USING CONSTANT TIME DELAY TO TEACH USE OF GOOGLE MAPS TO YOUNG ADULTS WITH INTELLECTUAL AND DEVELOPMENTAL DISABILITIES

by

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ABSTRACT

JESSICA G. ROUSEY. Using constant time delay to teach use of Google Maps to young adults with intellectual and developmental disabilities. (Under the direction of DR. LESLIE ANN BROSS)

Planning for secondary transition includes identification of postsecondary goals in the areas of continued education, employment, and independent living when appropriate (IDEIA, 2004). Independent living includes important components of adulthood such as community engagement, recreation, and travel skills. Young adults with intellectual and developmental disabilities (IDD) lag behind their same-aged peers in outcomes related to community engagement (Lipscomb et al., 2017a); specifically, challenges related to travel and transportation are a well-documented barrier to community engagement that young adults with IDD experience (Deka et al., 2016; Kersten et al., 2020). Many young adults with IDD rely on others to facilitate travel, and it is common for these individuals to ride in vehicles as passengers, use public transportation, or walk to destinations of interest (Deka et al., 2016). Travel skills are an identified predictor of postschool success (Mazzotti et al., 2016) and it is important for secondary educators and practitioners to teach young adults with IDD to navigate their communities safely and independently. The purpose of this dissertation was to examine the effects of constant time delay instruction on the ability of young adults with IDD to program and follow walking routes to unfamiliar community locations of their choice using the Google Maps (Google, 2024) application. Results of this intervention indicated a functional relation between constant time delay instruction and the percent of task analysis steps three young adults with IDD completed for programming and following a Google Maps walking route. Additional measures included generalization to use of the Apple Maps application; social validity of the intervention, as reported by the participants and their special education teachers; and participants' ability to problem-solve common issues that may occur when following a pedestrian route. Finally, study limitations, suggestions for future research, and implications for practitioners are discussed.

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CHAPTER ONE: INTRODUCTION

Secondary transition educators, practitioners, and researchers must consider effective practices for skill instruction in a variety of outcome areas for young adults with intellectual and developmental disabilities (IDD), including not only academics, employment, and independent living, but also community engagement and transportation. The purpose of this dissertation is to examine the effects of constant time delay instruction on the ability of young adults with IDD to program and follow walking routes to unfamiliar locations of interest using the Google Maps (Google, 2023) application (app). This chapter contains a statement of the problem, information related to postschool outcomes for young adults with IDD, the need for instruction in community engagement skills to maximize quality of life, delimitations, and definitions.

Statement of the Problem

Scholars, families, and self-advocates sometimes compare the transition from school to adulthood – and the challenges it may entail – to encountering a cliff (e.g., Hendren, 2021). For many individuals with IDD and their families, one of the most jarring changes to occur in this period is the halting of disability-specific services previously guaranteed by the Individuals with Disabilities Education Improvement Act ([IDEIA], 2004). Although students with disabilities are provided services such as specialized instruction, behavioral support, vocational training, and related services (e.g., occupational therapy, speech/language therapy) during school, IDEIA does not continue to guarantee these services after a student with a disability exits school. For this reason, secondary transition can be especially challenging for young adults with IDD. Young adults with disabilities generally lag behind same-age peers in measures of higher education attendance and attainment, employment, and independent living (Lipscomb et al., 2017a; Newman et al., 2011).

Educators and policymakers have recognized such gaps in postschool outcomes for decades, and as a result, special education legislation has evolved to include specific requirements for preparing young adults with disabilities for secondary transition. For example, Section 300.43 of IDEIA (2004) requires that students with disabilities receive transition services that include instruction, related services, community experiences, and development of employment, education/training, and independent living goals (if appropriate) to help support the transition from school to postschool life. Despite legal requirements and the best efforts of many educators, gaps in postschool outcomes in the three areas recognized by IDEIA (i.e., employment, education/training, independent living) persist for the majority of young adults with disabilities. In addition, young adults with IDD experience some of the poorest postschool outcomes of individuals in any disability category (Lipscomb et al., 2017b). Individuals with IDD include those with intellectual disability (ID), autism spectrum disorder (ASD), and other types of developmental disabilities (AAIDD, n.d.).

Tracking Postschool Outcomes

The passage of Public Law 101-476 in 1990 included the original mandate for researchers to track and analyze the postschool outcomes of individuals with disabilities. Because adult life is comprised of a myriad of skills and markers of "success," the most important postschool outcomes to measure have been debated within the field over time (Halpern, 1993). Initially, postschool outcomes were measured only in the areas of education/training, employment, and independent living. Since 1990, researchers have also begun to measure more complex, subjective outcomes, such as social and community engagement and quality of life (Lipscomb et al., 2017a; Raphael, 1996).

The series of government-funded National Longitudinal Transition Studies (NLTS) conducted since 1985 provide large-scale evidence of the persisting gap in postschool outcomes between young adults with and without disabilities. The original NLTS conducted from 1985 to 1993 included measures of form of employment (i.e., not employed, completing a work study, working in a sheltered environment, working in a part-time competitive job, working in a full-time competitive job) as well as trends in competitive employment, wages earned, postsecondary enrollment, and independent living status for young adults with disabilities transitioning from school to postschool life (Blackorby & Wagner, 1996). Data collected from 8,000 respondents indicated that young adults with disabilities experienced lower rates of postsecondary education, employment, and independent living than same-age peers without disabilities. Specifically, young adults with IDD did not maintain gains made in independent living and employment over the course of the five-year longitudinal study (Blackorby & Wagner, 1996).

Later iterations of the NLTS continued to reflect challenges in secondary transition for young adults with disabilities. The NLTS-2, which was conducted between 2000-2011, overlapped with the passage of IDEIA (2004) and the implementation of more specific requirements for supporting successful secondary transition. Although educators, families, and policymakers alike hoped for immediate improvements in postschool outcomes following the passage of IDEIA (2004), the NLTS-2 data indicated that continued improvement was still needed (Sanford et al., 2011). Similar to the original NLTS, the NLTS-2 included measures related to employment, wages, postsecondary enrollment, and independent living. The NLTS-2 survey also incorporated additional outcome measures including parenting and marital status, financial independence, friendship interactions, community participation, and criminal justice system involvement (Sanford et al., 2011). Across the above categories, individuals with disabilities again had poorer postschool outcomes than individuals without disabilities. Specifically, individuals with disabilities were less likely than peers without disabilities to enroll in postsecondary education, have paid jobs, be married, have a checking account or credit card, or to report any engagement in the community (Sanford et al., 2011).

The most recent iteration of the NLTS is the NLTS 2012. The NLTS 2012 included approximately 13,000 respondents with and without disabilities and provides a comprehensive view of the needs of students preparing to exit high school. In addition to traditional measures of preparedness related to education/training, employment, and independent living, the NLTS 2012 also included research questions regarding challenges to health and independence, engagement in school and social settings, and in-school activities to prepare for life after high school (Liu et al., 2018).

Analysis of the NLTS 2012 data indicated that young adults with disabilities require more in-school support to achieve positive postschool outcomes than peers without disabilities. For example, youth with disabilities report taking fewer actions to prepare for continued education and employment while still in school than peers without disabilities (Lipscomb et al., 2017a). This means that many youth with disabilities may graduate from high school without firm plans in place for continued learning or work. The NLTS 2012 data show that paid employment experiences for young adults with disabilities have declined over the past decade, suggesting that young adults with disabilities who wish to seek employment after exiting school may be underprepared and/or inexperienced (Liu et al., 2017). Additionally, youth with disabilities are less likely than peers without disabilities to independently perform activities of independent living, which includes tasks such as making appointments and traveling the community to reach locations outside the home (Lipscomb et al., 2017a). The NLTS 2012 data indicate that many young adults with disabilities experience decreased community engagement prior to exiting school, resulting in limited independence, challenges developing friendships, and relying on others to facilitate travel and transportation.

Conceptualizing and Measuring Community Engagement

Beyond the IDEIA-mandated areas of focus for transition (i.e., education/training, employment, independent living), other outcome areas are important to consider in evaluating the success of a person's secondary transition. For example, the postschool outcome area of independent living can include community engagement and participation. Community engagement helps lead to increased quality of life and sense of belonging for people with and without disabilities. It goes beyond simply having physical access to spaces and includes meaningful participation in neighborhoods, places of employment, congregations, and recreational spaces (Amado et al., 2013). Although considered important and even necessary for maximizing quality of life, community engagement can be challenging to measure, and researchers have proposed a number of community engagement frameworks over the years (e.g., Carter & Biggs, 2021; Hall, 2009; Van Asselt et al., 2015).

As described above, the National Longitudinal Transition Studies also began to incorporate measures of community engagement in the second and third iterations of the study (i.e., NLTS-2, NLTS 2012). When the NLTS was originally designed, researchers considered how the traditional postschool outcome areas of *employment* and *postsecondary education* overlapped to influence a person's "productive" community engagement (Newman et al., 2011, p. 103). In the NLTS-2, "productive community engagement" was defined as having participated in one or more of the following activities since leaving postsecondary education: a) working for pay in a competitive, supported, or sheltered work environment; b) attending an institution of higher education at a technical college, junior college, community college, or 2- or 4-year university program; or c) completing training in a specific job skill area from an adult service agency or program (separate from training provided by an employer or family member) (Newman et al., 2011).

Although community engagement facilitated by postsecondary education or employment is still a positive postschool outcome, the definition of "productive engagement" developed for the NLTS-2 left out other existing and meaningful opportunities for community engagement, such as attending social gatherings, developing friendships, or participating in recreation activities. Other transition scholars (e.g., Hall, 2009) have suggested additional domains of community engagement, such as participation in reciprocal personal relationships, involvement in community activities, and access to formal and informal community supports.

Analysis of community engagement for young adults again reveals discrepancies between individuals with and without disabilities. For example, youth with disabilities report less social involvement in their communities outside of school than youth without disabilities, indicating that gaps in engagement may exist even before secondary transition occurs (Lipscomb et al., 2017a). Youth with IDD often have annual and/or postsecondary goals related to increasing functional independence and friendships, indicating a common interest by many students, practitioners, families, and other Individualized Education Program (IEP) team members in enhancing community engagement (Shogren & Plotner, 2012). Other researchers have investigated the barriers to community engagement experienced by young adults with disabilities. Importantly, issues related to travel and transportation are a well-documented and often-cited barrier to community engagement that young adults with IDD experience (Deka et al., 2016; Kersten et al., 2020).

Travel Skills to Enhance Community Engagement

Travel skills are critical for maximizing community engagement and independence for young adults with and without disabilities. If a person cannot traverse their community, opportunities to interact with others, gain employment, and make self-determined choices decrease drastically. The importance of travel skills in achieving positive postschool outcomes has also been supported by research. For example, travel skills were identified as a predictor of postschool success in the Mazzotti et al. (2016) systematic literature review, based upon the evidence provided by two exploratory studies (Carter et al., 2012; McDonnall, 2011). In the postschool predictor literature, travel skills is defined as “the ability to get to places outside home independently” (Carter et al., 2012, p. 52).

Around the time that travel skills were identified as a predictor of postschool success, more researchers investigated interventions to teach travel skills to individuals with disabilities. Some of the earliest studies in this area involved the navigation of indoor spaces, which aligns with the emphasis on “functional independence” seen in early discourse regarding community engagement (Hall, 2009). For example, Cihak et al. (2010) used video models displayed on a video iPod to teach students with disabilities to independently navigate transitions between areas of a school building (e.g., carpool line to classroom, classroom to cafeteria). Researchers found a functional relation between use of the video models and the navigation skills of all four elementary school participants with disabilities. Similarly, Lancioni (2010) evaluated the effects of verbal and tactile (vibration) prompts delivered via a portable control unit on the indoor navigation skills of two adults with multiple disabilities. Participants were taught to find a specific room number in a building, following verbal prompts and vibrations delivered by the portable control unit. Both participants navigated the building faster and more accurately with the verbal and tactile prompts.

Although navigating indoor spaces is an important skill, travel skills more broadly also includes traveling outdoors from one location to another. Because individuals with disabilities travel their communities by walking, using public buses or trains, and/or riding as passengers or driving, researchers have also investigated methods to teach these skills. Several examples of interventions for teaching use of public transportation and travel skills are detailed below.

Use of Public Transportation

Because young adults with IDD drive less frequently than same-age peers without disabilities, public transportation can be a useful option for many individuals with disabilities who wish to travel independently (Deka et al., 2016). Using public transportation to reach a desired destination is a complex chained task that involves planning a route, reaching a stop or station, paying for access, requesting a stop, and exiting the bus or train at the correct time. Two examples of studies teaching use of public transportation to young adults with disabilities include Davies et al. (2010) and Price et al. (2017).

In a between-subjects group design study, Davies et al. (2010) evaluated the effects of a personal digital assistant (PDA)-based prompting system, *Wayfinder*, to support independent public bus travel by 23 young adults with disabilities. Participants were taught to identify pertinent visual landmarks while riding the bus to prepare to request a stop at the correct time. More participants in the experimental group requested stops at the appropriate time when using *Wayfinder* (73%) than did participants in the control group (8%).

Price et al. (2017) evaluated the effects of total-task chaining to teach four young adults with IDD to use Google Maps on a public bus. Participants completed a series of 15 steps following total-task chaining instruction to program and follow a fixed bus route on the Google Maps application. After receiving instruction, three of the four participants reached mastery criteria and independently traveled on the public bus. The studies completed by Davies et al. (2010), Price et al. (2017), and others indicate that young adults with disabilities can learn to independently travel their communities using public transportation.

Use of Travel Skills

Although public transportation is a useful tool to those who can access it, not every community has a sufficient offering of public transit options. Additionally, many individuals with disabilities rely on walking as a primary or regular mode of transportation (Deka et al., 2016). Like use of public transportation, walking to a location of interest also involves a series of chained steps, including planning a walking route, following walking directions, exercising proper safety precautions, and identifying when one has reached their desired location. Researchers such as Kelley et al. (2013), Yuan et al. (2019), and Rousey et al. (2023) have investigated strategies for teaching travel skills to young adults with IDD, which are described in more detail below.

Like Cihak et al. (2010)'s indoor navigation intervention, Kelley et al. (2013) also incorporated use of a video iPod to teach travel skills. Kelley et al. (2013) investigated the effects of video iPod-delivered prompting to teach pedestrian navigation skills to four young adults with IDD. The participants attended an inclusive postsecondary program on a college campus, and each participant learned to follow "landmark" photos loaded on the iPod to walk to an unknown location on the campus. Additionally, participants were able to generalize use of the iPod photo prompts to walk to new, unknown locations following intervention.

As technology tools have continued to develop, researchers have investigated the use of more modern tools to support community navigation. For example, Yuan et al. (2019) used constant time delay to teach programming of a Google Maps walking route to three young adults with IDD. These young adults were between 18 and 20 years old, possessed basic pedestrian safety skills (e.g., walking on sidewalk, crossing streets appropriately), and each owned a mobile phone that they already used for communicative and leisure-related purposes. Participants were taught to complete six steps for programming a walking route, and each of the three participants reached 100% accuracy for the route programming steps following constant time delay instruction. Yuan et al. (2019) did not include walking the programmed routes as a step of the task analysis, but the researchers did probe participants on following the programmed route after intervention was complete. Two of the three participants were able to follow their programmed maps, but the third participant required verbal prompting to complete the walking route.

To extend the line of inquiry established by Yuan et al. (2019), Rousey et al. (2023) also investigated the effects of constant time delay instruction to teach use of Google Maps to four young adults with IDD. The participants included two Black males, one White male, and one Black female, and all participants had a diagnosis of intellectual disability (ID) and/or ASD. The participants were aged 18-22 and attended a transition program on a college campus in a southeastern state, where they completed coursework with a special education teacher and held vocational internships within various departments on campus.

Rousey and colleagues (2023) made several important changes in their extension study that differentiate it from Yuan et al.'s (2019) study. The first change was to expand the task analysis from six steps to 12 steps, specifically to include following the programmed route and reaching the final destination as components of successful task completion. In addition, in

Rousey et al.'s (2023) study, participants followed their programmed maps during each session to reach their destination. Yuan et al. (2019) conducted just one "pedestrian navigation probe" per participant at the end of the study, during which participants attempted to follow their programmed routes. Second, instead of providing participants with an assigned location card or destination as in Yuan et al. (2019), Rousey et al. (2023) provided participants with three novel locations to choose from during each session and participants selected select the location they were most interested in visiting. Finally, Yuan et al. (2019) did not collect social validity data from participants whereas Rousey et al. (2023) collected social validity data from each participant following the intervention phase to understand their perceptions and opinions regarding the effectiveness and usefulness of the intervention.

Rousey et al. (2023) indicated a functional relation between use of constant time delay instruction and the number of task analysis steps participants completed for programming and following a Google Maps walking route to a novel location of interest. All four participants met mastery criteria (i.e., 11/12 task analysis steps completed independently) following constant time delay instruction. Additionally, participants indicated positive perceptions of the intervention and reported that they felt more confident walking to new locations after learning to use Google Maps.

Although following a walking route to a desired location involves many steps, the research completed by Kelley et al. (2013), Yuan et al. (2019), Rousey et al. (2023), and others indicates that prompting can be helpful in teaching young adults with disabilities to plan and follow walking routes. Walking is an appealing option for many young adults with disabilities because it is free of cost (Deka et al., 2016), and best strategies for teaching travel skills to young adults with disabilities is an important category of research in special education and other fields related to disability. Additionally, investigating strategies to teach use of Google Maps is important because Google Maps is a free and widely available navigation app and used broadly by individuals with and without disabilities. Individuals with disabilities can use Google Maps as a non-stigmatizing support to navigate their current and future environments, making use of Google Maps a potentially useful skill across the lifespan.

Need for Continued Research

Having access to reliable transportation is vital for a person to fully participate in their community (Bezyak et al., 2017; Jansuwan et al., 2013; Park & Chowdhury, 2018). Despite developing and increased awareness of the importance of travel skills to achieve postschool success, young adults with disabilities are still not traveling their communities at a level commensurate with their peers without disabilities (Brumbaugh, 2018). Underdeveloped or insufficient travel skills limit opportunities for self-determination and independence and can result in overreliance on parents, other family members, or friends to facilitate transportation (Deka et al., 2016; Verdonschot et al., 2009). The development of more high-quality studies involving travel skill interventions will help strengthen the evidence base for travel skills as a predictor of postschool success (Mazzotti et al., 2016, 2021) and will support the development of best practices in travel skill instruction. Additionally, it is important to consider *which* interventions work *for whom* and under *what conditions* (Toste et al., 2023), so continued travel skills research involving diverse participants is critical. Community engagement outcomes for young adults with IDD may continue to lag without further research regarding best practices in travel skills training. For these reasons, the purpose of this dissertation was to replicate and extend the Rousey et al. (2023) study to evaluate the effects of constant time delay instruction on the ability of young adults with IDD to program and follow a Google Maps walking route to an unknown location of interest. The specific research questions that guided this study are as follows (with questions 2, 3, and 5 being novel to this dissertation):

1. Is there a functional relation between using constant time delay to teach use of Google Maps and the number of task analysis steps young adults with IDD complete independently?
2. To what extent do the steps to program and follow a Google Maps walking route generalize to the use of Apple Maps for young adults with IDD?
3. To what extent does scenario-based teaching enhance the problem-solving skills of three young adults with IDD when using Google Maps for walking navigation?
4. What are the opinions and perceptions of transition-age youth with IDD regarding use of Google Maps to independently program and follow a walking route to reach a location of interest?
5. What is the social validity of using a Google Maps application to teach travel skills as reported by the teacher and job coach of the transition-age youth with IDD?

Additionally, Figure 1 below depicts the logic model guiding this study.

Delimitations of This Study

The present study employed a single-case, multiple probe across participants design (Horner & Baer, 1978). Although the rigor of this study was strengthened by prediction, verification, and replication across three participants, due to the nature of single-case research designs, external validity and generality of findings are limited. The results of this study do not independently establish the effectiveness of constant time delay to teach use of Google Maps to *all* transition-age youth with IDD. Rather, the findings add to a growing body of literature

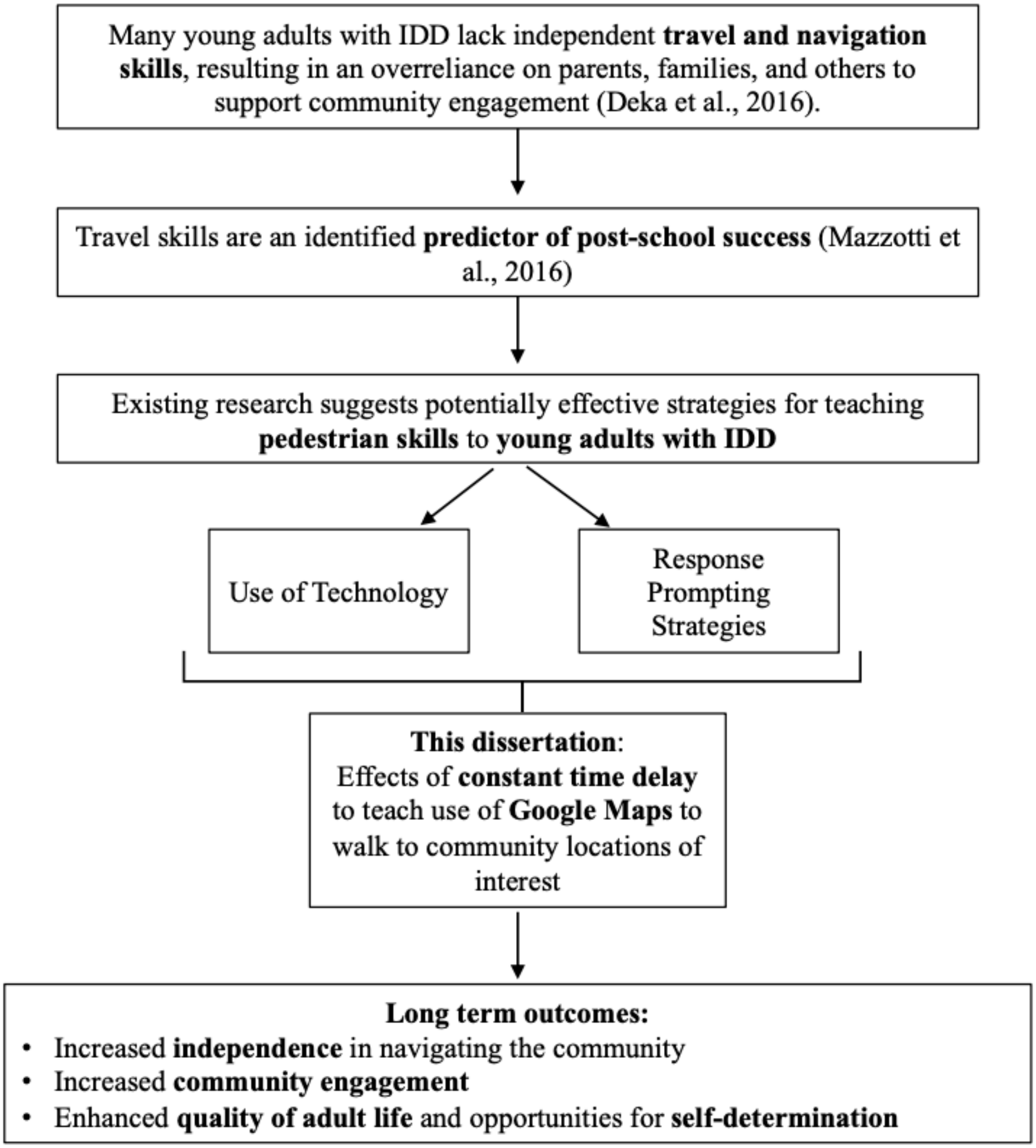

Figure 1. Logic model

regarding the utility of response prompting strategies to teach travel skills to transition-age youth with IDD.

A second delimitation of this study is the use of the Google Maps application itself. Google Maps, like all technology tools, may change over time and could even someday become obsolete. It is possible and quite likely that the technology used in this study will become out-of-date after some time. This is a trend within the literature related to travel skills training for individuals with disabilities, as evidenced by previous studies involving use of tools like iPods and PDAs (e.g., Kelley et al., 2013; Mechling & Seid, 2011). Additionally, smartphones are expensive, and the costs associated with obtaining a smartphone with the Google Maps application may limit who could benefit from this intervention. Future practitioners may consider applying the specific *teaching strategies* used in this study (i.e., constant time delay) to support travel skill development, if technology evolves to a point where Google Maps is no longer used or if obtaining a smartphone with the Google Maps app is not feasible.

A final delimitation of this study is that use of Google Maps and programmed walking routes were limited to locations within the University of North Carolina (UNC) at Charlotte campus. Although the University exists within a broader community (i.e., Charlotte Metro region), the University also represents a community itself. Campus locations for dining, recreation, potential employment, and social activities were used in this study to represent potentially desirable locations available within a larger community or municipality, but all locations exist on UNC Charlotte's campus.

Despite existing delimitations that must be accounted for, this study represents a potentially effective intervention for teaching the programming and use of a Google Maps walking route for young adults with IDD. Future researchers and practitioners may implement similar interventions with transition-age youth with whom they work. Replication of studies employing response prompting to increase independent pedestrian travel may eventually lead to identification of evidence-based best practices in teaching travel skills, providing young adults with disabilities the skills necessary to become more meaningfully engaged in their communities.

Definitions

Autism spectrum disorder: A disorder characterized by persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following: deficits in social-emotional reciprocity, nonverbal communicative behaviors, and in developing and maintaining relationships (American Psychiatric Association, 2013).

Community engagement: Beyond physical access, community engagement includes meaningful participation in neighborhoods, places of employment, congregations, and recreational spaces (Amado et al., 2013).

Community experiences: "Activities occurring outside the school settings, supported with in-class instruction, where students apply academic, social, and/or general work behaviors and skills." (Rowe et al., 2015, p. 120).

Constant time delay: "A procedure for transferring stimulus control from contrived response prompts to naturally existing stimuli. After the student has responded correctly to several 0-sec delay trials, after which presentation of the response prompt follows the instructional stimulus by a predetermined and fixed delay" (Cooper et al., 2020, p. 794).

Functional independence: "An individual's ability to perform activities of daily living" (Curzel et al., 2013, p. 94)

Intellectual and developmental disability: "A condition characterized by significant limitations in both intellectual functioning and adaptive behavior that originates before the age of 22" (AAIDD, n.d.)

Pedestrian skills: Examples include using sidewalks, crossing streets at appropriate locations and times, and effectively navigating routes that could include stairs, ramps, and other topographical features (PBIC, n.d.)

Postschool outcomes: Engagement in continued education/training, employment, and independent living following high school

Transition-age youth: Individuals between the ages of 16 and 24 (IWGYP, n.d.)

Travel skills: “The ability to get to places outside home independently” (Carter et al., 2012, p. 52).

Quality of life: “An index of adult performance, adjustment, and happiness” (Hunt & Marshall, 2012, p. G-6)

CHAPTER TWO: REVIEW OF LITERATURE

Although many people associate the passage from high school to adult life with the term "transition," transitions occur constantly over the course of a lifetime. Despite the settings, circumstances, and details that differ from one person to another, a commonality amongst all life transitions is that they can be multi-faceted and complex. The secondary transition experiences of young adults with IDD can be impacted by factors such as family background and involvement in the transition planning process, the quality of transition services and experiences the young person was provided during school, the opportunities for employment and social inclusion that exist within one's community, and even how motivated the individual is to succeed in adult life (Halpern, 1993). Due to these potential influences and more, individuals with disabilities experience the transition to adulthood in different ways according to their characteristics, family life and resources, and many other factors.

Researchers, practitioners, and young adults with IDD and with their families may define "successful" transition in different ways. Interestingly, what constitutes successful transition has also changed in special education law over time. The transition outcomes of young adults with disabilities have been tracked for decades (e.g., Blackorby & Wagner, 1996). Over time, the outcomes measured, data collected, and standard for what comprises successful transition have continued to evolve.

