A Survey of Assistive Technology in Cognitive Rehabilitation

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Dedication

This thesis is dedicated to
my mother, Lynn Marie Jorgenson,
and my husband, Jeffrey Bryant Niccum Speaks.

Abstract

In 2003, Hart, O'Neil-Pirozzi, and Morita surveyed clinicians on their experiences training clients with acquired brain injury (ABI) to use assistive technology for cognition (ATC). Their clinicians reported limited experience and low confidence with ATC. Clinicians expected common barriers to ATC use would be high cost and low client ability to learn. Clients at that time reported using primarily paper-based aids, although electronic aids were rated as more effective by users with brain injury (Evans et al. 2003). The ATC efficacy literature, instructional resources, available technology, and public familiarity with ABI and ATC have burgeoned in the past decade, warranting an updated and expanded report of clinician ATC experiences.

In the current study, 88 speech language pathologists (SLPs) completed a survey about their experiences training individuals with ABI to use ATC. SLPs were the primary providers of ATC services and described a variety of instruction methods for clients with both mild and severe deficits. Most clinicians provided ATC interventions for memory, organization, and planning using smartphones and other portable technology. About half of clinicians reported the amount of services they were able to provide for ATC were adequate, although total treatment time for most clients was less than seven hours. In contrast to clinicians from Hart's survey, clinicians in the current study did not report cost as a primary barrier to ATC services or success. Clinicians did not overwhelmingly agree on any specific barriers that limit their clients' access to services or success with devices, although about half reported they were not able to instruct in a natural setting and clients do not use their devices with consistency.

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Introduction

Individuals use several cognitive skills to complete their tasks of daily living. One or more of these skills might be impaired when an individual receives an acquired brain injury (ABI). ABI is a general term for brain injuries that are not developmental. Many individuals with ABI receive cognitive rehabilitation that includes assistive technology for cognition (ATC). ATC includes hundreds of devices such as pagers, smartphones, voice recorders, and alarm watches. Individuals with ABI are often trained by rehabilitation professionals (such as occupational therapists and speech-language pathologists) to use these devices effectively. Many individuals with ABI learn to incorporate their ATC device into daily life, ultimately lessening the effects of their injury and enhancing their independence. Inevitably, some individuals with ABI are not successful and abandon their devices after rehabilitation services end. Several studies have demonstrated positive effects after interventions with ATC (De Joode et al., 2010; Gillespie, Best, & O'Neill, 2012). Significantly less research is available on how ATC services are and should be provided outside the research paradigm. The most recent survey of clinicians' ATC experiences is now a decade old: Hart, O'Neil-Pirozzi, and Morita, 2003. The present study surveys clinicians' ATC experiences, including: devices, intervention targets, instructors, instruction methods, dosage, outcomes, and barriers.

ATC and its potential benefits for individuals with ABI will be defined. Common cognitive interventions and those identified as having good potential by clinicians in Hart et al.'s 2003 survey will be discussed. The most common ATC devices, including those popular among Hart's sample, will be described. A synthesis of the literature

will summarize ATC training variables, including trainer, instruction methods, and treatment dosage. Finally, outcomes for clients and barriers to ATC success will be described.

Acquired Brain Injury

ABI is an umbrella term for several types of injury with a variety of causes. Traumatic brain injury (TBI) is caused by traumatic forces acting on the brain. Those forces are created by objects hitting the head, by the head hitting a stationary object with speed (such as a steering wheel or sidewalk), or when the head undergoes rapid acceleration/deceleration (such as during an automobile accident) (Murray & Clark, 2006). TBI has been called the hallmark injury of the wars in Iraq and Afghanistan fought this past decade (Department of Veterans Affairs, 2010). Many ABIs are the result of internal mechanisms. Injury might result from reduced cerebral blood flow (such as during an ischemic stroke), bleeding on the brain (such as during a hemorrhagic stroke), or reduced oxygenation of the blood (hypoxia/anoxia, such as during drowning). Additionally, tumors (neoplasms) can exert pressure on neighboring cerebral structures. The extent of damage depends on the tumor's size, location, and rapidity of growth. Surgical excision of a tumor might cause additional cerebral damage (Murray & Clark, 2006). Brain injury might also result from disease or infection, including septicemia, multiple sclerosis, encephalitis, and meningitis. The mechanisms of damage are specific to each disease. For example, multiple sclerosis causes the destruction of white matter. Several neurotoxins may affect a developing or developed brain. Neurotoxicity may occur during drug abuse, exposure to toxins, or the administration of some

life-saving medical treatments (Murray & Clark, 2006). Dementia is the chronic and progressive loss of memory and other mental abilities and is characterized by localized or generalized neuropathology and cerebral atrophy. There are more than 50 types of dementia including Alzheimer's Disease, frontotemporal dementia, Pick's Disease, and Huntington's Disease (Murray & Clark, 2006). ABI is a large category of neurogenic disorders that includes: traumatic brain injury, stroke, aneurysm, hypoxia/anoxia, tumors, toxicity, multiple sclerosis, septicemia, meningitis, encephalitis, dementia, and others.

Assistive Technology for Cognition after ABI

The consequences of ABI include impaired cognitive skills in one or more areas. These deficits may cause an individual to be less successful in their daily activities. These daily activities may include remembering to go to an appointment on time or remaining attentive to routine tasks, such as dressing, long enough to complete them. The risks associated with cognitive impairment are often managed through containment of an individual in a safe setting, medications, direct verbal cues and supervision by caregivers, and barriers to unsafe tasks, e.g. the electricity to the oven is shut off in an assisted living apartment (Gillespie, Best, & O'Neill, 2012). With the cost of professional caregiving on the rise, extending an individual's independence through ATC might increase the efficiency of care (LoPresti, Mihailidis, & Kirsch, 2004). ATC includes hundreds of items such as alarm clocks, smartphones, global positioning systems (GPS), and pagers to help individuals compensate for a variety of cognitive deficits.

ATC supports cognitive skills across several areas of impairment. The World Health Organization's (WHO) International Classification of Functioning,

Disability, and Health (ICF) identified eleven specific mental functions: attention, memory, psychomotor functions, emotional functions, perceptual functions, thought functions, mental functions of language, calculation, sequencing complex movements, experience of self and time functions, and higher-level cognitive functions (executive functions), (2002, p. b140-b189). Any of these functions can be impaired as a result of ABI. In their survey of the ATC literature relating to ICF guidelines, Gillespie et al. (2012) found evidence for technology used to augment attention, memory, executive functions, and experience of self and time functions. They found there was little to no literature on technology used to augment psychomotor functions, perceptual functions, sequencing complex movements, and thought functions. The literature on emotional functions mainly focused on psychiatric disorders such as anxiety and schizophrenia (Gillespie et al., 2012), which are outside the scope of this paper. There is a wealth of literature on language that is outside the scope of this paper as it relates to augmentative and alternative communication technology (AAC). Of specific interest to this paper are attention, memory, executive functions, and experience of self and time functions. Below is a brief definition of each and a discussion of augmentation using ATC.

Attention. Attention is the foundation for most cognitive functions, including memory and problem solving. Individuals with an attention deficit might miss important information in a conversation in the presence of distractions, or they might walk away from a meal on the stove and cause a fire hazard (Murray & Clark, 2006).

The ICF defines attention as "specific mental functions of focusing on an external stimulus or internal experience for the required period of time" (2002, p. b140). There are several different types of attention. The most basic type of attention is

sustained attention on one stimulus without distractions. Focused/selective attention is on one stimulus when distractions are ignored. Shifting attention is a more complex type of attention and involves alternating attention between two or more stimuli. Divided attention is attending to two or more stimuli simultaneously (ICF, 2002, p. b140; Murray & Clark, 2006). Individuals with right hemisphere damage might neglect to attend to the left side of their body and/or to stimuli presented on the left. Right neglect resulting from left hemisphere damage is less common. (Murray & Clark, 2006). Gillespie et al. (2012) reported that ATC studies implementing an intervention for attention employed a variety of devices to alert individuals and thus prompt them to attend to a target internally (such as a personal goal) or externally (such as a limb). Several different devices could be used for alerting, including a cell phone with text messages, a device that monitors limb movements and emits a sound when a limb has not been moved recently, or conversely, devices such as smartphones are used for many functions.

Evans, Emslie, and Wilson (1998) used a basic paging system (NeuroPage) to assist a woman with right frontal lobe damage whose memory and general intellect remained relatively intact, but who experienced impairments of attention and executive function. The participant relied on her husband's verbal reminders to complete routine tasks, such as taking pills on time. The participant reported she might remember and "intend" to complete an action around the time it was meant to be completed, but often failed to initiate the action. The participant set her own schedule of reminders with the researchers. The pager beeped loudly and displayed a text message at the scheduled times. Throughout the experimental phases of the ABAB study the participant significantly increased task performance in her goal areas, per spouse report:

taking pills on time, water plants, washing items when needed. She reported initiating tasks upon hearing the beep of the pager and reported no instances of "intending" but not initiating. One hypothesis posed by the researchers is that her attention to the intended action was not sufficiently aroused by her own prospective memory. The beeping of the pager aroused her attention beyond a needed threshold, allowing her to initiate the task. In this way, reminders given to an individual with frontal lobe impairments might increase attention arousal for task initiation.

Memory. Memory can be adversely affected by many types of ABI. Memory loss is the primary cognitive change in most types of dementia. Deficient memory is the most common complaint among individuals with TBI (Arcia & Gualtieri, 1993). Wade and Troy (2001) reported that 75% of individuals with TBI continue to experience difficulty with memory 10-15 years after their injury. According to the ICF, memory includes registering, storing, and later retrieving information (2002, p. b144). Memory and attention are related. If an individual does not attend to the information at the time of presentation, they will not register it, cannot store it, and the information will not be available for retrieval later.

Memory includes short-term memory, long-term memory, working memory, and prospective memory. Short-term memory is a temporary store of recent information. Working memory are mechanisms or processes involved in the control, regulation, and active maintenance of task-relevant information in the service of complex cognition, including novel as well as familiar, skilled tasks (Miyake & Shah, 1999). Working memory extends short-term memory and includes, depending on the model used, the central executor, the visuo-spatial sketchpad, the phonological loop, and the

episodic buffer (Baddeley & Hitch, 1974; Baddeley, 2003). Working memory is necessary to solve problems given constraints and many other daily tasks. A working memory deficit is a common consequence of TBI and many other types of ABI (Vakil, 2005).

There has not been an abundance of literature addressing the use of technology to support working memory alone (Gillespie et al., 2012), although working memory may be one cognitive component aided when ATC is used to support executive functions, which will be described later. ATC can be used to compensate for short-term memory deficits. For example, Alm et al. (2004) reported that reminiscence aids allowed users with dementia to communicate using multi-media on a touch screen about events stored in long-term memory, even when short-term memory deficits prevented traditional narratives.

ATC is often used to compensate for long-term memory deficits. Long-term memory can be divided into two main categories: declarative memory and non-declarative memory. Non-declarative memory includes procedural memory, priming, simple classical conditioning, and non-associative learning (Squire, 2004). Procedural memory is often used for routine motor and simple cognitive tasks such as riding a bike, playing a familiar song on the piano, or performing simple arithmetic in one's head. Declarative memory can be split into two main subtypes. Episodic memory stores and recalls past events in one's own life. It is recently evolved, late-developing, and vulnerable to the mechanisms of aging and disease (Tulving, 2002). Semantic memory stores and recalls factual information not personally experienced, such as, the capital of Florida is Tallahassee.

Declarative and non-declarative memories can overlap, but the majority of information stored using ATC is declarative information and can be either episodic or semantic. Some individuals need support for non-declarative memory tasks, such as washing hands. These individuals can be trained by a clinician, coached using step-by-step directions by caregivers, or guided by ATC instructions. In ABI, long-term memory can be further divided into anterograde and retrograde memories. Anterograde memories are stored after the injury or disease onset, such as one's room number in a hospital. Retrograde memories are formed before the injury or onset, such as the address of one's childhood home. In ABI, individuals might have difficulty with retrograde memory, but commonly have difficulty with anterograde memory (Tulving, 2002). In TBI, individuals often will permanently lose memories stored just prior to the injury, including the traumatic event itself. Regardless, individuals with memory deficits as a result of ABI can have difficulty with one or more different types of memory. A number of ATC devices could be used to assist individuals with memory deficits. The type of information stored is as diverse as the users and might include contact information, notes about previous conversations, directions for navigation, and instructions for tasks. Several devices have the ability to store information, including desktop and laptop computers, smartphones, tablets (e.g. the iPad), personal digital assistants (PDAs), and voice recorders.

Several studies have used technology to augment prospective memory, the function that alerts us to attend appointments and to complete tasks on time. Prospective memory is both a task of memory and of executive functions (Groot, Wilson, Evans, & Watson, 2002). Good prospective memory leads to effective time

management and increased success with daily intentions. Gillespie et al. (2012) found studies with a time management intervention employed a variety of devices to remind the individual. Reminding is a macro-prompting function that alerts the individual at a specific time to an impending event, but usually does not provide step-by-step instructions for task completion. For example, a reminder presented at 9:00 a.m. might read "Dentist appointment at 10:00am," or "Remember to pack a lunch." Reminding can be done by a number of devices, including pagers, cell phones with voicemail or text messaging services, alarm watches/clocks, smartphones with reminder apps, and many others.

The largest ATC study, and the only randomized control trial to date, examined the ability of individuals to compensate for prospective memory with a simple ATC paging system. Wilson et al. (2001) led a randomized, controlled, cross-over study with multiple baselines to study the efficacy of the NeuroPage. The NeuroPage is a pager linked to a message service that sends personally composed messages at predetermined times. The schedule of reminders is entered into a computer, which results in an audible cue from the pager with an associated message for the user on designated dates and times (Wilson et al., 2001). The participants were 143 people with TBI, stroke, and other developmental difficulties. They were mostly male and beyond the point of expected spontaneous recovery. A wide range of ages (adults only) were represented in the study. All participants reported difficulty with prospective memory. Notably, many participants were referred to the study after multiple failures at rehabilitation. Outcome measures were percent success of daily tasks. These target tasks were agreed upon individually with each participant to be ecologically valid and beneficial. Clinicians were

not asked to program events and were not asked to initiate addition of new alarms. The majority (85%) of participants were more effective in daily tasks with the NeuroPage than without it, per self and caregiver reports. Improvements in daily task completion were maintained by most of the first treatment group seven weeks after the NeuroPage was removed. Researchers in this and other studies theorized that prospective memory interventions with technology facilitate an errorless learning period with increased cues; the individual learns their routine and is able to maintain that routine after the technology is removed. In statistical analysis, daily task effectiveness was not associated with age, sex, diagnostic group, level of impairment as determined by neurological tests, time since insult, or social variables, such as marital status or living at home. The intervention was less successful for those who decided they did not need the device, those who had severely limited awareness of their deficits, and those who declined cognitively or psychologically. A wide range of people were able to use the technology effectively, including seniors.

The NeuroPage is just one of many ATC devices capable of reminding individuals to complete tasks of daily living. According to "Efficacy and Usability of Assistive Technology for Patients with Cognitive Deficits: A Systematic Review" by De Joode, van Heugten, Verhey, & van Boxtel (2010) and the review of ATC by Gillespie et al. (2012) there is "strong" evidence for the use of ATC for prospective memory impairments. Good candidates for ATC intervention have regular events or responsibilities to habituate, have at least superficial awareness of their deficits, and have sufficient memory to use the device and understand its purpose. Great candidates have intact executive functioning abilities (De Joode et al., 2010).

Executive Functioning. The ICF defines higher-level cognitive functions (executive functions or EF) as "specific mental functions especially dependent on the frontal lobes of the brain, including complex goal-directed behaviors such as decision-making, abstract thinking, planning and carrying out plans, mental flexibility, and deciding which behaviors are appropriate under what circumstances" (2002, p. b164). To be an effective and independent citizen, an individual must be able to set daily goals (e.g. make dinner), carry them out at the appropriate times (e.g. dinner ready at 7 p.m. and not 11 p.m.), and cope with changes as they arise (e.g. company for dinner). There is not currently adequate research on ATC for decision-making, abstract thinking, and mental flexibility (Gillespie et al., 2012). Clinicians often target these skills for restorative treatments in various rehabilitation settings. The dearth of literature might reflect a lack of an effective ATC intervention for these skills. ATC might be able to augment planning and organizing skills with step-by-step prompting (Gillespie et al., 2012). A number of devices are capable of providing these prompts, including PDAs, smartphones, tablets, and dedicated/specialized prompting devices such as PEAT (Planning and Executive Assistant Trainer).

Kirsch et al. (2004) used ATC to target pragmatics. Pragmatics is a social linguistic skill impacted by several cognitive skills, especially memory and executive functions. The participant was an individual with ABI whose spoken contributions during group therapy exceeded socially acceptable levels in length and frequency. The intervention included voice messages sent to a PDA every 15 minutes that said, "Be brief." The participant was able to significantly reduce the length of his utterances during group meetings over the course of intervention. He did not decrease the

number of utterances, which was still inappropriate. This gives evidence to the possible value of technology for executive functioning.

Navigation. The ICF defines experience of self and time as, "specific mental functions related to the awareness of one's identity, one's body, one's position in the reality of one's environment and of time" (2002, p. b180). These skills allow individuals to orient themselves to their person, their location, and the date and time. Disorientation is a common consequence of ABI and might be temporary (as with some neurologic insults) or permanent and progressive (as with dementia). ATC might be used for navigation (Gillespie et al., 2012), such as those that provide successive prompts to give directions to the individual. These prompts might include sounds, verbal commands, environmental supports, or pictures (Sohlberg, Fickas, Hung, & Fortier, 2007; Kirsch et al., 2004). Other types of ATC use a Global Positioning System (GPS) to show an individual's location on a map and highlight a route to a destination. Devices that provide either type of assistance include PDAs, a dedicated GPS, and smartphones.

