation intervention for individuals with IDD enrolled in a postsecondary college program?

Method

Setting

The study occurred on a suburban campus spanning 3,500 acres with 15 departmental colleges and approximately 60 buildings (e.g., lecture halls, libraries, student union, athletic complexes, dormitories) on the main campus. Approximately 30,000 students attend classes on campus each year. The IPSE program within the university is a four-year certificate program that offers inclusive on-campus housing, coursework, and internships for students with an IDD. Students also participate in a variety of social organizations such as sororities, fraternities, structured dance club, and band.

The IPSE program provides academic, social, adaptive, and emotional supports to approximately 30 students from freshmen to seniors. Students in this program take college courses with the general population of students at the university including classes like fine arts, music, health, personal financial literacy, geology, and other courses related to students' career interests. Students receive numerous supports from the university staff and students including peer partners, person-centered planning, navigation and orientation supports, mental health services, and tutoring.

Participants

This study was approved by a university Institutional Review Board prior to data collection and participant selection. Participants were recruited from an IPSE program at a large public university. Three participants were chosen through convenience sampling (e.g., freshmen students in the IPSE program) and referrals from the IPSE director. Only two of the students participated in all phases of the study. Before beginning the study, the students were involved in approximately two weeks of orientation. The first was at the University level for all new students. The second was an orientation provided specifically for students in the IPSE program. Before orientation, both were new to the university campus, although one reported they had attended several sports events and were slightly familiar with the campus. English was the native language of both participants. Participants gave verbal and written consent to participate, and pseudonyms of their choice were assigned for confidentiality.

James

James was a 19-year-old, White male classified as a freshman with an IDD. James reported he had been to the university campus before with his parents. He was especially interested in learning how to get to the football stadium. Although James stated he used his phone to navigate to unfamiliar places, he did not specify how he used his phone. James reported he had an iPhone and he intended to download the university's map application on his device.

Ryan

Ryan was a 20-year-old, White male categorized as a freshman with an IDD. Ryan reported he had visited the campus with family and friends. He was interested in learning to navigate to the Social Sciences Center. Ryan stated he often used Google Maps and the Waze application to find unfamiliar places. Ryan had already downloaded the university's map application on his iPhone and reported having used the campus map application during his brief time on campus.

Experimental Design

We used a single-case experimental withdrawal design (ABAB) to evaluate the effectiveness of the university map application. ABAB designs are the simplest single-case design, do not require a control group, and are useful for observing changes in behavior following a certain treatment (Gast et al., 2018). To prevent interpretative limitations due to threats to internal validity, researchers use within-participant direct replication. Direct replication involves establishing a baseline, introducing the intervention, and then returning to baseline conditions which allows researchers to observe the effect of the intervention (Gast et al., 2018).

To establish a functional relation between independent and dependent variables a consistent pattern needs to be established over three to five data points (WWC, 2020). For this study, our independent variable was correct application of the university campus map application on independent navigation skills, the dependent variable. Our ABAB design consisted of a baseline condition in which participants were asked to navigate to three destinations without implementation of the university map application (A), an implementation of the map application (B), a return to baseline (A), and then return to use of the university map application (B). Due to our concerns with maturation effects, we chose to gather data exhibiting a pattern or trend across three sessions before moving to the next phase. Although five data points are preferable, obtaining three data points demonstrating an obvious pattern meets *What Works Clearinghouse* (WWC, 2020) single-case design standards with reservations We evaluated functional relation based on intrasubject replication across two participants, and intersubject through replications of the university map application intervention.

Intervention Agent

The intervention agents for this study were two second-year doctoral students in a special education degree program. The first author had a total of eighteen years teaching experience in special education, thirteen of which were primarily focused on students with IDD. The fifth author had six years of teaching experience, all six working with students having IDD. At least one intervention agent attended each session. Treatment integrity was taken by the first author through observance of 30% of sessions from each phase as led by the fifth author. As identified through the fidelity collection sheet, the fifth author followed the same protocol in leading each session in 100% of observations (e.g., asking students if they knew the direction to begin, following at an appropriate pace, not indicating by gesture, word or expression the direction the participant should take).