Postschool Outcomes for Young Adults with Disabilities

Some of the earliest efforts towards tracking postschool outcomes began in the 1980s. The Office of Special Education and Rehabilitative Services (OSERS) identified employment as the top priority for young adults with IDD; whether or not a person gained employment after leaving school was the main metric by which the success of a person's transition was evaluated

(Halpern, 1993). At that time, the definition of transition clearly reflected this priority: “Transition is an outcome-oriented process encompassing a broad array of services and experiences that lead to employment” (Will, 1983, p. 1). The OSERS transition model proposed around this same time depicted a starting point – high school – with three levels of services (i.e., no special services, time-limited services, ongoing services) all leading towards the landing point of employment (Halpern, 1985).

Although this definition of transition and its heavy focus on employment represented the stance of OSERS at the time, some special education scholars disagreed with the model. Some took issue with the portrayal of employment as the *most* meaningful adult outcome for *all* individuals. Specifically, a criticism of the OSERS model was how it lumped other adult achievements together (e.g., independent living, social relationships) as factors mostly valuable for their contribution towards securing employment (Halpern, 1983; 1985). What if a young person with a disability had other successes, but employment was not desirable or achievable for that person? Does that indicate a failed or unsuccessful transition?

In 1990, the passage of Public Law 101-476 provided practitioners with an updated and expanded definition of transition. These amendments to the Education of All Handicapped Children Act (i.e., P.L. 94-142; 1975) were intended to expand transition-related initiatives for young adults with disabilities. Public Law 101-476, which was also when this legislation was first renamed the “Individuals with Disabilities Education Act” (IDEA), provided the following definition of transition services:

> The term ‘transition services’ means a coordinated set of activities for a student, designed with an outcome-oriented process, which promotes movement from school to post-school activities, including post-secondary education, vocational training, integrated

> employment (including supported employment), continuing and adult education, adult services, independent living, or community participation. (P.L. 101-476, pp. 1-2)

Finally, in 2004, IDEA was reauthorized as the Individuals with Disabilities Education Improvement Act (IDEIA). This further expanded the description of secondary transition and provides the most current definition available to practitioners and researchers:

> [Transition is] a coordinated set of activities for a child with a disability that (a) is designed to be a results-oriented process, that is focused on improving the academic and functional achievement of the child with a disability to facilitate the child's movement from school to post-school activities, including postsecondary education, vocational education, integrated employment (including supported employment), continuing and adult education, adult services, independent living, or community participation; (b) is based on the individual child's needs, taking into account the child's strengths, preferences, and interests. (IDEIA 2004, [34 CFR 300.43 (a)] [20 U.S.C. 1401(34)])

The definition of transition services presented in IDEIA (2004) includes more outcomes of interest than just employment; it more comprehensively describes some of the skills and behaviors involved in adult life. This definition emphasizes the importance of incorporating student preferences, interests, strengths, and needs in the transition planning process. Successfully attending postsecondary education, gaining and keeping employment, and living independently all require a myriad of skills. Therefore, it is critical for educators and other practitioners to provide skill instruction to young adults with disabilities in all of these areas prior to their transition from school occurring.

The Workforce Innovation and Opportunity Act (WIOA, 2014, P.L. 113-128)

Beyond IDEIA (2004), more recent legislation exists with the shared goal of preparing young adults with disabilities for postschool life. For example, WIOA (2014) amended the Workforce Investment Act of 1998 with the intent to improve in-school transition services for individuals with disabilities. Specifically, WIOA was created to expand and improve supports for job-seeking individuals through increased education and training, with the ultimate goal of increasing the competitiveness of individuals with disabilities in the labor market. One of the most pertinent features of WIOA is the establishment of pre-employment transition services (pre-ETS). Pre-ETS consists of five activities required by WIOA, including: (a) job exploration counseling, (b) work-based learning experiences, (c) counseling related to postsecondary or continued education/training options, (d) training to prepare individuals for employment and independent living environments, and (e) instruction in self-advocacy. Pre-ETS activities should be delivered during high school to help prepare individuals with disabilities for success in work and learning after school.

Following the passage of the earliest legal initiatives for supporting transition, many researchers and practitioners took interest in determining best strategies for preparing young adults with disabilities for adulthood (Clark et al., 1994). This led to an influx of literature that presented similar concepts, but by different names: “life-centered career education” (Brolin, 1997); teaching students to navigate “major life demands” (Cronin & Patton, 1993); “adaptability skills” instruction (Mithaug et al., 1987); and teaching “functional skills” (Clark, 1994), for example. Although labeled with different names, each of these concepts relates to preparing young adults with disabilities for postschool life through an emphasis on the skills they will need in adult environments (e.g., skills used for work, community, and home).

Objective Measures of Transition Outcomes

In the same way that the definition of transition has been challenged over time, there is ongoing discourse regarding the best methodology for evaluating transition outcomes. Certain elements of a person's transition can be considered *objective*, meaning that these outcomes are observable, empirical, and oftentimes dichotomous (i.e., yes/no). As Halpern (1993) describes, whether someone holds a job at a given time is an example of an objective transition outcome. Conversely, *subjective* transition outcomes may not be as observable or easily measured, but still can contribute to a person's overall success in adult life. In Halpern's (1993) employment example, he identifies job satisfaction and fulfillment as subjective transition measures. Undeniably, measuring a person's job fulfillment would look different than determining whether someone is employed. Which measures are most important? Does one method of evaluating the success of transition lend more valuable information than the other? The sections below include examples of *objective* and *subjective* measures that have historically been used to evaluate transition outcomes for individuals with disabilities after exiting high school.

Department of Labor Statistics

Traditionally, objective, employment-related statistics were regarded as the best and most meaningful measures of how successful a young adult's secondary transition was (Halpern, 1993; Will, 1983). Although the view of successful transition has since expanded, objective statistics regarding labor force participation still help illustrate gaps between individuals with and without disabilities in adult life. Specifically, the U.S. Department of Labor publishes issue briefs and press releases that disaggregate data for adults with disabilities. These publications suggest that adults with disabilities lag behind adults without disabilities in many employment-related measures. For example, in a July 2021 press release, the Department of Labor reported that only

19.4% of individuals with disabilities were employed (U.S. Department of Labor, 2022). Across race and ethnicity categories, individuals with disabilities were less likely to be employed than individuals without disabilities (Kang et al., 2018). Additionally, the unemployment rate for individuals with disabilities (8.2%) was more than twice the unemployment rate of people without disabilities (3.5%), indicating a considerable discrepancy in which individuals are most often employed and which are not (Kang et al., 2018).

The Department of Labor also gathers and publishes statistics regarding the types of jobs held by employed individuals with disabilities. For example, in a 2023 report, the Department of Labor indicated that up to 30% of employed individuals with disabilities work at part-time jobs, compared to only 16% of individuals without disabilities (U.S. Department of Labor, 2023). Further, the report indicates that employed individuals with disabilities most frequently report working in the service, production, transportation, and material moving industries. They are least likely to report working in professional and related fields (U.S. Department of Labor, 2023).

Over time, the Department of Labor has also begun to collect more anecdotal data from individuals with disabilities related to barriers to employment. For example, a 2022 press release indicated that lack of education and training, an unmet need for workplace supports, and lack of transportation constitute some of the most frequently reported barriers to employment by individuals with disabilities (U.S. Department of Labor, 2022). The Department of Labor also collects information related to use of Career and Financial Assistance Programs, as well as modalities of work accessed by individuals with disabilities (e.g., in-person versus remote work). Although the Department of Labor serves many more functions than measuring postschool outcomes for individuals with disabilities, the objective statistics the Department reports lend insight regarding employment rates and trends for people with and without disabilities. Data suggest continued, persistent gaps in achievement related to employment for individuals with disabilities, resulting in lower rates of employment overall and higher rates of part-time work.

The National Longitudinal Transition Studies

Large scale, long-term research studies, such as the three National Longitudinal Transition Studies, are another method by which objective data regarding postschool outcomes for individuals with disabilities are collected. These longitudinal studies have been used to evaluate transition outcomes since the mid-1980s, and the evolution of the research questions guiding these studies mirrors the shift from employment-focused transitions to more holistic indicators of success in adult life. Below, each of the three renditions of the National Longitudinal Transition Study (i.e., NLTS, NLTS-2, NLTS 2012) is described, as well as associated data regarding postschool outcomes for individuals with disabilities.

The National Longitudinal Transition Study (NLTS; 1985-1993). The first longitudinal transition study, subsequently referred to as NLTS, was developed during the 1980s when the school-to-work transition was paramount. The Office of Special Education Programs (OSEP) contracted SRI International, a nonprofit research organization, to support study design and data collection procedures. The NLTS took place between 1985 and 1993, with data collected in two major waves (i.e., 1987 and 1990; NLTS 2, n.d.).

The intent of the NLTS was to measure the postschool outcomes of approximately 8,000 youth receiving special education services. Participants were evaluated in the areas of employment, wages, postsecondary education, and residential independence. The following items were measured for each respondent: a) form of employment (not employed, completing a work study, working in a sheltered environment, working in a part-time competitive job, working in a full-time competitive job); b) trends in competitive employment over time; c) trends in wages earned; d) trends in postsecondary enrollment, and; e) trends in independent living (Blackorby & Wagner, 1996).

Data collected from the NLTS suggested mixed outcomes for young adults with disabilities following the transition from school to adulthood. For example, data indicated that a number of young adults with disabilities continue to make progress in the areas of employment, education, and independent living after leaving high school. Despite making progress, the outcomes of young adults with disabilities still lag compared to young adults without disabilities (Blackorby & Wagner, 1996). The NLTS reported that young adults with disabilities earned a median wage of only $5.72 per hour and overall had lower educational attainment than young adults without disabilities (Blackorby & Wagner, 1996).

The NLTS also draws comparisons to outcomes reported by different identity groups (i.e., disability category, race/ethnicity, high school completion status). For example, the NLTS found that young adults with ID made greater gains in residential independence and employment than other disability groups immediately following high school; however, young adults with ID did not maintain these gains over the next three to five years after leaving school when compared to other disability category groups. The NLTS also suggested that factors related to gender, ethnicity, and high school completion status can impact adult outcomes (Blackorby & Wagner, 1996).

The National Longitudinal Transition Study-2 (NLTS-2; 2000-2011). Following the completion of the NLTS, a second iteration of the longitudinal transition study was initiated. Once again, OSEP, along with the Institute of Education Sciences (IES), contracted SRI International to support the development and execution of the NLTS-2. The NLTS-2 began in 2000 and concluded in 2011 (NLTS-2, n.d.).

The NLTS-2 included even more participants than the original NLTS; 11,270 youth and young adults with disabilities across the nation participated between 2000 and 2011. The intent of the NLTS-2 was similar to the original NLTS – to measure transition outcomes of youth who received special education services. Researchers used phone interviews, surveys, youth assessments, and academic transcripts to collect data from the participants (NLTS-2, n.d.).

Similar to the original NLTS, the NLTS-2 included outcome data related to employment, wages, postsecondary enrollment, and residential independence. In the NLTS-2, new outcomes reflecting an expanded view of success in adult life were added. These new outcome areas were parenting and marital status, financial independence, friendship interactions, community participation, and criminal justice system involvement (Sanford et al., 2011).

Similar to the NLTS, results of the NLTS-2 suggested that there was still a large gap to close between the adult outcomes of individuals with disabilities and individuals without disabilities. Sanford et al. (2011) detail some of these gaps in their report on the NLTS-2. For example, at the time data were reported, young adults with disabilities were less likely to enroll in postsecondary education than same-age peers without disabilities. Of note, individuals with ASD and ID were the least likely of any disability category group to enroll in postsecondary education. Young adults with disabilities were less likely to have paid jobs, and individuals with ASD and ID were again the least likely of any disability category group to report having a paid job. The mean hourly wage reported for individuals with disabilities was $9.40 per hour, compared to an average of $13.20 per hour for individuals without disabilities. Employed individuals with ASD or ID reported even lower hourly wages, at $7.70 per hour and $7.60 per hour, respectively. Only 36% of individuals with disabilities reported living independently (Sanford et al., 2011).

Data collected for the new outcome areas – parenting and marital status, financial independence, friendship interactions, community participation, and criminal justice system involvement – demonstrated continued gaps in achievement between young adults with and without disabilities. The NLTS-2 reported that young adults with disabilities were just as likely as same-age peers to be a parent, but less likely to be married or in a marriage-like relationship. Young adults with disabilities were less likely to have a checking account or credit card than same-age peers, suggesting limited financial independence for many respondents (Sanford et al. 2011).

Additionally, productive engagement in the community was lower for young adults with disabilities than for their same-age peers. The NLTS-2 defined productive engagement as participating in employment, postsecondary education, or specific job training outside of work. Individuals with ASD and ID were among the least likely disability category groups to be productively engaged. Only 41% of respondents with ASD or ID reported engaging in an extracurricular activity (i.e., taking lessons, volunteering, or participating in a community group) any time in the previous year (Sanford et al., 2011).

Although the NLTS-2 lends a more comprehensive view of adult outcomes than the original NLTS, the results for individuals with disabilities still indicated a need for more support and intervention in transition. Specifically, individuals with ASD and ID demonstrated the least likelihood for success in measures of employment, independent living, postsecondary education, and social/community engagement (Sanford et al., 2011).

The National Longitudinal Transition Study 2012 (NLTS 2012; 2010-2024). The most current iteration of the longitudinal transition study is presently in progress. The NLTS 2012 began in 2010 under a federal mandate to study IDEIA 2004 and associated outcomes for students with disabilities (Liu et al., 2018). It is sponsored by the U. S. Department of Education, and data collection in waves one and two of the study are supported by SRI International, RTI International, and Mathematica, a research and data consulting firm (National Center for Education Evaluation and Regional Assistance, n.d.).

Once again, the sample size for this new iteration of the NLTS increased – the NLTS 2012 includes data collected from almost 13,000 students, more than were sampled in the NLTS or NLTS-2. The sample for the NLTS 2012 was unique in more than just size; for the first time, students without IEPs were also included in data collection. Students without IEPs that participated in the study include individuals without an identified disability as well as students receiving services under Section 504 (Liu et al., 2018). Additionally, data from the NLTS 2012 have been published in three volumes that facilitate different data comparisons. Volume One includes comparisons to other youth (Lipscomb et al., 2017a), Volume Two draws comparisons across disability groups (Lipscomb et al., 2017b), and Volume Three presents comparisons over time (Liu et al., 2018).

Another update included in the NLTS 2012 is a list of new research questions. The five research questions below are used across all three published volumes of the results in slightly different forms:

> (a) What are the background characteristics of youth and the schools they attend? (b) What challenges do youth face relating to health, functional abilities, and independence? (c) How engaged are youth in school and with friends? What academic supports do youth receive? (d) How are youth preparing for life after high school? (Liu et al., 2018, p. iii)

Even at quick glance, it is apparent that the in-school transition activities of interest have changed since measurement began in the 1980s. The research questions guiding the NLTS 2012 reflect the complexity of preparing for adult transition. They also yield rich results, drawing a detailed picture of how young adults with disabilities prepare to exit high school and undergo secondary transition.

Volume One: Comparisons to Other Youth. The data presented in Volume One (Lipscomb et al., 2017a) compare the in-school transition activities of individuals who received special education services, individuals who received accommodations under Section 504, and individuals without an identified disability. This is the first time in the NLTS series that broad comparisons across these three groups of individuals have been possible. Volume One indicates that youth with IEPs are more likely than their peers to face socioeconomic challenges and to navigate other barriers related to health, communication, and daily living task completion. Youth with IEPs take fewer steps to plan for and obtain postsecondary education and employment than their peers. Additionally, youth with IEPs are less engaged in social and community-based activities than their peers. The data presented in Volume One suggest that youth with IEPs are more likely than peers with 504 plans or without disabilities to face unique challenges in preparing for secondary transition.

Volume Two: Comparisons Across Groups. Volume Two of the NLTS 2012 compares in-school transition activities across disability groups (Lipscomb et al., 2017b). The data in Volume Two were gathered from youth with an IEP only and did not include students with 504 plans or students without identified disabilities. Youth with IEPs who participated in the NLTS 2012 represent the 12 disability categories identified by IDEIA (2004): ASD, deaf-blindness, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, other health impairment, specific learning disability, speech of language impairment, traumatic brain injury, and visual impairment.

The data presented in Volume Two suggest that not only do in-school transition activities look different between youth with and without IEPs, but they also differ between disability categories. For example, along with youth with emotional disturbances, youth with ID experience the most socioeconomic challenges and are more likely to attend poorer-performing schools. Youth with ID, youth with ASD and youth with multiple disabilities are the least likely disability groups to take actions to prepare for postsecondary education or employment. Additionally, parents of youth with ASD, ID, or multiple disabilities are the least likely to expect their child to obtain postsecondary education or to live independently.

Volume Two also reveals social challenges unique to individuals with ASD and ID. Youth with ASD and ID are the most likely of any disability group to have needs related to communication and independent living tasks. Additionally, youth with ASD and ID are 10% to 36% less likely than youth with an IEP overall to report meeting with friends for a social activity at least once per week. The ability to compare data across disability groups suggests that young people with IDD may face some of the steepest challenges related to preparing for secondary transition.

Volume Three: Comparisons Over Time. The third and final published volume resulting from NLTS 2012 describes comparisons in transition activities over time (Liu et al., 2018). Volume Three examines data from the NLTS-2 and earlier phases of the NLTS 2012 to describe trends in in-school transition activities between 2003 and 2012. Additionally, data from the original NLTS are used when comparison points from later iterations exist. Looking at trends over time allows one to draw conclusions about the progress and general direction of transition activities and preparedness of individuals with disabilities to exit high school. Volume Three presents major findings related to trends in household factors, school engagement and services, transition planning, and participation in paid jobs. First, youth with IEPs are more likely than in 2003 to live in households facing economic challenges. This aligns with increases in use of federal food benefits by families of youth with IEPs between 2003 and 2012 and increases in proportion of youth with IEPs who received Supplemental Security Income between 2003 and 2012 (Liu et al., 2018). Additionally, youth with IEPs reported similar health quality in 2012 as they did in 2003, but the use of behavior-altering medication has increased for youth with IEPs since 2003 (Liu et al., 2018).

Other major findings in Volume Three relate to transition planning. For example, youth with IEPs received more services in school in 2012 than 2003, but were less likely to receive any services outside of school in 2012 than in 2003. Additionally, the percentage of youth with IEPs who reported meeting with school staff to complete transition planning activities decreased from 79% in 2003 to 70% in 2012. The percent of youth with IEPs who reported engaging in paid jobs prior to transition also declined from 27% in 2003 to 19% in 2012 (Liu et al., 2018). The data collected through the NLTS 2012 indicate that despite recent efforts to improve the quality and consistency of transition services, more improvement is needed to best prepare young adults with disabilities to exit school.

The Evolution of NLTS

The original NLTS tracked postschool outcomes related to employment, wages, postsecondary education, and residential independence. The NLTS-2 expanded to also include parenting and marital status, financial independence, friendship interactions, community participation, and criminal justice system involvement as transition outcomes of interest. The ongoing NLTS 2012 is the most comprehensive longitudinal transition study yet, signaling the tremendous growth in which transition outcomes are considered "worth" measuring between the 1980s and today.

It is important to note that the original NLTS did acknowledge the complexity of transition in some ways. For example, the original NLTS defined the residential independence outcome measure as participation in "an assortment of self-sustaining activities and competencies that indicate successful adjustment to adulthood" (Afflect et al., 1990; Blackorby & Wagner, 1996; p. 2). Even with this acknowledgement that many skills are needed to achieve successful adult outcomes, the measures taken in the NLTS still reflect the emphasis of the time, which was successful employment.

The next iterations of the NLTS (i.e., NLTS-2, NLTS 2012) measure "community engagement," which is more subjective of an outcome measure than employment status or hourly wage. As suggested by Halpern (1993), subjective transition outcomes are still critically important to prioritize. The NLTS-2 describes the benefits of community engagement, to include the chance for young adults with disabilities to connect with others who have shared interests, learn and develop new skills in the contexts in which they will be used, and to feel a sense of belonging through contribution to the broader community (Sanford et al., 2011). Subjective outcomes such as connection and belonginess are undeniably challenging to measure. Yet, some argue that life cannot be full or complete without such outcomes (Halpern et al., 1993).

Subjective Measures of Transition Outcomes

As indicated by the Department of Labor statistics and National Longitudinal Transition Studies, objective measures of postschool outcomes provide valuable information about how young adults with disabilities experience transition. It is also clear that although objective measures yield certain benefits – such as the ability to compare numeric data across subgroups – objective measures cannot quantify *every* aspect of what makes a person's transition successful or unsuccessful. For this reason, researchers have explored how to collect more subjective information about transition experiences, such as community or social engagement and overall quality of adult life.

Normalization

Early special education scholars explored transition-related concepts such as "normalization." The normalization principle originated in the late 1960s in Scandinavia, with the primary intent of "making available to the mentally retarded patterns and conditions of everyday life which are as close as possible to the norms and patterns of the mainstream of society" (Nirje, 1969, p. 19). This was particularly pertinent at the time, given that the first waves of adults with disabilities were transitioning from highly structured, institutionalized life to mainstream life (Edgerton, 1967). Adherence to the normalization principle was one of the first subjective metrics used in the field to evaluate the quality of life of individuals with disabilities. A person with a disability's level of "normalization" is not empirical or quantitative; yet frameworks for evaluating normalization have existed for decades. For example, Nirje (1969) describes several components of normalization, including concepts such as the following: maintaining a typical daily rhythm and routine of life; experiencing holidays, personal days, and travel; participating in normal events of the life cycle, such as childhood, schooling, the transition to adulthood, and old age; having the opportunity to make decisions and for others to respect those decisions; having regular social access to members of the opposite gender or sex; access to basic financial privileges; and access to safe, high-quality facilities (e.g., schools, hospitals, homes). Although concepts such as enjoying holidays and family time are not objectively measurable, Nirje and other scholars who support normalization posit that these outcomes are still important transition and adult life-related metrics for individuals with disabilities.

Quality of Life

Nirje's work on normalization helped pave the way for future research in both the conceptualization and measurement of quality of life (e.g., Halpern, 1993; Schalock, 2000). Quality of life can be defined as "the set of factors composing personal well-being" (Schalock, 2004, p. 205). Quality of life became a guidepost for research, evaluation, and service delivery in the 1980s as the field broadly reconsidered what was possible – and what the acceptable standard should be, in terms of quality of supports and resources – for individuals with disabilities living in the community (Schalock, 2000).

As more practitioners and researchers took interest in the concept of quality of life, it became necessary to develop a clear definition and clear protocols for measurement. While the widespread interest in quality of life measures was encouraging at the time, it also resulted in some confusion across the field. For example, Schalock (2000) notes that more than 100 different definitions of quality of life were known to exist in the 1980s. For this reason, scholars in the field of disability (i.e., Raphael, 1996; Schalock, 1996) conducted research to sort through questions of concept (e.g., is quality of life a single entity, or is it multidimensional?) and questions of measurement (e.g., what should be measured, and what tools can be used?) (Schalock, 2000). The literature that followed presented a clearer picture of what quality of life is and how one should measure it. Based upon this research, Schalock (2000) presents one framework with five overarching concepts related to quality of life, including: (a) quality of life is multidimensional, (b) a person's satisfaction can be used to measure quality of life, (c) quality of life exists in a hierarchy, (d) correlational research can help reveal factors linked to higher quality of life, and (e) no single tool completely measures quality of life; multiple methods are needed.

Quality of Life is Multidimensional. This is perhaps one of the clearest points of evolution between early transition's focus on employment only and the shift to a broader view of what constitutes success in adult life. Although Schalock (1996, 2000) presents eight specific dimensions of quality of life – emotional well-being, interpersonal relationships, material well-being, personal development, physical well-being, self-determination, social inclusion, and rights – it is most important to note that a person's quality of life does not depend on any one single factor. Rather, a person may experience a satisfactory quality of life through various combinations of these dimensions.

Satisfaction as a Measure of Quality of Life. The subjective nature of many of the dimensions of quality of life can make measurement challenging. Additionally, people may require more or less of the dimensions to achieve their own perceived maximum quality of life. For these reasons, scholars such as Schalock (2000) suggest assessing the individual's level of satisfaction to help measure quality of life. Schalock (2000) presents several benefits to this approach, including its usefulness in drawing comparisons across groups and developing common terminology across fields of practitioners.

Quality of Life is Hierarchical. As individuals experience transitions throughout their lives, values and priorities can shift. Schalock (2000) suggests that the quality of life dimensions work in a similar way. People value different dimensions at different levels; similarly, the dimension that may be most important to one person during young adulthood may carry less weight for him or her later in life. Schalock (2000) presents a potential hierarchy for the dimensions. Physical well-being is at the base of the pyramid, indicating importance across one's lifespan. Dimensions like personal development are closer to the top of the pyramid, indicating that a person may experiences phases of life where personal development is prioritized, and other phases where it is not as valued.

Importance of Correlational Research. The earliest attempts at measuring quality of life were comparisons between two groups (Schalock, 2000). For example, measuring the reported satisfaction of individuals living in a group home versus individuals living independently. While these comparisons resulted in some helpful information, they also led some researchers to question whether demographic, socioeconomic, or other factors either limited or increased a person's perceived quality of life (Schalock, 2000). For this reason, the methodology used to research quality of life has shifted over time to be largely correlational in nature; researchers tend to focus on measuring relationships between potential correlates and a person's reported quality of life (Schalock, 2000).

Multiple Measures are Needed. As quality of life is a multidimensional concept, it follows that no one tool can be used to measure it comprehensively. Schalock (2000) suggests two major categories of assessment to best measure quality of life: (a) personal appraisal, a subjective measurement in which a person responds to questions about his or her satisfaction with various components of life; and (b) functional assessment, in which a person provides numeric, quantifiable data through responses to surveys, questionnaires, and behavioral observation.

Quality of Life as an Outcome

The idea that all persons deserve a satisfactory quality of life is not new in the field and has persisted over time. For example, the Rehabilitation Act Amendments of 1992 (i.e., P. L.

102-569) specifically state that disability status does not diminish a person's rights to live independently, make self-determined choices, contribute to their communities, and enjoy full integration in mainstream society (Rehabilitation Act Amendments of 1992). While scholars like Schalock revolutionized the ways the field conceptualizes and measures quality of life, other scholars like Halpern (1993) have explicitly applied the quality of life framework as a useful and meaningful way to measure transition.

Halpern (1993) suggested three major areas for using quality of life to measure transition outcomes. First, he describes physical and material well-being, which encompasses physical and mental health, access to food, clothing, and safe lodging, financial security, and safety from harm or danger. Second, he identifies the area of performance of adult roles, which includes mobility and community access, employment, activities for leisure or recreation, interpersonal relationships, educational attainment, spiritual fulfillment, and citizenship. Finally, Halpern (1993) describes the personal fulfillment area, which includes happiness, satisfaction, and general sense of well-being. The areas for measurement identified by Halpern (1993) align closely with the eight dimensions identified by Schalock (2000), suggesting development of common language and terminology used across the field.

Because transition is complex, it follows that the measurement of transition outcomes is also complex. It is clear from the reviewed literature that both objective, factual measures (e.g., Department of Labor Statistics, NLTS series) and subjective measures (e.g., a personal appraisal conducted while evaluating quality of life) are necessary to comprehensively evaluate the "success" of transition outcomes for young adults with disabilities. Unfortunately, both objective and subjective measures presently indicate that postschool outcomes for young adults with disabilities continue to lag in many major aspects of adult life. Over the last two decades as these gaps have become more apparent and persistent, identifying evidence-based in-school predictors of postschool success has emerged as a major focus of transition research, with the intent of boosting postschool outcomes and ultimately increasing quality of life for young adults with disabilities.