There is strong evidence for the use of ATC for prospective memory impairments (De Joode et al., 2010; Gillespie et al., 2012; Svoboda & Richards, 2009; Wilson et. al, 2001). There is limited, but promising evidence for ATC in interventions targeting other cognitive areas including retrospective memory, navigation, and executive functioning (De Joode et al., 2010; Gillespie et al., 2012; Kirsch et. al, 2004; Sohlberg, et al., 2007).

In 2003, Hart, O'Neil-Pirozzi, and Morita surveyed 81 clinicians who provided services for individuals with TBI. Almost all reported high expectations for ATC interventions that targeted learning, memory, planning, and organization. Over half reported seeing good potential for attention and initiation interventions. Few

reported high expectations for interventions that targeted social and behavioral difficulties.

Assistive Technology Devices

Prior to smartphones, pagers, and alarm watches, individuals often used paper planners and written notes to compensate for memory and other cognitive functions (DePompei et al., 2008). In a survey of memory strategy and external aid use, Evans et al. (2003) found the most common aids/strategies reported by individuals with brain injury were: paper wall calendar or chart, notebook, lists, appointment diary, and asking others to remind them. Few (less than 10%) participants reported using alarm clocks, electronic organizers, pagers, or mobile phones, although these aids were rated by users as usually effective, and more effective than the most popular aids. Individuals with memory impairments rarely spontaneously seek out electronic memory aids and often rely on others to recommend them, which raises the importance of training clinicians to employ ATC in rehabilitation (Evans et al., 2003). ATC provides a multitude of new possibilities for cognitive rehabilitation that compliments, replaces, or expands on paper-based aids (DePompei et al., 2008). DePompei et al. compared the performance of over a hundred adolescent and young adult participants on tasks of prospective memory using two kinds of PDAs and a paper planner (2008). Participants were more effective at task completion during the PDA intervention phases than their baseline strategies. Participants were more successful with their baseline strategies (often verbal reminders from caregivers) than with the paper planners. Most participants continued to use their devices at a one-year follow-up. DePompei theorized that paper planners are least effective in

assisting individuals compensate for prospective memory because they rely on the individual's prospective memory to check the planner at the appropriate time. Dowds et al. (2011) completed a similar study comparing paper planner interventions to two types of PDAs in the adult population with similar results. In short, a paper system for prospective memory relies on the very cognitive systems that it attempts to supplement and ATC is able to close that gap through alerting functions.

Assistive technology devices for cognition could be almost any device capable of alerting and/or storing information. Many ATC devices are portable in order to travel with the user. Some devices are dedicated, meaning they serve only one purpose, and others perform multiple functions. There are several dedicated devices mentioned in the literature. A voice recorder or organizer might use tapes or a digital system to record information and augment memory (Hart, Hawkey, & Whyte, 2002; Oriani et al., 2003; van den Broek, Downes, Johnson, Dayus, & Hilton, 2000; Yasuda et al., 2002). The SmartPen (or similar device) records messages while the user writes notes on special paper. The user is then able to tap the written notes and hear the recording from that time. In this way, the SmartPen is a retrospective memory aid that augments written note taking strategies (Kennedy & Krause, 2011).

In recent years, hand-held computers with global positioning systems have become available commercially. These systems contain detailed maps of many countries and assist individuals with normal and impaired cognitive skills navigate in their community (Gillespie et al., 2012). The system is able to show an individual's position on a map, illustrate a route to a desired location, and provide step-by-step directions. A travel assistance device uses GPS to give appropriately timed cues for public

transit riders with disabilities. The device also alerts riders and caregivers when riders deviate from their intended route (Barbeau et. al, 2010).

There are several dedicated devices for alerting individuals, for either attention or prospective memory deficits. An alarm watch displays the current time and will sound or vibrate at programmed appointment times (Van Hulle & Hux, 2006). Medication reminders are a class of simple electronic devices that are available commercially. Many reminders function like alarm watches or count-down timers and attach to pill bottles. Others have pill boxes or automatic pill dispensers attached. These inexpensive, simple-to-use reminders have been clinically shown to increase medication compliance (Laster, Martin, & Fleming 1996; Chang et. al 1991). Pagers, specifically the NeuroPage (described above), are simple, effective means of alerting individuals and prompting them to complete activities of daily living. There is a wealth of literature on the effectiveness of paging systems in alerting individuals with brain injury (De Joode et. al, 2010; Evans, et al., 1998; Emslie, et al., 2007; Fish, Manly, Emslie, Evans, & Wilson, 2008; Fish, Manly, & Wilson, 2008; Kirsch, Shenton, & Rowan, 2004; Teasdale, et al., 2009; Wilson, et al., 2001; Wilson, Emslie, Quirk, Evans, & Watson, 2005; Wilson, Evans, Emslie, & Malinek, 1997). More recently, individuals have sent text messages to cell phones at specified times to duplicate the alerting function of a pager on a newer device (Fish et al., 2007; Stapleton, Adams, & Atterton, 2007). Alerts can also be sent to a cell phone via voice messaging/VoiceMail (Wade, & Troy, 2001).

The most widely researched multi-function device is the personal digital assistant (PDA), also called a palm pilot or palm top computer. These portable computers are capable of storing notes and voice memos to augment retrospective memory;

provide schedule, calendar, and money management applications (apps) to aid organization and planning; and send alerts to users for set alarms or calendar events (De Joode et al., 2010). In this way, these devices combine the features of several dedicated devices already described. There is considerable positive evidence for the use of PDAs to increase the independence of people with brain injury (Davies, Stock, & Wehmeyer, 2002; DePompei, et al., 2008; Dowds, et al., 2011; Gentry, 2008; Gentry, Wallace, Kvarfordt, & Lynch, 2008, Giles, & Shore, 1988; Kim, Burke, Dowds, & George, 1999; Kirsch, et al., 2004; Sainath, 2008; Sohlberg et al., 2007; Thone-Otto, & Walther, 2003; Wilson, Baddeley, Evans, & Shiel, 1994). The iPod (also called the iTouch) is a music playing device that can also function as a PDA. PDAs were replaced by PDA-phones in the mid-2000s, now called smartphones. These devices maintain many of the features and functions of PDAs while adding cellular phone service, GPS capabilities, and increased internet connectivity for e-mail and internet use. Few studies have been published on smartphones as ATC, but the literature on PDAs and several dedicated devices broadly applies (De Joode et al., 2010, DePompei et al., 2008, and Svoboda & Richards, 2009).

Most of the devices discussed above are portable; however, clinicians in Hart et al.'s 2003 survey reported using desktop and laptop computers with clients more often than portable devices. About two-thirds reported using desktop or laptop computers with clients, while about half used portable devices with clients. In their study, overall clinician confidence to teach individuals to use ATC was low. Two-thirds of clinicians reported they were "not at all confident" or "slightly confident" in their overall ability to teach clients with TBI about portable computer technology. Confidence was

positively related to a clinician's personal use of devices. Almost all clinicians used a desktop or laptop computer, while less than a quarter used portable devices. They concluded that as portable devices became more mainstream the price would likely drop. With a substantial barrier to device exposure removed, both clients and clinicians would be more willing to experiment with these devices for therapeutic purposes.

Service Providers

Once a person is identified to have cognitive deficits as a result of an ABI, they often receive rehabilitation services. The primary providers of rehabilitation services include physical therapists, occupational therapists, speech-language pathologists, and therapy assistants. Several other professionals might be available to extend the independence and well-being of an individual while receiving rehabilitation services, including: counselors, dieticians, dietary managers, doctors, nurses, nursing assistants, psychologists, psychiatrists, recreational therapists, rehabilitation engineers, religious leaders, respiratory therapists, social workers, and vocational counselors. Several of these individuals are capable of recognizing the need and potential for an individual to use ATC. Many more are capable of aiding the instruction and maintenance of a device. Recommending an ATC device and training an individual with ABI to use it fall under the scope of practice of both a speech-language pathologist and an occupational therapist (American Speech-Language Hearing Association, 2005 & 2007; American Occupational Therapy Association, 2004). In a review of the ATC literature, De Joode et al. (2010) found the individual who trained the research participants to use their new ATC was usually one of the researchers or was unidentified. The researchers were

usually speech-language pathologists or occupational therapists.

Instruction

Once the need for a device is established and the evaluation is complete, the individual begins to learn to use their new device. The instruction or acquisition phase of device use is crucial to individuals with brain injury. However, many clinicians have expressed little confidence in their ability to train individuals to use ATC (Hart et al., 2003). While a non-brain injured individual might learn a new device through reading the manual and trial and error methods, most people with brain injury prefer direct instruction (Hart, Buchhoffer, & Vaccaro, 2004). This is likely because their memory and executive functioning deficits necessitate the use of more intensive and targeted instruction methods. According to the review by De Joode et al. (2010), the training methods of most studies were ill defined and provided little guidance for clinicians. Specific training methods were usually not reported, or reported only as "demonstration" or "practice." Recently, more attention has been paid to the instruction methods for ATC acquisition.

Ehlhardt et al. (2008) provided guidelines for instructing individuals with neurogenic memory impairments, the most common impairment augmented by ATC. The recommendations were governed by a general call for systematic, deliberate, theoretically sound, and individualized treatment. The guidelines stemmed from a review of 51 studies written between 1986 and 2006. They emphasized throughout the article that clinicians are not simply rehabilitation professionals, but designers of curricula. Well-designed curricula have the potential to foster learning that is more

expedient and permanent, the kind of learning that leads to life-long benefits. Sohlberg and Turkstra's Optimizing Cognitive Rehabilitation (2011) synthesized and expanded on the instruction recommendations of Ehlhardt and others to discuss instruction methods for individuals with ABI and provide guidance for clinicians.

In order to optimize ATC instruction, goals should be clearly defined and complex tasks be broken into their smaller components for teaching and analysis of progress. Ideal intervention targets will be relevant after discharge, such as teaching an individual to remember medication times and not the usual time for speech therapy (Ehlhardt et al., 2008) . Errorless learning is an effective method of instruction for individuals with brain injury wherein client output is controlled and errors constrained. This allows clients to learn from their actions quickly, instead of jumping in haphazardly and then repeating their mistakes. Errorless learning methods are in contrast with trial and error learning and are used often with both mild and severely impaired clients. Errorless learning methods are most effective for implicit tasks and less effective for explicit information (Ehlhardt et al., 2008; Sohlberg & Turkstra, 2011). Shaping behavior involves rewarding actions that gradually approximate the target, where the amount of cueing fades from most to least during trials (Sohlberg & Turkstra, 2011). This method is often appropriate for individuals with severe deficits as it allows a clinician to effectively improve accuracy before fostering independence. Spaced retrieval aims to assist the individual to shift the information from short-term to long term memory by reducing errors and gradually increasing the amount of time between trials. If an individual makes an error during spaced retrieval, they practice the skill correctly and the amount of time between trials is halved. This method is effective with a

variety of cognitive disabilities, including dementia (Sohlberg & Turkstra, 2011). Effortful processing of concepts by the patient, thinking about doing instead of simply doing, will assist some individuals to improve attention, encoding, organization, explicit retrieval, and flexible learning. This type of processing could be facilitated by strategies such as verbal elaboration and imagery. Effortful processing is most effective with individuals with mild cognitive deficits as it increases the possibility of recall errors (Ehlhardt et al., 2008). Written and pictured instructions might increase a client's accuracy with the device during and after direct instruction sessions. Paper instructions allow individuals with language disorders and memory deficits to follow step-by-step instructions accurately, while reducing the effects of the transient nature of verbal instructions. Skill generalization to new targets and situations can be promoted by varying stimuli and providing multiple exemplars (Ehlhardt et al., 2008; Sohlberg & Turkstra, 2011).

Learners need substantial practice opportunities to compensate for memory deficits. An emphasis should be placed on trials with a reduction in demonstrations and explanations (Ehlhardt et al., 2008). The frequency of practice might have an impact on the long-term acquisition of skills. Individuals who participate in massed practice, where a person learns the material for an extended duration over only a few sessions, are expected to attain mastery quickly and also to attenuate quickly. Those who practice in short bursts over a long period of time are expected to rise to mastery at a slower pace, but will maintain that mastery for a significantly longer period. Thus, distributed practice is the preferred intervention dosage because long-term retention is the goal of rehabilitation (Ehlhardt et al., 2008; Sohlberg & Turkstra, 2011). Not all

individuals will benefit from all types of instruction methods. Skilled instructors providing personalized curricula can foster life-long skill acquisition and positive ATC outcomes.

Dosage

Dosage refers to the frequency of sessions, the length of those sessions, and over what period of time they occurred. The dosage of services should be customized with the client to reflect their treatment goals, personal factors (such as instruction methods and transportation to sessions), and agreed-upon criteria for mastery (e.g. "Mark will enter new appointments into his smartphone at least 90% of opportunities with no reminders from his wife or co-workers.") The amount of services actually provided to ATC users in research studies varies widely and is often not reported (De Joode et al., 2010; Ehlhardt et al., 2008). Reported treatment frequency ranged from one session only to daily sessions. Session length varied from 30 minutes up to two hours. Sessions continued for a week or up to several months (Ehlhardt et al., 2008). For example, Svoboda and Richards (2009) used systematic instruction methods to teach a woman with focal memory impairment to use a smartphone to remember appointments and other information. During the study, the researchers provided one-hour sessions twice a week for a total of eight weeks (16 hours total), at which point the participant met her goals and creatively generalized several skills to live more independently. Unfortunately, not all clients get the ideal amount of services to learn their new device and more information is needed from clinicians to define barriers to ATC service, which may include third party funding for services, client transportation, and high clinician caseload. As of this writing,

a survey of clinicians to define barriers to services has not been reported in the literature.

Outcomes

The goal of every ATC intervention is to increase the independence of the user. The evidence for ATC interventions is "strong," especially for prospective memory interventions (De Joode et al., 2010; Ehlhardt et al., 2008; Gillespie et al., 2012; Sohlberg & Turkstra, 2011). This finding is primarily based on positive outcomes described in the literature. However, ATC success should be more clearly defined. From the client's perspective, ATC success includes an efficient acquisition phase with a high criterion of mastery and a skill set that improves their independence long-term. Some studies defined success as a high percentage of scheduled calls to the clinic or remembering therapy goals during a few weeks of study, often with no follow-up (Dowds et al., 2011; Fish et al., 2007; Hart, Hawkey, & Whyte 2002; De Joode et al., 2010). Several studies had measured ecologically valid targets, including objectives set by the client or overall measures of independence (Emslie, et al., 2007; Fish, et al., 2008; Gorman, Dayle, Hood, & Rumrell, 2003; Kim, Burke, Dowds, & George, 1999; Kirsch et al., 2004; Stapleton, Adams, & Atterton, 2007; Teasdale et al., 2009; Thone-Otto & Walther, 2003; Wade & Troy, 2001; Wilson, et al., 2001). Only a few studies followed-up with participants to ensure they continued to use their device successfully (De Joode et al., 2010, dePompei et al., 2008; Fish, Manly, & Wilson, 2008; Giles & Shore, 1988). More research is needed to determine outcomes for the average client and what factors influence success.

In their survey of clinicians, Hart, et al. (2003) asked clinicians to predict requirements and barriers for ATC use. Clinicians answered an open-ended

question to identify cognitive, physical, and personality characteristics that would be required for ATC use and extrinsic factors that would help or impede use. The most common answer was cost, reported by over half of participants. Other external factors, reported by less than a quarter of participants, included previous computer skills, a stable family or support system, and lack of knowledge on the part of professionals to provide training and support. The most common cognitive factor reported was learning and memory, by almost half of participants. Other cognitive factors were reported by less than a quarter of participants included attention, insight into deficits, and initiation. About a third of participants listed fine motor skills/dexterity, a physical factor. Few mentioned vision or hearing. Motivation, a personality factor, was mentioned by about a quarter of participants. A few participants mentioned interest in technology, persistence/follow-through, openness to feedback, openness to new experiences, and frustration tolerance.

In short, the greatest barriers identified by this group were cost, memory/learning, and dexterity. These factors are interesting as ATC is meant to augment memory and a number of instruction methods are designed to help individuals with difficulty learning. Additionally, cost might not be a barrier when ATC outcomes reduce caregiver burden and reduce the cost of care overall. Wilson et al. (2001) reported positive outcomes when training a diverse crowd of individuals with ABI to use NeuroPage. Some individual case studies illustrate the functional and financial impact of ATC. One woman with marked organization and planning problems was living at home under the care of her family. After twelve weeks of intervention with the NeuroPage, she was able to carry out household tasks independently. This reduced family stress, eliminated the

need for respite care, and saved the woman's local health authority £6000 yearly, or about $7,000 USD in 2001 (Evans, Emslie, & Wilson, 1998). A young man with a TBI from a motor vehicle accident was seven years post-injury and wanted to move out of his parents' home. The NeuroPage aided the transition to his own apartment with 24 hour care. Caregiving services were reduced to twelve hours within three months and eventually the pager was no longer needed as his routines were habituated. In total, the transition to independence saved social services £60,000 in one year, comparable to about $70,000 USD at that time, (Wilson et al., 1999). Teasdale et al. (2009) measured caregiver strain in 99 caregivers of individuals with ABI before and after the NeuroPage intervention. The intervention improved measures of caregiver strain in both parents and spouses. Therefore, the literature demonstrates the potential of ATC to have a lasting impact on the independence of individuals with ABI and their families that far outweighs its initial costs.