Dependent Variables and Instrumentation

The dependent variable was correctly navigating to destinations through *directional checks*, which were defined as a verbal, gesture, or physical response indicating the correct direction to move in order to reach the desired location without assistance. This dependent variable was operationally defined and employed by McMahon et al. (2015) who used event recording to compare the percentage of correct direction checks made by participants across three treatments (paper map, Google Maps, augmented reality). Our study employed the same operational definition and data collection method, although our procedures involved the implementation and withdrawal of one treatment instead of three.

Ten destinations were chosen through participant interest during initial interviews and consultation between the graduate student researchers and the IPSE program director to ensure the destinations would be those the students would most likely attend while on the university campus (e.g., student union, cafeteria, dorm). Ten total destinations were chosen because we wanted to limit the destinations to those identified as most important for the participants to be knowledgeable of. The ten destinations were written on strips of paper and placed in a bag for participants to draw from. Researchers chose to have participants draw three destinations from the field of ten to provide a level of randomization in that participants were not accessing the sites in the same route each time. Using three destinations allowed students to approach important locations from a variety of directions, thus improving their knowledge of campus. Additionally, researchers felt it was important to travel in the order drawn, as order of destination has important implications for some employment (e.g., delivery or mail services) and for daily living skills where one must run errands in which some are time-bound and must be accessed in a certain order.

Data was collected and recorded at each directional check, which occurred at street crossings, crossroads, and right or left turns. Using a researcher-developed data collection form for event recording (See Appendix 1), the researcher trailed the participant, making tally marks for each directional check as the student made them, until the destination was reached. Pre-identified number of direction checks was not tallied before participants began because there were a multitude of possible routes a participant could choose to take. The data collection sheet was divided into three sections, one for each of the drawn destinations. Data included the name of the destination, the minimum number of directional checks it should take to reach the destination, and the tally of directional checks actually made by the participant. To determine the percentage of checks correctly performed, the researcher made tallies in real-time as they followed the participant. They made tallies in two ways. The first was a count of the minimum number of directional checks the participant should make to reach the destination. This was determined through researcher observation in conjunction with viewing the university map application at the same time to ensure the correct number of tallies. The researcher simultaneously collected data on how many directional checks the participant made in the case that the student did not take the most direct and efficient route or failed to follow the directions.

Once the first destination was reached, the participant was instructed to navigate to the next destination. If the participant indicated they did not know the direction to take, the session was ended and the participant received 0% on each of the remaining destinations not navigated to. Once the participant had traveled to all three destinations, or indicated they did not know how to commence, the session ended. The researcher counted the tallies of minimum possible directional checks and the tallies for the number of checks actually taken. The minimum number of checks was divided by the number of checks actually taken to get a percentage of correct directional checks for each of the three destinations. These three percentages were then averaged to get an average of correct checks per session.

Procedures

Baseline

Baseline data was taken by having students draw three destinations from a bag containing ten possible destinations. The students were asked to navigate without aid to the destinations in the order they were drawn. If the participant did not feel they could navigate to the first destination, the researcher ended the session and gave the participant 0% for each of the three destinations in the session, averaging 0% correct direction checks. If the participant indicated they could attempt to locate the first destination, they were instructed to begin walking and the researcher would trail a short distance behind the participant to observe the navigation choices made by the student. This process was continued through all three destinations for the session. We collected data for three baseline sessions.

Teaching Session. Once three data points had been taken for the baseline phase, we used a task analysis to teach students to access the map application on their mobile devices (See Appendix 2 for the complete Task Analysis). The task analysis was created by the first and fifth authors by each developing a task analysis and then comparing the two. The two task analyses contained the same steps for 100% agreement. The task analysis was provided to the participant during instructional sessions where they were led through the task-analysis steps by the intervention agent.

Independent Navigation

Once the participant independently completed all steps of the task analysis during the teaching sessions with 100% correct number of steps, the university's map application intervention was employed. Participants drew three random destinations from a bag with ten possible destinations. Then students accessed the university map and typed in their first destination. Once the university's system provided step-by-step directions, participants were asked if they knew which direction to begin. If the student answered affirmatively, they then independently navigated to the first destination. They were trailed by a researcher, walking at least six feet behind the participant so as not to inadvertently influence the student's directional choices and so that no undue attention was drawn to participants as they traversed the campus. If the answer was negative, the researcher ended the session.