The Predictors of Postschool Success

The skills that a person has when entering secondary transition are an important indicator of how successful his or her education was (Field et al., 1998). Educators, interagency teams, and families typically desire for students with disabilities to have meaningful educational experience that support positive postschool outcomes. For this reason, considerable research has been conducted to identify in-school factors that predict more positive postschool outcomes, including a series of systematic literature reviews and a meta-analysis (i.e., Haber et al., 2016; Mazzotti et al., 2016; Mazzotti et al., 2021; Test et al., 2009). The intent is for educators, other practitioners, and families to prioritize activities that correspond with the predictors to help support positive postschool outcomes for individuals with disabilities.

Test et al. (2009)

Test et al. (2009) conducted the original systematic review in this topic area, seeking out evidence-based in-school predictors that correlated with improved postschool outcomes in the areas of employment, education, and independent living. Through a systematic review of the literature, Test et al. (2009) identified 16 different predictors. Four of the 16 predicted improved outcomes in all three areas of employment, education, and independent living: inclusion in general education, paid employment or work experience, self-care and independent living skills, and student support. Seven of the 16 predicted improved outcomes in the areas of education and employment: career awareness, interagency collaboration, occupational courses, self-advocacy or self-determination, social skills, transition program, and vocational education. Finally, five of the 16 predicted improved outcomes for employment only: community experiences, exit exam requirements or high school diploma status, parental involvement, program of study, and work study.

Test et al. (2009) was the first time that the field of secondary transition established a set of evidence-based predictors based on Thompson et al.'s (2005) set of quality indicators for correlational research. Additionally, the authors presented levels of evidence to support each predictor and effect size calculations. Levels of evidence varied by predictor, but each predictor was supported by either "potential" or "moderate" levels of evidence. Effect sizes also varied by predictor and ranged from small to large.

Haber et al. (2016)

Several years after the publication of the first systematic literature review regarding predictors of postschool success, Haber et al. (2016) conducted a meta-analysis to further explore the relationships between the predictors and outcomes. Specifically, researchers were interested in determining which in-school experiences had the strongest relationships with positive postschool outcomes, as well as how these relationships may change depending on outcome area (i.e., employment, education, or independent living), research design, and/or student population.

Haber et al.'s (2016) research helped reinforce the findings of Test et al. (2009). The results of the meta-analysis indicated small, but positive and consistent, relationships between the in-school predictors and postschool outcomes. In their discussion, the authors also note variance in effects by outcome areas; for example, a predictor strongly related to positive outcomes in independent living may not predict positive outcomes in employment. For this reason, Haber et al. (2016) suggest tailoring transition programming and interventions to whatever most closely aligns with a student's postschool goals and interests.

Mazzotti et al. (2016)

Continuing in this line of research, Mazzotti et al. (2016) conducted a systematic review of NLTS-2 secondary analysis articles with a two-pronged purpose: a) to add evidence to the existing 16 predictors established by Test et al. (2009), and (b) to examine the literature for any new potential predictors of postschool success. Researchers found additional evidence to support nine of the 16 original predictors, including: career awareness, exit exam or high school diploma status, inclusion in general education, paid employment or work experience, parent involvement, self-care or independent living skills, social skills, vocational education, and work study. Although additional literature was identified to support these predictors, there was not enough new literature to support a change in level of evidence for any of the nine.

Additionally, Mazzotti et al. (2016) identified four new predictors of postschool success: parent expectations, youth autonomy, goal setting, and travel skills. As a predictor, parent expectations had a potential level of evidence to support positive postschool outcomes in the areas of education and employment. Youth autonomy had a moderate level of evidence to support positive postschool outcomes in the area of education, and a potential level of evidence to support positive postschool outcomes in the area of employment. Goal setting had emerging evidence to support positive postschool outcomes in the area of education. Finally, travel skills had a potential level of evidence to support positive postschool outcomes in the area of employment.

Mazzotti et al. (2021)

The most recent systematic review in this area was conducted by Mazzotti et al. (2021). Like Mazzotti et al. (2016), the purpose of the 2021 review was to a) to add evidence to the 20 identified predictors of postschool success, and b) to examine the literature for any potential new predictors of postschool success. The systematic review provided additional evidence for 14 of the 20 predictors, including: career and technical education (previously labeled "vocational education" in Test et al., 2009 and Mazzotti et al., 2016), exit exam or high school diploma status, goal-setting, inclusion in general education, paid employment or work experience, parent expectations, program of study, self-care or independent living skills, self-determination or self-advocacy, social skills, student support, transition program, work study, and youth autonomy or decision-making.

Unlike in the Mazzotti et al. (2016) review, this systematic review did yield sufficient results to justify a change in level of evidence for six of the predictors. Goal-setting, parent expectations, program of study, student support, and youth autonomy/decision-making shifted from promising to research-based. Additionally, career and technical education changed from research-based to evidence-based. This review did not result in sufficient findings to warrant a change in level of evidence for any of the other predictors.

The Mazzotti et al. (2021) review also resulted in identification of three new predictors: psychological empowerment, self-realization, and technology skills. Psychological empowerment was described as belief in a connection between behaviors and outcomes; this was determined to be a promising predictor in all three outcome areas (i.e., education, employment, and independent living). Self-realization was defined as a person's understanding of his or her own skills and needs; it was identified as a promising predictor in the areas of employment and independent living. Finally, technology skills – or the ability to operate computers and other electronic tools – was determined to be a promising predictor in the area of employment.

Predictors Related to the Present Study

The body of research regarding in-school predictors of postschool success has been impactful on the field of special education and secondary transition. Specifically, the systematic reviews identify factors that support better outcomes for individuals with disabilities, allowing educators, families, and other stakeholders to prioritize instruction and effort in the areas that best align with a student's postschool goals and wishes. The following predictors demonstrate closest alignment with the present study involving instruction to teach use of Google Maps: travel skills, self-determination/self-advocacy, and community experiences.

Travel skills is defined as "the ability to get to places outside home independently" (Carter et al., 2012, p. 52). The present study involves walking as a method of travel, and through intervention and instruction, participants will potentially increase their ability to navigate to unknown locations of interest outside the home, thereby strengthening their travel skills. Next, self-determination/self-advocacy is defined as "the ability to make choices, solve problems, set goals, evaluate options, take initiative to reach one's goals, and accept consequences of one's actions" (Rowe et al., 2015, p. 121). Participants in the present study will exercise self-determination/self-advocacy by selecting their desired walking location during each session, rather than being assigned a destination by the research team. Asking participants to be self-determined in selecting their own locations of interest is a component unique to this study, as destination choice is not commonly incorporated in the travel skills literature for individuals with IDD. Finally, community experiences are defined as "activities occurring outside the school setting, supported with in-class instruction, where students apply academic, social, and/or general work behaviors and skills" (Rowe et al., 2015, p. 120). Although participants will receive direct instruction in map programming, they will engage with their routes beyond the instructional environment by following them to reach their desired destinations. Navigating to new locations will allow participants the opportunity to further engage in the UNC Charlotte campus community.

Community Experiences in Transition

One of Test et al. (2009)'s original 16 predictors of postschool success is *community experiences*. In the 2009 systematic review, community experiences had a potential level of evidence to support positive outcomes in the area of employment. The evidence to support this predictor was an exploratory study conducted by White and Weiner (2004), in which students who engaged in community-based activities to support social, domestic, travel, and vocational skill development were more likely to achieve postschool employment than students who did not participate.

Frameworks for Community Engagement

The importance of supporting individuals with disabilities in the community has been studied for decades. Some of the earliest research involving adults with disabilities in the community came from the 1960s, when individuals who left institutions entered mainstream society and required instruction on how to participate in the community (e.g., Edgerton, 1967). Special education scholars have described a discrepancy between the concept of being "in" a community versus being "of" a community (e.g., Amado et al., 2013) – are individuals with disabilities simply existing in or around society, or are they actively engaged, valued, and welcomed?

Like quality of life, community engagement is a complex term with many definitions. Some scholars in the field have described community engagement in terms of how it facilitates a person's sense of belonging. For example, Carter and Biggs (2021) developed 10 dimensions of belonging, proposing that individuals with disabilities should be present, invited, welcomed, known, accepted, involved, supported, heard, befriended, and needed in order to achieve a sense of belonging. Although Carter and Biggs present these dimensions through the idea of belonging in a school setting, the same dimensions are applicable to membership in a broader adult community.

Other researchers have employed qualitative methods to describe what social inclusion and community engagement should look like for individuals with disabilities. Hall (2009) proposes a six-pronged framework, positing that individuals with IDD should all have: acceptance as an individual, beyond disability status or diagnosis; the opportunity to participate in meaningful and reciprocal relationships with others; the opportunity to become involved with community-based activities; the opportunity to hold a meaningful job in the community; and the opportunity to access both formal supports (e.g., vocational rehabilitation services) and informal supports (e.g., the advice of a trusted mentor or friend).

Additionally, researchers have identified specific enablers to social inclusion and community engagement. For example, Van Asselt et al. (2015) identify the following characteristics as supportive of community engagement: a motivation to grow in relationships with others, the opportunity to experience dignity in a valued community role (e.g., a job), the right to share and enjoy ordinary community places (e.g., a community park), the opportunity to use one's natural gifts and talents, and the chance to exercise control and self-determination in one's own life (Van Asselt et al., 2015). These enablers connect clearly to the work of others in this topic area, such as Hall (2009) and Biggs and Carter (2021).

Community Engagement for Individuals with IDD

While it is apparent that community experiences and engagement are important – both through the research-based frameworks scholars have developed, and through its designation as a predictor of postschool success – data indicate that, like measures in employment, education, and independent living, outcomes lag behind for young adults with disabilities when compared to same-age peers. Similar to trends observed in NLTS 2012 Volume 2, individuals with IDD often struggle the most of any disability group to obtain meaningful engagement within their communities (Amado et al., 2013; Stancliffe et al., 2007; Van Asselt et al., 2015; Verdonschot et al., 2009).

One major category of barriers impacting the community engagement of young adults with IDD involves interpersonal relationships. Young adults with IDD often experience difficulties developing friendships and social relationships (Stancliffe et al., 2007), and these challenges can impact a person's ability or motivation to engage in the community. For example, individuals with IDD often report they do not have many friends and that they typically view other disability service users, staff, and or family members as their closest friends (Amado et al., 2013). Additionally, approximately half of individuals with IDD surveyed in one study reported feeling lonely (Stancliffe et al., 2007); other individuals with IDD report that exclusion from group activities or limited interactions with new people can increase social isolation (Verdonschot et al., 2009). The size of one's community can also potentially influence the likelihood of engagement. People with IDD living in smaller communities have been observed to participate more than people with IDD living in large communities, but both groups engage less frequently in their communities overall than same-age peers without disabilities (Verdonschot et al., 2009).

Another category of barriers that can limit the community engagement of young adults with IDD is reliance on others. Some individuals with IDD report relying on others for advice, direction, and support in many or most areas of adult life (Verdonschot et al., 2009). Additionally, reliance on others for support in transport and travel can severely limit community engagement. For example, individuals with IDD sometimes struggle to access events or locations of interest independently and may require transportation from other people in order to navigate the community (Deka et al., 2016; Verdonschot et al., 2009).

Both objective and subjective measures of transition outcomes suggest that young adults with disabilities – and especially young adults with IDD – struggle to achieve positive postschool outcomes in the areas of education, employment, and independent living at rates that compare to same-age peers. Additionally, barriers related to social relationships, reliance on others, and lack of independent transportation are connected to poor outcomes for young adults with IDD in the area of community engagement. Although every individual is deserving of a life of quality and meaning (Schalock, 2000), it is apparent that more research is needed to maximize adult outcomes and community membership for young adults with IDD.

Transportation Usage and Trends for Young Adults with Disabilities

As noted above, transportation and travel can be challenging for some individuals with disabilities. Deficits in travel skills may create barriers related to employment and other adult outcome areas (U.S. Department of Labor, 2022; Verdonschot et al., 2009), but importantly, , some method of transportation or mobility is necessary for a person to participate fully in his or her community (Bezyak et al., 2017; Jansuwan et al., 2013; Park & Chowdhury, 2018). This section will explore related literature in the following areas: national transportation trends for individuals with disabilities; trends and barriers related to driving, public transportation, and pedestrian travel for individuals with disabilities; and implications of travel skills on the community and social engagement of individuals with disabilities.

National Transportation Trends for Individuals with Disabilities

Mobility and transportation are required for many tasks of daily living. Without a safe and reliable mode of transportation, it would be challenging to work, shop, attend postsecondary education coursework, engage in civic duties (e.g., to vote or volunteer), engage in leisure activities, or develop friendships. In an issue brief regarding the travel patterns of adults with disabilities in the United States, it is reported that up to 25.5 million Americans over the age of 5 have a disability impacting ability to travel or use transportation (Brumbaugh, 2018). Not only are the impacts of limited travel for people with disabilities potentially serious (e.g., no access to a job, no opportunities for social engagement), they are widespread, impacting millions of Americans.

Compared to people without disabilities, adult Americans with disabilities take fewer trips out of the home daily. Adults without disabilities average approximately 3.6 trips per day, while people with disabilities average only 2.6 trips per day (Brumbaugh, 2018). Specifically, adults with disabilities overall take fewer trips for work, social, and recreational purposes than people without disabilities, with the total number of trips taken for adults with disabilities continuing to decline over time (Brumbaugh, 2018).

Trips out of the home are a significant metric for several reasons. First, transition-age young adults with disabilities often greatly benefit from opportunities to learn and strengthen their skills in the community, because it is a natural environment and represents the true context in which the skills will be used (Browder et al., 1997). If a young adult is taking few or no trips out of the home on a regular basis, engagement in community-based instruction considerably decreases, limiting a person's opportunity to learn and practice adult life skills. Additionally, opportunities to engage in employment and postsecondary education entirely from one's home are limited. Not having the skills or support to navigate the community may limit a person's ability to achieve positive outcomes in these areas. Finally, taking few or no trips out of the home decreases a person's opportunities to develop interpersonal relationships and to participate meaningfully in the community, which may decrease a person's perceived quality of life or sense of belonging.

Due to the impact of disability on travel and mobility, people with disabilities often attempt to compensate for travel difficulties through other means. For example, many adults with disabilities (i.e., 44.3%) reported regularly asking others (e.g., friends, family) to drive them places if they are unable to reach a destination independently (Brumbaugh, 2018). Although asking others for a ride can be an effective method of transportation, it is not always the most reliable method; riding with others requires the availability of the driver at a specific time, and it also limits a person's ability to exercise self-determination and spontaneity in making plans.

To manage challenges with travel and mobility, other adults with disabilities report restricting their travel to the daytime (22.6%) and/or using some form of specialized transportation services (e.g., paratransit, Dial-A-Ride; 12.3%) (Brumbaugh, 2018). Once again, these methods can be effective with certain limitations. Limiting travel to the daytime may be possible if it aligns with a person's work schedule, but it does not allow much flexibility for social events, changes in plans, or emergencies. Reliance on specialized transportation services may present similar challenges. These systems sometimes require completion of lengthy and complex applications, and oftentimes a person must make a reservation far in advance if they wish to receive specialized transportation, making options like paratransit and Dial-A-Ride most useful only when a person has clear plans for travel ahead of time (Bross et al., 2023).

Generally, people with disabilities report a lack of opportunities and resources related to travel training (Feeley et al., 2015). This means that many young adults with disabilities may exit school without a personal plan for travel, or even an understanding of the transportation options that exist within one's community (Feeley et al., 2015). Below, trends and challenges specifically related to car transportation, use of public transportation, and pedestrian travel for individuals with disabilities are described.

Car Transportation for Individuals with Disabilities

In 2021, as many as 91.7% of American households reported owning at least one personal vehicle (Tilford & Megna, 2023). Although it is highly common for adults to travel to work and complete other daily trips via a personal vehicle, people with disabilities travel by car less frequently than people without disabilities (Brumbaugh et al., 2018). People with disabilities may travel by car as a driver or passenger, or they may use a ridesharing application (e.g., Uber, Lyft) to hail an on-demand ride from a driver (Deka et al., 2016). Relevant statistics and barriers related to each method (i.e., driving, riding as a passenger, or using a ridesharing application) are detailed in the following sections.

Driving a Personal Vehicle. While driving is a desirable and attainable goal for many individuals with disabilities, some adults with IDD experience challenges related to driving that make it undesirable or not feasible as a transportation option (Deka et al., 2016). For example, some individuals with IDD present with decreased responsiveness to hazards, challenges regarding physical coordination, executive functioning challenges, and differences in social literacy and responsiveness (Deka et al., 2016; Sheppard et al., 2010). These factors can result in fear or nervousness regarding driving (e.g., Bross et al., 2023) and may make driving a dangerous option.

The training and testing requirements to become a licensed driver can also present challenges to individuals with disabilities. Driving exams are typically highly standardized and must be completed independently. Because licensure exams and testing can be challenging, some individuals with disabilities choose not to take the test, or must take and retake the test a number of times before passing (Bross et al., 2023).

Riding in a Vehicle as a Passenger. People with disabilities travel more frequently as passengers in others' cars (38.9%) than people without disabilities (16.1%) (Brumbaugh, 2018). Parents, other family members, or friends may provide rides to individuals with disabilities who need to travel to work, continued education, or other activities (Deka et al., 2016). Although rides from others can be a feasible method of transportation for those with considerable family or friend support, the utility of this transportation method obviously relies on the availability of the driver. Parent drivers of individuals with disabilities have reported difficulty in scheduling rides; sometimes rides are needed at times that are inconvenient, or at times when the driver is working or otherwise unavailable (Bross et al., 2023).

Depending on others for a ride can also impact the passenger. Young adults with disabilities who need rides from others must set up the ride, wait for the person to arrive, and work around any scheduling conflicts. For this reason, a person with a disability relying on someone for a ride may not be able to make last-minute plans or changes of plan. Additionally, depending on others for a ride can limit a person's independence and self-determination (Bross et al., 2023). For example, an adult who wants to go on a romantic date might not wish to be dropped off by a parent or family member. Riding as a passenger in a car permits a person to travel from one location to another, but it does not always allow the flexibility or independence that young adults with disabilities desire or deserve.

Using Ridesharing Applications. Smartphone applications such as Uber and Lyft allow individuals to hail a ride on demand, setting both a desired pickup and drop-off location. Although these applications are free to download, the cost of the rides can be quite expensive. For example, a 5.2-mile Lyft ride from a school to a coffee shop in one urban setting can cost almost $20 (Bross et al., 2023). This makes ridesharing applications difficult to afford for many potential users, especially for some individuals with disabilities who may be working only part-time or at a low-paying job (Bross et al., 2023).

Another component related to use of ridesharing applications is the accessibility of the application's interface. Some individuals with disabilities report that these applications employ complicated navigation systems or that the applications are challenging to use; for example, requesting a ride and programming the starting and ending destinations requires cognitive processing skills that can be challenging for some application users with disabilities (Alanazi, 2022). Others report that certain features, such as cashless payment and availability of drivers at any time, establish ridesharing applications as a feasible transportation option for people with disabilities (Alanazi, 2022).

One additional consideration regarding use of ridesharing applications is the location in which they will be used. Although ridesharing applications like Uber and Lyft are frequently used and commonly available in urban and suburban areas, people who live in rural areas may have reduced access to on-demand rides (Cochran & Chatman, 2021). Additionally, individuals living in rural areas may need to travel longer distances to reach a destination of interest, which a ridesharing application may not facilitate (Bross et al., 2023).

People with disabilities may travel the community by driving, riding in another person's car as a passenger, or by hailing an on-demand ride through a ridesharing application. Although driving is possible for many young adults with IDD, challenges related to hazard perception, achieving licensure (i.e., passing the driver's exam and road test), and parent or young adult fear can render driving an unworkable option (Bross et al., 2023). Many individuals with IDD depend on others to provide rides, which means they are reliant on the schedules and availability of others to travel the community (Brumbaugh et al., 2018; Deka et al., 2016). Finally, ridesharing applications may offer opportunities for increased independence, but can be costly, with options being especially limited in rural areas (Alanazi, 2022; Bross et al., 2023; Cochran & Chatman, 2021).

Public Transportation for Individuals with Disabilities

Considering that individuals with disabilities drive less frequently than people without disabilities, it is perhaps unsurprising that people with disabilities use public transit for a higher percentage of trips (4.3%) than people without disabilities (2.7%) (Brumbaugh, 2018). Public transit options vary by city or location and may include options such as public buses, trains, trams, or rail systems. The population density of a particular area may impact which or how many transit options exist, with urban areas typically providing a broader array of options than rural areas (Bross et al., 2023). Furthermore, it is important to note that a person's use of public transportation depends on his or her ability to access a transit station or stop; a person cannot access public transportation without first accessing the station. Although stations and stops may be abundant in urban areas, rural areas may have few or no stops close to a person's home. Some people with disabilities indicate that simply reaching the transit stop can be a challenge due to the inadequacy of stops on fixed routes (Bezyak et al., 2017; Feeley et al., 2015).

Physical Accessibility. After the Americans with Disabilities Act (ADA) was passed in 1990, the physical accessibility of public transportation increased (Americans with Disabilities Act, 1990; Bezyak et al., 2017). The ADA mandates that public transportation systems must provide certain accommodations, including transportation information in a variety of accessible formats (e.g., braille or electronic format schedules), adaptive equipment such as lifts, ramps, and securement devices, and access for trained service animals (Americans with Disabilities Act, 1990). Despite these requirements set forth by the ADA, people with disabilities report continued challenges related to the accessibility of public transportation, including inoperable or damage lifts or ramps and failure by transit workers to provide stop announcements or route identification in accessible formats (e.g., announced aloud) (Bezyak et al., 2017).

Attitudes of Transit Workers. In addition to accessibility challenges, some individuals with IDD state that they have experienced attitudinal barriers in encounters with public transit workers (Bezyak et al., 2017; Feeley et al., 2015). Public transportation systems in the United States require transit workers to complete safety trainings, and many transit workers complete the Community Transportation Association of America's Passenger Service and Safety training (i.e., PASS training) (Feeley et al., 2015). Although PASS training includes a module about ASD , transit workers are informed about ASD traits but not trained in disability-related behaviors or support strategies (Feeley et al., 2015). This may result in some transit workers having only a surface-level understanding of intellectual and developmental disabilities, rather than a deeper understanding of how they might offer support and accommodation to a passenger with this type of disability. Because transit workers must promote and maintain the safety of all passengers, some workers may perceive disability-related traits and externalizing behaviors as "dangerous" or threatening to passenger safety, resulting in bias towards passengers with IDD for this reason (Feeley et al., 2015).

Disability-specific Traits. Some disability-specific traits can also make use of public transportation challenging. Using a fixed-route transportation system such as a bus or train requires numerous skills. Comprehension, executive functioning, memory, and more serve as critical components for using public transportation to successfully reach a final destination (Friedman & Rizzolo, 2016). Because some individuals with IDD require extra support and instruction in these skill areas and others, independent use of public transportation can be challenging unless adequate training is provided (Friedman & Rizzolo, 2016). Additionally, it is important to note that public transportation sometimes runs on an imperfect schedule. It is not uncommon for a bus or train to be late or out-of-service unexpectedly. Because public transportation can sometimes be unpredictable, some individuals with IDD feel anxious about using it or relying on it to travel (Feeley et al., 2015).

The barriers to use of public transportation described above can create challenges for individuals with disabilities who wish to travel their communities independently. Although the passage of the ADA in 1990 resulted in public transportation that is more physically accessible, issues persist related to inoperable or broken equipment and failure to provide information (e.g., upcoming stop announcements) in multiple accessible formats (Bezyak et al., 2017). Additionally, the attitudes of public transit workers may decrease the appeal of this method of transport for individuals with disabilities. Transit workers generally receive minimal training related to people with disabilities and sometimes mistake externalizing behaviors as dangerous, resulting in unwarranted biases towards individuals with IDD (Feeley et al., 2015). Further, individuals with disabilities may need additional instruction to master the comprehension, executive functioning, and memory demands required for successful use of public transportation (Friedman & Rizzolo, 2016). Public transit options such as buses, trains, trams, or rail systems are most useful to those living in densely populated, urban areas; individuals living in rural areas may not have access to a transit station or stop and therefore cannot consider public transportation as a travel option.

Pedestrian Travel for Individuals with Disabilities

After riding as a passenger in a car, walking is the second most common transportation mode used by individuals with disabilities (Brumbaugh et al., 2018). In one survey of adults with ASD, respondents reported walking for a variety of purposes, including to get to a place of work or employment, to attend education or training, to participate in social or recreational activities, to complete shopping or daily errands, and to get exercise (Deka et al., 2016). Although it is more likely that an individual with IDD possesses the prerequisite skills to travel by foot than by driving or using public transportation, a number of barriers exist to the safe and successful pedestrian travel of individuals with disabilities.

Like both driving and use of public transportation, pedestrian travel requires critical thinking and executive functioning skills that can be challenging for some individuals with IDD (Deka et al., 2016). For example, crossing streets, judging the distance and speed of oncoming traffic, and managing street noise and distractions can make walking difficult or dangerous for individuals with IDD (Benson et al., 2016; Deka et al., 2016; Feeley et al., 2015). Additionally, the physical features present on the walking route can present challenges. Crowded sidewalks, routes without sidewalks, lack of street crossing indicators, and lack of streetlights can create barriers to pedestrian travel (Deka et al., 2016). Additionally, one survey suggests that more than half of respondents (i.e., 53.5%) with ASD did not know how to safely and independently cross a street without help from another person (Deka et al., 2016). Parents and young adults alike may possess valid concerns related to the safety of pedestrian travel as a transportation mode (Bross et al., 2023; Deka et al., 2016).

Young adults with IDD may value walking as a transportation option differently, depending on whether they reside in a rural, suburban, or urban setting. Like use of ridesharing applications and public transportation, walking can be a less feasible transportation option for individuals living in rural areas. This could be because locations are more spread out in rural locations, requiring individuals to walk longer distances (Ivan et al., 2001). Additionally, some parents and families voice safety concerns regarding walking in rural areas (Bross et al., 2023). In rural areas, roads and walking routes may not have pedestrian safety features like sidewalks or crossing signals, which are present more frequently in urban and suburban areas.

Although walking is an attainable and cost-effective method of transportation for many young adults with IDD, several barriers exist to pedestrian travel. Walking requires an individual to react quickly to surroundings, manage distractions, and accurately judge the distance and speed of oncoming traffic, which can all be challenging tasks for some young adults with IDD (Benson et al., 2016; Deka et al., 2016; Feeley et al., 2015). Physical components of a walking route, such as the presence or absence of sidewalks, street lights, and crossing signals, can also impact whether a young adult with IDD chooses to walk somewhere and how successful he or she is in doing so (Deka et al., 2016). Finally, whether a location is rural, suburban, or urban may impact how safe and feasible pedestrian travel is as a transportation mode, with urban and suburban areas being more walkable than rural areas (Bross et al., 2023).

The literature and data reviewed above indicate that individuals with disabilities, and young adults with IDD in particular, struggle to travel and navigate their communities independently. Regardless of whether a person travels by car, via public transportation, or by foot, it is challenging to meaningfully engage in one's community if he or she does not have a reliable mode of transportation. For example, in a survey of individuals with disabilities, almost 70% of respondents indicated that unmet transportation needs negatively impacted their social lives and relationships (Bascom & Christensen, 2017). While a number of identified transportation barriers are systemic, such as challenging standardized driving tests (Bross et al., 2023), insufficient disability-related training for public transit workers (Feeley et al., 2015), and the paucity of both ridesharing and public transportation options in rural areas (Bross et al., 2023), other transportation barriers relate to disability-specific skill deficits. For example, some young adults with IDD may experience executive functioning and memory challenges (Deka et al., 2016; Friedman & Rizzolo, 2016; Sheppard et al., 2010), making chained tasks such as taking the public bus or programming and following a walking route uniquely difficult. For this reason, researchers have considered various interventions over the past two decades to support the community navigation skills of individuals with disabilities. The following section reviews the literature related to community navigation interventions for individuals with disabilities, including navigation of indoor spaces, use of public transportation, and pedestrian navigation.