The Present Study

In light of the evidence that ATC improves outcomes for individuals with ABI and their families, many clinicians have begun distributing such devices (O'Neil-Pirozzi, Kendrick, Goldstein, & Glenn, 2004). As recently as 2003, clinicians reported little confidence in their ability to provide ATC services (Hart et al.). Recent publications (Sohlberg & Turkstra, 2011; Ehlhardt et al., 2008) provide explicit instructions for training individuals with brain injury to use ATC. However, there is little literature on how most clinicians provide ATC services and the outcomes for the average client outside the research paradigm. Additionally, the technological landscape has

changed drastically since clinicians were last surveyed about their use of ATC with clients and the barriers to doing so effectively (Hart et al. 2003).

The primary purpose of the present study is to give an updated and expanded report on clinician experiences of ATC services, including: intervention targets, devices, trainers, instruction methods, treatment dosage, client outcomes, and barriers.

Research questions include the following:

1. What are the intended target areas of ATC interventions for individuals with ABI?
2. What ATC devices do clinicians use themselves? And what devices do they provide to clients with ABI?
3. Who (what professionals) provides ATC services?
4. What instructional methods do clinicians use when teaching individuals with ABI to use ATC? Does this vary predictably based on the severity of the patient?
5. What is the treatment dosage for individuals with brain injury to use ATC? Does this vary predictably by treatment setting?
6. Are there relationships between the dosage of ATC services and the clinicians' opinion of the adequacy of these services? What barriers prevent clinicians from providing more ATC services?
7. What are the reported outcomes of ATC interventions? When clients fail to maintain device use, what are the reasons? When clients succeed with their devices, how often do they generalize their skills in new, untaught ways?

We propose the following hypotheses:

1. Clinicians will most often report training individuals with ABI to use ATC for prospective memory targets.

2. Clinicians will most often report using smartphones, alarm clocks, computers, and GPS navigation systems themselves. Clinicians will most often report recommending and instructing clients to use smartphones and alarm watches.

3. Occupational therapists and speech-language pathologists will be the clinicians who most often report providing device selection, introduction, and ongoing support services.

4. Clinicians will report using a wide variety of device instruction methods and that demonstration and trial/error learning methods will be among the most widely reported. Clinicians will use a wider variety of methods with clients with mild deficits.

5. The dosage of ATC services provided will vary widely across clinicians and employment settings.

6. Clinicians who reported providing less services will also report the amount of services was not adequate. The most common barrier to providing services will be cost and client discharged from setting.

7. Clinicians will report an estimated device abandonment rate of over 50% within two years of device introduction. Clinicians will most often report estimated reasons for abandonment as "reduced client insight or perceived need by the client," "reduced caregiver involvement," and "unresolved technical difficulty with the device." At least 20% of clinicians will report a client creatively generalized their ATC skills to new devices, functions, etc.

Methods

Survey Creation

To study the presented hypotheses, we created a survey of twenty-seven questions that could be anonymously accessed on-line through the survey engine surveymonkey.com. Members of the NeuroCognitive Communication Lab (NCCL) at the University of Minnesota-Twin Cities, all graduate students who are SLPs, provided feedback during survey. To provide face validity, individuals used their clinical experiences with individuals with ABI and their knowledge of the ATC literature to create questions. A previous survey on technology use and ABI (Hart et al. 2003) was reviewed for content to ensure the present survey included a full list of ATC commonly used by individuals with ABI and clinicians. See Appendix A for the final survey.

The twenty-seven questions on the Technology and Cognitive Rehabilitation for Individuals with Acquired Brain Injury Survey (TCR Survey) included yes/no, multiple choice, and open-ended answer formats. Answer choices were presented in random order when appropriate. Answer choices that displayed items in a serial order (eg. "1 day, 2-6 days, 1-2 weeks, 3-5 weeks, more than 6 weeks") were presented as flipped one of two ways. For example, presenting either "1 day" or "more than 6 weeks" as the first choice and all other answers following in serial order. Answer options listing professions (occupational therapist, rehabilitation engineer, etc.) were always presented alphabetically. As appropriate, most questions included an "other" or "comment" free-response space for clinicians to clarify responses.

The first three questions collected demographic information about clinicians, who indicated their sex, date of birth, and occupation. Clinicians then reported

their basic clinical experiences. Clinicians who indicated they had never provided services to individuals with ABI to use ATC were redirected to a disqualification page re-iterating the purpose of the study. The clinicians reported the number of years employed in their occupation, current employment setting (e.g. medical: outpatient, educational: school), approximate quantity of clients served using ATC, and the diagnostic groups they have served with ATC.

In a series of questions, clinicians reported which professionals (OTs, SLPs, etc.) were involved with ATC recommendation, selection, instruction, and follow-up and which professionals primarily provided these services. Clinicians identified ATC devices and functions for which they had provided services and later, those they used themselves.

Further details were queried about how clients were instructed to use ATC, including the dosage of instruction. Clinicians reported whether a device trial period was provided to clients during the selection process and if so, for how long. They reported ATC instructional methods for clients with mild and severe cognitive deficits. Additional questions probed the quantity of services provided for ATC instruction, whether clinicians believed this amount to be adequate, and barriers to providing the ideal amount of services. Clinicians reported the outcomes of ATC services including continued client device use, reasons for device abandonment, and spontaneous generalization of ATC skills.

Distribution and Consent

The first page of TCR survey was the consent form approved by the Institutional Review Board for Human Subjects at the University of Minnesota. At the end

of the consent form, clinicians were asked four comprehension questions about salient information from the consent form including participant anonymity and relationship with the University. At the conclusion of the survey, individuals were given the opportunity to provide their name and email address if they wanted to participate in a drawing for a $30 Amazon.com gift card.

The TCR survey was distributed on-line from June 8th, 2012 to September 12th, 2012 through several electronic avenues, including the American Speech-Language Hearing Association Special Interest Group 2: Neurophysiology and Neurogenic Speech and Language Disorders listserv, the Academy of Neurological Communication Disorders and Sciences (ANCDS) listserv, the American Occupational Therapy Association, Inc. (AOTA) research forum, the Veterans Affairs (VA) rehabilitation staff via e-mail and personal communications, the Rancho Los Amigos National Rehabilitation Center staff via e-mail, the Minnesota Speech-Language Hearing Association (MSHA) healthcare listserv, and colleagues of the researchers via personal communications. All responses were anonymous. When provided, participant names were used solely to identify winners of the gift card drawing.

Data included in analysis

Not all of the 190 total responses could be included in the final analysis. Twenty-six clinicians did not complete the survey beyond question nine, which concluded the demographics section of the survey. They did not provide responses to questions needed for useful analysis and were eliminated from the final analysis. A number of suspected fraudulent responses were collected after August 6th, 2012. For example,

several clinicians claimed to practice in three to eleven rehabilitation professions each, including neurology, social work, and speech-language pathology. A professional reported both a birth date in 1997 and having spent 6-9 years in his profession by 2012. There were also three consecutive responses reporting an identical birth date. These suspected fraudulent responses occurred after the survey was advertised on the AOTA research web forum. The responses likely occurred as an attempt to procure one of the gift cards offered by raffle. Consequently all 86 responses collected after August 6th, 2012 were removed from the data set. Clinicians who wished to enter the gift card raffle provided an e-mail address. Responses collected after August 6th, 2012 that included an e-mail address associated with .va, .edu, or other professional institutions were considered genuine responses by the researchers and added back into the data set. Four responses were not associated with one of these domain names, but gave additional details about their experiences during the survey through a free-response area. For example: identifying additional treatment methods, describing device generalization observations, or writing an additional reason a client discontinued device use. These four responses were likely genuine and included in the data set.

The responses remaining in the analysis were overwhelmingly speech-language pathologists. There was an insufficient number of responses from other professionals for useful analysis. Six clinicians who were not speech-language pathologists were removed from the data set. A total of 88 responses were included in the final data set for analysis. The process of response elimination is represented in Figure 1.

Results

Survey Population

Of the 190 total clinicians, 88 were included in the final analysis (see Figure 1). All clinicians reported providing services to individuals with ABI to use electronic aids for cognition. One social worker who responded "no" to this question was directed to a disqualification page thanking them for their time and re-iterating the purpose of the study. This clinicians' responses were not included in the final analysis.

The overwhelming majority (78, 89.7%,) of clinicians were female and few (9, 10.3%) were male. One participant did not indicate their sex (see Table 1 for demographics). All but one participant reported their birth date. One participant reported a birth date in 2012, likely by mistake. This date was removed from the analysis. All clinicians were 24.5 to 65.3 years of age at the time of survey completion. The mean participant age was 46.4 years and the standard deviation was 11.8 years.

There were an insufficient number of clinicians (6 out of 94) reporting professions other than speech-language pathology; these were excluded from further analysis. Thus responses from only speech-language pathologists (SLPs) were analyzed. Two individuals also reported being a "professor" and an "assistive technology professional." Almost half of the individuals (42, 47.7%) reported more than 20 years experience in their field. Many clinicians (26, 29.5%) reported 10-19 years experience. Less than a quarter of clinicians reported less than ten years experience (see Table 1).

Clinicians had the option to select more than one employment setting and all clinicians reported at least one setting. Clinicians reported a variety of employment settings, primarily medical (see Table 2). Over half of the clinicians (52, 59.1%) reported

working in a "Medical: Outpatient" setting followed by working in a "Medical: Inpatient Rehabilitation" (32, 36.4%) or "Medical: Acute Care" (25, 28.4%) setting. Few clinicians reported working in other settings and no clinicians reported working in "Adult Day Care," "Educational: School," "Research Agency or Facility," or "Public Health Department" settings. Nine clinicians (10.2%) identified additional work settings, such as "VA hospital," "oncology hospital," "post-acute programs," "home and community based rehabilitation," and "Medical: long-term acute care" (See Appendix B). Over half of clinicians reported working in at least one medical setting across the continuum of care from acute care to long-term nursing facilities.

Clinicians were asked to estimate the number of clients to whom they had provided ATC services (including recommending, selecting, instructing, and trouble shooting). Almost all clinicians estimated a number. Estimated values ranged from 1 to 975 individuals. The mean number of individuals served was 95.8, and the median was 50. About 80% of clinicians estimated serving 100 individuals or less.

All clinicians reported providing ATC services to at least one diagnostic group (see Table 3). As expected, almost all clinicians (85, 96.6%) reported serving individuals with traumatic brain injury and most (66, 75%,) reported serving individuals who had experienced a stroke. Almost half of the clinicians reported serving individuals with deficits resulting from hypoxia or anoxia. Less than half reported serving individuals with multiple sclerosis, aneurysm, tumor, dementia, encephalitis, meningitis/septicemia, toxicity, or Huntington's disease. Ten clinicians reported additional diagnostic groups they had served, including mental health (PTSD, ADD, schizophrenia) and cognitive changes as a result of chemotherapy (See Appendix B).

Intervention Targets and Devices

All clinicians identified at least one ATC intervention target for which they had provided services (see Table 4). The majority of reported targets fell into two categories: memory and organization/planning. Almost all clinicians reported providing services for clients to use calendar and schedule functions, To-Do list functions, alarms and reminders, and writing and recording note functions. Most clinicians reported ATC for managing contacts, step-by-step task direction functions, retrospective memory journaling functions, and navigation functions. Less than half of clinicians reported ATC for money management. Twenty clinicians reported other ATC functions, including: memory or cognitive training, functions that allow a phone or client to be located, social story creation functions, medication management, pain or anxiety management, and PTSD coaching (See Appendix B).

All clinicians reported providing services with at least one type of ATC device. As expected, a large number of clinicians reported using devices that are recent and commercially available such as a smartphone or other cell phone with multiple functions (72, 81.8%), digital voice recorder or tape recorder (66, 75.0%), tablet (63, 71.6%), watch with an alarm (59, 67.0%), portable electronic aide (PDA) or electronic organizer (57, 64.8%), iPod Touch (53, 60.2%), desktop or laptop computer (52, 59.1%), GPS navigation system (46, 52.3%), SmartPen (41, 46.6%), or text messaging using a cell phone (38, 43.2%). Many of the most commonly reported devices are multi-function devices, able to provide more than one function (planning, reminding, etc.) such as the smartphone, tablet, iPod Touch, and PDA. Many reported devices used for

medication reminder alarms such as the Dose Alert Pill Reminder (54, 61.4%), although it is unclear whether clinicians interpreted this option as a dedicated device (including Dose Alert, which attaches to medication bottles) or as a function of a smart phone or similar device. Half reported providing use of an alarm clock. Few reported the use of a voicemail message system, pager, two-way pager or "walkie-talkie". Although presented as an option, no clinicians reported using a CB radio with a client as ATC (see Table 5 and Figure 2). Ten clinicians identified additional ATC devices, including: MyBionicBrain (a paper and software system designed for individuals with TBI), speech to text software programs, text to speech software programs, and "PACK drive with CogLink email system" a portable computing tool that increases the simplicity and accessibility of computers (see Appendix B).

Clinicians were asked to report ATC devices that they have used personally or professionally, recently or in the past. As expected, most clinicians reported using a smartphone (70, 86.4%), text messaging using a cell phone (69, 85.2%), and GPS navigation system (61, 75.3%). Many clinicians, but less than expected reported using a desktop or laptop computer (74, 91.4%), Voicemail message system (69, 85.2%) and alarm clock (67, 82.7%). Half of the clinicians (44, 54.3%) reported using a tablet device, such as an iPad. Less than half of clinicians reported ever using a digital voice recorder, pager, iPod Touch, watch with alarm, portable electronic aid/PDA/electronic organizer, SmartPen, medication reminder alarms, two-way pager or "walkie-talkie", or CB radio. (See Table 5 and Figure 3).

Clinicians were presented with the same list of devices when reporting devices they personally used and those they used with clients (see Table 5 and Figure

2). As expected, clinicians reported that smartphones were used with high frequency by both groups. Other new devices, such as tablets and SmartPens, were also commonly reported, although these were used with clients more often. Clinicians reported more personal use of devices such as pagers, text messaging using a cell phone, computers, iPods, Voicemail, GPS navigation systems, and alarm clocks than used with clients; however, voice recorders, alarm watches, and portable electronic organizers were used more often with clients than for their own personal use. Clinicians reported using medication reminders often with clients and rarely themselves, whereas older technologies, including "walkie-talkies," and CB radios, were rarely used by clinicians or clients.

Service Providers

A set of questions were created to determine which members of the treatment team were involved in providing different aspects of ATC service (questions 12, 13, 15, and 24). Those services may include: recommending that an ATC device is needed, selecting an ATC device, instructing the individual to use their ATC, and providing follow-up and trouble-shooting for continued ATC device use. Clinicians were also asked to identify the *primary* providers of these services. Response choices were presented in a two-column format, wherein clinicians were given the option to select that a member of the treatment team was one of the individuals involved or was a primary service provider/decision maker.

Most clinicians identified at least one member of the treatment team who provided input when deciding that an ATC device was needed. Most

clinicians indicated that the client (82, 96.4%), the SLP (82, 96.4%), and the client's family, care provider, or other supportive individuals (77, 90.1%) provided input when deciding that an ATC device was needed. Of these individuals, most clinicians indicated that the client (75, 88.2%) and SLP (73, 85.9%) were the primary deciders and more than half indicated the family (50, 58.8%) was a primary decider. About half of clinicians indicated that the neuropsychologist and occupational therapist (OT) provided input, but few reported these individuals were primary deciders. Few clinicians indicated that the physical therapist (PT), recreational therapist, rehabilitation engineer, vocational counselor, physician, or nurse provided input (see Table 6). Seven clinicians reported that other individuals are involved in deciding an ATC device, including a caseworker, social worker, rehabilitation specialist with expertise working with individuals who are blind, cognitive therapist, and community stakeholders such as an employer or teacher. See Appendix B which contains a complete list of other individuals involved in deciding an ATC is needed.

Clinicians identified at least one member of the treatment team who provided input during ATC device selection. Almost all clinicians reported the SLP (83, 98.9%) and client (81, 96.4%) provided input during device selection. Most reported that the client's family, care provider, or other supportive individuals (72, 85.7%) provided input. Of those, most clinicians identified the client (74, 88.1%) and the SLP (70, 83.3%) as primary selectors, while almost half identified the client's family as a primary selector (38, 45.2%). Less than half of clinicians reported the OT as involved in device selection and few identified them as a primary selector. Few clinicians reported that other service providers were involved in device selection at all, and less identified them as

primary selectors (See Table 7). Four clinicians identified additional individuals involved, including: a prosthetics purchasing agent (sometimes primary selector), cognitive therapist, and IT department. One participant reported that clients often already have ATC-capable technology that they want to use, such as a smartphone or computer (See Appendix B).

Almost all clinicians identified at least one member of the treatment team who provided ATC instruction. Almost all clinicians reported that the SLP was the primary ATC instructor (80, 95.2%). Less than half of clinicians reported the OT as involved in ATC instruction (36, 42.9%) and less than a quarter identified them as a primary instructor (20, 23.8%). Less than a quarter of clinicians identified other service providers as instructors and fewer reported they were primary instructors (See Table 8). Eight clinicians identified other individuals who provided ATC instruction including a device vendor, school or university tech departments, cognitive therapist, and independent living skills worker (See Appendix B).