Return to Baseline

Students were asked to draw three destinations and then navigate to those destinations without using the map application on their phones.

Independent Navigation Intervention

Intervention was reinstated with students again drawing three destinations and independently navigating to those destinations through the use of the campus map application.

Maintenance

A maintenance check occurred approximately one month after the end of the study. A long-term maintenance check was completed approximately 18 months after conclusion of the study when an additional questionnaire was developed and approved by IRB for data collection of demographic information.

Interobserver Agreement (IOA)

The fifth author implemented all sessions with 30% (two of six per phase) of sessions being attended by the fifth author and the first author. The researchers each kept tally marks of the directional checks taken by participants and the number of expected checks occurring during the participants' routes. Point-by-point comparison of directional checks were completed upon arrival at each destination. Point-by-point comparisons were 100% across 30% of all sessions and phases.

Treatment Fidelity

The fifth author performed all sessions, with 30% (two of six) of sessions being observed by the first author to ensure fidelity of implementation. Implementation was observed with 100% fidelity for baseline, intervention, withdrawal, and reinstated intervention sessions.

Social Validity

A nine-question maintenance interview was conducted approximately one month after study completion. The post-study interview protocol was developed to measure participants' opinions of ease of using the university map application, possible benefits they experienced through the study, expectations of future use, and perceptions of their participation in additional navigation research. An additional maintenance check was conducted approximately eighteen months after the study's end, in which participants were asked if they had continued to use the university campus map application to navigate.

Results

Students were involved in only one session per day which was scheduled around students' class and work schedules. Each student participated in four to five sessions per week. Baseline sessions without the map application intervention lasted approximately three minutes, allowing enough time to explain expectations before the student reported not knowing how to find the first destination and thus ending the session. Task analysis sessions were approximately 15 minutes for each student. Students demonstrated their ability to access and use the map application during the first session with scaffolded verbal support after two examples of modeling. By the third session, students accessed the map application with no verbal support. The baseline with intervention phase and the return to baseline phase varied from eight to twenty-nine minutes depending on the destinations drawn and their distance apart.

Data are presented in a series of graphs for this single case experiment utilizing a withdrawal design. Data are analyzed using visual analysis techniques based on level, trend, and variability both within and between phases (Cooper et al., 2020).

James

James's data are presented in Figure 1. When examining the level change from baseline to intervention phase one, there is an immediate and clear change. After James demonstrated a steady state during the teaching session, training was faded and independent navigation occurred. James achieved 100% of directional checks during intervention phase one. Upon return to baseline, there was an immediate return to baseline data conditions of 0% for James; however, on the third day of his second baseline, James achieved 100%. He then maintained 100% throughout the second independent navigation intervention phase. During the maintenance phase, one month after independent navigation, and two months after arriving at campus, James was successfully maintaining his learned navigation skills.

Ryan

Figure 2 illustrates Ryan's data. Comparing baseline data to the first intervention session, there was an immediate effect in correct directional checks after use of the map application—first with training, and then with independent navigation. However, withdrawal did not show a tremendous effect, with Ryan successfully navigating an average of 92% of directional checks without using the map application. The reinstatement of independent navigation indicated a continuation of high levels of directional checks (100%). Like James, Ryan was able to maintain his learned navigation skills one month after the intervention, and two months after arriving at campus.

Social Validity

We found the participating students quickly learned the process of finding new locations on their hand-held devices. At the one-month maintenance check, the students reported they regularly used the campus map applications when navigating to new places. Follow-up interviews were conducted with participants who completed the study a few months after the final data collection. James reported continued use of the map application to find places on campus and in the community. Ryan reported they seldom used the map application to find places on campus because they felt they knew the campus well enough after almost two years they did not need assistance. In Ryan’s words, “[I used the map application] a lot when I was a freshman, but not as much now because I know places.” Ryan reported that although he does not use the campus map application to navigate campus much, he has generalized use of the map application and currently uses it for travel around the community.