Community Navigation Interventions for Individuals with Disabilities

The purpose of the present study is to determine whether using constant time delay to teach use of Google Maps to young adults with IDD increases participants' ability to walk to novel community locations of interest. Walking was selected as the mode of transportation for this study because it is free of cost, convenient, and a method that many young adults with IDD already use to travel (Deka et al., 2016). Beyond walking, young adults with IDD may also drive, ride as a passenger in a car, use public buses or rail systems, or ride a bike (Deka et al., 2016). Although navigating one's community through one or more of these modalities is essential for various life activities, such as working, shopping, and engaging in social opportunities, many individuals with IDD struggle to navigate their communities successfully and independently (Richter & Test, 2011). To support independent community travel skills for individuals with IDD, researchers have identified a number of effective interventions. Below is an overview of the literature regarding several of these strategies, including indoor spaces navigation interventions, public transportation interventions, and travel skill interventions.

Indoor Spaces Navigation Interventions

Although not typically considered traditional "community navigation" interventions, interventions to teach navigation of indoor spaces were some of the earliest navigation-based studies in this topic area. In 2010, Lancioni and Cihak et al. both completed studies in this area. Lancioni's study aimed to evaluate the effects of an adapted orientation technology tool on the indoor navigation skills of adults with disabilities, including identifying specific rooms within a given indoor space. The two participants in this study were both diagnosed with multiple disabilities, and researchers taught them to navigate a rehabilitation center using a small technology device that provided instructions via verbal prompts and vibrations. This pocket-sized device delivered automated spoken directions (e.g., "turn to your right") in response to sensors that were placed around the hallways to help direct participants to the desired location. Following the study, both participants navigated the building faster and more accurately than they did during baseline sessions.

Additionally, Cihak et al. (2010) used video models displayed via video iPod to teach students with disabilities to navigate the inside of a school building. Four elementary-aged students with ASD participated in this ABAB withdrawal design study, which took place at their four respective elementary schools in inclusive, general education settings. Participants first received pretraining from their classroom teacher on using the video iPod. Next, participants used the iPod to watch self-model videos of themselves transitioning throughout various locations in the school environment (e.g., bus to classroom, cafeteria to bathroom). Data indicated a functional relation between video modeling via iPod and the independent transitions and school navigation of all four participants.

While the body of research regarding interventions to teach navigation of indoor spaces is sparse, Lancioni (2010) and Cihak et al. (2010)'s studies demonstrate that multiple strategies can be effective in teaching individuals with IDD. Additionally, prompting tools such as Lancioni's vibrating speech device and Cihak et al.'s video iPod continue to appear in later studies, suggesting the utility of technology devices to support independent navigation skills.

Public Transportation Navigation Interventions

Although not every city or locale is equipped with robust public transportation systems, many municipalities have devoted focused time and funding towards developing public transit options in recent years (American Public Transportation Association, 2023). Public transportation can be a desirable option for individuals with disabilities who may prefer not to drive or who might need to access locations that are not within a reasonable walking distance (Deka et al., 2016). Researchers have demonstrated several effective interventions for teaching individuals with disabilities to use various forms of public transportation, which are described in greater detail below.

In an early study regarding public transportation use, Davies et al. (2010) evaluated the efficacy of a personal digital assistant (PDA)-based prompting system, *WayFinder*, equipped with early GPS capabilities. In this between-subjects group design study, 23 young adults with disabilities were divided into experimental and control groups. The participants in the experimental group were taught to use the prompting device to travel along a public bus route by finding landmarks along the route and using them to request a stop at the appropriate time. Davies et al. found that this intervention was effective; 73% of the participants in the experimental group requested a stop at the correct time to reach the desired location, as compared to only 8% of participants in the control group who did not use the PDA navigation tool. Similarly, Stock et al. (2013) also investigated the efficacy of *WayFinder* to support individuals with IDD in navigating a fixed-route public bus. When compared to the control group, the 26 participants who were taught to use *WayFinder* required fewer training sessions to reach independence in navigating the bus route, and they also were able to generalize use of the *WayFinder* to request stops on novel bus routes. Although PDAs have become obsolete in the years since these studies, research by Davies et al. and Stock et al. suggested that technology tools could effectively support adults with IDD in navigating public transportation.

Other research on navigating public transportation includes use of video instruction. Video instruction is an evidence-based practice that involves using recorded demonstrations to teach targeted behavioral, academic, and/or social skills to learners (Steinbrenner et al., 2020). Specifically, Mechling and O'Brien (2010) used video instruction to teach three young adults with IDD to use landmarks to request desired stops when riding a public bus along a fixed route. In this multiple probe design study, the three participants received video instruction in a simulated environment (i.e., classroom) and then completed in-vivo generalization probes on the city bus. Mechling and O'Brien found the video instruction to be effective; all participants generalized the steps for requesting a desired stop during the generalization probes with no further in-vivo instruction required.

More recent studies addressing public transportation access employed technology tools more familiar in today's age, such as the Google Maps application. For example, Price et al. (2017) found that four young adults with IDD could learn to use Google Maps to take a public bus following total-task chaining. First, participants received pretraining, in which they were taught to use and navigate the Google Maps application on their personal smartphones. Next, researchers provided instruction on using Google Maps through total-task chaining and constant time delay. Through total-task chaining, the researchers taught the full sequence of the 15-step task analysis for using Google Maps to take the bus. During the constant time delay trials, participants were provided 5 s to independently complete each task analysis step; if they did not complete the step within the allotted time, the researcher provided additional prompts to support the participant in continuing (e.g., the verbal prompt "take out your phone and open Google Maps"). Following instruction, participants took the bus to desired locations around a college campus and within the community. Three of the four participants achieved mastery following instruction and were able to independently navigate the bus route.

A few years later, McDonnel et al. (2021) demonstrated the efficacy of an individualized public transportation training program on the travel skills of 10 individuals with IDD. After completing a pre-assessment regarding travel supports, each participant received eight individualized, in-vivo training sessions that best addressed their support needs and desired travel locations. Accompanied by a researcher, participants traveled on fixed-route transportation systems such as buses and subways, practiced skills such as street-crossing and programming

Google Maps directions, and learned how to problem solve within community settings (e.g., what to do when lost). A paired *t* test of pre- and post-assessment scores for participants revealed a statistically significant increase of scores, meaning each participant required less support in navigating the community following the individualized transportation training sessions.

As demonstrated above, various instructional strategies have been successfully used to teach use of public transportation to individuals with IDD. Following the intervention phase in each study, adults with IDD were better and more independently able to use public transportation to travel to locations of interest.

Pedestrian Navigation Interventions

Although public transportation can be beneficial to those who have access to it, not every municipality has public buses or rail systems available to its residents. Additionally, even when one can take public transportation, it is common to need to walk after exiting the public bus or rail to reach one's final destination. For these reasons, researchers have also investigated the effects of different interventions to teach travel skills to individuals with IDD. Researchers have applied travel skill interventions that leverage technology (i.e., Kelly et al., 2013; McMahon et al., 2015; Mechling & Seid, 2011; Smith et al., 2017) and that rely upon response prompting to support skill acquisition (i.e., Agri & Batu, 2020; Batu et al., 2004). The interventions detailed below have shown positive effects in teaching travel skills to individuals with IDD.

Technology Tools to Teach Travel Skills

Like the public transportation interventions discussed above, several of the existing travel skill studies incorporated technology tools that may now be considered outdated (e.g., PDAs, iPod). Although the tools themselves may be used less frequently, the studies still make meaningful contributions to the literature base by supporting the benefits of leveraging technology-delivered prompts to teach travel skills. Below are descriptions of these foundational technology-based studies that continue to inspire further research in community navigation and access.

Mechling and Seid (2011) used a multiple probe across three destinations design to investigate the effects of PDA-delivered prompting (i.e., picture, auditory, and video prompts) on the pedestrian navigation skills of three young adults with IDD. Each participant attended a transition program that was hosted on a university campus, and participants were taught to use the PDA to walk to several locations of interest, including a cafeteria, a gaming and entertainment center, and a copy/print center. The slides displayed on the PDA included photographs depicting the next visual landmark in the route, an auditory prompt to accompany the picture, and an auditory prompt directing the participant to find the next landmark. During baseline probes, none of the three participants completed any of the route steps. Following intervention and application of the PDA-delivered prompting system, all participants increased the number of route steps they completed independently across all three walking routes. Participants maintained the number of route steps completed independently using the PDA prompts following the end of the intervention phase.

Kelley et al. (2013) conducted a similar study to Mechling and Seid (2011), but with one major difference. Specifically, Kelley and colleagues investigated the efficacy of a video iPod, rather than a PDA, to teach pedestrian navigation skills to young adults with IDD. This multiple probe study included four participants who attended an inclusive postsecondary program at a university. The walking destinations consisted of locations around the campus such as the library, a science building, and the student recreation center. During baseline sessions, participants received a printed campus map and were told to use it to find a destination. After baseline was complete, participants received pretraining in using the video iPod, including how to operate the buttons and scroll through photos loaded on the device. Then, during intervention, participants used the landmark photos loaded on the video iPod to follow a route and reach a destination. Researchers collected maintenance data up to 232 days after the end of intervention, and three of the four participants maintained at 100% on all maintenance sessions when asked to use the iPod to follow a previously trained route. Additionally, participants generalized use of the video iPod to follow new, untrained routes during generalization sessions with high levels of accuracy. This study was the first to incorporate a “smart” prompting device (i.e., iPod) to support individuals with IDD in walking to a location.

Since 2013, other researchers have continued in this line of travel skill research. In an alternating treatments design study, McMahon et al. (2015) compared the effects of augmented reality navigation, the Google Maps application, and paper maps in teaching four college students with IDD to walk to unknown locations. The four participants attended an inclusive postsecondary education program at a large university. The walking destinations included nearby businesses in the surrounding city that were potential future employers for the participants. During baseline, participants were given a paper map and asked to use it to find a business location. None of the participants were able to complete more than 30% of the directional steps independently during baseline. Then, in each of the three intervention conditions, researchers measured the number of correct directional steps made by participants using either a paper map, Google Maps, or an augmented reality map. All participants required additional prompting in the Google Maps and printed map sessions, but participants were able to navigate more independently during the augmented reality map sessions. Findings showed a functional relation between the augmented reality map and the percent of directional steps participants completed independently.

Given that McMahon et al. (2015)'s research suggested the efficacy of augmented reality maps, additional researchers further investigated the same technology tools. Smith et al. (2017) conducted an ABAB reversal design study examining the effects of an iPhone with an augmented reality map application (i.e., "Heads Up Navigator" application) on the number of independent waypoint decisions made by participants walking to a novel location. In this study, waypoint decisions were defined as taking the correct path (e.g., turning left or right) towards the final destination. The three participants were young adults with IDD who attended an inclusive postsecondary education program at a university. During baseline, participants used a paper map to find a novel location with an average of 28% of correct waypoint decisions. Next, researchers used the model-lead-test strategy (Adams & Engelmann, 1996) to pretrain participants on the Heads Up Navigator augmented reality application. Researchers demonstrated use of the Heads Up Navigator, led participants in practicing with the Navigator, and then assessed participant use of the Navigator. After pretraining, the initial intervention phase occurred, followed by a withdrawal phase (i.e., augmented reality application removed), and a final phase where the augmented reality application was reinstated. All participants demonstrated rapid and substantial increases in correct waypoint decisions when provided pretraining and access to the augmented reality application.

Because walking is a common transportation method used by many individuals with IDD (Deka et al., 2016), teaching safe and effective travel skills is critical. The above researchers in this area have investigated the efficacy of technology-based prompting tools (i.e., PDAs, iPods, Google Maps, augmented reality maps) to increase independent travel skills in participants with IDD.

Response Prompting to Teach Pedestrian Navigation Skills

Although a majority of the literature regarding pedestrian navigation skills involves technology-based interventions, two identified studies investigated specific instructional strategies that were free of technology integration. Both studies employed response prompts, which are prompts (e.g., verbal instructions, modeling) delivered to a learner immediately before or during the performance of a target behavior to support errorless learning (Cooper et al., 2020). Batu et al. (2004) employed total-task presentation and most-to-least prompting (i.e., starting with physical guidance and gradually reducing to visual and verbal prompts; Cooper et al., 2020) to teach travel skills to five youth with IDD. Additionally, Agri and Batu (2020) used progressive time delay to teach travel skills to three youth with IDD. Progressive time delay is an instructional strategy that begins with simultaneous presentation of a desired stimulus and a controlling prompt (i.e., 0 s trials); then, the instructor gradually implements an increasing time delay between the desired stimulus and controlling prompt (e.g., 1 s delay, 2 s delay) to allow the participant a chance to perform the target behavior independently (Cooper et al., 2020). Batu et al. (2004) and Agri and Batu (2020) are described in greater detail below.

In 2004, Batu and colleagues conducted a multiple probe across behaviors study replicated across five youth with IDD. The participants were all enrolled in a vocational secondary school in which they received specialized instruction. The researchers created a simulated street-crossing environment in the gymnasium in the school, and all sessions prior to generalization took place in this simulated environment. During baseline, participants were assessed on three skills: crossing a street via an overcrossing, crossing a street using pedestrian walk signals, and crossing a street without safety signals. Participants were asked to demonstrate each skill in the simulated environment, and the baseline trial ended as soon as the participant made a mistake or missed a task analysis step for the skill being assessed. During the intervention phase, participants were instructed using total-task presentation and most-to-least prompting. All five participants were able to complete 100% of task analysis steps with decreasing prompts within the intervention sessions. Additionally, Batu and colleagues conducted generalization settings in real city streets following intervention. All five participants completed 100% of task analysis steps correctly across the three street-crossing conditions during in-vivo generalization sessions.

Nearly 2 decades after Batu et al. (2004)'s study, Agri and Batu (2020) examined the effects of progressive time delay to teach travel skills to individuals with IDD. In this multiple probe across participants study, three youth with IDD were taught to cross the street in a simulated traffic training facility located at a university. In baseline and intervention sessions, researchers measured the number of correct task analysis steps completed by each participant for a five-step street-crossing task analysis. During baseline, all three participants completed 0% of the task analysis steps correctly. During intervention sessions, participants were provided instruction through progressive time delay (i.e., 2 s, 4 s, and 6 s delay trials) in completing each of the five steps. Participants continued in the intervention phase until they reached 100% of task analysis steps for at least three consecutive opportunities. Researchers also collected generalization data for each participant in a semi-structured real environment (i.e., a real street, but with traffic controlled by two police officers for safety). All participants completed 100% of the task analysis steps correctly during generalization probes. Although one participant was later unable to participate in maintenance due to unrelated behavioral concerns, the other two participants maintained their skills at 100% across three probes.

The above studies suggest that a number of interventions, both technology-related tools and response prompting strategies, can be useful in increasing travel skills. Use of technology tools such as PDAs, video iPods, and smartphone applications (i.e., augmented reality applications, Google Maps) have all shown to be effective in teaching travel skills to individuals with IDD (Kelly et al., 2013; McMahon et al., 2015; Mechling & Seid, 2011; Smith et al., 2017). Additionally, other researchers have used response prompting strategies free of technology integration, such as most-to-least prompting and progressive time delay, to effectively teach travel skills to individuals with IDD (Agri & Batu, 2020; Batu et al., 2004). Whether an individual with IDD prefers to use technology or not, the included studies suggest there are potential strategies to increase travel skills either way.

Response Prompting to Teach Use of Google Maps for Travel Skills

Many individuals with and without disabilities rely upon smartphone applications to manage and support activities of daily living (e.g., alarms, reminders, calendars, maps). In fact, a 2018 survey indicates that up to 95% of teenage youth have access to a smartphone and that 45% indicate they are on it “almost constantly” (Schaeffer, 2021). One popular and useful smartphone application is Google Maps (Google, 2023). Google Maps users can input a desired location to program a route, select a desired type of transportation (e.g., walk, drive), and track their route progress in real time using the embedded GPS software. Google Maps includes several accessibility features such as screen reader compatibility, voice guidance, adjustable text size, filters for accessible transit, and more. Additionally, Google Maps is free and has no affiliated costs to use. These features, paired with the relatively unobtrusive and non-stigmatizing delivery format of a smartphone, makes Google Maps use a relevant tool for people with IDD and those interested in supporting their community navigation skills.

Although some individuals may learn to use Google Maps without direct instruction, response prompting methods may be particularly helpful in teaching chained tasks – such as use of Google Maps – to individuals with IDD (Cooper et al., 2020). To date, two known studies specifically involve response prompting to teach use of Google Maps for travel skills to individuals with IDD (Kearney et al., 2010; Yuan et al., 2019). Kearney et al.'s study includes peer-delivered least-to-most prompting and error correction, while Yuan et al. employed constant time delay procedures in intervention. Each study is described in greater detail next.

Total Task Presentation and Least-to-Most Prompting

In a multiple probe across participants study, Kearney et al. (2021) investigated the effects of a peer-mediated instructional package, including total task presentation and error correction, on use of Google Maps to walk to a location. Three young adults with IDD participated in this study, which took place on a university campus where the participants attended an inclusive postsecondary education program. During baseline and intervention sessions, participants were evaluated using a 10-step task analysis for programming a Google Maps route and following it to a desired destination. Targeted locations of interest included restaurants, lecture halls, athletic facilities, student housing, the library, and other campus locations.

During baseline sessions, participants were given the verbal directive to use their smartphones to find a way to walk to the location. No participant was able to complete any of the task analysis steps independently during baseline sessions. Next, participants were provided two peer training sessions in which a peer presented the total task of setting and following a Google

Maps walking route on the participant's smartphone. The peer mediator used least-to-most prompting to correct any errors participants made. During intervention sessions, the participants were again asked to use their smartphones to walk to the location. Researchers measured the number of task analysis steps completed correctly, and all three participants reached 100% of steps completed independently within six or fewer intervention sessions.

Researchers conducted two maintenance sessions with each participant within 6 weeks of the conclusion of intervention sessions. During maintenance sessions, two of the three participants maintained 100% accuracy. The third participant achieved 100% accuracy after 2 weeks and 90% accuracy after 3 weeks. Kearney and colleagues' study indicates that total-task presentation and least-to-most prompting delivered by a peer mediator effectively increased the Google Maps use and travel skills of three college-aged individuals with IDD.

Constant Time Delay

Similar to Kearney et al. (2021), Yuan et al. (2019) taught the use of Google Maps to three young adults with IDD. Instead of least-to-most prompting and error correction procedures like Kearney et al. (2021), Yuan et al. (2019) employed a constant time delay procedure. The three participants in Yuan et al.'s study were enrolled in an inclusive postsecondary education program, and this study took place on a university campus where the participants attended classes. The dependent variable was participants' adherence to a six-step task analysis for programming a route on Google Maps.

During baseline and intervention sessions, participants were provided a location notecard that displayed the name of a location somewhere on the university campus without the address. During baseline, participants were given a location card and unlocked iPad and were told to use Google Maps to find the way there. If the participant did not complete the step within 5 s or made a mistake, the researcher terminated the session. Intervention sessions began with the same directive, but participants were provided 0-s delay trials, in which they received a prompt simultaneously to complete the task analysis step. After three 0-s delay trials, researchers implemented a 5-s delay trial to allow participants the opportunity to complete a step independently. After a student completed a step independently within 5 s for five consecutive trials, participants were taught the next steps in the task analysis in the same manner.

Two of the three participants were able to complete all six task analysis steps with 100% accuracy following the time delay sessions. The third participant completed between three and six steps correctly during the post-instruction sessions, which prompted the researchers to provide a booster session. Following the booster session, the third participant also reached 100% accuracy in completing the six task analysis steps. Yuan and colleagues did not include walking the programmed route as a component of their task analysis, but they did conduct several probes to determine whether the participants could follow the routes they had programmed to reach a destination. Two of the three participants were able to reach the destination independently using the Google Maps route, whereas the third participant required two verbal prompts to reach the location.

The research by Kearney et al. (2021) and Yuan et al. (2019) showed that instructional strategies, such as the use of task analysis and response prompting procedures of least-to-most prompting and constant time delay, were effective in teaching individuals with IDD to use Google Maps to program walking routes. While Kearney et al.'s task analysis included following the programmed route to reach the final destination, Yuan et al. probed this skill separately without including it as a step in their task analysis. Each author team indicated that more research is needed in this topic area to replicate and confirm their findings.

Finally, Rousey et al. (2023) conducted a modified replication of Yuan et al. (2019)'s study, which also involved use of constant time delay to teach use of Google Maps for pedestrian routes for individuals with IDD. Despite their similarities, Yuan et al. (2019) was selected for replication over Kearney et al. (2021) due to the nature of the constant time delay teaching procedure, which provides participants opportunities for errorless or nearly-errorless learning. In contrast, Kearney et al.'s intervention involved error correction procedures, indicating that participants had the opportunity to make numerous mistakes throughout the learning process. Additionally, some previous research suggests that time delay procedures (as used in Yuan et al.) can result in more rapid skill acquisition than least-to-most prompting (as used in Kearney et al.) for individuals with IDD (Heckaman et al., 1998). Faster travel skill development would allow participants to become more independent and more engaged in their communities, sooner.

Rousey et al. (2023)'s study is different from Yuan et al. (2019) in several significant ways. First, we elaborated on Yuan et al.'s original six-step task analysis and parsed out twelve smaller steps. Smaller, more discrete task analysis steps were added to help avoid participant confusion and to make clear the distinctions between each step, an important component of component task analyses (Carter & Kemp, 1996). Second, in Rousey et al. (2023), participants had the opportunity to select a location of interest to program a walking route for. This differs from Yuan et al. in that participant choice was paramount; participants were not assigned a location as in Yuan et al. and instead selected a destination that was of interest to them. Third, following the programmed walking route was incorporated as a component of the task analysis. Although Kearney et al. (2021)'s study included following the route as a component of the task analysis, Yuan et al. did not. Following the route is of particular importance because if a participant cannot follow a route they have programmed, they will still not be able to use it to get to a desired location. Fourth, Yuan et al. did not collect social validity data from participants regarding the use of Google Maps. Rousey et al. (2023) collected post-assessment data that reflects participant opinions on the utility and feasibility of the Google Maps application for pedestrian navigation.

The present dissertation is an extension of Rousey et al. (2023), which includes a novel stimulus generalization measure allowing researchers to assess similar behaviors in untrained contexts (Ledford & Gast, 2018). Twice during the study, participants were probed on untrained use of the Apple Maps smartphone application, standard to all Apple devices (Apple, 2022) to find an unknown location, rather than the Google Maps application. While Apple Maps serves the same function as Google Maps, the layout and exact steps required to program and follow a route differ slightly (e.g., different appearance of menu and search bar, different icons for selecting transportation method). Probing use of Apple Maps twice allowed us to determine whether stimulus generalization has occurred.

Additionally, a novel component to this extension of Rousey et al. (2023) was collecting social validity data from the participants' special education teacher. At the end of the study, participants and their teacher participated in semi-structured interviews to provide information regarding their opinions and perceptions of the intervention, as well as its perceived usefulness in participants' current and future environments.

Summary

Whether individuals with IDD choose to drive, walk, use public transportation, or travel another way, being able to navigate one's community independently leads to increased engagement and opportunities for self-determination. Researchers have investigated several interventions to support community navigation for individuals with IDD, including navigation of indoor spaces (Cihak et al., 2010; Lancioni, 2010); use of public transportation systems (Davies et al., 2010; McDonnel et al., 2021; Mechling & O'Brien, 2010; Price et al., 2017; Stock et al., 2013); and travel skills (Agri & Batu, 2020; Batu et al., 2004; Kearney et al., 2010; Kelly et al., 2013; McMahon et al., 2015; Mechling & Seid, 2011; Smith et al., 2017; Yuan et al., 2019). While many of these studies include prompts delivered by technology tools such as PDAs, iPods, or smartphones, others integrate additional response prompting to support skill development. The present study employs response prompting (i.e., constant time delay) to teach use of a technology tool (i.e., Google Maps), contributing to the growing body of community navigation research through incorporation of social validity measures, increased opportunities for participant preference, use of the behavior chain interruption strategy to teach problem-solving skills, and stimulus generalization probes that are unique to this study.

CHAPTER THREE: METHOD

The primary purpose of this study was to determine whether using constant time delay instruction increased the ability of young adults with IDD to effectively use Google Maps. The specific research questions that guided this study were:

1. Is there a functional relation between using constant time delay to teach use of Google Maps and the number of task analysis steps young adults with IDD complete independently?
2. To what extent do the steps to program and follow a Google Maps walking route generalize to the use of Apple Maps for young adults with IDD?
3. To what extent does scenario-based teaching enhance the problem-solving skills of three young adults with IDD when using Google Maps for walking navigation?
4. What are the opinions and perceptions of transition-age youth with IDD regarding use of Google Maps to independently program and follow a walking route to reach a location of interest?
5. What is the social validity of using a Google Maps application to teach travel skills as reported by the teacher and job coach of the transition-age youth with IDD?

This study included three young adult participants who received instruction on a 12-step task analysis for programming and following a Google Maps novel walking route to a destination of their choice on a university campus. I employed a single-case, multiple probe across participants design (Horner & Baer, 1978) to demonstrate the effects of constant time delay instruction to teach map programming and pedestrian navigation skills to young adults with IDD.

Institutional Review Board and School District Approval

Prior to the onset of any recruitment or research activities, I received approval to conduct research with human subjects from the Institutional Review Board (IRB) at UNC Charlotte. The potential participants targeted for this study were young adults with disabilities who attended a transition program on the UNC Charlotte campus. The students receive special education services through a local school district and are under the jurisdiction of this school district, rather than the University. For this reason, I also completed an application to conduct research with the school district prior to beginning the study. Throughout the recruitment and consent processes, I followed the school district's requirements related to obtaining signed parent consent for all interested participants, regardless of guardianship status. Prior to beginning data collection, I also obtained signed student consent and signed parent/student liability waivers. The liability waiver was approved by the legal department at UNC Charlotte in Fall 2022, prior to the beginning of the pilot version of this study. All consent and assent materials, as well as the liability waiver, are attached in Appendix A.

Researcher Information

At the time this study was conducted, I was a third-year doctoral candidate in the Department of Special Education and Child Development at UNC Charlotte. Prior to conducting the present study, I completed a pilot version of this study with similar participants in spring 2023. Other recent work of mine includes co-authoring several manuscripts regarding interventions to support skill development for transition-age youth with IDD. Prior to beginning my doctoral studies, I worked as an early childhood special education teacher and as an employment coordinator and course instructor for an inclusive postsecondary education program held on a college campus in the Southeast.

For this study, I served as the primary interventionist and data collector. I trained secondary data collectors to record interobserver agreement and procedural fidelity data. My other responsibilities during this study included (a) obtaining UNC Charlotte and school district approval, (b) completing the recruitment and consent procedures, (c) scheduling session times with the participants' teacher, (d) developing materials used throughout baseline, intervention, and generalization/maintenance phases, and (e) sharing pertinent progress and updates with members of my dissertation committee.

Participants, Setting, and Materials

The participants in this study were three young adults with disabilities who attended a transition program on a college campus. All three participants were assigned pseudonyms after agreeing to participate, and pseudonyms *only* were used on all data collection materials, graphed data, and descriptions provided in this dissertation. The participants for this study were recruited through the transition program at UNC Charlotte because of the partnership between the public school district and Department of Special Education and Child Development at UNC Charlotte. The identity of the participants and the affiliated school district were not and will not be revealed at any point before, during, or after this study.

Eligibility to Participate

To be considered eligible to participate in this study, potential participants were required to meet the following inclusion criteria: (a) have a diagnosis of intellectual and/or developmental disability including ASD; (b) demonstrate visual acuity required for viewing an application on a smartphone screen; (c) possess the physical stamina to walk up to one mile at any pace; and (d) currently require support from another person to walk to new or unfamiliar locations. I prioritized recruitment of participants who represented diverse identities and experiences, including not only race/ethnicity but also components such as level of support needs and those experiencing multiple intersectionalities. I collaborated with the transition program teacher to determine whether an interested potential participant met all inclusion criteria.