Many clinicians identified at least one member of the treatment team who provided ATC follow-up or troubleshooting. Clinicians had previously reported that the SLP most often instructed and the OT sometimes instructed. Similarly, clinicians reported these two as the most likely members of the treatment team to provide follow-up and trouble-shooting services. SLPs were as the primary individuals to provide follow-up services (68, 87.2%) and OTs were identified by less than half to provide these services (33, 42.3%). Few clinicians (11) reported other professionals as being involved in ATC follow-up or trouble shooting (see Table 9) including a care provider, cognitive therapist, independent living skills worker, Certified Brain Injury Specialist (CBIS),

social worker, and device vendors such as Apple (see Appendix B).

Instruction and Dosage

Almost all clinicians shared their ATC instruction methods and dosage. They were asked to distinguish between methods used with clients who present with mild cognitive deficits and those with severe cognitive deficits, although these terms were not defined for clinicians. Definitions for the various kinds of instruction were provided and these can be found in Appendix A, TCR Survey Questions. Eight clinicians reported they did not serve individuals with severe cognitive deficits, whereas all clinicians reported they served individuals with mild cognitive deficits. The most commonly employed ATC instruction methods with any type of client were direct instruction in step-by-step procedures (79, 96.3%), demonstration (78, 95.1%), written instructions (71, 86.6%), shaping behavior and fading cues (70, 85.4%), task analysis (69, 84.1%), errorless learning (61, 81.7%), and trial and error (62, 75.6%). Many reported employing effortful processing, quizzing, verbal elaboration, and verbal scripting with all client types. Imagery was the least commonly employed method with either type of client and reported by less than half of clinicians. The most commonly employed methods with clients with mild cognitive deficits were demonstration (73, 89.0%), direct instruction in step-by-step procedures (67, 81.7%), and written instructions (63, 76.8%). The most commonly employed methods with clients with severe cognitive deficits were direct instruction in step-by-step procedures (66, 80.5%) and demonstration (65, 79.3%). Many clinicians employed direct instruction in step-by-step procedures with both groups, but more clinicians employed demonstration, written instructions, task analysis,

trial and error, effortful processing, quizzing, verbal elaborations, verbal scripting, and imagery with clients with mild cognitive deficits than clients with severe deficits. Clinicians reported employing errorless learning and shaping behavior with fading cues more often with clients with severe deficits (see Table 10 and Figure 3). Seventeen clinicians provided details on additional treatment methods employed with either group. Seven clinicians used step-by-step picture, video, or voice cues specific to the device during instruction. Three clinicians collaborated with other ATC service stakeholders such as schools, employers, and caregivers. Other responses can be found in Appendix B.

Because it is possible that the number of instructional techniques varied by severity of disability, a repeated measures, one-way ANOVA was conducted. The severity of disability was considered an ordinal value and given dummy codes prior to being entered into analysis. The number of instructional techniques reported was a continuous variable, with a range from zero to twelve methods. Clinicians reported using significantly more instructional techniques with individuals with mild disabilities (M=7.27, SD=2.63) than with individuals with severe disabilities [M=5.70, SD=3.26; $F(1,81) = 18.72$, $p < .001$, $\eta^2 = .19$].

Clinicians also reported on the amount of services typically provided to instruct a client on their new ATC device. Almost all clinicians reported the number of sessions and how many minutes of those sessions, were spent on the device. About a third of clinicians reported providing less than four sessions on device instruction and in five to nine sessions. Less than a quarter provided 10-24 sessions and only a few reported providing 25-50 sessions. No one provided more than 50 sessions and no one provided 'no' services (see Table 11).

Clinicians were asked to report the minutes spent working with an individual on their device, excluding the minutes spent on other therapy goals. Less than half of clinicians reported working with the client on their ATC device for 15-30 minutes per session (36, 43.9%). About a third reported working with the device for 30-45 minutes per session (30, 36.6%). Few clinicians reported working with the device for less than 15 minutes or more than 45 minutes per session (see Table 12). By combining the median answers to these two questions, we may conclude that clients commonly spend 30-45 minutes for five to nine sessions, or about 150 to 405 total minutes (or 2 ½ to 6 ¾ hours), being trained to use their new ATC device.

It is possible that the amount of time instructing clients on ATC devices is related to the facility setting where services are provided and the number of team members who provide services. For example, it was reasoned that clinicians would provide smaller dosages of treatment to inpatients than outpatients and as the number of team members increased, the treatment dosages provided by a single clinician would decrease. A variety of statistical methods were used to examine the relationships. Answers to dosage related questions (the number of treatment sessions and the number of minutes per session) were considered ordinal data, meaning that there was an ordered ranking to the possible answers. The number of treatment sessions ranged from 1-4, 5-9, 10-24, 25-50, 50-100, and > 100 and the number of minutes per session ranged from < 15, 15-30, 30-45, 45-60, and > 60. These were given dummy codes prior being entered into a logistic regression. Severity of disability was also an ordinal variable. The settings in which services were provided were collapsed into either inpatient or outpatient settings. The number of team members was a continuous variable, with a range from 1 to 10, with a median

of 2.

Logistic regression was used to determine if treatment dosage (number of treatment sessions, minutes per session) predicted the setting in which services were provided. The median and mode number of sessions was five to nine sessions. The median number of minutes per session was 30-45 minutes and the most common answer was 15-30 minutes. Results indicated that the number of treatment sessions did not predict the presence of outpatient delivery of services (p=.39); nor did the number of minutes per treatment session (p=.31). However, minutes per treatment session did significantly predict the delivery of inpatient services (p=.04), whereas the number of sessions did not predict inpatient service delivery (p=.18).

Dosage could also be related to the number of members on a team who provide services in which larger the teams provided smaller individuals doses of treatment. To examine this possibility, a non-parametric Spearman rho correlation was conducted that included both measures of dosage (number of sessions, minutes per session) and the number of team members (M=2.1; SD=1.8). Correlations were small and non-significant. The correlation between team members and minutes per session was .06 (p=.58) and the correlation between team members and number of sessions was .16 (p=.14). Furthermore, minutes per session and number of sessions were not significantly related (-.03, p=.79).

Clinicians were asked if the amount of services they were able to provide were adequate for device instruction by rating their agreement with the statement *"The amount of services I am able to provide is adequate to instruct individuals to use their device."* About half agreed with the statement (49.4%, 40). Less than half somewhat agreed with the statement (43.2%, 35). A few clinicians disagreed with the statement

(7.4%, 6). This information was used by the online survey to direct the clinicians to one of two pages; those that stated they agreed were sent directly to a question about what barriers exist to the ideal amounts of services, whereas those that disagreed or somewhat agreed were sent to a question asking them to clarify the ideal amount of services. Almost all clinicians who were posed the question responded that they would like to provide more services for device instruction (92.7%, 38), not less (7.3%, 3).

Clinicians were asked judge whether or not the services they provide clients with ATC needs were adequate by agreeing with the statement 'The services I provide are adequate' using a likert rating scale of 'agree', 'somewhat agree' or 'disagree'. To examine whether or not judgments of 'adequacy' of services was predicted by dosage, two binary logistic regressions were conducted. Neither the number of minutes per session nor the number of sessions significantly predicted whether or not clinicians judged services as adequate ($p = .12$, $p = .34$ respectively).

Clinicians were also asked to report barriers to the ideal amount of services for device instruction. A number of options were provided and clinicians were also asked to write their own. Responders were split into two groups. The "adequate" group comprised forty clinicians that had previously indicated they believed the amount of services they were able to provide for device instruction was adequate. The "inadequate" group (forty-one clinicians) indicated they disagreed or somewhat agreed that they were able to provide adequate services. All barriers were reported by the inadequate group with higher frequency although the two groups were a similar size (see Table 13). The only exception was "client transportation" which was reported slightly more by the adequate group. When examining the groups' responses together, the most commonly

reported barrier was "unable to instruct in a natural setting" (44, 54.3%). Less than half of clinicians identified any of the following barriers: client motivation/attitudes (not related to insight), funding, client had reduced progress due to co-morbid conditions, caregiver motivation/attitudes, and client transportation. Less than a third of clinicians reported client financial burden, clinician caseload, client fatigue/ability to tolerate sessions, patient discharged from setting, or client therapy burnout as a barrier to the ideal amount of services.

Five clinicians from the adequate group and seven clinicians from the inadequate group reported other barriers to the ideal amount of services. Clinicians from both groups identified clinician comfort with new technology as a barrier. Two individuals from the inadequate group reported a lack of internet accessibility at the facility limited ATC services. Two individuals from the adequate group reported that clients with mild deficits may be too busy for therapy or do not attend scheduled appointments. Clinicians from the inadequate group identified constraints from the Medicare-Medicaid system and swift discharge from setting preventing adequate time for services once device arrives or is purchased. A full list of additional reported barriers is available in Appendix B.

Outcomes

Clinicians were asked to report the intervention outcomes, but were asked to discount clients that discontinued device use due to medical decline. Most clinicians (80, 91.0%) reported the percentage of clients who continued to use their devices for at least two years. About a third of clinicians reported that they did not follow their clients for that length of time and could not estimate a device retention rate (31.3%, 25).

A couple clinicians had less than two years experience at their work and could not estimate device retention for that reason. Few clinicians (3, 3.8%) reported that less than a quarter of their clients continued using their ATC devices. Some clinicians (17, 21.3%) reported that 25-50% of clients continued using their ATC devices. About a third of clinicians (23, 28.8%) reported that over half of their clients continued device use. A few clinicians (10, 12.5%) reported that almost all of their clinicians continued device use (see Table 14). Seven clinicians added comments to their responses, most reporting that they do not track clients for two years or clients are unavailable for follow-up after this interval (See Appendix B).

Clinicians reported the reasons, or their best guesses, that ATC devices were abandoned by their clients. Most clinicians (80, 91.0%) reported at least one abandonment reason (see Table 17). The most common reason, reported by more than half of clinicians (52, 65.0%) was the client did not use device with consistency (e.g. setting alarms daily, adding appointments as needed). Less than half of clinicians reported one of the following reasons: device lost (31, 38.8%), device broken (26, 32.5%), client usually forgot to wear/check device (24, 30.0%), technical issues- assistance not sought by client or caregiver (24, 30.0%), poor insight into deficits (23, 28.8%), medical decline of the client (22, 27.5%), or client unable to adapt device/program to changes in daily life (e.g. changing usual alarm time) (20, 25.0%). Less than a quarter reported one of the following reasons: client did not view device as useful- not related to insight, device became obsolete and no longer supported by manufacturer/service provider, caregiver not able/willing to assist with device maintenance, caregiver unable to adapt device/program to changes in daily life, device not charged, client did not like

device, caregiver did not view device as useful, caregiver forgot to program device, or device not optimal for client. Few clinicians reported the following reasons: client not willing/able to pay recurring costs/fees associated with use, change of caregiver, unable to provide service for device maintenance, technical issues unable to be remedied with assistance, instruction insufficient due to funding, medical decline of caregiver, or instruction insufficient due to other reasons(s). A few clinicians were not able to provide an accurate guess about device abandonment because none of their clients discontinued device use (2, 2.5%), their clients did not progress past initial instruction with their device (13, 16.3%), or they do not follow up with clients and could not guess (16, 20.0%).

Nine clinicians provided additional reasons their client discontinued ATC device use, including: too many devices, client did not like being "told" what to do all the time even though it was a PDA and not a person, and "most ABI/TBI clients cannot use and program devices without caregiver support" (See Appendix B).

Most clinicians (88, 92.0%) reported whether they had observed any instances of spontaneous generalization of ATC skills in their clients. Over half of clinicians reported at least one of their clients had begun to use their device in new, untaught ways (43, 53.1%). About a third reported that they did not follow-up with clients and could not give an accurate answer (31, 38.3%). Few reported their clients did not progress past initial instruction or showed no evidence of spontaneous generalization. Those who replied their clients had expanded use of their devices independently were prompted to provide details. Twenty-four clinicians reported their clients discovered new apps to use on smartphones and other devices. These apps included: PTSD tracking, headache logs, relaxation breathing, entertainment, music, videos, diet and exercise

monitoring, money management, grocery apps, memory games, project management, organization, planning, calendars, prospective memory, and taking notes. Other responses included: generalizing skills to new settings (e.g. academics or work, four responses), expanding use of speech to text smartphone option to novel functions (two responses), cognitive training software/games (two responses), updating devices (two responses), and entertainment (two responses). See Appendix B for a complete list.

Discussion

The purpose of the present study was to update and expand upon reports of clinician ATC experiences including: intervention targets, devices, trainers, instruction methods, treatment dosage, client outcomes, and barriers. The most recent survey of clinicians in this area of practice was published by Hart et al. in 2003. Changes in the technology available to consumers and instructional resources available to clinicians (Sohlberg & Turkstra, 2011; Ehlhardt, 2008) since that time warranted an updated report on ATC services being provided outside the research paradigm. What follows is a discussion of the results of the current survey in the context of previous findings.

Survey Population

In order to put the current study in context, the participant group will be discussed. Clinicians in the current survey were all SLPs and overwhelmingly female, similar to national trends (ASHA, 2009). The clinicians in Hart's survey were also mostly female, but hailed from a variety of disciplines associated with rehabilitation. In their sample, SLPs comprised less than a quarter of the sample. The mean age of clinicians in the current survey was 46, similar to the national average of working SLPs (43, ASHA, 2009) and ten years older than the mean age of the clinicians in Hart's survey. About half of the current group had more than twenty years experience in the field and another third had ten to twenty years experience (median of ten to nineteen years). Hart's clinicians worked a mean of seven years at the time of survey completion. According to data gathered by the ASHA the mean years experience for all SLPs working in health care is about seventeen years. The current sample's experience level is similar to

nationwide averages, but more than Hart's sample.

The current sample of clinicians is distinct from most clinicians nationally and similar to Hart's clinicians as they were recruited via mostly online methods, likely had an interest in ATC which sparked their interest in the study, and had provided ATC services at least once. These recruitment methods yielded a sample of clinicians who likely had greater than average ATC knowledge, interest, and experience.

Similar to Hart, a high number of clinicians reported working in inpatient and outpatient medical settings. Clinicians in the current study reported serving clients with stroke and TBI most often. Clinicians in Hart's study were recruited from rehabilitation centers participating in the Traumatic Brain Injury Model System program and a conference on ATC for TBI. The sample sizes for each study were similar. Importantly, clinicians in Hart's survey were recruited with any level of ATC experience while clinicians in the current survey were required to have provided ATC services at least once. Overall, the current study group is similar to Hart's survey population and national data in important ways; however, the samples for the two survey studies differ significantly in profession and experience.

Intervention Targets and Devices

What are the intended target areas of ATC interventions for individuals with ABI?

Prospective memory was the most common intervention target discussed in the efficacy literature. There is emerging and promising evidence for the use of ATC for other cognitive areas including navigation and executive functioning (EF) (De Joode et al., 2010, Gillespie et al., 2012). Clinicians from Hart et al.'s sample reported

high expectations for ATC interventions targeting areas of memory/learning and organization/planning. Reported intervention targets in the current study fell in line with the expectations of Hart's sample. Popular targets included: calendars and schedules, to do lists, alarms and reminders, writing and recording notes, managing contacts, and task directions.

These interventions primarily help users compensate for memory and EF deficits. According to Gillespie et al., memory and EF are supplemented by alerting, reminding, storing and displaying, and micro-prompting device functions (2012). Portable ATC technologies are ideal for these tasks as they expand upon previously available paper-based and non-portable devices. For example, a cell phone may be an ideal ATC device to remind an individual to take her pills. This small device can fit in a purse or on a belt, emit a loud sound to alert the user to the task, and display a text message with task specifics, such as "Take one large white tablet from your pill box." A paper reminder schedule would not beep and an alarm clock would not display a reminder message, nor travel with the user. The expanded functionality and portability of many popular devices make ATC the ideal intervention strategy for these target areas. Hence, clinicians reported commonly using ATC for the interventions at which it excels.

More than half of the clinicians in this study reported providing ATC services for retrospective memory journaling and navigation. These were not mentioned as likely intervention targets by Hart's clinicians. Retrospective memory journaling is an intervention long recommended by rehabilitation professionals to augment memory and completed in paper journals that likely has simply transferred to ATC devices (Murray & Clark, 2006). Many ATC devices offer increased storage, increased

organization of journal entries, automatic reminders to complete entries, and are smaller than paper journals.

Several studies have provided evidence for the efficacy of ATC to target navigation (Gillespie et al., 2012; Sohlberg et al., 2007; Kirsch et al., 2004). Global positioning systems are now standard on many smartphones and used often by the general public. Navigation relies on memory and EF systems, which are already being supplemented by ATC for other tasks. Over half of clinicians in the present study reported providing ATC services to increase the independence and safety of their clients while navigating. Hart et al. did not include navigation as one of the possible areas for remediation in their survey.

What ATC devices do clinicians use themselves? And what devices do they provide to clients with ABI?

ATC compliments, replaces, and expands upon paper-based and other aids (DePompei et al., 2008). The portability and capability of technology has increased in recent years, lending itself well to therapeutic purposes (Gillespie, 2012). According to the current sample of clinicians, the most popular ATC devices include: smartphones, digital voice recorders and tape recorders, tablets, alarm watches, PDAs, medication reminder alarms, iPod Touches, desktop/laptop computers, GPS navigation systems, and alarm clocks (as reported by more than half of clinicians). Smartphones were the runaway favorite, reported by over 80% of the sample. Digital voice recorders and tape recorders were reported by three-quarters of the sample. Notably, the top seven choices are portable. This is in contrast to the experiences of the clinicians in Hart's

sample. Only half of Hart's clinicians reported using any portable ATC devices with clients and two-thirds reported using desktop or laptop computers with clients. The use of portable devices in the current study outpaced the use of desktop and laptop computers by over twenty percentage points. The reverse was true in the previous study by Hart, indicating a new practice trend towards portable devices.