Discussion

We determined the effects of an intervention to increase the independent navigation skills of students with IDD attending an IPSE program. This study extends upon current literature by providing an option to teach navigation skills to students prior to or when first attending an IPSE program with minimal staff resources while utilizing the university's free map application on the student’s personal smartphone. Three participants began this study; however, only two carried out the full intervention, an attrition rate of 33%. For both participants that completed all conditions of the study, there was an immediate level change after baseline upon the introduction of the map-based application intervention. Two participants who completed the study, Ryan and James, showed the ability to maintain these navigation skills over time. While return to baseline for James and Ryan was not an immediate decrease from the phase prior, there may be alternative explanations for this occurrence. For instance, the students' familiarity with campus increased as students spent more time on-campus, and they began traveling from their on-campus dorms to more places across campus as they began to feel a greater level of comfort.

Overall, these results demonstrate the promise of this independent navigation intervention for individuals with IDD new to a campus-based program. Like much of the previous literature involving handheld electronic devices, our results were suggestive that presentation and application of wayfinding through technology can be very successful. Handheld technology is becoming more accessible, more common, and thus, more socially valid. Emerging technology such as map applications and augmented reality tools have the potential to support persons with IDD to become more independent and self-determined (McMahon et al., 2015). Such tools provide the ability to effectively navigate independently, which supports positive outcomes such as self-determination, community involvement, and employment (Shogren et al., 2009).

Furthermore, use of mobile devices has the potential to help young adults with IDD with a variety of skill deficits related to education, employment, finances, health, and independent living (Cihak et al., 2010; McMahon et al., 2015; Yuan et al., 2019). The implications of personal, handheld devices on independent navigation and self-determination have been mentioned in several previous studies (e.g., McMahon et al., 2015; Yuan et al., 2019) and are further strengthened by our findings. In our study, use of the university map application improved independent navigation to novel destinations.

Several researchers have noted the need for replication of navigation skill interventions using technology applications (Kelley et al., 2013, McMahon et al., 2015; Mechling & Seid, 2011). Though our results were similar to previous findings using Google Maps for navigation (Kearney et al., 2020; McMahon et al, 2015; Price et al., 2018; Yuan et al., 2019), our study extended the research by using a university map application to access directions for pedestrian navigation. This study contributes to the growing body of research on the effects of independent travel skills using smartphones while also utilizing a specific university's application. The university map application is used by many students across the campus. Since it was designed to help all students navigate the university's large campus, using the map application is a realistic and normalized practice.

Additionally, our study further contributed to the knowledge base in that the participants traveled to three destinations each session, whereas much of the previous research focused on arrival at one destination using a variety of prompts (Kearney et al., 2020; McMahon et al., 2015; Smith et al., 2017). The college campus where the study took place was very large and traveling to and between places is an important skill to learn to save time and energy. Therefore, with three destinations, the hope was the students could generalize their independent travel skills using the university map application to travel to and from a variety of places rather than just one location at a time. The ability to travel to multiple destinations from various starting points adds a complex component that has important implications for future travel and employment (e.g., planning a vacation route, completing a delivery route). Follow up interviews eighteen months after completion of the study indicated participants continued to use the map application to find unfamiliar destinations. Ryan indicated he used the map application to find places in the community, a generalization of the study which has far reaching effects on his ability to be self-sufficient.

Implications for Practice

The success of our intervention and the value of the pedestrian navigation skills students learned lend credence to the importance of teaching these skills. For instance, our study showed students with IDD learned how to independently travel to unfamiliar locations using task analysis training and a smart phone navigation application. Task analysis and smart phone navigation applications can be used by secondary teachers to teach independent navigation skills before students attend IPSE programs. Teaching these skills in advance provides students with the time they may need to learn, without the additional stress of being in an unfamiliar environment.

We recommend practitioners start small, start early, and plan for the transition their students will experience as they begin navigating to unknown locations as part of their post-secondary education, employment, or leisure activities. Practitioners can start small by incorporating independent travel skills into their existing routines during the school day. These could be embedded into the task analysis created for the specific activity. For instance, if the goal is to teach the student to stop at the edge of the street, that would be included as one step of the task analysis. Another easily implemented strategy is helping students identify directionality. This could be as simple as letting students walk ahead while the practitioner trails behind the leader and tells them to turn right at the hallway intersection or turn left into the open doorway. Another less-obvious approach may be to use bug-in-ear technology to give directions discreetly as students navigate the hallways. To take it a step further, practitioners could discuss safety when crossing the hallway and relate it to safety when crossing a street.