Potential participants were also considered for exclusion criteria. For the purposes of this study, potential participants were excluded if they: (a) possessed physical impairments or limitations that prevent walking up to one mile at any pace; (b) were blind or deaf/hard-of-hearing; (c) had a history of elopement or unsafe behavior, according to teacher report; or (d) did not require any support in walking to new locations or could already do so independently. I collaborated with the transition program teacher to consider each potential participant for these exclusion criteria. In addition to the above exclusion criteria, I also conducted preliminary observations of participants while collecting baseline data. If a participant had completed 10 or more of the 12 task analysis steps independently during a baseline session without any instruction, they would be excluded from the study. If this had occurred, I would have worked with that participant individually to provide instruction on the remaining task analysis steps rather than completing the full intervention with them. None of the participants in this study were excluded during preliminary baseline observations.

At the beginning of the study, I conducted informal meetings with each participant to better understand their previous experiences related to travel skills and community engagement. For example, I asked participants about the communities in which they lived, how they currently navigated the UNC Charlotte campus (e.g., being escorted by a peer or teacher), and about events and locations they typically liked to travel to. Additionally, I asked participants about what they considered to be a “successful” adult life, including how they would like to navigate their communities in the future. The descriptions of James, Caitlin, and Derek below were formed using their input and responses to the questions above.

James

James is a 19-year-old Black male with ID and a speech/language impairment. James responded to questions in short spoken words and phrases or with a speech output program on his iPhone. James shared that when walking to new places on campus, he typically preferred to try to find it alone first and then ask for help from his teachers if needed. He shared that he is a big fan of sports – football in particular – and that his favorite community locations were the gym and other athletic facilities or fields where he could play sports. James shared that he owned a personal smartphone and that he used it to access social media applications, send text messages to friends and family, and watch videos on YouTube. When asked what a successful future looked like to him, James shared that he hopes to get "a job to make money" and to stay involved with football recreationally. Additionally, he shared that he wants to continue living at home with his family and wants to stay in Charlotte within his current community.

Caitlin

Caitlin is a 20-year-old white female with ID and ASD. She responded to questions in spoken words and sentences. Caitlin shared that when trying to find new places on campus, she typically asks her teachers for help. In the community more broadly, Caitlin's favorite locations are restaurants. She stated that she enjoys going to a favorite Italian restaurant with her family. Caitlin owns a personal smartphone and uses it to make calls and to send texts, access social media applications like TikTok, watch YouTube videos (especially of her favorite K-Pop boy bands), and to play puzzles and games. When asked what she envisions a successful future to look like, she shared that she wants a romantic partner and hopes to have a boyfriend in the future. She hopes to get a job in the medical field and to someday learn to drive and receive her driver's license.

Derek

Derek is a 20-year-old Hispanic male with ASD. He responded to questions in spoken words and sentences. When trying to find new locations on campus, Derek shared that he prefers to try independently first and then ask for help from his teachers if needed. Derek's favorite community locations are the gym and that he also likes to go to "a restaurant to get a cheeseburger." Derek owns a personal smartphone and uses it for a variety of purposes, including texting family and friends, watching YouTube videos, and playing games, especially Sonic Dash. When asked what he envisions a successful future to look like, Derek shared that he wants to get a job where he can "wear suits to downtown." Derek hopes to live independently rather than with his family and also stated he wants to "spend time with friends."

Setting

This study took place on UNC Charlotte's campus. Because participants met in the Cato College of Education each morning prior to their campus internships, all sessions for baseline, intervention, and generalization/maintenance phases began in the lobby outside of their classroom. During intervention sessions where instruction occurred, participants and researchers sat together one-on-one at small tables in the lobby. At the beginning of each session throughout the study, participants selected novel campus locations to walk to. No one participant walked to the same destination twice throughout the duration of the study. Walking destinations included in this study represented a variety of features of the UNC Charlotte campus, including athletics fields and facilities, gymnasiums, the aquatic center, dining halls, student health and counseling centers, the campus employment office, and recreational areas, such as the campus botanical garden. A full list of campus locations included in this study is available in Appendix B.

Materials

A smartphone with the Google Maps application installed was the most essential material to the study. I also used a deck of location cards, a watch timer, and paper data sheets. All materials are described in more detail below.

iPhone 11 and Google Maps Application

Although participants owned their own personal smartphones, for this study, all participants used my iPhone 11 to program and follow walking routes with the Google Maps application. I made the decision to have all participants use my phone for the following three reasons: (a) to help prevent participants from having easy access to the Google Maps application on their own phones to practice with outside of study sessions; (b) to help ensure availability of technology during sessions (e.g., prior to each session, I ensured my phone was fully charged, the app was downloaded, and that the phone was connected to campus Wi-Fi); and (c) because relying on participants to bring and use their own smartphones for the intervention could present unforeseen barriers (e.g., phone is not charged or at home).

As requested by the partnering school district for this study, I took several steps to ensure that participants could not access other applications or content on my personal device. First, I signed out of iCloud to temporarily remove all my personal files from the iPhone. Then, I set my iPhone to “Do Not Disturb” to silence any incoming notifications. Lastly, I enabled a Screen Time setting, in which a participant who tried to open any application *except* Google Maps was blocked and required to input a password, which only I had access to. These measures transformed my personal iPhone into a “blank slate” tool for participants to use during each session. Because the Google Maps application interface includes the same map displays, GPS features, and data repositories between the iPhone and Android versions, participants still benefitted from learning the application on an iPhone, even if they personally owned an Android device.

Throughout the study, I checked to ensure the Google Maps application on my iPhone was up to date with any version updates or bug fixes. Prior to each session, I ensured that no previous search history in the Google Maps application was recorded, requiring each participant to type in the full location name or address to find it. The Google Maps application was always located on my home screen in plain sight (i.e., not nested inside home screen folders) for all sessions.

Location Cards

To help participants select a destination of interest to walk to, I created a deck of approximately 20 location cards that featured various destinations around the UNC Charlotte campus. Before creating the deck of location cards, I collaborated with the participants' transition teacher to eliminate any locations that the students already knew and frequented. I only created location cards of destinations that the transition teacher indicated the participants would not be able to locate independently.

Each location card was made using a 4" x 6" white index card. On the unlined side of the index card, I wrote the location name at the top. I wrote location names exactly as they appear on the Google Maps application. Underneath the location name, I included a photo of the outside of the location. All photos were taken on my iPhone 11 camera and were printed in color. Beside the photo, I wrote a brief description of the location. For example, the Belk Gym card included "gymnasium," "aquatic center," and "volleyball courts." Finally, on the back of the card, I wrote the street address for the location exactly as it appeared in the Google Maps application.

Watch Timer

I used the timer on my Apple Watch SE to keep track of timed delay intervals in the intervention phase. Specifically, during the constant time delay trials, I started a 10-second timer as the participant initiated a task analysis step. When he or she completed that step and moved to the next, I restarted the 10-second timer using the "repeat" function on my watch timer. The timer vibrated silently at the end of each interval, in a manner that the participants did not notice or appear distracted by.

Data Collection Sheets

All data for this study were recorded on paper data sheets. Paper data sheets listed student pseudonym, date and session number, and the observer's initials. Data sheets for the baseline and intervention phases are included in Appendix C. Interobserver agreement and procedural fidelity data were also collected on paper data sheets. Procedural fidelity data sheets are included in Appendix D. All completed paper data sheets were stored in a locked file cabinet in my office, located in the College of Health and Human Services. None of the data sheets included any identifying information for participants.

Dependent Variable and Secondary Measures

This study investigated five research questions, related to the efficacy of the constant time delay instructional strategy for teaching map programming, the extent to which map programming skills generalize between applications, the extent to which scenario-based teaching increased the problem-solving skills of participants while following a Google Maps walking route, and the social validity of the intervention as perceived by participants and their special education teacher. Below, outcome variables of interest for each research question are described.

Dependent Variable: Task Analysis Steps

Research question #1 represents the main goal of this study and the associated dependent variable. The primary dependent variable for this study was the number of task analysis steps completed independently for programming and following a walking route to a novel location using Google Maps. The task analysis developed for this study consisted of 12 total steps and was adapted from Yuan et al. (2019)'s six-step task analysis for programming a Google Map walking route. Each participant was scored on the number of task analysis steps they completed independently out of 12 total steps. If a participant completed a step correctly, without prompting, and within the time frame allotted for initiation (i.e., 10 seconds), he or she received credit for that step. If a participant completed a step incorrectly, asked for or required support, or did not initiate the step within 10 seconds, he or she did not receive credit for that step, and it was recorded on the paper data sheet with level of prompt provided (i.e., verbal prompt, physical model, or researcher performs step). The complete 12-step task analysis that was used for this study is included in Appendix E.

Secondary Measure: Generalization

The second research question for this study involved generalizing map programming and following skills to use of Apple Maps, which is another navigation intervention that shares similar features and functionality to Google Maps. This is an example of setting/situation generalization, as it involved demonstrating the same target responses (i.e., programming and following a walking route) under new, untrained stimulus conditions (i.e., an untrained navigation application; Cooper et al., 2020).

Like use of Google Maps, participants' generalization to use of Apple Maps was measured using a task analysis. The 12-step Google Maps task analysis was modified to represent the exact steps of programming a route on Apple Maps, reflecting small differences in application layout and appearance. For example, Google Maps shows a walking icon for pedestrian routes, while Apple Maps presents a dropdown of transportation options for users to choose from. During generalization probes, participants received credit for any Apple Maps step completed correctly, independently, and within the allotted time for initiation (i.e., 10 seconds). Participants did not receive credit for any steps completed incorrectly, steps where support was requested or necessary, or steps that were not initiated within the 10 second time delay.

Secondary Measure: Problem-Solving Skills

The third research question for this study involved using scenario-based teaching to prepare participants to solve common problems that could occur while following a Google Maps walking route, including phone battery dying, encountering a construction zone, and starting a route from an unfamiliar place. This research question served as a mechanism to implement the behavior chain interruption strategy (BCIS; Cooper et al., 2020). Participants were interrupted during the regular task chain of programming and following a map and were taught to implement a three-part problem-solving framework to overcome the problem and reach their desired destination.

To measure participants' application of the problem-solving framework during problem-solving probes, I developed a five-step task analysis. The steps included independently programming the map, attempting a "try by myself" strategy, "ask for help" strategy, and/or a "return to class" strategy, and overcoming the problem to reach their desired destination. The data sheet used for problem-solving probes is available in Appendix G.

Secondary Measure: Social Validity

The fourth and fifth research questions for this study concern the opinions and perceptions of participants and their special education teachers on the intervention and study procedures. At the conclusion of the intervention phase, I conducted semi-structured, one-on-one interviews to gather feedback from the participants and their teachers. Semi-structured interviews "incorporate both open-ended and more theoretically driven questions, eliciting data grounded in the experience of the participant as well as data guided by existing constructs in the particular discipline within which one is conducting research" (Galletta & Cross, 2013, p. 45). Although I provided several uniform questions to each participant, I permitted participants and their teachers to share feedback naturally and conversationally and to provide information beyond their answers to my questions. Participants and their teachers were told that they could ask to have any question repeated or reworded, and that they could skip any question or topic they did not wish to discuss. I did not collect audio recordings of the semi-structured interviews, but a secondary data recorder and I were present to manually transcribe participant responses for later analysis. A description of the data analysis procedures for the semi-structured interviews is included below under "Data Analysis." Additionally, the semi-structured interview questions for social validity are included in Appendix F.

Interobserver Agreement and Procedural Fidelity

I prioritized accurate data collection and adherence to procedures throughout this study. Below, I describe methods that were used for collecting interobserver agreement and procedural fidelity data throughout all phases of the study.

Interobserver Agreement

Interobserver agreement is the extent to which two observers agree, expressed as a percentage, after observing and recording a person's behavior "simultaneously but independently" (Ledford & Gast, 2018, p. 119). To evaluate interobserver agreement, I trained two secondary data collectors on all data collection procedures, including use of the data sheets and the 12 steps of the Google Maps task analysis. A trained secondary observer was present on more than 30% of all sessions across baseline, intervention, and maintenance/generalization phases to collect interobserver agreement data. For each session with a secondary data collector present, the point-by-point method was used to calculate the percentage of interobserver agreement (Ledford & Gast, 2018). Point-by-point agreement is calculated by dividing the number of agreements by the number of agreements plus disagreements, and then multiplying this quotient by 100 to convert to a percentage.

Throughout the study, I calculated interobserver agreement immediately following each session in which two observers were present. Although single-case research guidelines historically suggest a minimum of 80% agreement on average (e.g., Kazdin, 2010), I chose to set 90% interobserver agreement as the minimum for this study. If any session with two observers had interobserver agreement under 90%, I would have reviewed the data collection procedures one-on-one with that observer and completed a session of practice data collection to provide additional support. This was not necessary during any point in the study.

Procedural Fidelity

Procedural fidelity is the degree to which the conditions of the study are delivered and implemented as they were intended (Ledford & Gast, 2018). The two secondary data collectors also helped collect procedural fidelity data during this study. Prior to the beginning of the study, I trained the doctoral students on implementation of each phase of the study and reviewed the paper checklists they would use to evaluate procedural fidelity. A trained secondary observer was present on more than 30% of all sessions across baseline, intervention, and maintenance/generalization phases to collect procedural fidelity data.

The minimum acceptable procedural fidelity percentage for this study was 90%. If an implementer was reported to fall below 90% adherence to procedures, I would have provided an individual review session to support that implementer in following study procedures exactly. This was not needed at any point during the study. Procedural fidelity checklists that were used throughout each phase of the study are available in Appendix D.

Data Analysis

This study employed a single-case, multiple probe across participants design (Horner & Baer, 1978) and adhered to the What Works Clearinghouse (WWC) Quality Indicator standards for single-case design. During baseline, I collected three data points for each participant consecutively on the number of task analysis steps completed independently prior to any instruction or intervention. The participant whose baseline data points were the lowest and most stable was the first to enter the intervention phase. After entering intervention, participants completed two consecutive 0-second delay teaching trials, in which they were prompted to complete 100% of the task analysis steps correctly. Then, the 10-second delay trials began; participants were permitted 10 seconds to independently initiate and/or complete each task analysis step. Participants had to complete at least 11/12 task analysis steps independently for three consecutive sessions to reach mastery criteria. As a participant in the intervention phase approached mastery criteria, I collected at least three consecutive baseline probes for the participant whose baseline probes reflected the second lowest and most stable data, prior to the second participant entering intervention. I repeated this process across the three participant tiers.

Analysis of Graphed Data

Across participants, I used visual analysis of the graphed data to look for the following components: immediacy of effect, changes in level or trend, data variability, and any overlapping data (Cooper et al., 2020). I looked for three or more demonstrations of effect across participants to determine whether a functional relation exists between constant time delay instruction and use of Google Maps to program and follow a walking route.

For this study, I used visual analysis alone to determine the effectiveness of the intervention, rather than visual analysis plus effect size calculation. While best practices for calculating effect size are widely agreed upon in communities which implement group design studies, there is ongoing debate regarding appropriate effect size methodology for single-case research. Due to concerns with how imposing statistical methods on single-case data may violate important distributional assumptions, I instead relied on visual analysis techniques to determine whether a functional relation exists. Basing data analysis on visual analysis alone is a common practice among single-case researchers in the field, as proposed effect size measures for single-case design remain flawed (Kratochwill et al., 2013).

Analysis of Social Validity Data

Following participant interviews, I examined responses across participants for potential themes regarding their likes and dislikes of the study, as well as for emergent themes regarding the impact of increased travel skills on opportunities for current and future community engagement. I began by reviewing transcribed interview notes from both recorders for broad descriptive codes and themes. Next, I reviewed all descriptive codes for those which were most pertinent to my social validity research question. I then considered how codes could be further grouped into categories that represented major themes related to participant opinions and perceptions (Gallette & Cross, 2013, p. 128). During social validity data analysis, I also recorded direct quotes from interviewees that contributed to the identification of descriptive codes and categories. Because I did not audio record semi-structured interviews, having two researchers present to take notes was necessary to accurately represent participant responses.

Procedures

Each participant completed one to three 30-minute sessions per week during this study, for a total of between 11 and 17 total sessions for each participant. Each session occurred in the morning, after participants arrived on the UNC Charlotte campus but before they reported to their on-campus internships. This arrival time is typically spent completing independent work or practice tasks, so participants did not miss any regular instruction to participate. As noted previously, each session began in the downstairs lobby of the Cato College of Education at UNC Charlotte. I selected the College of Education lobby as a starting point because of its convenience and familiarity to the participants.

Baseline

At the beginning of the study, I collected three consecutive baseline probes for each of the three participants. During the first baseline session with each participant, I described what the session would involve and what they would be asked to do. After sitting down with the participant at a small table in the College of Education lobby, I presented the deck of location cards. I asked the participant to mix up or shuffle the deck of location cards in any way they would like. Then, I took the shuffled deck, spread the cards out with street addresses facing up and pictures/names facing down, and asked the participant to randomly pick any three cards from the deck. After the participant selected three location cards, I asked the participant to look at the cards and tell me whether they had ever been to one of these places before. If the participant said "yes," I asked him or her to return the card to me and randomly select a new one. This process repeated until the participant had three unfamiliar location cards. After three unfamiliar location cards were selected, I asked the participant to choose the one they would most like to visit based on the photo, description, and location name.

Next, I provided the verbal instruction, "please use Google Maps to find the way to walk there." I gave the participant my unlocked iPhone 11, which was signed out of iCloud, set to Do Not Disturb, and had Screen Time locks enabled to prevent access to any applications except Google Maps. I started my 10-second watch timer immediately after providing the verbal instruction. If a participant completed a task analysis step independently within the 10-second period, the step was marked as completed. If they did not complete the step within 10 seconds or completed it incorrectly, I asked for my iPhone back, turned so that the participant could not see the screen, completed the step for them, and then returned the iPhone so that the participant could continue. This allowed participants an independent opportunity to attempt each step of the task analysis during all baseline probes.

Throughout all phases of this study, participants were always accompanied by a researcher when walking. The researcher was nearby (approximately 10 feet away), but out of sight of the participant to allow them to follow the map independently and to help avoid any inadvertent prompting by the researcher. During baseline sessions, trials were *only* terminated if the participant did not attempt task analysis step nine (i.e., "participant starts walking and begins following the programmed route"), or if they made any errors while attempting step 10 (i.e., "participant follows each step in the walking directions"). This is because supporting a participant in completing either of these steps would require a verbal, gestural, or physical prompt; getting up to start walking and following each direction cannot be "researcher-completed," as could the other steps of programming the route using the app. During baseline, if a participant did not get up to start walking or makes a wrong turn while walking, I terminated the trial by saying "That is all for today! Thank you for your time."

The three consecutive baseline probes for each participant all followed these same procedures. The participant whose three baseline probes showed the lowest and most stable data was entered into the intervention phase first. The other participants who remain in baseline were probed at least once per week in this same manner. As the first participant neared mastery criteria in the intervention phase, the participant with the second-most low and stable baseline data probes was again probed three consecutive times immediately prior to moving to the intervention phase.

Intervention

This study employed constant time delay teaching (Wolery et al., 1992). Constant time delay involves two conditions: a) 0-second delay trials, in which the target stimulus and controlling prompt are delivered simultaneously to provide opportunities for the learner to practice the target response with no errors; and b) constant delay trials, during which a predetermined response interval (e.g., 10 seconds) is inserted between the stimulus and controlling prompt, providing the learner an opportunity to perform the target response independently. Accordingly, the intervention phase for this study included these two conditions in the following manner: a) two consecutive sessions of 0-second delay teaching trials, and b) up to seven 10-second time delay trials. Each condition is described in greater detail below.

0-Second Delay Teaching Trials

Like in baseline, all 0-second delay teaching trials began in the lobby of the Cato College of Education. As before, I gave the deck of location cards to the participant and asked for him or her to shuffle or mix up the deck. I fanned the shuffled cards out, with addresses only visible and the photos and location names turned down towards the ground. I asked each participant to randomly select three cards from the deck and to let me know if they were familiar with any of the three they selected. If so, I asked them to hand me the known location card and replace it with an unknown one from the deck. Then, I asked the participant to choose the location they would most like to visit from the three options on the cards.

After the participant selected his or her desired destination, I gave the participant my unlocked iPhone with the directive, "please use Google Maps to find the way to walk there." This time, I provided prompts for each task analysis step to support the participant in completing them errorlessly. For example, for task analysis step three (i.e., "participant locates and presses the search bar in Google Maps"), I pointed to the search bar on the screen and presented a verbal prompt ("tap the search bar"), allowing the participant to then tap the search bar to complete task analysis step three. Because each step in the 0-second delay teaching trials was prompted, all participants completed 100% of task analysis steps during this condition.

10-Second Time Delay Trials

After completing two consecutive 0-second delay teaching trials, participants entered the 10-second time delay condition. In this condition, all initial procedures were the same as in baseline and the 0-second delay teaching trials. Participants shuffled the location cards, randomly selected three unknown locations, and then picked their most desired location of the three options. In this condition, after I provided my unlocked iPhone and the verbal directive "please use Google Maps to find the way to walk there," I waited 10 seconds within each task analysis step before providing any prompting to the participant. This allowed him or her the opportunity to complete each step independently before receiving support.

After each session, I graphed a data point to reflect the number of task analysis steps the participant completed independently out of 12 possible steps. To count, the participant had to correctly complete or initiate the step within the 10-second time delay. To meet mastery criteria, participants had to complete at least 11/12 task analysis steps independently for three consecutive sessions. Participants were allotted up to seven 10-second time delay sessions to meet mastery. If they did not meet mastery criteria within seven sessions, I would have provided individual booster sessions before moving that participant to the maintenance and generalization phase. The booster sessions were designed to include three 0-second delay trials and two 10-second delay trials for each frequently missed task analysis step, specific to that participant. No participant required any booster sessions during this study.

Following the Programmed Route

All baseline and intervention sessions presented participants the opportunity to follow their programmed maps towards their chosen destination. As noted above, participants *never* followed walking routes alone; a member of the research team was present for the full duration of every walk that took place during this study. As participants followed their walking routes, I or another researcher followed behind the participant, out of their view but nearby (i.e., approximately 10 feet away). If a participant took a wrong turn, missed a turn, or expressed confusion, frustration, or distress, a researcher immediately provided verbal and/or gestural prompts to support the participant in navigating back to the route. The accompanying researcher was instructed to tally the number of wrong or missed turns and requests for help, but there was no limit to the number of prompts that the researcher could provide. Participants were always supported in reaching their desired final location.

After reaching the desired location and completing the final task analysis step, I asked the participant if they would like to explore the destination. If the participant said yes, I accompanied them as they walked around the location. The participant was able to explore the location for up to 10 minutes, time permitting. If the participant did not wish to explore the destination, they were not required to. I (or the accompanying researcher) walked back to the College of Education with the participant at the end of the session.

Maintenance and Generalization

A participant had to complete at least 11/12 task analysis steps independently for three consecutive sessions to reach mastery criteria. A participant was given up to seven 10-second delay trials to attempt to reach mastery. After reaching mastery, participants entered the maintenance and generalization phase.

Maintenance

I conducted two maintenance probes for each participant following the end of the intervention phase. All procedures for maintenance probes exactly mirrored the procedures used in the 10-second constant time delay trial sessions in the intervention phase. Participants shuffled the location cards, picked three unknown locations, selected their top choice, and were told to "please use Google Maps to find the way to walk there." Participants were provided 10 seconds to perform each step independently before I provided a prompt. In the maintenance phase, participants were again scored on the number of task analysis steps they completed independently out of 12 total.

Generalization

In addition to the two maintenance probes, each participant also completed two generalization probes. This study investigated setting/situation generalization, which is defined as "the extent to which a learner emits the target behavior in a setting or stimulus situation that is different from the instructional setting" (Cooper et al., 2020, p. 799). Specifically, I investigated whether map programming skills generalized from use of Google Maps to use of Apple Maps, which is similar in form and function to the trained Google Maps application. One generalization probe was conducted during the baseline phase, and the second occurred following completion of the intervention phase.

The 12-step Google Maps task analysis was adapted to exactly match the steps required to program a map on Apple Maps. I used the Apple Maps task analysis to measure the number of steps participants completed independently in programming and following an Apple Map to an unknown location of interest. Like before, all procedures in the generalization probes exactly mirrored the procedures used in the 10-second constant time delay trial sessions in the intervention phase. Participants again shuffled the location cards, picked three unknown locations, selected their top choice, and were asked to "please use the Apple Maps app to find the way to walk there." Participants had 10 seconds to independently perform each step before I provided a prompt. All participants received sufficient prompting to support them in successfully using Apple Maps to program and follow a walking route to a desired location.

Problem-Solving Probes

Following maintenance and generalization probes, each participant completed three additional problem-solving probes. First, I provided one-on-one scenario-based instruction for each problem type (i.e., phone battery dies, construction zone, starting a route from an unknown location) using PowerPoint slides. The slides included a description of the three-step problem-solving framework, a practice scenario that we completed together, and true/false knowledge check questions. After completing the scenario-based instruction, participants programmed a map, began to follow it, and were interrupted with the problem we had learned about that day. Participants then applied the problem-solving framework to overcome the problem and reach their destination. Participants completed one problem-solving probe per session and were scored on a five-step task analysis.

Single-Case Research Quality Indicators

This study was designed in accordance with the What Works Clearinghouse (WWC) quality indicators for single-case designs. Chapter Four includes graphical and tabular representation of the results to research questions 1, 2, and 3. The independent variable (i.e., constant time delay instruction) was systematically introduced through the two 0-second teaching trials and through implementation of a 10-second delay following instruction. A secondary data collector was present for more than 30% of data points and across baseline, intervention, and maintenance/generalization phases. Finally, data probes align with WWC recommendations in that (a) baseline probes overlap vertically for the first three consecutive sessions across participants, (b) three consecutive probes were conducted immediately prior to introducing the independent variable, and (c) for cases in which the independent variable had not yet been introduced, a probe point is present when another case first receives the intervention (What Works Clearinghouse, 2022).

CHAPTER 4: RESULTS

This chapter contains a description of the results of this study. First, levels of interobserver agreement and procedural fidelity are reported. Then, results for each research question are presented.

Interobserver Agreement

One doctoral student in special education and one special education associate researcher served as secondary data collectors for a portion of study sessions across baseline, intervention, and maintenance/generalization phases. Before secondary data collectors attended any sessions, I trained them on use of the data collection tool and on each step of the task analysis. To train secondary data collectors, I first modeled each step of the task analysis. Then, I completed a practice session with each secondary data collector in which I acted as the "participant" and had the secondary data collectors score my performance using the data collection tool. The secondary data collectors scored the practice session with 100% interobserver agreement, signifying that they were sufficiently trained.

The secondary data collectors attended 33% of sessions across baseline, intervention, and generalization/maintenance phases to collect interobserver agreement data. The point-by-point method was used to calculate interobserver agreement across all phases of the study (Ledford & Gast, 2018). Interobserver agreement ranged from 92% to 100%, with a mean of 99% agreement across sessions. Because interobserver agreement levels remained above minimal standards (i.e., 80%; Ledford & Gast, 2018), retraining was not required for either secondary data collector during this study.

Procedural Fidelity

The same doctoral student in special education and special education associate researcher also recorded procedural fidelity data for this study. Prior to any sessions occurring, I trained the secondary data collectors on use of the procedural fidelity checklists. Because procedures varied slightly between baseline, 0-second delay, and 10-second delay sessions, three procedural fidelity checklists were used (i.e., one for each type of session). To train secondary data collectors, I first described each component of the baseline procedural fidelity checklist. Then, I completed a practice session with each secondary data collector in which I acted as the implementer with an imaginary “participant” and had the secondary data collectors score my procedural fidelity using the checklist. Finally, I reviewed the procedural fidelity items that were unique to the 0-second delay and 10-second delay trial checklists.