PDAs, the NeuroPage, cell phones, and voice recorders are the most common devices to appear in the rehabilitation efficacy literature (De Joode et al., 2010). There is additional literature on the efficacy of medication reminder alarms from the medical and pharmacological research communities (Laster et al., 1996; Chang et al., 1991). This is somewhat congruous with devices currently prescribed by clinicians. The literature on PDAs, cell phones, and several dedicated devices (e.g. alarm watches, GPS systems) is applicable to the discussion of smartphones as these technologies have many of the same capabilities. However, to date there have been only two papers on the efficacy of a smartphone and none on tablets known to this writer and reviewed by DeJoode et al. in their meta-analysis (De Joode et al., 2010; Svoboda & Richards, 2009; DePompei et al., 2008).

In Hart's sample, more than two-thirds of clinicians reported no or little confidence in their ability to instruct a client to use ATC. Few clinicians were 'very confident' in providing ATC services. In their analysis, clinicians who used portable devices themselves and with clients were more confident in their ATC skills. In the current study, all clinicians reported personal use of at least one type of portable ATC (including the smartphone, digital voice recorder, tablet, watch with alarm, iPod Touch, GPS navigation system, SmartPen, Cell phone, Pager, and Two-way Pager).

Almost all clinicians in the current sample reported personal use of a smartphone and use of smartphones with clients. The current study did not ask about clinician confidence in ATC instruction. Clinician confidence in providing ATC services might be higher than levels reported in 2003 as the factors previously associated with clinician confidence (personal and client exposure to ATC) appear to have shifted. However, as discussed above, these two groups of respondents differed based on their use of ATC for ABI. Additionally, clinician resources on ATC instruction methods have been made available in recent years, and may have had the result of reducing variability in clinical instruction and improve the confidence of some clinicians (Ehlhardt et al., 2008; Sohlberg & Turkstra, 2011).

Service Providers

Who (what professionals) provides ATC services?

Clinicians in the current survey were all SLPs who had some experience with ATC. These clinicians reported that they were the primary providers of ATC services, including recommendation, selection, instruction, and trouble-shooting. About a quarter of clinicians reported OTs were also a primary instructor. Other disciplines were usually reported as "involved" but not primary contributors. Providing rehabilitation for cognitive deficits, including training compensatory device use and strategies, falls under the scope of practice of both speech-language pathologists and occupational therapists (American Speech-Language Hearing Association, 2005 & 2007; American Occupational Therapy Association, 2004). Reports of occupational therapy involvement were lower than expected, which might reflect their absence in the sample pool and not

their involvement in ATC services. Responses by occupational therapists were removed from the data set due to a low response rate. Finally, clinicians reported a high amount of client and family involvement throughout the therapy process.

Instruction

What instructional methods do clinicians use when teaching individuals with ABI to use ATC? Does this vary predictably based on the severity of the patient?

ATC instruction is a multi-stage process from learning device basics to applying the technology to everyday situations. Teaching one client to use one device might take a wide arsenal of instructional methods. The scattered responses about instructional methods might indicate the complexity of device acquisition or clinicians' struggle to apply methods judiciously.

According to the instructional literature, an emphasis should be placed on instructional trials with a reduction in demonstrations and explanations (Ehlhardt et al., 2008). This is in contrast to the high number of clinicians in this survey who reported using demonstration as an instruction method with all types of clients. However, clinicians were not asked how often during the instructional process they use demonstration in comparison with other methods. The second most popular instruction method was direct instruction in step-by-step procedures, used with both mildly and severely impaired individuals. This finding is in line with current recommendations and client preference for primarily hands-on training (Ehlhardt et al., 2008; Hart, Buchhoffer, & Vaccaro, 2004).

Three quarters of clinicians reported using written instructions with

individuals with mild cognitive deficits, likely indicating these clients' increased ability to practice outside of therapy with minimal guidance. Yet, two-thirds of clinicians also used written instructions with individuals with severe impairments. Clinicians were unable to give details about whether written instructions were used by clients or families and the level of complexity of the instructions. Many clinicians also reported using voice, picture, and video instructions- all of which might be appropriate for a client with ABI.

Task analysis is an integral part of direct instruction and rehabilitation in general as it means to break down complex tasks into smaller goals. This method is helpful to instruct and measure the progress of a variety of clients. Two-thirds of clinicians reported employing this strategy with individuals with mild deficits and less than half with severe impairments. The lower response rate might indicate that clinicians are not always aware of using this method with clients or that they are not using the method to its full potential for instruction.

Errorless learning procedures and trial and error learning are in contrast to one another, yet both were commonly reported by clinicians. Trial and error methods were used by over three quarters of clinicians when teaching clients with mild cognitive deficits, whereas only about a quarter used this method with severely impaired clients. The mildly impaired group is more likely to benefit from a less structured therapy approach as they have more cognitive resources to problem solve device use. Two-thirds of clinicians reported using errorless learning methods with individuals with severe deficits while less than half used them with mildly impaired clients. Errorless learning methods were reported less overall compared with error-full learning despite the advantages of constraining errors in both client groups (Ehlhardt et al., 2008).

Shaping behavior and fading cues is most useful when clients are initially unable to complete the desired task with high accuracy given the maximum cuing level (Sohlberg & Turkstra, 2011). This method was used by two thirds of clinicians to instruct clients with severe deficits, the primary population to benefit. Half of clinicians also reported using it with individuals with mild deficits. This is surprising as several clinicians reported using both trial and error learning methods (low structure) and shaping behavior (high structure). Clinicians were not given the opportunity in the survey to describe more fully when they used these methods.

Clinicians reported using more instructional methods with individuals with mild disabilities than those with severe disabilities. This was expected as clients with mild disabilities have access to greater cognitive resources and therefore are able to utilize a wider variety of instruction methods. Additionally, mildly impaired clients are more likely to use more complex devices for more complex tasks, necessitating a more complex instruction phase. In summary, clinicians reported using many methods appropriately to instruct clients with mild and severe deficits; however, not all methods appear to be used to their full potential.

Dosage and Barriers

What is the treatment dosage for individuals with brain injury to use ATC? Does this vary predictably by treatment setting?

Dosage is defined as the frequency of sessions, duration of sessions, and the span of time over which sessions occur. The ATC efficacy literature reported a wide range of dosages and many studies did not include that information (De Joode et al.,

2010, Ehlhardt et al., 2008). Clinicians in the current study reported providing a median of five to nine, 30-45 minute sessions, or about 2.5-6.5 hours of ATC instruction services. This is a fraction of the sixteen hours of services provided by Svoboda and Richards, who trained a client with focal memory impairment to use a smartphone (the most popular technology reported in this study).

Through a variety of statistical analyses we compared reported dosage to setting (inpatient or outpatient) and number of team members providing services. The relationship between dosage and these factors did not reach statistical significance, except that inpatients appear to receive shorter sessions. Clients are not receiving more services for ATC instruction in a particular phase of recovery (inpatient or outpatient) and are not receiving less SLP services because other team members are involved. The low number of hours spent with each client to provide instruction services remains surprising, especially as the most common technology reported (the smartphone) is complex. This evidence begs the question of whether clinicians outside the research paradigm are providing more efficient services or less effective services than those whose treatments are published.

Are there relationships between the dosage of ATC services and the clinicians' opinion of the adequacy of these services?

Only about half of clinicians reported they were able to provide an adequate amount of services. Clinicians' opinion of the adequacy did not vary predictably by treatment dosage (sessions or minutes) as expected. Those who provided a lower dosage were not more likely to report that services were not adequate. This might

indicate that it is the quality, not quantity, of those sessions that impacts a clinicians' perception of adequacy.

What barriers prevent clinicians from providing more ATC services?

Clinicians did not report any one barrier to services with an overwhelming majority. The most common barriers reported were "unable to instruct in a natural setting" and "client motivation and insight," which are barriers to almost all types rehabilitation and not specific to ATC. Even those barriers were only reported by about half of the clinicians. Funding and the financial burden on the client were only a barrier to services according to about a third of clinicians. This is surprising as the clinicians in Hart et al. expected cost to be a primary barrier to ATC use. Possibly, clinicians and third party payers are cooperating to provide ATC services for adults with ABI in a way that is different from ten years ago. Or, clinicians have become more confident in providing these services and they are better able to document the medical necessity of ATC services to payers. Also, clinicians who have never provided ATC services due to third party constraints were not included in the sample, as all clinicians were required to have provided services at least once.

A few clinicians did write-in that clinician comfort with technology remains a barrier to ATC services. Clinician comfort with technology appears to be improving as a majority of the current clinicians personally used smartphones, a new technology. More also wrote that limited internet access at their facility was a barrier to ATC services. This will hopefully fall away as the cost and availability of reliable internet services continues to improve across the globe. Rehabilitation departments may wish to

collaborate with therapeutic recreation and other stakeholders to present a cost-benefit report on facility-wide wireless internet access to administrators. The report should highlight potential improvement in the independence and quality of life of residents in the technology age.

Outcomes

What are the reported outcomes of ATC interventions?

About a third of clinicians reported that they do not follow their clients for more than two years and could not estimate device retention rates and reasons for device abandonment. Many reported that once a client is discharged from a setting, no further follow-up is available. Unfortunately, clinicians who do not or are not able to follow-up with clients about device use cut off a critical portion of education for the clinician. Without feedback on what systems work for which clients and why, clinicians are bound to continue their practice patterns instead of improving upon them. Health care systems, especially outpatient care, would likely improve the quality of therapy services and generate business by encouraging clinicians to follow-up periodically with discharged clients.

Clinicians reported a range of ATC retention rates, most 25-75%. Few reported that all of their clients continued device use or that less than a quarter continued use. All of DePompei et al.'s participants continued device use after one year (2008), while only about half of Kim et al.'s participants continued device use (2000). The participants in Wilson et al. frequently discontinued device use after a few weeks, however this was because by that time the clients had learned their routines and no longer

needed the devices (2001). By this writer's observation, most ATC studies (like the clinicians who read them) did not follow-up with clients long term and could not report whether ATC users continued to successfully use their devices. There have been no previous reports of device retention rates outside the research paradigm known to this writer, and therefore this information can not be compared to previous rates.

When clients fail to maintain device use, what are the reasons?

Clearly, some proportion of clients abandon their ATC devices after discharge from therapy. Clinicians identified several reasons clients discontinued use. The most common reason was the client did not use the device with consistency, identified by more than half of clinicians. This reason is similar to another popular response: clients usually forgot to wear/check device. This relates to the earlier report that the primary barrier to ATC services is the inability to provide services in a natural setting. Clinicians appear to have difficulty instructing clients to generalize skills to outside the clinic setting, given that most services are provided in a formal clinic setting, such as a hospital. Clinicians reported that clients abandon their devices upon returning home, not having received the skills to carry-over device use. About five percent of clinicians reported working for home health in the current sample, compared to only 15% nation wide (ASHA, 2009). For clinicians affiliated with a medical setting, they must improvise and create real world applications of ATC within the clinic and/or hospital. .

Wilson et al. reported that not all individuals need to use their devices indefinitely (2001). In their sample, individuals who used the NeuroPage to learn a routine discontinued device use after a few weeks as they no longer needed the device.

This study omitted an answer option for clinicians to indicate that clients discontinued use because they had met their goals with the device and no longer needed it. However, clinicians were given the option to write-in their own reasons and this was not reported.

Other commonly reported reasons for abandonment include: device lost, device broken, and technical issues- assistance not sought by client/caregiver. For a variety of cognitive and physical reasons, adults with brain injury are more likely than an uninjured adult to lose, drop, forget, become frustrated with, and make poor decisions about a device. This is relevant to the discussion about which devices are optimal for individuals with brain injury. Smartphones were the most commonly reported ATC device in this study; however, these devices have a glass screen that is easily cracked or shattered by unimpaired adults, including this writer on two occasions. These devices are new technology and therefore prone to theft. Adults with brain injury might also make the kinds of decisions that would leave them more vulnerable to theft, such as forgetting to lock a car with a device inside. Reduced fine motor skills (a barrier identified by clinicians in Hart's survey) would increase the likelihood a device will be dropped while in use. Difficulty problem solving and initiating would likely contribute to an increased rate of technical issues with devices. A client might have difficulty with a feature of their device, they are not able to fix it themselves through trial and error, and might not ask for assistance, instead the item is "broken" and is put in a drawer. Collaboration with occupational therapy services and other stakeholders may help anticipate some of these difficulties and prevent ATC abandonment. For example, devices can be attached to the user by clip or lanyard (DePompei et al., 2008). Clinicians in the current study identified applications that will give the location of a client or device if lost.

About a quarter reported that the client did not view the device as useful (not related to insight) or the caregiver was not able/willing to assist with device maintenance. Both of these factors might be improved with enhanced customization of therapy goals to facilitate client/caregiver buy-in. Essential to all rehabilitation is the ability of the clinician to connect skills to functional outcomes and ATC services are no different. DePompei et al. found that adolescents were more likely to have a positive attitude about their device if they were also taught to use "fun" features, such as games, customized backgrounds or cases, and photos. One of their participants commented, "It helps me to remember to do homework and use phone numbers. I like the size and the case. It just makes me feel cool."

When clients succeed with their devices, how often do they generalize their skills in new, untaught ways?

The hope of all clinicians teaching ATC skills is their clients will customize their ATC experience to foster greater independence in the real world. Most clinicians reported their clients used their devices in new, untaught ways. Clients often seek out new apps on their smartphones, as many non-impaired adults do. Effective therapy would also include strategy training on how to select appropriate and useful apps that will help clients self-compensate once they are discharged from therapy.

Limitations and Future Research

The present study was limited by several factors. First, the sample included only SLPs. Attempts were made to attract responses from individuals from other

disciplines, but an insufficient number responded to be included in the sample. This may have an effect on who reportedly provides services, instruction methods used, and how often ATC is used.

The recruitment methods likely yielded a sample of clinicians who were more likely to have interest and experience with ATC. Those who had not provided ATC services were asked to discontinue the survey as their responses would be less meaningful when reporting instruction methods and barriers. By introducing this variable, it eliminated all individuals who were prevented from providing ATC services and those who usually referred these clients to a colleague. Therefore, the current study might overestimate the rate of ATC exposure and use. It might underestimate the effects of barriers such as cost. For example, if a clinician knows her MAC (Medicare Administrative Contractor) will not reimburse for ATC services, she will experience a significant funding barrier. This individual would not have been able to participate in the current study, leading to an underestimation of barriers to service.

An important finding of Hart et al. 2003 was that clinicians did not feel confident in providing ATC services. Although clinicians' confidence was not obtained in the current study (due to survey length), it is unlikely that this was the case given clinicians' report of their own use of ATC for personal and/or professional reasons.

The current study enhanced our understanding of the instruction methods clinicians use to instruct clients with mild and severe deficits to use ATC. The resulting data make it clear that clinicians use a variety of instruction methods. Clinicians were not able to provide information about how much they used each method and with which devices. Additionally, spaced retrieval, an important method in the literature,

was omitted from the list of methods. Three clinicians wrote in this method, but the prevalence of use is not currently known.

Future research should focus on the device maintenance problem encountered by clinicians in this study. Clinicians are not able to treat in a natural context and clients have difficulty using their devices consistently in the real world. Clinicians use a variety of instruction methods, but appear to struggle in creating durable outcomes. The current study merely provides a head count of the number of clinicians who use an instruction method with mild or severely impaired clients, even if they use it rarely. An in-depth survey or observational study would report the frequency methods are used, with which clients, functions, and devices and connect them to outcomes. The perspectives of individuals with ABI who have used or desire to use ATC would be valuable. This information has the potential to report gaps in clinical practice, which could shape instructional literature and education materials to suit the current needs of clinicians.

Further research should provide evidence on the efficacy of smartphones with clients with ABI. This relatively new technology is widely used yet under-represented in the literature. These devices are easily broken, lost, and stolen, presenting additional challenges to successful implementation. Smartphones are also complex, dynamic devices that are difficult to use for clients with fine motor, visual, or cognitive deficits.

Research is needed into clinician confidence in providing ATC services. Many factors related to clinician confidence appear to have improved, e.g. more clinicians are portable ATC users themselves. Instructional literature and web resources have expanded since Hart's clinicians reported low confidence levels in 2003. Additional measures might compare clinician confidence to instructional methods and

client outcomes.

Finally, a sample of participants representing several disciplines with a variety of ATC experience (including no experience) should be polled on many of the same questions addressed here. The depth of involvement of disciplines other than speech-language pathology in ATC is likely under-represented here. The instructional methods used and barriers experienced by other disciplines might be different and illuminating. A more varied participant sample would report on ATC's prevalence in cognitive rehabilitation. This would allow a more nuanced discussion of technology trends in cognitive rehabilitation and how these devices and skills trickle down to all types of clients and clinicians.

Summary and Clinical Significance

The current study expanded on previous reports of clinician experiences with ATC. Previous studies provided positive evidence for clients with ABI to use ATC. A decade ago, clinicians reported little experience and low confidence in training clients to use ABI and most clients were still using paper methods.