Embedding small strategies within day-to-day instruction develops the concepts in a natural environment. Since a familiar setting such as the school building is a safe place to develop navigation skills, there is no reason not to start teaching these skills even earlier than secondary school. Even much younger students are able to understand traffic is dangerous and to learn to choose safe crossing sites. In addition, many students with IDD need additional time and practice to become proficient at new tasks (Vaughn et al., 2015), and starting earlier allows students to develop and practice these important skills. Teaching map skills such as symbol representation, legends, cardinal directions, and the ability to identify a route from one place to a new destination are all skills that could be taught early on and help lead to successful navigation in new environments like high school, places in the community, and college campuses.

Our third recommendation is for postsecondary practitioners. Ryan and James experienced success independently navigating campus as a result of the intervention using the university's navigation application. This intervention was not obtrusive and did not require a large number of staff to implement. Since many IPSE programs are staffed by small numbers of employees, we recommend teaching students how to use their smartphones to navigate to classes through their university's map application during freshman orientation. This will help alleviate some staffing needs during the first few weeks of the semester. While some students may need additional navigation support, most students can learn to navigate campus independently using their smartphone applications, allowing IPSE staff to tend to other needs of students in the program.

Limitations

There were several limitations to our study. To meet What Works Clearinghouse ([WWC] Kratochwill et al., 2010) standards, a reversal/withdrawal design must have a minimum of four phases per case with at least five data points per phase. Since our study only had three data points across each phase, it qualifies as *Meet Standards with Reservations*. Additionally, the number of participants in our study was reduced due to attrition resulting in a rating of *Meet Standards with Reservations* (Kratochwill et al., 2010).

Next, maturation effects were evident in our results, despite our desire to complete the study before students became familiar with the campus. Maturation effects are a threat to internal validity and occur with natural knowledge gathering over time (Kratochwill et al., 2010). In our study, we chose high-travel destinations the students would most likely have the need to be knowledgeable of, such as their dormitory. These high-travel destinations limited our study because the more time the students had to become familiar with the campus, the less sure we could be of the effectiveness of our intervention. We had hoped by using a withdrawal design we could lessen maturation effects. However, data collection began once the students had already been on campus for two weeks participating in various Freshmen orientation activities, which included activities to aide in familiarity with the university campus. The data collection did not start during the orientation because the IPSE program Director had concerns about overwhelming the students their first few days getting acclimated.

Future Recommendations and Iterations

There were several issues with the intervention we would like to note for future researchers. First, the university's map application was not always accurate, depending on the location needed. For instance, the map application would often have a directional arrow indicating no turns, but to follow or stay on a certain path which created confusion for students.

Future research should attempt troubleshooting with the map application to ensure the accuracy of specific college campus locations. Alternatively, if this is not possible, a problem-solving protocol could be incorporated into any navigation intervention training program. Another issue arose when determining the best route to a particular destination and encountering unexpected obstacles (e.g., walkways being closed for construction) along the route.

An additional consideration is the participant's reading level. While the participants in our study did not appear to have any difficulty in reading the names of the destinations or typing them into the map application, other students enrolled in an IPSE program may need additional accommodations for reading written clues. One natural accommodation for those participating in our study was typed clues provided on strips of paper, so participants had the correct spelling of the destinations to put into the university's map application. Although not accessed during the current study, another accommodation could be the voice-to-text feature many smartphones have readily available.

Lastly, the task analysis used provided instruction on how to access the map application but did not provide students opportunity to practice following directions given through the application. The issue of applying and completing a task based on the supplied method (e.g., task analysis) for independent navigation was addressed through pretraining in previous research (e.g., McMahon et al., 2015; Smith et al., 2017). Although our participants did not have difficulty in this area, future researchers should expand the task analysis to include the application of directions given by the map application. We understand the limitations of this study may impact the quality, however, we believe it is important to share the information with other IPSE programs.