The secondary data collectors recorded procedural fidelity data for 36% of sessions across baseline, intervention, and generalization/maintenance phases. Across the study, procedural fidelity ranged from 89% to 100% with a mean of 99%.

Results by Research Question

Research Question 1: Is there a functional relation between using constant time delay to teach use of Google Maps and the number of task analysis steps young adults with IDD complete independently?

Results of Research Question 1 (i.e., percent of task analysis steps completed for programming and following a Google Maps walking route) are presented below in Figure 2. Additionally, Table 1 includes mean and standard deviation for the task analysis steps completed by each participant across each condition of the study. The task analysis for programming and following a Google Maps walking route consisted of 12 steps and was used for all baseline, 0-

second delay, 10-second delay, and maintenance trials. Visual analysis of graphed data indicates a functional relation between use of constant time delay and the percent of task analysis steps completed across the three participants. The functional relation was determined by immediacy of effect following constant time delay instruction and three demonstrations of effect across the three participants. Additionally, the data paths predicted during baseline changed in a therapeutic direction upon implementation of constant time delay instruction, and these changes were replicated across the three participants (Leford & Gast, 2018).

James

James's graphed data appear in the top tier of the graph in Figure 2. During baseline, James's probes were somewhat variable and overall low in level. He completed between 8% and 42% of task analysis steps (mean = 31%) independently. Because his baseline scores were the lowest between the three participants, and because James began to descend between probe 3 and probe 4, I chose to intervene with him first.

Next, James completed two consecutive 0 s delay trials, during which I used constant time delay to teach him each step of the 12-step task analysis. This teaching strategy allowed James to complete the full task chain errorlessly for two consecutive sessions. After completing two sessions with a 0 s delay, I implemented a 10 s delay so that James had the opportunity to independently attempt each of the 12 steps. Even with the 10 s time delay in place, James continued to complete each of the 12 steps independently; there was an immediacy of change in level from baseline points. James met mastery criteria (i.e., at least 11 of 12 task analysis steps completed for three consecutive sessions) within his first three 10 s probes. Summative visual analysis indicated a functional relation was present for James.

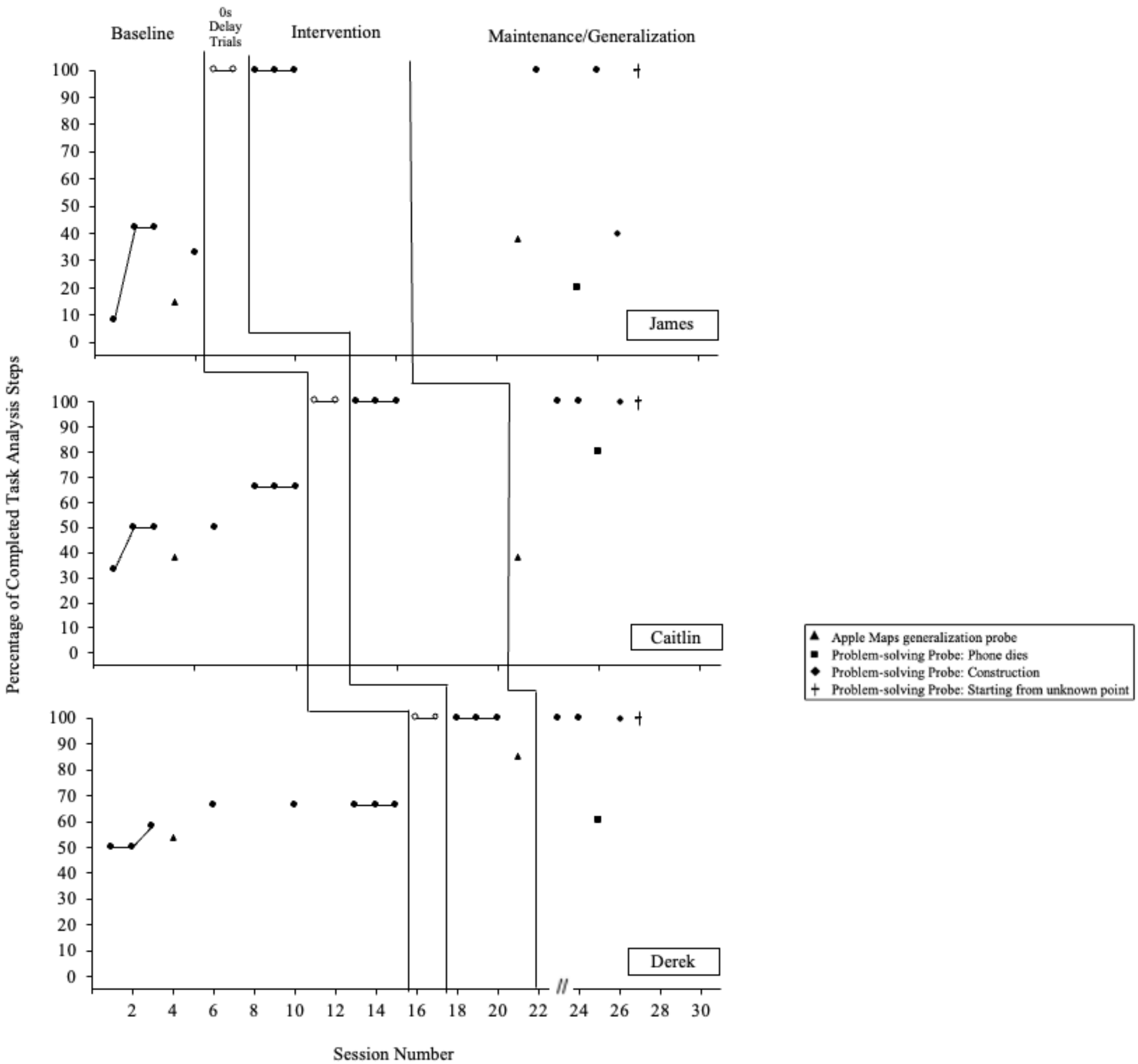

Figure 2. Percentage of completed task analysis steps

Note. The break in the graph represents district winter break from December 19 to January 8. The open data points reflect prompted responses (i.e., 0s delay teaching trials).

After reaching mastery criteria in the intervention phase, James entered the maintenance phase. I conducted maintenance probes for James at four and six weeks post-intervention, right before and right after an extended holiday break. During both maintenance probes, James completed 100% of task analysis steps independently. He did not require any prompting or support to program and follow the walking route to reach his desired destination.

Caitlin

Caitlin's graphed data appear in the second tier of the graph in Figure 2. During baseline, Caitlin's probes were somewhat variable; she completed between 33% and 66% of task analysis steps (mean = 54%) independently. The percent of steps she completed increased between probes one and two, was stable across probes two through four, increased between probes four and five, and remained stable between probes five through seven (immediately prior to intervention). Because Caitlin's baseline scores were higher than James's but lower than Derek's, I chose to intervene with her second.

Next, Caitlin completed two consecutive 0 s delay trials, during which I used constant time delay to teach her each step of the 12-step task analysis. This teaching strategy allowed Caitlin to complete the full task chain errorlessly for two consecutive sessions. After completing two sessions with a 0 s delay, I implemented a 10 s delay so that Caitlin had the opportunity to independently attempt each of the 12 steps. Even with the 10 s time delay in place, Caitlin continued to complete each of the 12 steps independently; there was an immediacy of change in level from baseline points. Caitlin met mastery criteria (i.e., at least 11 of 12 task analysis steps completed for three consecutive sessions) within her first three 10 s probes.

Table 1

Mean and Standard Deviation of Percentage of Google Maps Steps Completed

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
James	31.25	16.07	100	0	100	0
Caitlin	55.17	13.39	100	0	100	0
Derek	61	7.33	100	0	100	0

After reaching mastery criteria in the intervention phase, Caitlin entered the maintenance phase. I conducted maintenance probes for Caitlin at three and four weeks post-intervention, immediately following an extended holiday break. During both maintenance probes, Caitlin completed 100% of task analysis steps independently. She did not require any prompting or support to program and follow the walking route to reach her desired destination. Summative visual analysis indicated a functional relation was observed for Caitlin.

Derek

Derek's graphed data appear in the bottom tier of the graph in Figure 2. During baseline, Derek's probes were the most stable of the three participants and also the highest. He completed between 50% and 66% of task analysis steps (mean = 61%) independently. His baseline probes ascended between probes two and three (from 50% to 58%) and again between probes three and four (from 58% to 66%), but then remained stable at 66% for the remaining five baseline probes. Because his baseline scores were the highest among the three participants, I chose to intervene with him last, after providing instruction to James and Caitlin.

Next, Derek completed two consecutive 0 s delay trials, during which I used constant time delay to teach him each step of the 12-step task analysis. This teaching strategy allowed Derek to complete the full task chain errorlessly for two consecutive sessions. After completing two sessions with a 0 s delay, I implemented a 10 s delay so that Derek had the opportunity to independently attempt each of the 12 steps. Even with the 10 s time delay in place, Derek continued to complete each of the 12 steps independently; there was an immediacy of change in level from baseline points. Derek met mastery criteria (i.e., 11 of 12 task analysis steps completed for three consecutive sessions) within his first three 10 s probes.

After reaching mastery criteria in the intervention phase, Derek entered the maintenance phase. I conducted maintenance probes for Derek at two and three weeks post-intervention, following an extended holiday break. During both maintenance probes, Derek completed 100% of task analysis steps independently. He did not require any prompting or support to program and follow the walking route to reach his desired destination. Summative visual analysis indicated a functional relation was present for Derek.

Research Question 2: To what extent do the steps to program and follow a Google Maps walking route generalize to use of Apple Maps for young adults with IDD?

Results of Research Question 2 (i.e., percent of task analysis steps completed for programming and following an Apple Maps walking route) are presented below in Figure 2, represented by triangle markers. Participants completed untrained Apple Maps generalization probes twice during the study: once during the baseline phase, and a second time after completing all intervention sessions. During Apple Maps generalization probes, participants were not provided any instruction or support related to using the application. Like in baseline sessions, if a participant could not or did not complete a task analysis step within 10 s, I took the phone back and completed the step for the participant out of his or her sight before returning the phone so they could attempt the next step. I used an adapted 13-step task analysis for Apple Maps generalization probes, and participants were scored on the percent of the untrained 13-step task analysis they completed independently. Results of the Apple Maps generalization probes are reported by each participant below.

James

James completed his first Apple Maps probe during baseline (i.e., session 4) and his second during the maintenance/generalization phase (i.e., session 21). On the first Apple Maps probe, James completed 15% (i.e., two of 13) task analysis steps independently. Although James had not received instruction in use of either Google Maps or Apple Maps at the time of the first Apple Maps probe, his untrained Apple Maps probe was lower than his untrained Google Maps probes were.

James completed his second Apple Maps generalization probe during the maintenance/generalization phase. By the second Apple Maps probe, James had received considerable instruction on use of Google Maps, but still no instruction related to Apple Maps. James completed 38% (i.e., five of 13) of Apple Maps task analysis steps during the second generalization probe, which was more than he completed during the first Apple Maps probe.

Caitlin

Caitlin completed her first Apple Maps probe during baseline (i.e., session 4) and her second during the maintenance/generalization phase (i.e., session 21). On the first Apple Maps probe, Caitlin completed 38% (i.e., five of 13) task analysis steps independently. Although Caitlin had not received instruction in use of either Google Maps or Apple Maps at the time of the first Apple Maps probe, her untrained Apple Maps probe was lower than her untrained Google Maps probes were.

Caitlin completed her second Apple Maps generalization probe during the maintenance/generalization phase. By the second Apple Maps probe, Caitlin had received considerable instruction on use of Google Maps, but still no instruction related to Apple Maps. Caitlin completed 38% (i.e., five of 13) of Apple Maps task analysis steps during the second generalization probe, which was the same as what she scored during the first Apple Maps probe.

Derek

Derek completed his first Apple Maps probe during baseline (i.e., session 4) and his second immediately after meeting mastery criteria in the intervention phase (i.e., session 21). On the first Apple Maps probe, Derek completed 54% (i.e., six of 13) task analysis steps independently. Although Derek had not received instruction in use of either Google Maps or Apple Maps at the time of the first Apple Maps probe, his untrained Apple Maps probe was slightly lower than his untrained Google Maps probes were.

Derek completed his second Apple Maps generalization probe immediately after reaching mastery criteria in the intervention phase. By the second Apple Maps probe, Derek had received considerable instruction on use of Google Maps, but still no instruction related to Apple Maps. Derek completed 85% (i.e., 11 of 13) of Apple Maps task analysis steps during the second generalization probe, which was more than he completed during the first Apple Maps probe.

Research Question 3: What is the effect of scenario-based teaching on the Google Maps problem-solving skills of three young adults with IDD?

Research Question 3 relates to the three problem-solving generalization probes conducted with each participant after the conclusion of the intervention phase. Each participant was taught to use a three-step problem-solving framework (i.e., “try by myself,” “ask for help,” and “return to class”) to solve three different issues a person may encounter when using Google Maps to follow a walking route. The three problems taught were: (a) your phone battery dies, (b) you encounter a construction zone, or (c) you need to start a route from an unknown location.

Each problem-solving probe session included scenario-based instruction, three true/false learning check questions, and an opportunity to practice applying the three-step problem solving framework (i.e., “try by myself,” “ask for help,” or “return to class”) within the context of that specific problem. Each scenario-based lesson included problem-specific strategies to help participants apply the framework. For example, the “try by myself” strategies for what to do when your phone dies included looking for a campus map or for posted signage that could help you find your way. The slides used to provide scenario-based instruction for all three problem types are included in Appendix H.

The results of Research Question 3 are included in Figure 2 across all three participant tiers. Square data points represent problem-solving probe #1 (i.e., phone battery dies), diamond-shaped data points represent problem-solving probe #2 (i.e., encountering a construction zone), and cross-shaped data points represent problem-solving probe #3 (i.e., starting a route from an unknown location). Below, results are reported by probe type across all three participants.

Problem-Solving Probe #1: Phone Battery Dies

James, Caitlin, and Derek each completed problem-solving probe #1 during the generalization/maintenance phase. Participants were asked to program a map and begin to follow it, but shortly into the route, I informed each participant that “the phone was dead” and they could no longer use it to look at their map. Each participant was scored on the percent of task analysis steps completed for using the problem-solving framework. The five-step task analysis used for all problem-solving probes is located in Appendix G.

For problem-solving probe #1 (i.e., phone battery dies), James completed 20% (1 of 5) of task analysis steps independently during his practice opportunity. After programming the map independently, James required verbal prompting to complete the remainder of the task analysis steps once the phone was "dead." He did not independently attempt any strategies within the framework but was able to demonstrate a "try by myself," "ask for help," and "return to class" strategy after I provided verbal prompts.

Caitlin completed problem-solving probe #1 next. She completed 80% (4 of 5) of task analysis steps independently during her practice opportunity. Caitlin required verbal prompting only during the first strategy after the phone was "dead" (i.e., "try by myself"). After reminding her to look in her environment for items that could help her find her way, Caitlin completed the other steps of the problem-solving framework (i.e., ask for help, return to class) independently.

Derek was the final participant to complete problem-solving probe #1. He completed 60% (3 of 5) of task analysis steps independently during his practice opportunity. Derek attempted to ask for help right after the phone "died" and before attempting a "try by myself" strategy; he also required verbal prompting in remembering what to do if he had already attempted "try by myself" and "ask for help" strategies.

Problem-Solving Probe #2: Encountering a Construction Zone

James, Caitlin, and Derek each completed problem-solving probe #2 during the next session. Participants were asked to program a map and begin to follow it, but shortly into the route, I informed each participant that we were approaching a "construction zone" and they could no longer walk in the direction prescribed by the map (e.g., pretending Craver Road is closed for repair). Each participant was scored on the percent of task analysis steps completed for using the problem-solving framework. The five-step task analysis used for all problem-solving probes is located in Appendix G.

For problem-solving probe #2 (i.e., encountering a construction zone), James completed 40% (2 of 5) of task analysis steps independently during his practice opportunity. After programming the map independently, James began to walk, but did not attempt any strategies after I informed him that we were approaching a construction zone. He required verbal prompting to attempt a “try by myself” strategy (i.e., walk another way and let the map re-route), attempted to “ask for help” independently, and required a verbal prompt to attempt the final strategy, “return to class.”

Caitlin completed problem-solving probe #2 next. She completed 100% (5 of 5) of task analysis steps independently during her practice opportunity. After telling Caitlin that we were approaching a construction zone, she independently attempted a “try by myself” strategy and walked a different direction to let the map re-route. She then independently asked for help by saying, “Do you know where Union Deck is?” and identified that she could still “return to class” if the other options did not solve the problem.

Derek was the final participant to complete problem-solving probe #2. He completed 100% (5 of 5) of task analysis steps independently during his practice opportunity. Following the scenario-based lesson, Derek independently attempted “try by myself,” “ask for help,” and “return to class” strategies for encountering a construction zone without any verbal prompting or support.

Problem Solving Probe #3: Starting a Route from an Unknown Location

Problem-solving probe #3 was the final session James, Caitlin, and Derek completed during this study. For these sessions, I walked each participant to a random location on campus (e.g., unmarked walkway, cut-through path, building loading dock) before asking them to begin their practice opportunity. Each participant was scored on the percent of task analysis steps completed for using the problem-solving framework. The five-step task analysis used for all problem-solving probes is located in Appendix G.

For problem-solving probe #3 (i.e., starting a route from an unknown location), James completed 100% (5 of 5) of task analysis steps independently during his practice opportunity. After I walked him to a random starting point, James independently attempted each strategy type without any prompting or support. He demonstrated a “try by myself” strategy (i.e., programmed a map to a nearby known location), asked for help appropriately, and expressed that to “return to class” if he was already lost, he would call or text his teacher for help.

Caitlin completed problem-solving probe #3 next. Like in problem-solving probe #2, she completed 100% (5 of 5) of task analysis steps independently during her practice opportunity. I walked Caitlin to an unknown starting point, and after asking what she would do next, she demonstrated “try by myself,” “ask for help,” and “return to class” strategies that matched what we reviewed during the scenario-based lesson.

Derek was the final participant to complete problem-solving probe #3. Like Caitlin, Derek also completed 100% (5 of 5) of task analysis steps independently during his practice opportunity. After walking Derek to an unknown starting point, he first attempted to make a map back to a known location independently. Next, he demonstrated asking for help appropriately. Finally, he pulled up his teacher’s phone number to show how he could get help to “return to class” if he was lost.

Research Question 4: What are the opinions and perceptions of transition-age youth with IDD regarding use of Google Maps to independently program and follow a walking route to reach a location of interest?

Research Question 4 relates to the social validity of this study as reported by the study participants. Following the conclusion of data collection, I conducted semi-structured, one-on-one interviews with each participant to better understand their opinions and perceptions of the intervention. Before each interview, I told participants they could ask to have any question reworded and could skip any question they did not wish to answer. I asked participants one question at a time and took notes as they responded, along with a second notetaker (i.e., the secondary data collector who also collected interobserver agreement and procedural fidelity data). If participants wished to share more beyond their responses to the questions, we continued to take notes and allowed them to share as much or as little as they wished. A full list of the semi-structured interview questions is available in Appendix F. The sections below detail responses provided by each participant, as well as general themes and connections identified between participant responses.

James

James completed his semi-structured interview with the support of his speech therapist and responded to each interview question through short spoken words or phrases and gestures. James said he enjoyed learning to use Google Maps and described it as “kind of easy.” James identified Belk Gymnasium as his favorite walking location because “they have basketball.” During previous sessions, James shared that he liked to watch and play different sports in his free time, so it makes sense that Belk Gymnasium was a destination that James selected and wanted to explore after finding.

When asked if he would change anything about the sessions or if he would keep them the same, James said he would “keep the same.” James pulled up the Google Maps application on his personal phone during the interview session and pointed to the icon; I asked if he downloaded it to use again in the future, and he nodded. Lastly, when I asked James whether he felt he was successful at learning to use Google Maps, he did not immediately respond. I asked if he would like for me to ask the question a different way, and he nodded. After rephrasing to ask, “do you feel like you did a good job using Google Maps,” James smiled and nodded.

Caitlin

Caitlin completed her semi-structured interview independently and responded using spoken words and phrases. When asked about her experience using Google Maps, Caitlin responded, “It was fun because I got to walk anywhere on campus. It was easy to use.” Caitlin identified the campus Light Rail station as her favorite selected destination: “I got to see which station we get off at.” During a previous session, Caitlin selected the Light Rail station as her destination. While walking there, she shared with researchers that she had ridden the Light Rail before, but only within a few blocks back and forth in Uptown. Through this study, Caitlin learned that the Light Rail goes all the way to campus and that it could take her lots of different places around town.

Caitlin reported that she would not change anything about the study procedures, and that she felt better at finding new places after the Google Maps sessions than she did before. When asked whether she preferred choosing her destinations or if she would have liked to be assigned a walking destination, Caitlin said “I liked getting to choose where we walked.” Caitlin plans to keep using Google Maps because it allows her to “check out places by [herself].” She even shared anecdotally during a walk that she hopes to use Google Maps when she takes a family trip to South Korea in the future. Caitlin’s interview concluded after I asked her whether she felt she had been successful learning to use Google Maps. With a smile, Caitlin shared: “Yes, because I loved using it. It gave me confidence.”

Derek

Derek completed his semi-structured interview independently and responded to interview questions through spoken words and phrases. Derek described his experience with Google Maps: "It was fun, using the phone. It was easy." Derek did not identify a specific favorite destination at first and stated he enjoyed just "walking around," but after looking back through the deck of location cards, Derek selected Robinson Hall as a favorite destination. Robinson Hall for the Performing Arts hosts several galleries and performances spaces, which Derek chose to explore in a previous session after locating the building.

Next, Derek shared that he would keep the sessions the same if we were to do them again. He also responded "yes" when asked if he felt better at finding new places and whether he thought he would use Google Maps on his own in the future. Derek stated he preferred choosing his own destinations, rather than having them assigned to him by a researcher. Last, Derek was asked if he felt he was successful learning to use Google Maps. "Yes! It was cool."

Themes Across Participants

Several common themes emerged across participant responses, including *value of choice*, *intent to continue using Google Maps*, and *personal sense of success*. Each theme is discussed in more detail below, supported by participant quotations and details from the semi-structured interviews.

Value of Choice. Caitlin and Derek both specifically identified that they enjoyed being able to choose their walking destination for each session, rather than having a destination assigned or predetermined by a researcher. Notably, the location that each participant identified as their favorite during the semi-structured interviews aligned with interests and hobbies participants had expressed at other times during the study. For example, James shared about his love of sports from the first session and identified Belk Gymnasium as his favorite destination. Further, Caitlin shared about her affinity for travel during early sessions and selected the Light Rail station as her favorite destination. As noted before, Caitlin shared that one of her favorite aspects of the whole study was that "[she] got to walk *anywhere* on campus." Embedding participant choice and autonomy throughout the study appears to have increased the social validity of use of Google Maps for the participants, as they were able to directly experience how use of Google Maps could connect them with places of personal interest on campus.

Intent to Continue Using Google Maps. James, Caitlin, and Derek all expressed intent to continue using Google Maps in the future outside of the contexts of this study. Although Caitlin was the only participant to identify a specific time and place she wanted to use Google Maps in the future (i.e., during an upcoming family trip to South Korea), Derek and James both downloaded the application to their personal phones after the study and answered "yes" when asked if they planned to use it on their own. Additionally, James, Caitlin, and Derek all answered "yes" when asked if they thought Google Maps would be a helpful tool in life. Participants expressing intent to use Google Maps in the future, as well as participants downloading Google Maps to their own phones, suggest that travel skill instruction – and more specifically, a community navigation intervention – were socially valid topics for these three participants.

Personal Sense of Success. Before the study began, I conducted pre-interviews with each participant to learn more about their future goals, needs, and personal beliefs related to the concept of "a successful adulthood." In doing this, I hoped to frame my support and instruction based on the specific hopes each participant articulated for their adult lives. Unsurprisingly, the participants described different visions of "success," but each participant mentioned at least one goal reflecting independence; for example, "learning to drive," "living by [himself]", or "getting a job to make money." Through their pre-interview responses, I observed that participants valued opportunities for self-determination and desired to be independent.

During the semi-structured social validity interviews, I asked participants whether they felt they were successful at learning to use Google Maps. When asking this question, I did not define success or give any examples; I wanted participants to interpret the word "success" uniquely and personally, as they had during the pre-interviews. James, Caitlin, and Derek all responded that they felt successful, and Caitlin specifically shared that the sessions "gave [her] confidence." Derek and James's responses to the semi-structured interview questions also alluded to opportunities for self-determination (e.g., preferring to choose their own destinations, choosing destinations that align with hobbies), suggesting that each participant viewed opportunities for independence and choice as positive aspects of the study.

Research Question 5: What is the social validity of using a Google Maps application to teach travel skills as reported by the teacher and job coach of the transition-age youth with IDD?

The final research question relates to the opinions and perceptions of the participants' special education teacher (pseudonym "Mr. Martin") and job coach (pseudonym "Ms. Wright") related to this study. After completing data collection and conducting semi-structured interviews with participants, I scheduled an interview with Mr. Martin and Ms. Wright. A complete list of the questions discussed is included in Appendix F, and Mr. Martin's and Ms. Wright's responses are detailed below.

Mr. Martin and Ms. Wright first described how their transition-age students typically locate new or unknown places on campus. "Someone would have to show them," Mr. Martin commented. Ms. Wright agreed: "Yes, we have to go with them in person." I asked Mr. Martin and Ms. Wright to describe the process they generally use for orienting their students to campus, especially when they have students who are new to campus and the transition program. Mr. Martin shared: “our students come back to campus two weeks before the rest of the college students in August. We use those two weeks to walk around and learn the campus.” Ms. Wright stated that specifically, they walk around to learn where dining options are, practice using the campus bus system together, and walk to each building where the students’ internships are held, so that students have seen their employment sites prior to their first day of work. Mr. Martin added that multiple trips to the internship sites are typically needed before students can report to work independently: “once [the students] actually get their internship assignments, we have to walk them back a few more times before they learn the way.”

Mr. Martin and Ms. Wright had shared already that orienting students to campus was time-consuming, so next, I asked Mr. Martin and Ms. Wright about how *their* day-to-day responsibilities might be different if their students had independent navigational skills. “It would be one fewer skill we have to focus on,” Mr. Martin commented. He shared that he and Ms. Wright provide instruction on many different transition topics, such as budgeting, professional emails, paying bills, job applications, and more. “We could spend less time on [travel skills] training and there would be more time for more job experiences.”

My final question for Mr. Martin and Ms. Wright was about how they imagined their *students’ lives* might be different if they could all navigate campus independently. Mr. Martin replied, “it would give them more independence, both as students and adults.” Ms. Wright added, “they could navigate to other spaces then, too. Grocery stores, doctors’ appointments… the community in general.” Mr. Martin ended our conversation by saying, “this has been an excellent study. It has been very helpful for the [students], to gain independence for now and also for the future."

CHAPTER 5: DISCUSSION

This chapter includes a discussion of study results and how they contribute to the literature base. First, study limitations and suggestions for future research are discussed. Next, a discussion of study results organized by each research question is included. Finally, implications for practitioners related to response prompting, following programmed maps, designing baseline probes, the availability of smartphone supports, and participant safety are discussed.

Study Limitations and Suggestions for Future Research

Despite careful study design and high levels of procedural fidelity, there are several limitations to this study that are important to consider. The limitations relate to sample size, participants' previous exposure to campus, use of the researcher's smartphone, and route inequivalence. Each limitation is described and discussed below, along with suggestions for future research that would address the limitation.