The current study begins to illustrate current ATC clinical practice, outcomes, and barriers. Clinicians used new, portable devices to target memory, organization, planning, and navigation- the very targets at which these devices excel. Clinicians reported using a variety of different methods to train individuals to use these devices and tailor their treatments to the skills of the client, although they may not use all methods to their full potential. Training dosage was usually under seven hours, and many report this to be adequate. Those who provided less services were not more likely to report

that the amount of services was inadequate. Surprising to the researchers, cost and third party funding were not primary barriers to service. Clinicians did not overwhelmingly agree on any single barrier as impeding their ability to provide services, although half identified their inability to provide treatment in a natural setting as a barrier. Clinicians reported a wide range of device retention rates (25-75%) and many stated they could not estimate retention as they do not follow-up with clients. The lack of follow-up is troubling at a clinical and system-wide level, as it allows clients to fall through a web of support and prevents clinicians from gaining valuable feedback about their services. Clinicians guessed their clients abandoned their devices for a variety of reasons. Many reported their clients simply did not use their devices consistently. This is a maintenance and generalization problem, which is negatively impacted by a clinician's inability to train in a natural context and the overall low dosage of services. Further research should focus on how we can best support clinicians in promoting long-term ATC outcomes.

Tables

Table 1. Demographics, Sex and Age (N=87)

Demographics, Questions 3,4, & 6					
Sex	Female			Male	
	89.7% (78)			10.3% (9)	
*Age in years**	Range 24.5-65.3	Mean 46.4	Median 48.2		SD 11.8
Years in Profession	0-2	3-5	6-9	10-19	20+
	2.3% (2)	13.6% (12)	6.8% (6)	29.5% (26)	47.7% (42)
*1 participant listed a birth date in 2012, likely in error, and has been removed from analysis					

Table 2. Demographics, Employment Setting (N=88)

Question 7. Where do you currently work? Select the setting/s that best characterize/s where you work. If not currently employed, list your most recent work setting. You may wish to select more than one answer.

Medical: Outpatient	59.1% (52)
Medical: Inpatient Rehabilitation	36.4% (32)
Medical: Acute Care	28.4% (25)
University/College Clinic	17.0% (15)
Medical: Long-Term Nursing Facility	10.2% (9)
Private Practice/Clinic	6.8% (6)
Medical: Home Health Agency	4.5% (4)
Federal Uniformed Service	2.3% (2)
Medical: Assisted Living Facility	1.1% (1)
Adult Day Care Center	0.0% (0)
Educational: School	0.0% (0)
Research Agency or Facility	0.0% (0)
Public Health Department	0.0% (0)
Other (please specify)	10.2% (9)

Table 3. Diagnostic Groups Served (N=88)

Question 9. For which diagnostic groups have you: -Recommended the use of an electronic aid -Selected a specific electronic aid -Instructed clients in the use of a specific electronic aid -Provided clients with follow-up support for an electronic aid

Traumatic Brain Injury	96.6% (85)
Stroke	75.0% (66)
Anoxia/Hypoxia	43.2% (38)
Multiple Sclerosis	38.6% (34)
Aneurysm	34.1% (30)
Tumor	34.1% (30)
Dementia	34.1% (30)
Parkinson's Disease	26.1% (23)
Encephalitis	18.2% (16)
Meningitis/Septicemia	8.0% (7)
Toxicity	6.8% (6)
Huntington's Disease	3.4% (3)
Other (please specify)	11.4% (10)

Table 4. ATC Intervention Targets (N=88)

Question 11. Below is a list of functions. Which ones have you recommended or instructed on any device?	
Calendars/ Schedules	98.9% (87)
To Do lists	95.5% (84)
Alarms/ Reminders	94.3% (83)
Writing/Recording notes	88.6% (78)
Managing contacts	71.6% (63)
Step-by-step task directions	69.3% (61)
Retrospective memory journaling	63.6% (56)
Navigation	51.1% (45)
Managing money	45.5% (40)
Other: Please tell us what other functions you use.	22.7% (20)

Table 5. ATC Devices used by Clients and Clinicians (N=88/81)

Question 10. Which of these electronic devices have you used (recommended, selected, instructed) with clients?
Question 28. What devices do/did you use in your personal and professional life? Include any device you use now or have used in the past. Check all that apply.

	Client	Clinician
Smartphone (such as an iPhone) or other cell phone with multiple functions	81.8% (72)	86.4% (70)
Digital voice recorder or tape recorder	75.0% (66)	39.5% (32)
Tablet (such as an iPad)	71.6% (63)	54.3% (44)
Watch with alarm	67.0% (59)	29.6% (24)
Portable Electronic Aid (PDA)/ Electronic Organizer	64.8% (57)	22.2% (18)
Medication reminder alarms (such as Dose Alert Pill Reminder)	61.4% (54)	11.1% (9)
iPod Touch (sometimes called iTouch)	60.2% (53)	85.2% (69)
Desktop/ Laptop computer	59.1% (52)	91.4% (74)
GPS navigation system	52.3% (46)	75.3% (61)
Alarm clock	50.0% (44)	82.7% (67)
SmartPen	46.6% (41)	37.0% (30)
Text messaging using a cell phone	43.2% (38)	85.2% (69)
Voicemail message system	18.2% (16)	85.2% (69)
Pager	10.2% (9)	37.0% (30)
Two-way pager or "walkie-talkie"	2.3% (2)	7.4% (6)
CB radio	0.0% (0)	3.7% (3)
Other (please specify)	11.4% (10)	0.0% (0)

Table 6. Device Recommendation (N= 85)

Question 12. In column one, select all of the individuals who are involved in deciding that an electronic aid is needed for a client. In column two, select the primary individuals involved in deciding that an electronic aid is needed for a client. This may be a smaller group.

	Primary Deciders	All Individuals Involved
Speech-Language Pathologist	85.9% (73)	96.4% (82)
Client	88.2% (75)	96.4% (82)
Client's Family, Care Provider, or Other Supportive Individuals	58.8% (50)	90.6% (77)
Occupational Therapist	16.5% (14)	50.6% (43)
Neuropsychologist	10.6% (9)	47.1% (40)
Physician	5.9% (5)	44.7% (38)
Vocational Counselor	4.7% (4)	37.6% (32)
Physical Therapist	0.0% (0)	23.5% (20)
Nurse	0.0% (0)	21.2% (18)
Recreational Therapist	0.0% (0)	16.5% (14)
Rehabilitation Psychologist	1.2% (1)	12.9% (11)
Rehabilitation Engineer	1.2% (1)	4.7% (4)
Other		7

Table 7. Device Selection (N= 84)

Question 13. In column one, select all the individuals involved in selecting a device for a client. In column two, select the primary individuals involved in selecting a device for a client. This may be a smaller group.

	Primary Selectors	All Individuals Involved
Speech-Language Pathologist	83.3% (70)	98.9% (83)
Client	88.1% (74)	96.4% (81)
Client's Family, Care Provider, or Other Supportive Individuals	45.2% (38)	85.7% (72)
Occupational Therapist	13.1% (11)	35.7% (30)
Neuropsychologist	2.4% (2)	14.3% (12)
Vocational Counselor	2.4% (2)	13.1% (11)
Physician	1.2% (1)	11.9% (10)
Physical Therapist	1.2% (1)	8.3% (7)
Nurse	1.2% (1)	7.1% (6)
Rehabilitation Engineer	3.6% (3)	6.0% (5)
Recreational Therapist	0.0% (0)	3.6% (3)
Rehabilitation Psychologist	0.0% (0)	3.6% (3)
Other		4

Table 8. Device Instruction (N= 82)

Question 15. In column one, select all the individuals who instruct clients/families to use devices. In column two, select the primary the individuals who instruct clients/families to use devices.

	Primary Instructors	All Individuals Involved
Speech-Language Pathologist	95.2% (80)	97.6% (82)
Occupational Therapist	23.8% (20)	42.9% (36)
Nurse	2.4% (2)	17.9% (15)
Neuropsychologist	2.4% (2)	13.1% (11)
Physical Therapist	1.2% (1)	13.1% (11)
Vocational Counselor	1.2% (1)	11.9% (10)
Recreational Therapist	1.2% (1)	7.1% (6)
Rehabilitation Engineer	2.4% (2)	4.8% (4)
Physician	0.0% (0)	4.8% (4)
Rehabilitation Psychologist	0.0% (0)	3.6% (3)
Other		8

Table 9. Device Follow-up (N= 78)

Question 24. In column one, select all the individuals involved in providing follow-up and troubleshooting for client device use. Select all that apply. In column two, select the primary individuals involved in providing follow-up and troubleshooting for client device use. Select all that apply. This may be a smaller group.

	Primary Follow-up Individuals	All Individuals Involved
Speech-Language Pathologist	87.2% (68)	89.7% (70)
Occupational Therapist	21.8% (17)	42.3% (33)
Vocational Counselor	5.1% (4)	18.0% (14)
Nurse	2.6% (2)	12.8% (10)
Recreational Therapist	1.3% (1)	9.0% (7)
Physical Therapist	1.3% (1)	7.7% (6)
Rehabilitation Engineer	5.1% (4)	7.7% (6)
We do not provide these services	2.6% (2)	7.7% (6)
Rehabilitation Psychologist	1.3% (1)	3.8% (3)
Physician	0.0% (0)	3.8% (3)
Other		11

Table 10. Instruction Methods (N= 82)

Question 16. In column one, select the methods you would likely use to instruct a client with a mild cognitive deficit. Select all that apply. In column two, select the methods you would likely use to instruct a client with a severe cognitive deficit. Select all that apply. You will have the opportunity to describe additional methods in the next question.

	Mild Cognitive Deficit	Severe Cognitive Deficit
Demonstration	89.0% (73)	79.3% (65)
Direct Instruction in Step-by-Step Procedures	81.7% (67)	80.5% (66)
Written Instructions	76.8% (63)	63.4% (52)
Trial and Error	72.0% (59)	25.6% (21)
Task Analysis	67.1% (55)	47.6% (39)
Quizzing	62.2% (51)	37.8% (31)
Effortful Processing	58.5% (48)	29.2% (24)
Verbal Elaboration	52.4% (43)	23.1% (19)
Shaping Behavior and Fading Cues	50.0% (41)	68.3% (56)
Errorless Learning	44.0% (36)	68.3% (56)
Verbal Scripting	37.8% (31)	28.0% (23)
Imagery	35.4% (29)	18.3% (15)
Not Applicable: I do not provide these services	0.0% (0)	9.8% (8)
Other		17

Table 11. Session Quantity (N= 82)

Question 18. Regardless of session length, about how many sessions were provided to instruct a client to use their device?	
I do not provide these services	0.0% (0)
0-4	36.6% (30)
5-9	36.6% (30)
10-24	19.5% (16)
25-50	7.3% (6)
50-100	0.0% (0)
100+	0.0% (0)

Table 12. Minutes with Device per Session (N= 82)

Question 19. Regardless of session length, about how much time did you spend working with an individual on their device per session? For example, if you spent 20 minutes of a 45 minute session on the device, you would answer 15-30 minutes. If you spent 20 minutes of a 20 minute session on the device, you would also answer 15-30 minutes.	
I do not provide these services.	0.0% (0)
Less than 15 minutes	3.7% (3)
15-30 minutes	43.9% (36)
30-45 minutes	36.6% (30)
45-60 minutes	13.4% (11)
More than 60 minutes	2.4% (2)

Table 13. Barriers to Ideal Amount of Services (N= 40/41/81)

Question 21 or 23. What barriers impede your ability to provide the ideal amount of services for device instruction? Select all that apply.

	Adequate Group	Inadequate Group	Total Responses
Unable to instruct in a natural setting	45.0% (18)	63.4% (26)	54.3% (44)
Client motivation/attitudes (not related to insight)	37.5% (15)	53.7% (22)	45.7% (37)
Funding	30.0% (12)	48.8% (20)	39.5% (32)
Client had reduced progress due to co-morbid conditions	30.0% (12)	43.9% (18)	37.0% (30)
Caregiver motivation/attitudes	27.5% (11)	43.9% (18)	35.8% (29)
Client transportation	37.5% (15)	31.7% (13)	34.6% (28)
Client financial burden	22.5% (9)	39.0% (16)	30.9% (25)
Clinician caseload	12.5% (5)	43.9% (18)	28.4% (23)
Client fatigue/ability to tolerate sessions	22.5% (9)	31.7% (13)	27.2% (22)
Patient discharged from setting	20.0% (8)	31.7% (13)	25.9% (21)
Client therapy burnout	7.5% (3)	19.5% (8)	13.6% (11)
I do not provide these services	0.0% (0)	0.0% (0)	0.0% (0)
Other	12.5% (5)	17.1% (7)	14.8% (12)

Table 14. Clients Who Continued Device Use (N= 80)

Question 25. What percentage of your clients continued to use their devices for at least 2 years? Please exclude clients who abandoned their devices due to medical decline.	
My client(s) did not progress past initial instruction with their devices.	0.0% (0)
I do not follow up with clients and can not estimate this value.	31.3% (25)
I have less than two years experience at my work and can not estimate this value.	2.5% (2)
0-25%: Few of my clients continued to use their devices	3.8% (3)
25-50%: Some of my clients continued to use their devices	21.3% (17)
50-75%: Most of my clients continued use of their devices	28.8% (23)
75-100%: Almost all of my clients continued use of their devices	12.5% (10)

Table 15. Clinician Reports of Device Abandonment Reasons (N= 80)

Question 27. Thinking of your clients only, what were the reasons, or your best guesses, that they discontinued device use? Please mark all applicable answers and consider writing your own.

Client did not use device with consistency (e.g. setting alarms daily, adding appointments as needed)	65.0% (52)
Device lost	38.8% (31)
Device broken	32.5% (26)
Client usually forgot to wear/check device	30.0% (24)
Technical issues, assistance not sought by client or caregiver	30.0% (24)
Poor insight into deficits	28.8% (23)
Medical decline of the client	27.5% (22)
Client unable to adapt device/program to changes in daily life (e.g. changing usual alarm time)	25.0% (20)
Client did not view device as useful (not related to insight)	23.8% (19)
Caregiver not able/not willing to assist with device maintenance	23.8% (19)
Device became obsolete and no longer supported by manufacturer/service provider	23.8% (19)
Caregiver unable to adapt device/program to changes in daily life	20.0% (16)
I do not follow up with clients and can not make an accurate guess	20.0% (16)
My client(s) did not progress past initial instruction with their devices	16.3% (13)
Device not charged	16.3% (13)
Client did not like device	12.5% (10)
Caregiver did not view device as useful	12.5% (10)
Caregiver forgot to program device	12.5% (10)
Device not optimal for client	11.3% (9)
Client not willing/able to pay recurring costs/fees associated with use	10.0% (8)
Change of caregiver	10.0% (8)
Unable to provide services for device maintenance	10.0% (8)
Technical issues, unable to be remedied with assistance	6.3% (5)
Instruction insufficient due to funding	5.0% (4)
Medical decline of caregiver	3.8% (3)
None of my clients discontinued use of their devices.	2.5% (2)
Instruction insufficient due to other reason(s)	2.5% (2)
Please consider writing your own reason(s):	11.3% (9)