While the limitations of this study are significantly more than other more robust research, we believe it is important to share this research and corresponding information with other IPSE programs. Maryam Mirzakhani, the first woman and first Iranian to win the Fields Medal for her work in mathematics, stated the following about her research:

> I don't have any particular recipe. It is the reason why doing research is challenging as well as attractive. It is like being lost in a jungle and trying to use all the knowledge that you can gather to come up with some new tricks, and with some luck, you might find a way out (Carey, 2014).

Independent navigation is a common deficit and continually noted need for students in IPSE programs (Lee & Taylor, 2022; McMahon & Smith, 2012); however, like finding a way out of the jungle, this navigation protocol combines research and best practice knowledge and offers promising results to help students with IDD successfully and independently navigate campus without the need for additional IPSE staff and expensive resources. This protocol also prevents the lack of independent navigation skills being cited as one of the reasons students with IDD choose to not continue with their postsecondary education programming. We hope that this navigation protocol or a modified version of it will help other ISPE programs to successfully teach their students to navigate campus throughout their programming and beyond.

Conclusion

This study extends previous research demonstrating promising effects of handheld personal devices used to prompt independent navigation for persons with IDD. As IPSE programs become more abundant, the number of university students with IDD will also increase. Providing interventions for students to develop wayfinding and independent navigation skills will become imperative for student success. This is especially true as most IPSE programs have limited funding and personnel to address independent navigation needs. Using a university map application for independent navigation is one way to increase student mobility across campus and the greater community.

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Figure 1

James

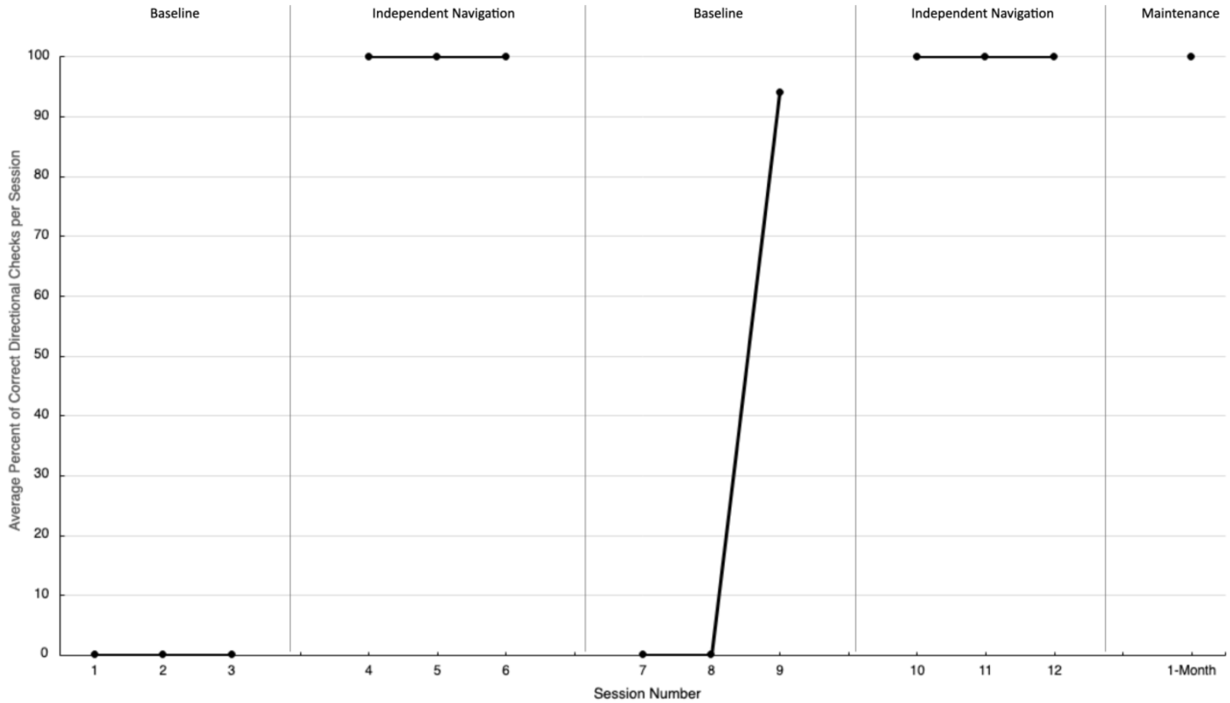

Figure 2

Ryan