First, through use of a single-case, multiple probe across participants design, I was able to evaluate the effects of constant time delay on three young adults with IDD's use of Google Maps. The internal validity of this research design is strong and permitted me to control for threats to internal validity, such as maturation and testing. I was able to determine a functional relation between constant time delay and percent of task analysis steps completed across the three participant tiers (Ledford & Gast, 2018). Despite the strengths of this research design, there were only three participants, which considerably limits the external validity of results. In order to strengthen the external validity of study results, future research teams may conduct direct replications of this study with other young adults with IDD who meet similar inclusion criteria (Cooper et al., 2020).

Second, participants were already familiar with some areas of campus and walkways due to their daily activities, including walking from the bus to the classroom, from the classroom to internships, and from internships to the dining hall. Additionally, I was unable to know for certain exactly where participants had walked before and had to rely on participant self-report and teacher report. It is possible that participants selected an “unknown” location to walk to that they had actually visited previously. Future researchers may consider conducting similar studies when transition-age youth with disabilities first encounter a new setting (e.g., during orientation week for an inclusive postsecondary education program) to more accurately ensure that all locations included in the study are truly unfamiliar to participants.

Third, the researcher’s iPhone was used for all map programming and walking during the study. I chose to use my iPhone for the study in order to ensure it was always available, fully charged, and connected to campus Wi-Fi, and also to ensure that all application settings were the same across participants (e.g., no participants received audio prompts from the Google Maps application). Although using my iPhone to conduct this study offered several valuable points of consistency across participants, it is important to note that not every young adult with IDD has an iPhone and that some may not own a smartphone at all. Future researchers should consider having participants use their personal devices (e.g., iPhone, Android, iPad) in order to decrease the generalization necessary to use map programming skills outside of study sessions. Additionally, future researchers may use a comparative or multitreatment design to determine whether enabling Google Maps’ additional built-in features (e.g., audio prompts, voice-to-text) impacts participant performance on task analysis steps.

Fourth, not every walking route completed by participants was equivalent in terms of distance, number of directional steps, or difficulty. For example, some destinations took us across campus and down unmarked pathways and parking lots, while others were only a few minutes from participants' classroom and involved only one turn. For this reason, the true difficulty of task analysis step 10 (i.e., "Participant follows each step in the walking route") varied by session. Future researchers may attempt to standardize route length and difficulty to ensure routes are comparable across all sessions. Additionally, future researchers may create a different measurement tool (e.g., a rubric) that allows participants to receive "credit" for successfully completing longer and more challenging routes.

Despite these limitations, the present study has enhanced understanding of the usefulness of constant time delay to teach use of Google Maps to young adults with IDD. Results of this study suggest that constant time delay is an effective and efficient strategy for teaching use of Google Maps. Further, and perhaps most importantly – as noted by participants and their teachers, gaining pedestrian navigation skills can lead to confidence, independence, and connection within the community, which can be empowering to young adults with IDD.

Discussion of Study Results by Research Question

Research Question 1: Constant Time Delay to Teach Use of Google Maps

The main purpose of this study was to determine if constant time delay was an effective teaching method to increase the walking navigation skills of young adults with IDD when using Google Maps. Participants selected unfamiliar locations of interest on a college campus, and their performance was measured against a twelve-step task analysis for programming and following a walking route using Google Maps. Data indicated a functional relation between use of constant time delay and the percent of task analysis steps completed for James, Caitlin, and Derek.

James

Following two consecutive 0-second delay instructional trials, each of the three participants experienced a large and immediate increase in percent of task analysis steps completed. James had the lowest and most stable baseline data and was the first participant to enter the intervention phase. He completed between 8% and 42% of task analysis steps (mean = 31%) independently during baseline probes. After two sessions of 0-second delay instructional trials, James completed 100% of task analysis steps independently with a 10-second time delay across the following three trials. Additionally, when probed for maintenance at four and six weeks post-intervention, James completed 100% of task analysis steps independently on both trials.

Caitlin

Caitlin had the second lowest and most stable baseline data and was entered into the intervention phase second, after James. She completed between 33% and 66% of task analysis steps (mean = 54%) independently during baseline probes. After two sessions of 0-second delay instructional trials, Caitlin completed 100% of task analysis steps independently with a 10-second time delay across the following three trials. Additionally, when probed for maintenance at three and four weeks post-intervention, Caitlin completed 100% of task analysis steps independently on both trials.

Derek

Because Derek's baseline data was the highest across the three participants, he was the final participant to enter the intervention phase. He completed between 50% and 66% of task analysis steps (mean = 61%) independently during baseline probes. After two sessions of 0-second delay instructional trials, Derek completed 100% of task analysis steps independently with a 10-second time delay across the following three trials. Additionally, when probed for maintenance at two and three weeks post-intervention, Derek completed 100% of task analysis steps independently on both trials.

It is noteworthy that each participant reached mastery criteria within the 10-second delay condition (i.e., completing at least 11 of 12 task analysis steps independently for three consecutive sessions) within their first three opportunities. The efficacy of constant time delay to teach map programming to young adults with IDD has also been demonstrated in other studies (e.g., Yuan et al., 2019); however, a unique outcome of the present study was that *all* participants experienced immediacy of effect and reached mastery criteria at the first opportunity (i.e., after three 10-second delay trials). Given the relative speed at which participants increased their map programming skills, constant time delay may be an appealing choice for practitioners who wish to implement efficient strategies to teach transition-related or travel skills to young adults with IDD.

Research Question 2: Apple Maps Generalization

A second purpose of the study was to measure the extent to which route programming steps generalized between the Google Maps and Apple Maps applications. Participants completed Apple Maps generalization probes once during baseline and a second time after reaching mastery criteria. Participants did not receive instruction or support in using Apple Maps at any point during this study.

Participants' generalization of map programming skills to use of Apple Maps varied. James completed 15% of Apple Maps task analysis steps on his first probe and 38% of steps on his second probe. Derek completed 53% of Apple Maps task analysis steps on his first probe and 85% of steps on his second probe. Caitlin remained consistent across both Apple Maps generalization probes, completing 38% of task analysis steps on the first and second probes. Although Caitlin did not increase the percent of Apple Maps steps completed across the two generalization probes, James and Derek both increased percent of steps completed between probe one and probe two. Because no training on use of Apple Maps occurred before the second probe, but instruction on Google Maps *had* been provided, it is reasonable to conclude that James and Derek may have generalized some of the Google Maps task analysis skills to use of Apple Maps.

Testing the setting/situational generalization of map programming skills between use of Google Maps and Apple Maps is a unique feature of this study. Setting/situational generalization occurs when an individual exhibits a trained target response (i.e., programming and following a map) under untrained stimulus conditions (i.e., the Apple Maps application) (Cooper et al., 2020). Other previous travel skill studies have investigated generalization to untrained routes (e.g., Kelley et al., 2013), but because each route used in this study was an untrained route, examining potential setting/situational generalization with use of Apple Maps is one way that the present study further extends the literature base. Setting/situational generalization is important in the context of pedestrian navigation because it is possible that navigation applications and technology may continue to update or change in appearance with time. Additionally, setting/situational generalization is important because an individual may prefer, or may only have access to, one navigation application over another.

Research Question 3: Problem-Solving Probes

In addition to the two Apple Maps generalization probes, participants also completed three problem-solving probes each after intervention sessions were complete. All three participants had increasing data trends across the three problem-solving probes, which makes sense because they had received multiple sessions of instruction related to using problem-solving strategies by the final trial. James scored lowest on problem-solving probe one (i.e., 20% of steps completed), but then increased to 40% of steps completed and 100% of steps completed across problem-solving probes two and three, respectively. Caitlin and Derek both completed several steps independently during problem-solving probe one; Caitlin completed 80% of steps and Derek completed 60% of steps. Both Caitlin and Derek increased to 100% of steps complete for problem solving probes two and three. The rapid skill gains experienced by the participants across only three sessions suggest that scenario-based instruction was effective in teaching participants to apply the problem-solving framework to three types of problems that may occur when following a Google Maps walking route.

The problem-solving probes in this study served as a mechanism to implement the behavior chain interruption strategy (BCIS; Cooper et al., 2020). Because programming and following a Google Maps walking route is a chained behavior consisting of many steps, interrupting the chain was critical to support participants in using map programming skills in real life, when it may not be possible to follow each trained step exactly as taught. Although previous studies have employed BCIS with transition-age individuals with disabilities (e.g., Duker et al., 1994), BCIS is not often used to teach transition-related skills (Carter & Grunsell, 2001). Further, this study is the first known travel skill study to implement BCIS, offering a meaningful contribution to the literature.

Research Question 4: Participant Social Validity

At the conclusion of the study, participants were interviewed about their opinions and perceptions regarding the intervention. Participants responded to semi-structured interview questions conducted in a one-on-one setting. Several themes emerged from participant interview responses, including *value of choice*, *intent to continue using Google Maps*, and *personal sense of success*. Participants expressed that they preferred choosing their walking destinations rather than having them assigned, and all participants also shared that they anticipate using Google Maps again in the future.

Participant choice and relevance were priorities within this study, and the semi-structured interview format encouraged participants to reflect and share about their experiences in depth. Conducing semi-structured social validity interviews was a unique contribution of this study, as most other travel skills studies report participant social validity through Likert-type scaled questions, with or without an open-ended question (e.g., Kearney et al., 2021; Kelley et al., 2013; McMahon et al., 2015); through informal participant comments (e.g., Davies et al., 2010); or do not report participant social validity at all (e.g., Yuan et al., 2019). The semi-structured interview format used in this study allowed for more detailed responses from each participant than a numeric Likert-type scale might yield. This is a unique and meaningful contribution to the literature base, as participant responses provided a deeper understanding of the study's true impact, beyond what the data points showed (e.g., "I loved using [Google Maps]. It gave me confidence.")

Research Question 5: Teacher and Job Coach Social Validity

At the conclusion of this study, the participants' special education teacher and job coach were surveyed about their opinions and perceptions regarding the intervention and general relevance of the study topic. Mr. Martin and Ms. Wright shared about the typical procedures for helping their transition-age students walk to unknown locations on campus, which include touring the campus as a group before the college students return and providing one-on-one support to students who need to walk somewhere new, often more than once. Mr. Martin and Ms.

Wright shared that this process is time-consuming and that if their students had more independence in finding new places, there would be time for more instruction on other transition-related activities, such as work-based learning and job experiences.

Most previous travel skill studies do not elicit social validity feedback from anyone except the study participants (e.g., Davies et al., 2010; Kearney et al., 2021; McMahon et al., 2015; Mechling & O'Brien, 2010). However, some research teams have used Likert-type questionnaires to survey undergraduate students who supported participants in skill development (Kelley et al., 2013), participants' parents (Batu et al., 2004), or the participants' teacher and teaching assistants (Mechling & Seid, 2011). Although valuable information can be gleaned from responses to Likert-type questionnaires, conducting social validity interviews with stakeholders who provide instruction and support to transition-aged individuals yields richer information about the study's perceived relevance. It is also important to understand whether practitioners – those who are most often tasked with teaching travel skills – view the intervention as feasible, relevant, and worthwhile. This study extends the literature base as it is the first known travel skills study to include semi-structured interviews of the participants *and* their teacher and job coach. Further, Mr. Martin and Ms. Wright reported satisfaction with the feasibility and relevance of the intervention.

Implications for Practice

Results of this study suggest that constant time delay may be an effective way to teach young adults with IDD to program and follow walking routes using Google Maps. These findings carry implications for practitioners, who may wish to implement similar interventions to support travel skill development with the individuals with whom they work. Young adults with disabilities who possess travel skills may be more successful following exit from high school

(Mazzotti et al., 2016), rendering travel skills an important topic for instruction at the secondary level. Below, several implications and considerations for practitioners who teach young adults with IDD are described.

Response Prompting to Teach Map Programming Skills

Previous studies have demonstrated that response prompts delivered by an implementer can support young adults with IDD in learning map programming skills (e.g., Kearney et al., 2021; Yuan et al., 2019). Response prompts involve the presentation of a cue that result in an individual exhibiting the correct response (Cooper et al., 2020). Kearney et al. (2021) implemented total task chaining with a system of least prompts, and Yuan et al. (2019) used constant time delay, as did the present study.

The present study reinforces previous findings that response prompting systems can be used to teach map programming skills to young adults with IDD. All three participants programmed and followed a Google Maps walking route with 100% accuracy after only two sessions of 0-second time delay instruction. Response prompting is an evidence-based practice that is frequently used to teach academic skills and some transition skills, such as grocery shopping skills (Rowe et al., 2021; Steinbrenner et al., 2020).The present study demonstrates the potential usefulness of response prompting to provide travel skills training, and practitioners who are already familiar with response prompting procedures may feel well-equipped to use it for this new skill area. Because response prompting is also free of cost and does not require any specific qualifications to implement (Otten et al., 2024), time delay could be a desirable strategy for practitioners who wish to effectively and efficiently teach travel skills to young adults with IDD.

Following a Programmed Map

This study included following the programmed map and reaching the final destination as components of the 12-step task analysis. Of the two similar studies in this area, one also included following the map as a task analysis step for mastery (Kearney et al., 2021) while the other did not (Yuan et al., 2019). Although Yuan et al. (2019) did not include following the map in their task analysis, the researchers probed this skill once per participant and found that the participants did not require additional instruction in order to follow the programmed map. Similarly, participants in Kearney et al. (2021)'s study were able to independently follow a programmed map as a component of the task analysis after two or fewer intervention sessions.

The results of the present study reinforce the findings of Yuan et al. (2019) and Kearney et al. (2021), as participants in this study did not require further training on following the programmed map beyond what was provided during the two 0-second delay instructional trials. This is important to note because following a programmed map includes other embedded skills, such as following cardinal directions and understanding how the graphic display of the map represents the real, physical environment. No participants across the current study or previously conducted 0-time delay studies (i.e., Kearney et al., 2021; Yuan et al., 2019) required additional instruction on following the programmed map, so it is possible some young adults with IDD could develop independent pedestrian navigation skills quickly if taught to use a maps application.

Format of Baseline Trials

Several previous studies in this area employed single-opportunity probes for baseline data collection (e.g., Price et al., 2017; Yuan et al., 2019). This meant that if participants made an error during any task analysis step during baseline probes, the trial was immediately terminated and all subsequent steps were marked as "incorrect" for that session (Alexander et al., 2015). The present study differs in that during baseline probes, participants had the opportunity to attempt each task analysis step, regardless of performance on previous steps. I chose this format because I wanted participants to contact natural reinforcement as often as possible (i.e., getting to walk to the destination they chose), and using single-opportunity probes would compromise this opportunity. For example, if a participant did not know what the Google Maps icon looked like, using single-opportunity probes would mean he or she would never have the chance to even touch the iPhone during the entire baseline phase. This could be particularly problematic and discouraging for individuals who are entered into the intervention phase in later tiers.

Additionally, allowing participants to attempt each task analysis step in baseline probes offered a more complete picture of participants' preexisting skills. For example, during baseline, Derek was able to complete a few of the map programming steps independently – and could even follow the map once it was programmed – but he did not know to select "walking" as the method of transportation when programming the map, so the application provided him driving directions each time that did not translate accurately to walking around campus. Because Derek had the opportunity to attempt each step during baseline probes, it was clear *prior* to beginning the intervention phase which steps he would need support with. This allowed me to provide only the prompting and instruction he needed during intervention probes, while he continued to complete the remainder of the task analysis steps independently. Practitioners who wish to teach travel skills to young adults with IDD should consider the benefits of conducting baseline probes in this manner. Allowing participants to attempt each step independently during baseline probes may increase efficiency of instruction in the intervention phase, as it is clear early in baseline how the participant performs on each step of the task and which steps may require additional instruction or support.

Availability and Acceptability of Smartphone Supports

Across the social validity data of other similar studies, participants have indicated that the Google Maps application is a discreet and nonstigmatizing support (e.g., Price et al., 2017). The social validity data collected in the present study also support this claim. In response to semi-structured interview questions, participants indicated that they planned to continue using Google Maps on their own devices in the future, and even hoped to use it in locations off-campus (e.g., a family trip). One participant showed me that he had downloaded the Google Maps application on his phone at the end of the study. Additionally, one participant indicated that "using the phone" was part of what made the sessions "fun." Because all participants in the present study reported already using smartphones for other activities (e.g., watching YouTube, playing games, texting and calling others), it is logical that using a smartphone for community navigation was acceptable and aligned well with their previous smartphone experiences. When possible, secondary educators and practitioners should consider using socially valid tools (e.g., smartphones) when providing transition skill instruction to support participant buy-in.

Although smartphones and internet connection are available to many young adults with IDD and their families, some individuals do not have access, which limits those who may benefit from this intervention (Yuan et al., 2019). Although all participants in this study had access to their own personal smartphones, the first author's phone was used for intervention to aid in consistency across participants. Practitioners may consider other technology tools (e.g., school- or agency-owned iPad with internet access) to broaden access and include individuals who may not own a personal smartphone.

Considerations for Safety

Development and use of safe travel skills was paramount in the planning and execution of this study. Previous travel skill studies involving participants with IDD have discussed many safety considerations, including supervision when crossing busy streets or traffic (Agri & Batu, 2004), proximity fading in unfamiliar locations or environments (Price et al., 2017), and the appropriateness (or inappropriateness) of certain types of prompts while walking (e.g., video prompts versus static picture prompts; Kelley et al., 2013). Based on these examples and considerations from previous studies, I built multiple safety measures into this study.

First, participants always walked with a research team member present and never walked a route alone. Although the research team member walked slightly behind the participant to minimize the potential for unintentional visual prompting, having a researcher present during each walk was beneficial for a) ensuring participant safety, b) providing prompts if needed, and c) increasing participant confidence and comfort. Second, during each walk, research team members reiterated the importance of using all identified crosswalks and crossing signals and walking only on sidewalks or paved walking paths. Research team members were careful to model all of these safety skills themselves during each walk as well. Third, research team members always followed the walking pace and preferences (e.g., walking up a ramp instead of climbing multiple flights of stairs) set by participants. Participants were encouraged to walk as slowly or quickly as they desired and felt comfortable with. Lastly, all sessions were held approximately one hour before the first university course time began. This meant that campus was generally quiet and not subject to very much vehicle or foot traffic during sessions.

Practitioners who wish to implement a similar intervention with other young adults with IDD may adopt some or all of the above safety measures. In the context of this study, these safety measures were effective for several reasons. First, participants seemed to view research team members as “teachers” or authority-type figures. Before walking sessions, the participants’ teacher would instruct them to “go work with Jess,” so participants knew that the walks were teacher-endorsed and that they were expected to behave safely. Second, as Mr. Martin shared in his social validity interview, his transition-age students are provided some instruction regarding basic campus navigation at the beginning of each school year. As the students routinely cross a major campus road to travel from their classroom to the dining hall, each participant was already familiar with how to operate a crossing signal and cross a street safely before the study began. Third, the participants’ transition program already requires that students have generally low rates of challenging behavior, follow verbal instructions, and have an effective system of communication. If any participant had displayed challenging behavior that could potentially compromise their safety when walking (e.g., elopement), additional safety measures and planning would have been necessary to implement this type of study.

Practitioners who wish to implement a similar intervention should consider a variety of safety measures based on specific student need. It is likely that some young adults with IDD would need pre-training on basic travel skills prior to being taught to program and follow a walking route that includes street-crossing or potential contact with vehicle traffic. Additionally, practitioners who work with populations that exhibit challenging or unpredictable behavior may consider teaching general community and traffic safety skills as a prerequisite to map programming and travel skill training. Rather than avoiding travel skills instruction due to safety concerns, secondary educators and practitioners can consider a number of options, including pre-teaching if necessary, to both support participant safety and maximize opportunities for independence.

Environmental and Weather Considerations

In addition to safety considerations, environmental and weather considerations also carry implications for teaching travel skills to young adults with IDD. Data collection for the present study occurred between late October and late January in the early mornings, meaning that the temperature was often very cold during sessions. Participants were reminded before each walk to grab an extra jacket or coat, and on days that were especially cold, I provided participants with estimates of how many minutes a route would take before they decided to program a map. Occasionally, participants chose to swap their selected destination for a shorter unknown route on cold mornings. Additionally, during December and January sessions, I provided gloves that participants could choose to wear (or not) during walking sessions. The gloves made one component of the task analysis challenging (i.e., "Step 12: participant clicks 'end route' or red button after reaching final location"). When participants chose to wear the gloves due to cold temperatures, they received credit for Step 12 if they attempted to tap the "end route" button, even if the touch screen did not respond due to the gloves.

Beyond cold temperatures, inclement weather also impacted the study. Two data collection days were rescheduled due to heavy rain. Although rain is an unavoidable factor in day-to-day commute and travel, I chose to reschedule in these instances to prioritize participants' comfort, safety, and overall experience. I did not want to request that any participant walk in heavy rain during the winter, especially because participation was voluntary and I could not ensure that participants brought appropriate rain gear to campus for rainy sessions.

Practitioners who wish to teach travel skills to young adults with IDD will face similar considerations regarding temperature and weather. Although this study was conducted during cold weather, teaching travel skills during very hot weather could also pose participant safety and comfort concerns. Additionally, practitioners serving areas that receive ice or snow would need to consider participant comfort and safety when teaching travel skills. Although the weather is not controllable, practitioners can consider time of year, weather trends, and additional supports (e.g., gloves) when planning for travel skills instruction that occurs outdoors. Practitioners could include a “problem-solving probe” regarding inclement weather and could provide instruction on how the task analysis steps might look different if there is heavy rain or other poor weather. Providing travel skills instruction during various times of year and in differing weather conditions is one way that secondary transition educators and practitioners can help young adults with disabilities generalize these skills and use them more successfully within their daily lives.

Conclusion

Because young adults with IDD experience lower rates of community engagement than their peers without disabilities, it is important for secondary educators and practitioners to provide instruction related to travel skills. Results of this study suggest that constant time delay can be an effective strategy for teaching young adults with IDD to program and follow a Google Maps walking route to an unfamiliar location of interest on a college campus. Further, participants demonstrated some potential generalization to use of an untrained navigation application (i.e., Apple Maps) and were able to develop problem-solving skills related to use of Google Maps following scenario-based instruction. Finally, participants and their special education teacher and job coach expressed that the intervention was socially valid and that learning to navigate independently increased participants’ confidence and personal sense of success. By providing travel skills instruction, practitioners can support young adults with IDD in developing increased levels of community engagement, becoming more independent in navigating the community, and experiencing a higher quality of adult life and increased opportunities for self-determination.

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APPENDIX A

UNIVERSITY OF NORTH CAROLINA
CHARLOTTE

Department of Special Education and Child Development
9201 University City Boulevard, Charlotte, NC 28223-0001

Consent to be Part of a Research Study

Title of the Project: Teaching Use of Google Maps to Young Adults with Intellectual and Developmental Disabilities
Principal Investigator: Jessica Rousey, M.A.T., Doctoral Candidate, Department of Special Education and Child Development, UNC Charlotte
Faculty Advisor: Leslie Bross, PhD
Co-investigators: Brianna Soares, M.Ed., Department of Special Education and Child Development, UNC Charlotte; Valerie Mazzotti, PhD, University of Kansas

Your child is invited to participate in a research study. Participation in this research study is voluntary. The information provided is to help you decide whether or not to participate. If you have any questions, please ask the principal investigator.

Important Information You Need to Know:

- The purpose of this study is to teach transition-age youth with disabilities to walk to new locations of interest on the UNC Charlotte campus using the Google Maps application.
- If your child chooses to participate, he/she/they will be asked to participate in a minimum of 11 instructional sessions about how to use Google Maps. The maximum number of sessions dependent on student data is approximately 17. He/she/they will also be asked to use Google Maps to walk to a desired location on UNC Charlotte's campus within a one-mile radius of the starting point.
- If your child chooses to participate, each session will require approximately 30 min of his/her/their time.
- Potential risks or discomforts from this research include experiencing challenges while navigating the campus. These risks or discomforts will be alleviated by support provided by research staff.
- Benefits may include learning how to use Google Maps to walk to new locations around UNC Charlotte's campus, visiting different locations, and becoming more independent.
- If your child chooses not to participate, they may still participate in regular community-based instruction and activities through your program or organization.

Please read this form and ask any questions you may have before your child decides whether to participate in this research study.

Why are we doing this study?

The purpose of this study is to teach transition-age youth with disabilities to walk to new, unfamiliar locations on a college campus using the Google Maps application. The intent is for participants to develop useful skills that could lead to increased independence in safely navigating the community.

Why is your child being asked to be in this research study?
Your child is being asked to be in this study because they are a transition-age youth between the ages of 18 and 22 with a documented disability who participates in a program or organization that conducts community-based activities.

What will happen if my child takes part in this study?
If your child is interested in participating, the research team will first obtain permission and consent from the parent/legal guardian of each potential participant. Then, the research team will obtain student consent/assent, and the student and parent/guardian will complete a liability waiver.

If your child chooses to participate, he/she/they will attend a minimum of 11 sessions in which we teach them to use Google Maps and observe them setting up a walking route on the application and using it to walk to a campus location. Each session will last approximately 30 minutes for 2 or 3 times per week for approximately 6-8 weeks.

Some things he/she/they will be asked to do include: 1) choose locations around campus where you would like to walk to, 2) participate in instruction sessions to learn to use Google Maps, 3) use Google Maps to walk to locations on campus, and 4) complete a brief interview to share their thoughts about using Google Maps before and after the study.

We will collect information only about your child's use of the Google Maps application and pedestrian navigation skill acquisition.

What benefits might my child experience?
Benefits may include learning how to use Google Maps to walk to new locations around UNC Charlotte's campus, visiting different locations, and becoming more independent.

What risks might my child experience?
Potential risks or discomforts from this research include experiencing challenges while navigating the community, such as getting lost, feeling frustrated while using the application, and/or visiting new locations on the UNC Charlotte campus that are unfamiliar to your child. These risks or discomforts will be alleviated by support provided by research staff. Specifically, **your child will never be alone** in the community during the behavioral observation sessions. Your child will always be supervised by research staff while in the community.

All research involves a chance that something bad might happen to you. This may include the risk of personal injury. In spite of all safety measures, your child might develop a reaction or injury from being in this study. If such problems occur, the researchers will help you get medical care, but any costs for the medical care will be billed to you and/or your insurance company. UNC Charlotte has not set aside funds to pay you for any such reactions or injuries, or for the related medical care. You do not give up any of your legal rights by signing this form.

How will my child's information be protected?
We plan to publish the results of this study. To protect your child's privacy, we will not include any information that could identify you or your child. We will protect the confidentiality of the research data by not using your child's name on any paper data collection forms and storing all data collected in locked filing cabinets in the primary researcher's office.

Other people may need to see the information we collect about you. These people may include members of the research team, other people who work for UNC Charlotte, the partnering program/organization, or other agencies as required by law or allowed by federal regulations.

How will my child's information be used after the study is over?
After this study is complete, data collected about your use of the Google Maps application will be stored in Dr. Leslie Bross's locked office file cabinet and/or password-protected computer for up to one year. All of the data will be de-identified. No information or data about your child will be shared without additional informed consent.

Will my child receive an incentive for taking part in this study?
Your child will not receive any financial incentive for taking part in this study.

What are my child's rights if they take part in this study?
It is up to you and your child to decide to be in this research study. Participating in this study is voluntary. Even if your child decides to be part of the study now, he/she/they may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

Who can answer my questions about this study and my child's rights as a participant?
For questions about this research, you may contact Jessica Rousey at jrousey@charlotte.edu.

If you have questions about your child's rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Office of Research Protections and Integrity at 704-687-1871 or uncc-irb@charlotte.edu.

By signing this document, you are agreeing for your child to be in this study. Make sure you understand what the study is about before you sign. You will receive a copy of this document for your records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

Parent or Legally Authorized Representative Consent
By signing this document, you are agreeing to [your child's **OR** the person's named below] participation in this study. Make sure you understand what the study is about before you sign. You will receive a copy of this document for your records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.
I understand what the study is about and my questions so far have been answered. I agree for [my child OR the person named below] to take part in this study.