Figures

Figure 1. Process of Response Elimination from the Final Data Set

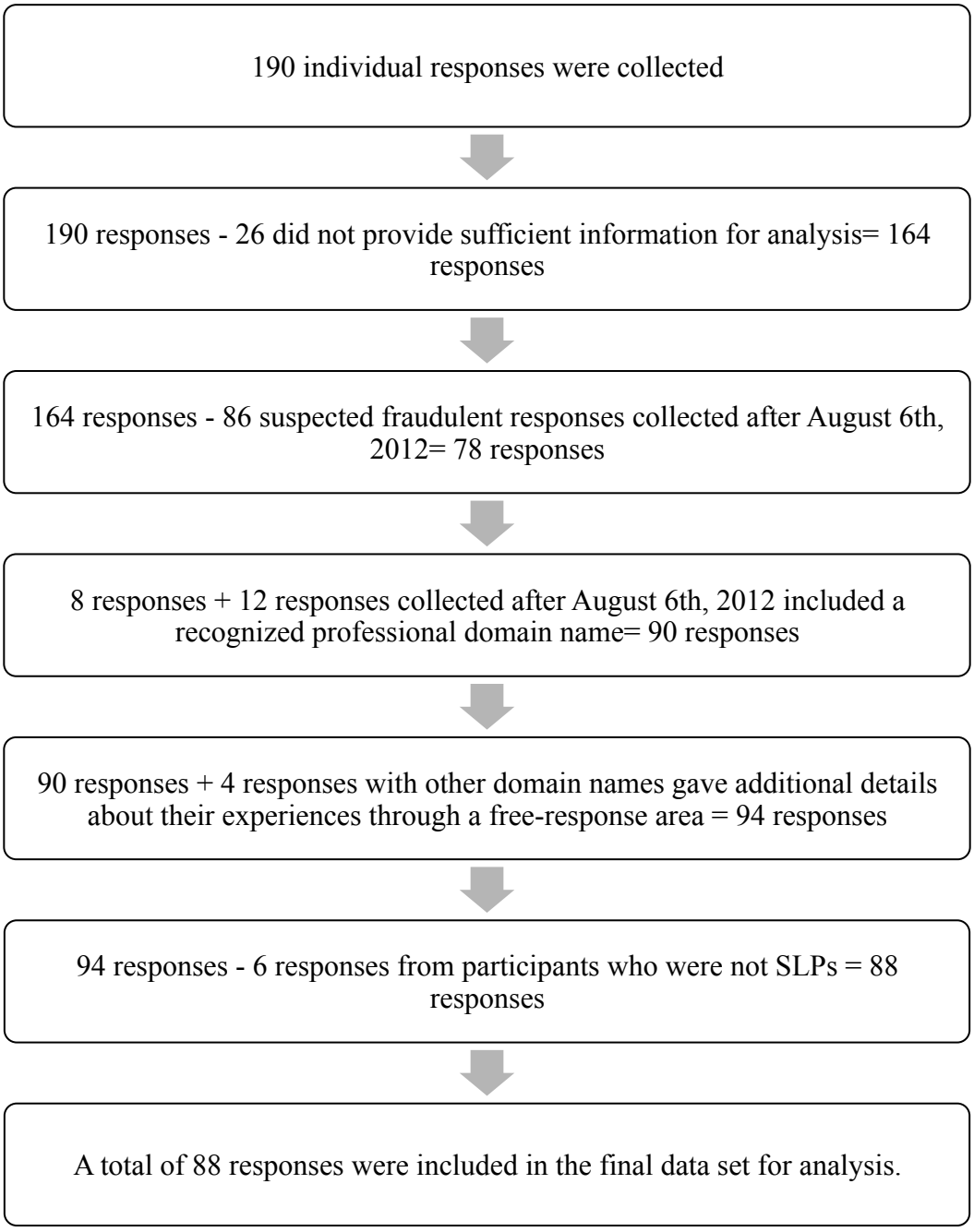


Figure 2. Frequency of Devices Reportedly used by Clients and Clinicians

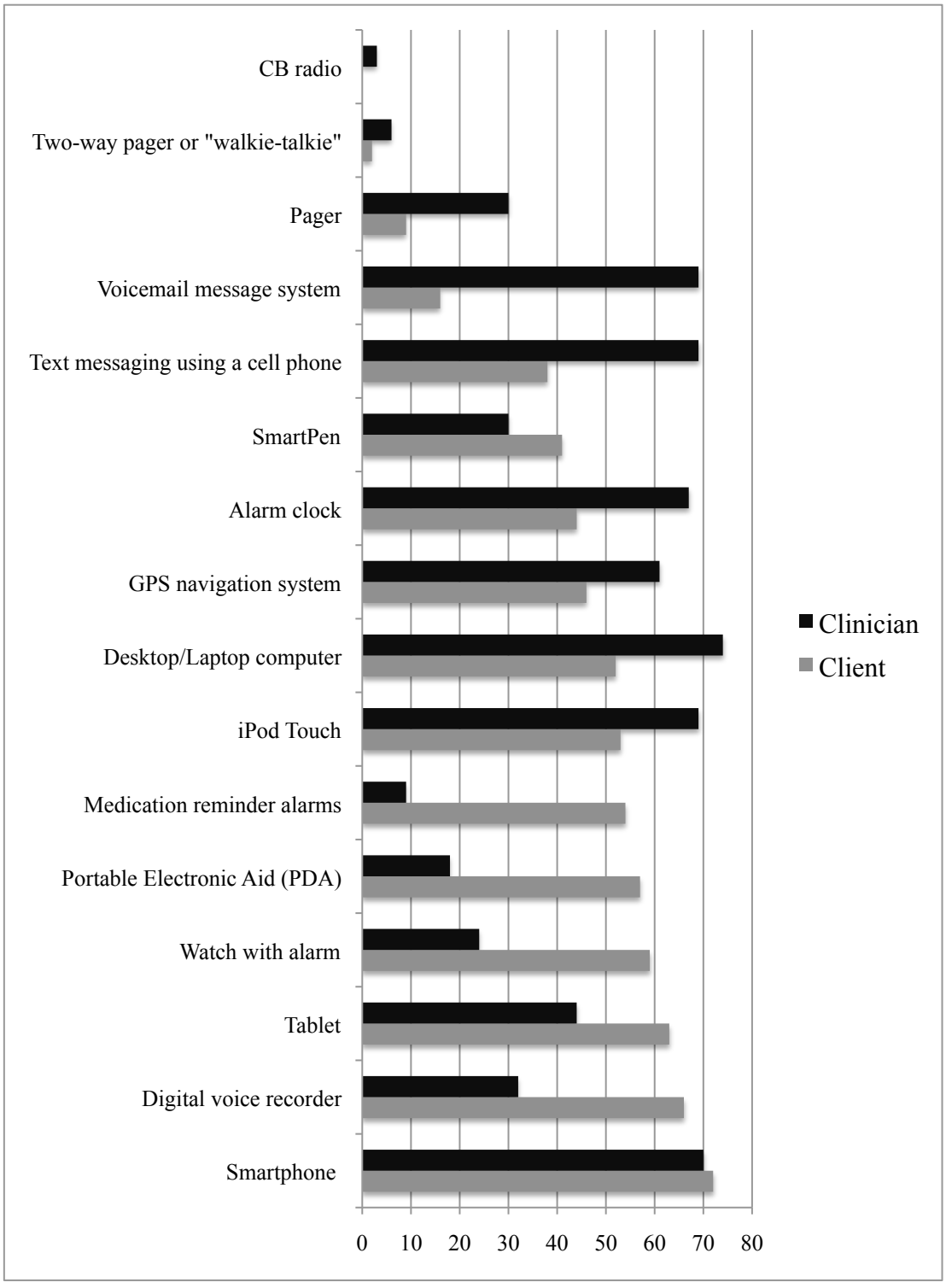


Figure 3. Frequency of Reported Instruction Methods

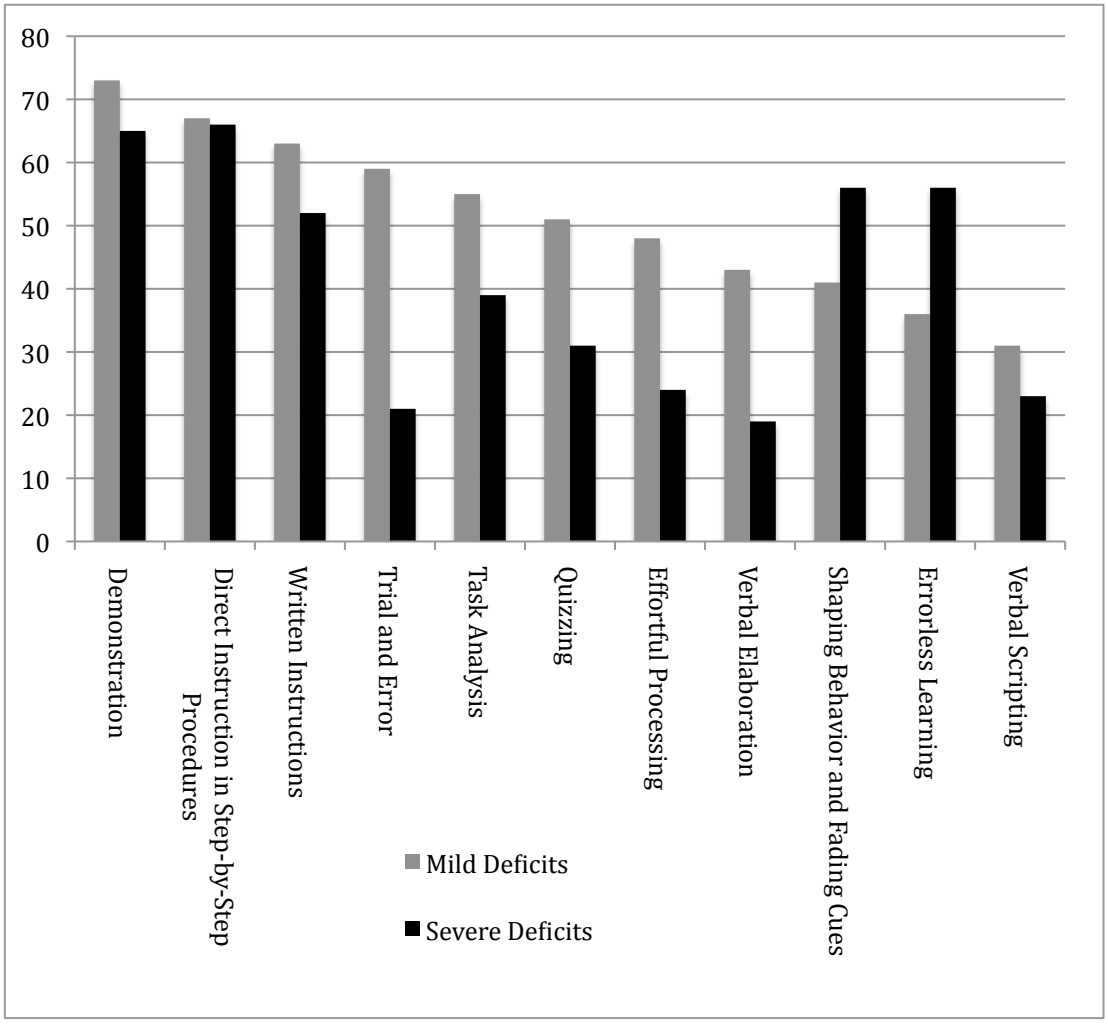
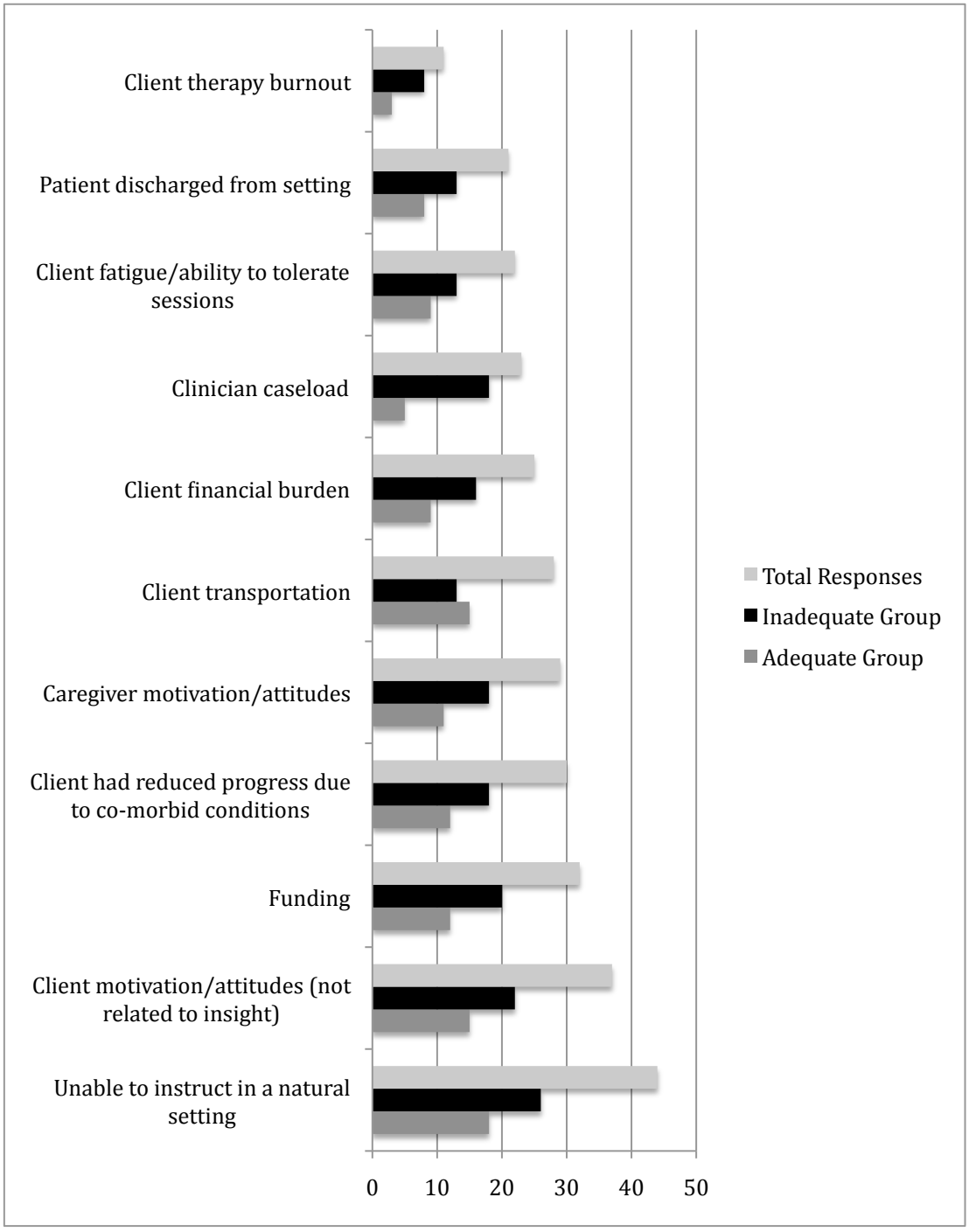


Figure 4. Frequency of Reported Barriers to the Ideal Amount of Service



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Appendix A

2. Demographics

For the following survey, please recall your experiences assisting individuals with ABI to use electronic aids. Electronic aids could include watches, desktop or laptop computers, voicemail message systems, answering machines, pagers, cell phones, voice recorders, apps found on smart phones and tablets, etc.

Please do not include the use of augmentative and alternative communication devices for speech and/or language when considering your answers. We are only interested in electronic aids used to support cognitive problems after ABI.

2. Have you provided services to individuals with ABI to use electronic aids for cognition?

- ○ Yes
- ○ No

3. Your date of birth

Date MM / DD / YYYY

4. Sex

- ○ Male
- ○ Female

5. Select your occupation. Select all that apply.

- ☐ Neuropsychologist
- ☐ Occupational Therapist
- ☐ Occupational Therapy Aide
- ☐ Occupational Therapy Assistant
- ☐ Physical Therapist
- ☐ Physical Therapy Assistant
- ☐ Recreational Therapist
- ☐ Rehabilitation Engineer
- ☐ Rehabilitation Psychologist
- ☐ Social Worker
- ☐ Speech-Language Pathologist
- ☐ Speech-Language Pathology Assistant
- ☐ Vocational Counselor
- ☐ Other:

6. How long have you been employed in this occupation? Consider only the years after you completed all the requirements for your degree.

- ○ 0-2 years
- ○ 3-5 years
- ○ 6-9 years
- ○ 10-19 years
- ○ more than 20 years

Comment

7. Where do you currently work? Select the setting/s that best characterize/s where you work. If not currently employed, list your most recent work setting. You may wish to select more than one answer.

- ☐ Medical: Acute Care
- ☐ Medical: Inpatient Rehabilitation
- ☐ Medical: Outpatient
- ☐ Medical: Assisted Living Facility
- ☐ Medical: Long-Term Nursing Facility
- ☐ Medical: Home Health Agency
- ☐ Adult Day Care Center
- ☐ Educational: School
- ☐ Private Practice/Clinic
- ☐ University/College Clinic
- ☐ Research Agency or Facility
- ☐ Federal Uniformed Service
- ☐ Public Health Department
- ☐ Other (please specify)

3. Your Experiences

Please think about when you have provided services to clients with ABI to use electronic aids. Remember we are interested in technology used to support cognitive impairments, rather than technology used for augmentative and alternative communication.

8. For how many total clients have you provided any of the following:

-Recommended the use of an electronic aid
-Selected a specific electronic aid
-Instructed clients in the use of a specific electronic aid
-Provided clients with follow-up support for an electronic aid

Estimate total:

9. For which diagnostic groups have you:

-Recommended the use of an electronic aid
-Selected a specific electronic aid
-Instructed clients in the use of a specific electronic aid
-Provided clients with follow-up support for an electronic aid

- ☐ Anoxia/Hypoxia
- ☐ Aneurysm
- ☐ Toxicity
- ☐ Traumatic Brain Injury
- ☐ Dementia
- ☐ Huntington's Disease
- ☐ Meningitis/Septicemia
- ☐ Multiple Sclerosis
- ☐ Encephalitis
- ☐ Parkinson's Disease
- ☐ Tumor
- ☐ Stroke
- ☐ Other (please specify)

10. Which of these electronic devices have you used (recommended, selected, instructed) with clients?

- ☐ GPS navigation system
- ☐ iPod Touch (sometimes called iTouch)
- ☐ Alarm clock
- ☐ Voicemail message system
- ☐ Pager
- ☐ Medication reminder alarms (such as Dose Alert Pill Reminder)
- ☐ Tablet (such as an iPad)
- ☐ CB radio
- ☐ SmartPen
- ☐ Portable Electronic Aid (PDA)/ Electronic Organizer
- ☐ Desktop/ Laptop computer
- ☐ Smartphone (such as an iPhone) or other cell phone with multiple functions
- ☐ Digital voice recorder or tape recorder
- ☐ Two-way pager or "walkie-talkie"
- ☐ Text messaging using a cell phone
- ☐ Watch with alarm
- ☐ Other (please specify)

11. Below is a list of functions. Which ones have you recommended or instructed on any device?

- ☐ To Do lists
- ☐ Navigation
- ☐ Alarms/ Reminders
- ☐ Step-by-step task directions
- ☐ Managing contacts
- ☐ Calendars/ Schedules
- ☐ Retrospective memory journaling
- ☐ Managing money
- ☐ Writing/Recording notes
- ☐ Other: Please tell us what other functions you use.

4. Device Recommendation and Selection

For the following questions, please think about when you have provided services to clients with ABI to use electronic aids. Remember we are interested in technology used to support cognitive impairments, rather than technology used for augmentative and alternative communication.

12. In column *one*, select *all* of the individuals who are involved in deciding that an electronic aid is needed for a client.
In column *two*, select the *primary* individuals involved in deciding that an electronic aid is needed for a client. This may be a smaller group.