____
Participant Name (PRINT)

____
Parent/Legally Authorized Representative Name and Relationship to Participant (PRINT)

____
Parent/Legally Authorized Representative Signature Date

Assent Form
Google Maps Pedestrian Skill Study

"I am interested in helping young adults with disabilities travel to more locations within their communities. I am conducting a research study to do this. If you choose to participate in this research study, activities will include using the Google Maps application to walk to locations on the UNC Charlotte campus. These locations may be dining facilities, academic buildings, campus bus stops, athletic facilities, or other places based on your own interests. I or other research staff will conduct a maximum of 17 sessions in which we teach you to use Google Maps and observe you setting up a walking route on the application and using it to walk to a campus location. Each session will last approximately 30 minutes for 2 or 3 times per week. Some things you will be asked to do include: 1) choose locations around campus where you would like to walk to, 2) participate in instruction sessions to learn to use Google Maps, 3) use Google Maps to walk to locations on campus, and 4) complete a short interview to share about your experiences. You will never be alone on campus when you walk to new locations. Research staff will be with you at all times to offer assistance if needed.

This is a voluntary research study, so you can choose to participate or not. You can also decide to stop participating at any time. I am happy to answer any questions you may have now or any time we are working together. Do you have any questions about the research study?

Do you want to take part in this research study?"

<u>Assent to Participate</u>

I understand what the study is about and my questions so far have been answered. I agree to take part in this study. By signing below, I affirm that I have participated in the assent process.

____
Participant Name (PRINT)

____
Signature Date

____
Name and Signature of person obtaining assent Date

**LIABILITY WAIVER, ASSUMPTION OF THE RISK,
AND INDEMNIFICATION AGREEMENT
FOR UNC CHARLOTTE PROGRAM**

In consideration for being allowed by UNC Charlotte to participate in the Google Maps Pedestrian Skill Study (hereinafter "Program") the undersigned agrees as follows:

I do hereby affirm and acknowledge that I am participating in the Program for my own personal benefit, and have been fully informed of the inherent hazards and risks associated with using Google Maps to navigate UNC Charlotte's campus while being followed by a member of the research team. Such hazards and risks may include, but are not limited to: property damage or loss, slips, trips, falls, sprains, breaks, cuts, bruising, head injuries, accidents, getting lost, emotional discomfort, serious injury, permanent disability, death, and other personal injuries. I ACCEPT AND ASSUME ALL RISKS arising out of participating in the Program, known and unknown, involving me and my property in the aforementioned activity. I am voluntarily participating in the Program in reliance upon my own judgment and knowledge of my own experience and capabilities.

I understand that a determination of my ability to participate in the Program should be made by a physician, if necessary. I understand that I am advised to obtain the approval of a physician if I am uncertain as to my physical fitness for the Program. I represent and warrant that to the best of my knowledge and belief, I am physically and mentally able to participate in the Program. If during my participation in the Program, I need emergency medical treatment and I or my parent or legal guardian is unable to give consent for or make arrangements for that treatment, I authorize University employees to take whatever measures are necessary to protect my health and well-being, including, if necessary, hospitalization. I understand that I am encouraged seek approval from a physician if there is a health or safety concern that would reasonably be expected to affect my ability to participate in the Program. I further understand that treatment for any medical problems I may suffer is my responsibility and will be paid by me and/or covered by my insurance.

To the maximum extent permitted by law, I release, indemnify, and hold harmless UNC Charlotte, its trustees, officers, employees and agents from any and all liability, losses, costs, damages, claims or causes of action of any kind or nature whatsoever, and expenses, including attorney's fees, arising from or proximately caused by my participation in this Program, including claims for negligence, mistake, injury, property damage or loss, emotional discomfort or harm, permanent disability, or wrongful death. I further agree to accept and assume for myself, my assigns, executors, and heirs any and all such risks and losses that may occur.

I understand that this is a legal document and is binding on me, my heirs and assigns and those who may claim by or through me. I certify that I have had an adequate opportunity to read and understand this document and ask questions about it. I certify that any questions I had were answered to my satisfaction.

I HAVE READ THIS AGREEMENT, I UNDERSTAND IT AND I AGREE TO BE BOUND BY IT.

If you are your own legal guardian please sign (1a) and print your name (1b).
If a parent or other person is your legal guardian, please have them sign (2a) and print (2b) their name.

(1a) Signature of *Young Adult Participant:* ____ Date: ___________

By signing this agreement, I certify that I (a) am at least eighteen years old, (b) have read and understood the foregoing Liability Waiver, Assumption of Risk, and Indemnification Agreement, (c) have full capacity to enter into this agreement and (d) agree to be bound by the terms of this agreement.

(1b) Printed Name of Young Adult Participant: ____

By signing this agreement, I certify that I (a) am the parent or legal guardian of the above Young Adult Participant, (b) have read and understand the foregoing Liability Waiver, Assumption of Risk, and Indemnification Agreement (c) currently am and will be legally responsible for the obligations and acts of the Young Adult Participant as described in this agreement, and (d) agree, for myself and for the Young Adult Participant, to be bound by the terms of this agreement.

(2a) Signature of *Parent/Guardian:* ____ Date: ___________

(2b) Printed Name of Parent/Guardian: ____ Date: ___________

APPENDIX B

Location Name	Location Address	What is it?
Smart Market – Robinson Hall	9027 Mary Alexander Rd.	Dining
Smart Market – Storrs	9115 Mary Alexander Rd.	Coffee
Rowe Building	9119 University Rd.	Vending (1 beverage, 1 snack)
South Village Crossing	8917 Johnson Alumni Way	Dining
Belk Gymnasium	8911 University Rd.	Gym, aquatics center
Halton-Wagner Tennis Complex		Tennis facilities
King Building	9037 University Rd.	Employment offices
Reese Building	9035 University Rd.	Employment offices
UNC Charlotte Main Station	9025 Cameron Blvd.	Light rail stop
UNC Charlotte Botanical Gardens	9090 Craver Rd.	Scenic location
UNC Charlotte Student Health Center	9530 Poplar Terrace Dr.	
Black Box Theater	9027 Mary Alexander Rd.	Music/drama venue
Belk Plaza		Outdoor courtyard
Halton Arena	9201 University City Blvd.	UNC Charlotte Basketball arena
Brocker Pond	8918 University Rd.	Scenic location
Aurum Café	9029 Craver Rd.	Dining

APPENDIX C
Data Sheets for Baseline and Intervention Phases

Pseudonym: ___________ Observer #1: _____________
Date/Condition: _______________ Observer #2: _____________

Google Maps Study – Data Collection Sheet (Baseline)			
Task Analysis Step	**Notes**		
1. Participant scrolls to home screen where Google Maps app is located.	Independent	Researcher performs step	
2. Participant taps the Google Maps app to open.	Independent	Researcher performs step	
3. Participant locates and presses the search bar in Google Maps.	Independent	Researcher performs step	
4. Participant types the destination name in the search bar.	Independent	Researcher performs step	
5. Participant confirms the address in one of two ways: • Selects destination in current city • If there are two locations sharing the same name, participant confirms the correct address on the back of the location card.	Independent	Researcher performs step	
6. Participant clicks on the blue directions button to begin route.	Independent	Researcher performs step	
7. Participant presses the walking icon.	Independent	Researcher performs step	
8. Participant clicks the blue start button.	Independent	Researcher performs step	
9. Participant starts walking and begins following the programmed route.	Independent	N/A	
10. Participant follows each step in the walking directions.	Independent	N/A	
11. Participant reaches final location.	Independent	N/A	
12. Participant clicks "end route" or red button after reaching final location.	Independent	Researcher performs step	

*Percentage of steps performed **independently**:* __________ *IOA:* ___________

Pseudonym: ___________
Date/Condition: _______________

Observer #1: _____________
Observer #2: _____________

Google Maps Study – Data Collection Sheet (Intervention)					
Task Analysis Step	**Prompting Required?**				**Notes**
1. Participant scrolls to home screen where Google Maps app is located.	Independent	Verbal prompt	Physical model	Researcher performs step	
2. Participant taps the Google Maps app to open.	Independent	Verbal prompt	Physical model	Researcher performs step	
3. Participant locates and presses the search bar in Google Maps.	Independent	Verbal prompt	Physical model	Researcher performs step	
4. Participant types the destination name in the search bar.	Independent	Verbal prompt	Physical model	Researcher performs step	
5. Participant confirms the address in one of two ways: • Selects destination in current city • If there are two locations sharing the same name, participant confirms the correct address on the back of the location card.	Independent	Verbal prompt	Physical model	Researcher performs step	
6. Participant clicks on the blue directions button to begin route.	Independent	Verbal prompt	Physical model	Researcher performs step	
7. Participant presses the walking icon.	Independent	Verbal prompt	Physical model	Researcher performs step	
8. Participant clicks the blue start button.	Independent	Verbal prompt	Physical model	Researcher performs step	
9. Participant starts walking and begins following the programmed route.	Independent	Verbal prompt	N/A	N/A	
10. Participant follows each step in the walking directions.	Independent	Verbal prompt	N/A	N/A	
11. Participant reaches final location.	Independent	Verbal prompt	N/A	N/A	
12. Participant clicks "end route" or red button after reaching final location.	Independent	Verbal prompt	Physical model	Researcher performs step	

*Percentage of steps performed **independently**:* __________

IOA: ___________

APPENDIX D
Procedural Fidelity Data Sheets

Pseudonym: ___________ Observer #1: _____________
Date/Condition: _______________ Observer #2: _____________

Google Maps Study – Procedural Fidelity Checklist (BASELINE)			
Researcher Step	**Yes**	**No**	**Notes**
1. Implementer asks participant to shuffle deck of location cards.			
2. Implementer asks participant to randomly choose three location cards from the deck.			
3. Implementer asks participant if they have ever been to any of these locations. If "yes," implementer asks participant to choose a new card or cards randomly from the deck.			
4. Implementer asks participant to choose the one location they would most like to visit.			
5. Implementer provides verbal directive "use Google Maps to find the way to walk there."			
6. Implementer starts 10 s timer.			
7. Implementer turns away to complete any step the participant cannot complete within 10 s.			
8. Implementer ends session if/when participant makes a wrong turn when following Google Maps directions.			
9. Implementer does not provide any additional prompting or feedback to support participant in using Google Maps.			

Total implementer steps completed: ____ / 9

Pseudonym: ___________ Observer #1: _____________
Date/Condition: _______________ Observer #2: _____________

Google Maps Study – Procedural Fidelity Checklist (0-second Delay Teaching Trials)			
Researcher Step	**Yes**	**No**	**Notes**
1. Implementer asks participant to shuffle deck of location cards.			
2. Implementer asks participant to randomly choose three location cards from the deck.			
3. Implementer asks participant if they have ever been to any of these locations. If "yes," implementer asks participant to choose a new card or cards randomly from the deck.			
4. Implementer asks participant to choose the one location they would most like to visit.			
5. Implementer provides verbal directive "let's use Google Maps to find the way to walk there."			
6. Implementer places task analysis within view of the participant.			
7. Implementer simultaneously provides **verbal instruction** (e.g., "find Google Maps on the home screen) and **controlling prompt** (e.g., points to app on home screen) for each step of task analysis.			
8. After route is programmed, implementer walks behind participant and provides prompts if participant makes a wrong turn.			
9. Implementer tallies number of prompts required to reach destination.			
10. After reaching destination, researcher provides verbal praise and accompanies participant back to COED.			

Total implementer steps completed: ____ / 10

Pseudonym: ___________ Observer #1: _____________
Date/Condition: _______________ Observer #2: _____________

Google Maps Study – Procedural Fidelity Checklist (Intervention, 10-second Delay)			
Researcher Step	**Yes**	**No**	**Notes**
1. Implementer asks participant to shuffle deck of location cards.			
2. Implementer asks participant to randomly choose three location cards from the deck.			
3. Implementer asks participant if they have ever been to any of these locations. If "yes," implementer asks participant to choose a new card or cards randomly from the deck.			
4. Implementer asks participant to choose the one location they would most like to visit.			
5. Implementer provides verbal directive "let's use Google Maps to find the way to walk there."			
6. Implementer places task analysis within view of the participant.			
7. Implementer waits 10 s for participant to complete each step independently before providing **controlling prompt** (e.g., points to app on home screen) for each step of task analysis.			
8. If participant does not respond within 10 s for any step, researcher provides controlling prompt (e.g., verbal prompt, physical model) so participant can complete step.			
9. After route is programmed, implementer walks behind participant and provides prompts if participant makes a wrong turn.			
10. Implementer tallies number of prompts required to reach final destination.			
11. After reaching final location, researcher provides verbal praise and accompanies participant back to COED.			

Total implementer steps completed: ____ / 11

APPENDIX E
Google Maps Task Analysis
Originally adapted from Yuan et al. (2019)

1. Participant scrolls to home screen where Google Maps app is located.
2. Participant taps the Google Maps app to open.
3. Participant locates and presses the search bar in Google Maps.
4. Participant types the destination name in the search bar.
5. Participant confirms the address in one of two ways: • Selects destination in current city • If there are two locations sharing the same name, participant confirms the correct address on the back of the location card.
6. Participant clicks on the blue directions button to begin route.
7. Participant presses the walking icon.
8. Participant clicks the blue start button.
9. Participant starts walking and begins following the programmed route.
10. Participant follows each step in the walking directions.
11. Participant reaches final location.
12. Participant clicks "end route" or red button after reaching final location.

Note. This task analysis was adapted from Yuan et al. (2019)'s six-step task analysis for programming a Google Maps walking route:

Yuan, C., Balint-Langel, K., & Hua, Y. (2019). Effects of constant time delay on route planning using Google Maps for young adults with intellectual and developmental disabilities. *Education and Training in Autism and Developmental Disabilities*, *54*(3), 215–224.

APPENDIX F
Semi-Structured Interview Questions

The following questions are the open-ended interview questions that were asked to participants and their teachers following the conclusion of the study. Respondents could skip any question and could ask for clarification or for a question to be re-worded.

During semi-structured participant interviews, two recorders from the research team were present. There was not audio recording, but research team members both transcribed participant responses as participants shared.

Participant Questions

1. Tell us about your experiences using Google Maps.
    a. Was it fun?
    b. Was it easy or difficult?
2. Which types of places were your favorite to walk to (dining hall? Sports complex?) and why?
3. If we were going to use Google Maps again, would you change anything or keep it the same?
4. Do you think knowing how to use Google Maps will be helpful in your life? Why or why not?
5. Do you feel like you are better at finding new places now than before you started using Google Maps?
6. Did you enjoy choosing which location to walk or would you have preferred if someone else picked for you?
7. Do you feel like you were successful in learning to use Google Maps? Why or why not?

Teacher and Job Coach Questions

1. How do your students typically locate new or unknown places on campus?
2. Please describe the process you use for orienting students to campus.
3. How would your day-to-day responsibilities look different if students were able to find new places independently?
4. How do you think students' live would be different if they were able to find new places independently?

APPENDIX G
Problem-Solving Probe Data Sheet

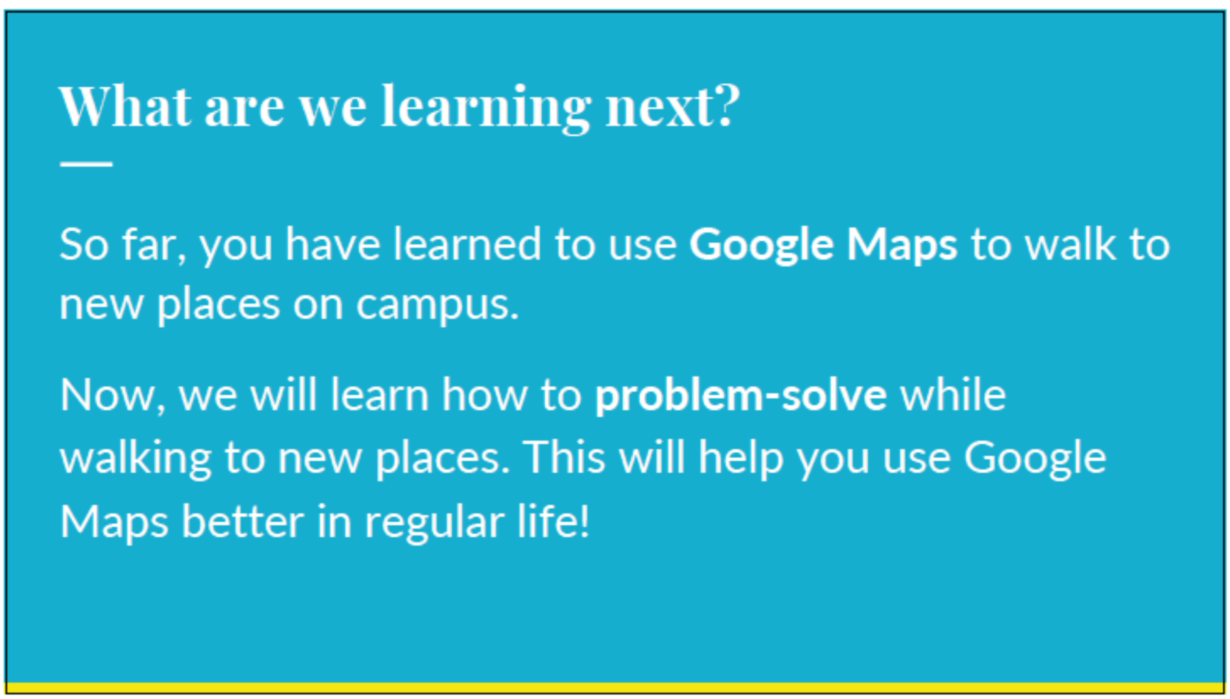
Google Maps Problem Solving Probes		
Step	**+ / -**	**Notes (Prompting, etc.)**
1. Young adult independently programs map to correct location.	+ -	
2. Young adult attempts at least 1 "**try by myself**" strategy.	+ -	
3. Young adult attempts at least 1 "**ask for help**" strategy if they cannot resolve the issue alone. *(If problem resolved in step 2, mark + here.)*	+ -	
4. Young adult **walks back to classroom** if they cannot resolve the issue alone or with help. *(If problem resolved in step 2 or 3, mark + here.)*	+ -	
5. Young adult overcomes problem to reach final destination?	+ -	

Total: ____/5

APPENDIX H

Problem-Solving Probe Scenario-Based Instruction Slides

1



2

How will we solve problems?

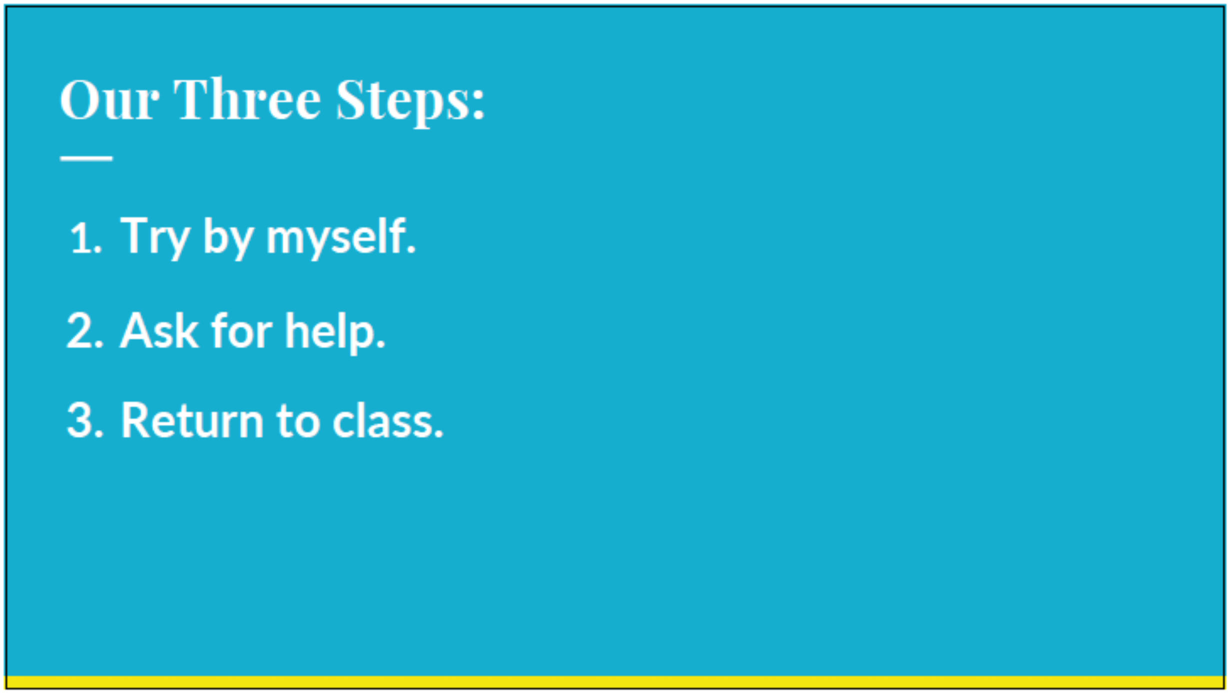
1 Try by myself.	2 Ask for help.	3 Return to class.
First, **try solving the problem yourself.**	If you can't solve the problem yourself, **ask for help.**	If you can't solve the problem yourself or with help, **return to the classroom.**

3

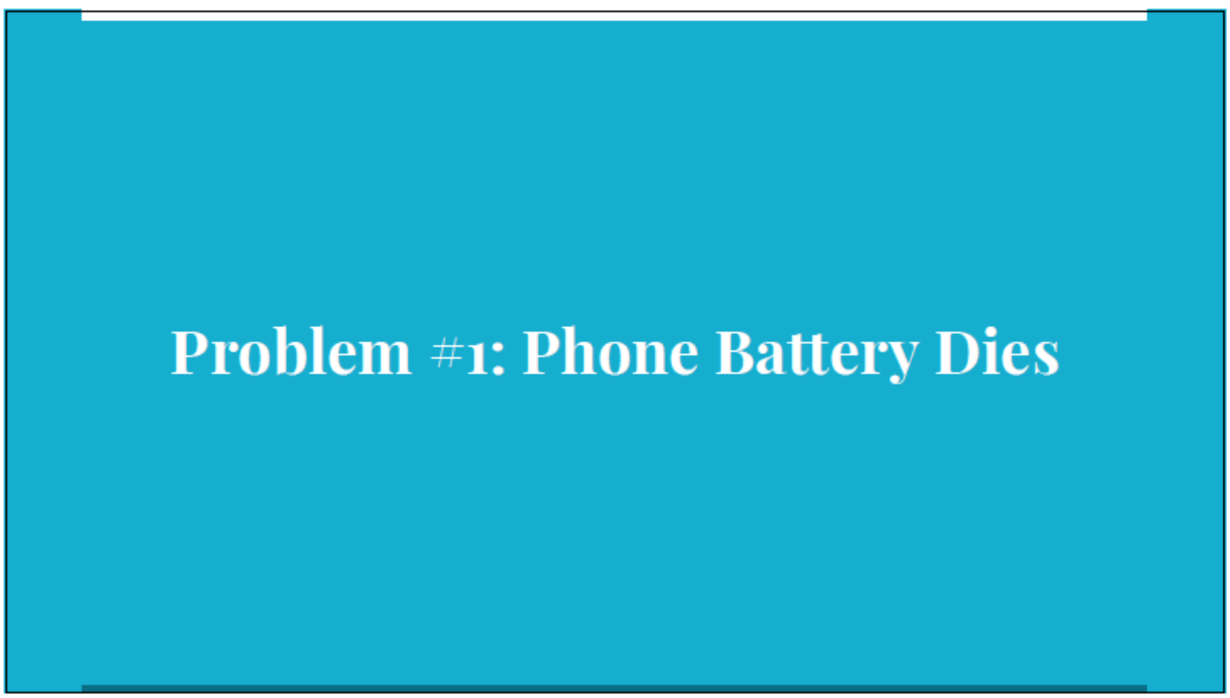
What problems will we learn to solve?

1. Your **phone battery dies** while walking
2. You have to walk around a **construction zone**
3. You need to start a route from an **unknown place**

4


Our Three Steps:
1. Try by myself.
2. Ask for help.
3. Return to class.

5


Problem #1: Phone Battery Dies

6

Problem #1:

Oh no! You're walking from the **Student Union** to the **Botanical Gardens** and your **phone battery dies.**

Let's think through our 3 steps:

1. Try by myself
2. Ask for help
3. Return to class

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Step 1: Try by myself

- Read nearby **campus signs** to look for your destination name with an arrow.
- Look around to see if you can **see your destination.**
- Look for a **campus map**.

8

Step 2: Ask for help

- Look for a **student or employee** walking nearby.
- Walk over to the person and ask, "**do you know where <u>the botanical garden</u> is?**"
- If the person gives directions, say "thank you" and follow their directions.
- If the person cannot help, ask another person.

9

Step 3: Return to Class

After you **try by yourself** and **ask for help**, you can **<u>return to class</u>** if you still cannot find your desired location.

Walk back to the classroom and ask ________ ________ for help.

10

Review - Phone Battery Dies

True or false?

1. If your phone dies, you should **try by yourself first**.

2. If you can't solve the problem yourself, you can **ask for help.**

3. If your phone dies, you should go **back to the classroom** without trying by yourself.

11

Let's practice!

Please make a map to **Lynch Hall**. We will start walking, but our phone battery will die along the way.

You will use our **3 steps** to solve the problem:

1. Try by myself.
2. Ask for help.
3. Return to class.

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Problem #2: Construction Zone

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Problem #2:

You're walking from the **Student Union** to the **Union Deck** and you see a **construction zone.** The sidewalk is closed and you can't follow the route on your map.

Let's think through our 3 steps:

1. Try by myself
2. Ask for help
3. Return to class

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Step 1: Try by myself

- Walk around the construction zone safely.
- Look at your **new route** on Google Maps. It will update by itself.
- Follow your new route to reach your destination.

15

Step 2: Ask for help

- Look for a **student or employee** walking nearby.
- Walk over to the person and ask, "**do you know where the Union Deck is?**"
- If the person gives directions, say "thank you" and follow their directions.
- If the person cannot help, ask another person.

16

Step 3: Return to Class

After you **try by yourself** and **ask for help**, you can **return to class** if you still cannot find your desired location.

Walk back to the classroom and ask [redacted] for help.

17

Review - Construction Zone

True or false?

1. When you walk around a construction zone, Google Maps will reroute to help you **try by yourself.**
2. If you can't navigate the construction zone yourself, you can **ask for help.**
3. If you see a construction zone, you should **return to class** right away.

18

Let's practice!

Please make a map to **the Student Union**. We will start walking there, but we will run into a construction zone.

You will use our **3 steps** to solve the problem:

1. Try by myself.
2. Ask for help.
3. Return to class.

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Problem #3: Unknown Start Point

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Problem #3:

You take the bus to **South Village Crossing** for lunch, but will need to walk back to the **College of Education** independently. You don't know your way around South Village very well.

Let's think through our 3 steps:

1. Try by myself
2. Ask for help
3. Return to class

21

Step 1: Try by myself

- Even though you aren't sure where you are, you can still make a **Google Map** to find the way back!
- Use the Google Maps app to make a walking route to your desired destination.
- Look for familiar buildings or signs that you recognize.

22

Step 2: Ask for help

- Look for a **student or employee** walking nearby.
- Walk over to the person and ask, "**do you know how to get to the College of Education from here?**"
- If the person gives directions, say "thank you" and follow their directions.
- If the person cannot help, ask another person.

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Step 3: Return to Class

After you **try by yourself** and **ask for help**, you can ask [redacted] for help returning to class.

Use your phone to call or text [redacted] to ask for help.

24

Review - Unknown Start Point

True or false?

1. Even if you don't know your starting location, you can still use Google Maps to **try by yourself.**
2. If you can't navigate the route yourself, you can **ask for help.**
3. If you don't know where you are, you can ask [redacted] to help you **return to class.**

25

Let's practice!

We will start walking around campus and **stop** at an unfamiliar point. You will then find your way back to the **College of Education**.

You will use our **3 steps** to solve the problem:

1. Try by myself.
2. Ask for help.
3. Return to class.