	All Individuals Involved	Primary Deciders
Client	☐	☐
Client's Family, Careprovider, or Other Supportive Individuals	☐	☐
Neuropsychologist	☐	☐
Nurse	☐	☐
Occupational Therapist	☐	☐
Physical Therapist	☐	☐
Physician	☐	☐
Recreational Therapist	☐	☐
Rehabilitation Engineer	☐	☐
Rehabilitation Psychologist	☐	☐
Speech-Language Pathologist	☐	☐
Vocational Counselor	☐	☐

Other (please specify the individual's professional title and if they are a primary decider)

13. In column *one*, select *all* the individuals involved in selecting a device for a client. In column *two*, select the *primary* individuals involved in selecting a device for a client. This may be a smaller group.

	All Individuals Involved	Primary Selectors
Client	☐	☐
Client's Family, Careprovider, or Other Supportive Individuals	☐	☐
Neuropsychologist	☐	☐
Nurse	☐	☐
Occupational Therapist	☐	☐
Physical Therapist	☐	☐
Physician	☐	☐
Recreational Therapist	☐	☐
Rehabilitation Engineer	☐	☐
Rehabilitation Psychologist	☐	☐
Speech-Language Pathologist	☐	☐
Vocational Counselor	☐	☐

Other (please specify the individual's professional title and if they are a primary selector)

14. If you allow a trial period before selection is finalized about how long would this period last?

- ○ N/A: We do not usually provide a trial period.
- ○ 1 day
- ○ 2-6 days
- ○ 1-2 weeks
- ○ 3-5 weeks
- ○ More than 6 weeks

5. Device Instruction

For the following questions, only consider sessions that provided instruction and training. Do not include supportive services for device maintenance and troubleshooting provided later.

15. In column *one*, select *all* the individuals who instruct clients/families to use devices. In column *two*, select the *primary* the individuals who instruct clients/families to use devices.

	All Individuals Involved	Primary Instructors
Neuropsychologist	☐	☐
Nurse	☐	☐
Occupational Therapist	☐	☐
Physical Therapist	☐	☐
Physician	☐	☐
Recreational Therapist	☐	☐
Rehabilitation Engineer	☐	☐
Rehabilitation Psychologist	☐	☐
Speech-Language Pathologist	☐	☐
Vocational Counselor	☐	☐

Other (please specify the individual's professional title and if they are a primary instructor)

16. In column *one*, select the methods you would likely use to instruct a client with a mild cognitive deficit. Select all that apply.
In column *two*, select the methods you would likely use to instruct a client with a severe cognitive deficit. Select all that apply.

You will have the opportunity to describe additional methods in the next question.

DEFINITIONS

Demonstration: The client watches a task completed by the clinician.
Trial and Error: The client attempts a task with or without cues and learns from their mistakes.
Quizzing: The client attempts a task with clinician feedback.
Task Analysis: The clinician breaks down a complex task for instruction and progress tracking.
Errorless Learning: The clinician provides support/cues to reduce client errors during attempts.
Imagery: A client engages in mental rehearsal of the task.
Shaping Behavior and Fading Cues: The clinician shapes the client's attempts into improving approximations of the target with reinforcements and then fades cues.
Verbal Elaboration: The client uses mnemonics, rhymes, or other associations to remember task completion details/steps.
Verbal Scripting: The client recites a memorized verbal script to complete a task.
Effortful Processing: The clinician encourages the client to think about the procedures when completing the task.
Written Instructions: The client reads written cues to complete a task.
Direct Instruction in Step-by-Step Procedures: The clinician guides client attempts with step-by-step instructions.

	Mild Cognitive Deficit	Severe Cognitive Deficit
Errorless Learning	☐	☐
Imagery	☐	☐
Demonstration	☐	☐
Trial and Error	☐	☐
Task Analysis	☐	☐
Direct Instruction in Step-by-Step Procedures	☐	☐
Verbal Scripting	☐	☐
Verbal Elaboration	☐	☐
Shaping Behavior and Fading Cues	☐	☐

Effortful Processing	☐	☐
Written Instructions	☐	☐
Quizzing	☐	☐
Not Applicable: I do not provide these services	☐	☐

17. <u>Related to the question above, please describe any *additional* methods you use to instruct clients.</u>

Please indicate whether you use each method for clients with <u>mild cognitive deficit, severe cognitive deficit, or both.</u>

If you have no additional methods, you may choose to leave this box blank.

6. Device Instruction Time Frame

For the following questions, only consider sessions that provided instruction and training and not supportive services for device maintenance and troubleshooting provided later.

18. Regardless of session length, about how many sessions were provided to instruct a client to use their device?

- ○ I do not provide these services
- ○ 0-4
- ○ 5-9
- ○ 10-24
- ○ 25-50
- ○ 50-100
- ○ 100+

19. Regardless of session length, about how much time did you spend working with an individual on their device per session?
For example, if you spent 20 minutes of a 45 minute session on the device, you would answer 15-30 minutes.
If you spent 20 minutes of a 20 minute session on the device, you would also answer 15-30 minutes.

- ○ I do not provide these services.
- ○ Less than 15 minutes
- ○ 15-30 minutes
- ○ 30-45 minutes
- ○ 45-60 minutes
- ○ More than 60 minutes

20. "The amount of services I am able to provide is adequate to instruct individuals to use their device."

Do you agree?

- ○ Agree
- ○ Somewhat Agree
- ○ Disagree

7. Device Instruction Time Frame

For the following questions, only consider sessions that provided instruction and training and not supportive services for device maintenance and troubleshooting provided later.

21. What barriers impede your ability to provide the ideal amount of services for device instruction? Select all that apply.

- ☐ Client financial burden
- ☐ Clinician caseload
- ☐ Patient discharged from setting
- ☐ Client therapy burnout
- ☐ Client had reduced progress due to co-morbid conditions
- ☐ Funding
- ☐ Client transportation
- ☐ Client fatigue/ability to tolerate sessions
- ☐ Caregiver motivation/attitudes
- ☐ Client motivation/attitudes (not related to insight)
- ☐ Unable to instruct in a natural setting
- ☐ I do not provide these services
- ☐ Other (please specify)

8. Copy of page: Device Instruction Time Frame

For the following questions, only consider sessions that provided instruction and training and not supportive services for device maintenance and troubleshooting provided later.

22. Please complete the statement.

Sometimes I would like to provide...

- ○ more services for device instruction.
- ○ less services for device instruction.

23. What barriers impede your ability to provide the ideal amount of services for device instruction? Select all that apply.

- ☐ Patient discharged from setting
- ☐ Client fatigue/ability to tolerate sessions
- ☐ Client had reduced progress due to co-morbid conditions
- ☐ Client therapy burnout
- ☐ Unable to instruct in a natural setting
- ☐ Client financial burden
- ☐ Client transportation
- ☐ Clinician caseload
- ☐ Funding
- ☐ Caregiver motivation/attitudes
- ☐ Client motivation/attitudes (not related to insight)
- ☐ I do not provide these services
- ☐ Other (please specify)

9. Device Follow-up and Retention

Now please consider the time after the instruction phase for your client and their device, when you were no longer providing regular therapy for device use, but were available for follow-up and trouble shooting.

24. In column *one*, select *all* the individuals involved in providing follow-up and troubleshooting for client device use. Select all that apply.
IIn column *two*, select the *primary* individuals involved in providing follow-up and troubleshooting for client device use. Select all that apply. This may be a smaller group.

	All Individuals Involved	Primary Follow-up Individual(s)
Nurse	☐	☐
Occupational Therapist	☐	☐
Physical Therapist	☐	☐
Physician	☐	☐
Recreational Therapist	☐	☐
Rehabilitation Engineer	☐	☐
Rehabilitation Psychologist	☐	☐
Speech-Language Pathologist	☐	☐
Vocational Counselor	☐	☐
We do not provide these services	☐	☐

Other (please specify the individual's professional title and if they are a primary follow-up individual)

25. What percentage of your clients continued to use their devices for at least 2 years? Please exclude clients who abandoned their devices due to medical decline.

- ○ My client(s) did not progress past initial instruction with their devices.
- ○ I do not follow up with clients and can not estimate this value.
- ○ I have less than two years experience at my work and can not estimate this value.
- ○ 0-25%: *Few* of my clients continued to use their devices
- ○ 25-50%: *Some* of my clients continued to use their devices
- ○ 50-75%: *Most* of my clients continued use of their devices
- ○ 75-100%: *Almost all* of my clients continued use of their devices

Comments:

26. <u>For the clients that *continued* device use, did any begin to use their devices in new, untaught ways</u>?

For example, a client who was taught to use his smartphone to track appointments began using an app to keep track of money without instruction.

- ○ My client(s) did not progress past initial instruction with their devices.
- ○ I do not follow up with clients and can not give an accurate answer.
- ○ No
- ○ Yes (please describe)

27. Thinking of your clients only, what were the reasons, or your best guesses, that they discontinued device use? Please mark all applicable answers and consider writing your own.

- [ ] My client(s) did not progress past initial instruction with their devices
- [ ] None of my clients discontinued use of their devices.
- [ ] Medical decline of the client
- [ ] Device not charged
- [ ] Client usually forgot to wear/check device
- [ ] Client did not use device with consistency (e.g. setting alarms daily, adding appointments as needed)
- [ ] Client unable to adapt device/program to changes in daily life (e.g. changing usual alarm time)
- [ ] Poor insight into deficits
- [ ] Client did not like device
- [ ] Client did not view device as useful (not related to insight)
- [ ] Device lost
- [ ] Device broken
- [ ] Client not willing/able to pay recurring costs/fees associated with use
- [ ] Medical decline of caregiver
- [ ] Change of caregiver
- [ ] Caregiver not able/not willing to assist with device maintenance
- [ ] Caregiver did not view device as useful
- [ ] Caregiver forgot to program device
- [ ] Caregiver unable to adapt device/program to changes in daily life
- [ ] Technical issues, assistance not sought by client or caregiver
- [ ] Technical issues, unable to be remedied with assistance
- [ ] Device became obsolete and no longer supported by manufacturer/service provider
- [ ] Device not optimal for client
- [ ] Instruction insufficient due to funding
- [ ] Unable to provide services for device maintenance
- [ ] Instruction insufficient due to other reason(s)
- [ ] I do not follow up with clients and can not make an accurate guess
- [ ] Please consider writing your own reason(s):

10. Clinician Device Use

Please think about electronic aids *you* use personally and professionally.

28. What devices do/did you use in your personal and professional life? Include any device you use now or have used in the past. Check all that apply.

- ☐ CB radio
- ☐ Portable Electronic Aid (PDA)/ Electronic Organizer
- ☐ Voicemail message system
- ☐ Digital voice recorder or tape recorder
- ☐ Desktop/ Laptop computer
- ☐ Watch with alarm
- ☐ Smartphone (such as an iPhone) or other cell phone with multiple functions
- ☐ Text messaging using a cell phone
- ☐ GPS navigation system
- ☐ Tablet (such as an iPad)
- ☐ Alarm clock
- ☐ Medication reminder alarms (such as Dose Alert Pill Reminder)
- ☐ iPod Touch (sometimes called iTouch)
- ☐ Two-way pager or "walkie-talkie"
- ☐ SmartPen
- ☐ Pager

Appendix B
Summary of Collected Free-Responses to Survey Questions

Question 7. Employment Setting, Other
VA hospital (2 responses), oncology hospital, nursing homes, rehabilitation hospital, post-acute, home and community based rehabilitation (2 responses), post acute brain injury program/short term and long term, Medical: long term acute care, and retired, sub

Question 9. Diagnostic Groups Served, Other
ALS, PTSD (4 responses), schizophrenia (2 responses), ADHD/ADD, depression/anxiety, seizure disorder, macular degeneration, recurring colloid cyst in third ventricle of brain leading to repeated surgeries and encephalomalacia, cognitive changes after cancer "chemobrain," cognitive delay, ESL, and Multiple Artik

Question 10. Devices Used by Clients, Other
MyBionicBrain, Dragon Naturally Speaking, TextHelp Read & Write Gold, Kurzweil 3000, Boogie Board LCD Tablet, Go Talk, countdown timer (MotivAider), pocket calendars, weekly/monthly planners, talking reminder clock, locking electronic pill dispenser wired to MD office, various apps, amplifier worn, small wrist talker or picture maker, speech devices, buttons-yes/no, and PACK drive with CogLink E-mail system

Question 11. ATC Functions, Other
Games or programs for improving attention, multiple types of memory, executive function, etc. (6 responses), camera and video (3 responses), grocery shopping (2 responses), Learning (flashcard apps; spaced-retrieval app), managing time and work tasks, pertinent apps- (PTSD coach, headache management, medication management, etc), medication management, music when anxious, relaxation function, voice memo, goal maintenance, specific job related procedures, dictation with Dragon Naturally Speaking for correspondence, taking and recording blood glucose readings at timed intervals; eating, retrieval of important medical or emergency contact info, assist caregiver in locating client if separated in public, tracking phone, information processing, software to make social stories, networks, symbols/pictorial , NEWS-2-YOU.COM, visual reminders, and reading

Question 12. Device Recommendation, Other
Caseworker, blind rehabilitation specialist (2 responses, involved but not primary), employer, teacher/professor, social worker, resource facilitator (in TBI group), activities director, cognitive therapist, and legal guardian (if purchasing a device)

Question 13. Device Selection, Other
Prosthetics purchasing agents are involved and can sometimes be the primary selector requiring eventual intervention/discussion with treating clinicians, cognitive therapist, IT department, and most of my clients are high level and already have a smart phone or lap top. I will help them maximize their ability to use the system. Usually we trial a "feature" of the device for 1-2wks to determine if it is working for them.

Question 15. Device Instruction, Other
Family members (2 responses), device vendor-primary, school or university tech departments, cognitive therapist, independent living skills worker, IT department, and social worker.

Question 16. Instruction Methods, Other
Step-by-step picture/video/voice cues specific to device (7 responses), off-topic comments (3 responses), Collaboration with school, university, employer, staff, family, caregiver (3 responses), Attention Process Training (both), encourage development of metacognitive strategies (mild), tools to aid social cognition ability and theory of mind, "intent analysis"" process asking patients to assess the purpose of the given tool and process, Cloze process for verbal scripting, repetitive practice, "Methods above with different levels of complexity based on client," "Methods above with different levels of complexity based on client," "I do not typically recommend electronic devices for severe cognitive impairment because I find they cannot typically learn the steps required. The device can be used with maximum cueing but there is no carryover to day to day use," "For folks with both mild and severe cognitive deficits, I work on the process of strategy selection, identifying specific app features that will be of greatest benefit (e.g. snooze alarms) through ongoing evaluation of specific strategies in functional contexts with peers and family. This includes going into the app store to look at descriptions of features and consumer reviews of features and encouraging people to find their own apps and strategies," and "Use a simple calendar, pt writes down information. Determines if they understand how electronic device would be used. If this is reliable then go on to use of an electronic device."

Question 21. Barriers to Ideal Amount of Services- Adequate Group, Other
Client unavailability due other responsibilities (work, school, family) -- mild/TBI & PTSD population primarily, no show for additional training, device was too complicated to operate for individual, client or caregiver computer knowledge/experience, familiarity of the various device options, and staying fluent with the ever changing technology.

Question 23. Barriers to Ideal Amount of Services- Inadequate Group, Other
Lack of internet accessibility at the facility (2 responses), as a clinician- limited time to always be current on the newer devices- based on pt preference - not always familiar with each device, length of time required to receive ordered equipment, patient may be discharged by the time I get it to start training, frustration on the part of client, scope of transfer and generalization related issues, and constraints of the Medicare-Medicaid system.

Question 24. Device Follow-up, Other
Other: Client or family members (3 responses), social worker, nurse, prosthetics purchasing agents, device vendors, device manufacturers (sometimes as primary), next level of care provider, cognitive therapist, independent living skills worker, MA CCC/SLP, Certified Brain Injury Specialist (CBIS), and Apple personnel at the Apple store.

Question 25. Clients Who Continued Device Use, Comments
We do not track device usage for 2 years post issue; after 2 years they are already discharged from service; unfortunately, I have not followed up consistently enough and for that period of time (2 years later) to comment on this; clients are not available for f/u for this period of time; when considering the small subset that I would see 2 yrs post, 25-75%. This is widely variable, mTBI clients would likely not need the supports, but likely still use their smartphones for appointments; appropriate selection of clients and matching devices results in best outcomes; and I do not follow-up this far into the future.

Question 26. Device Spontaneous Generalization, Descriptions
Descriptions: New apps (24 responses) including: PTSD tracking, headache logs, relaxation breathing, entertainment, music, videos, diet and exercise monitoring, money management, grocery apps, memory games, project management, organization, planning, calendars, prospective memory, and taking notes;
Other responses (did not specifically mention apps): generalizing skills to new settings (e.g. academics or work, 4 responses), expanding use of speech to text smartphone option to novel functions (2 responses), eBooks, study aids, cognitive training software/games (2 responses), music creation, social media, medication management, making to-do lists, spreadsheets, updating devices (2 responses), updating software, new technology components, speed dial, adding pictures to contacts, entertainment (2 responses), task reminders, notebooks, journaling, synchronizing a smartphone calendar with that of a significant other, and note-taking.

Question 27. Clinician Reports of Client Abandonment Reasons, Other
Too many other caregiver responsibilities; unable to reliably manage more than one device - e.g. cell phone and iTouch, they upgraded device (wanted an iPhone 4 instead of iTouch); did not like being "told" what to do all the time even though it was a PDA and not a person; gave their devices to their spouses for school or other uses because they did not feel they needed them; most ABI/TBI clients cannot use and program devices without caregiver support; changing caregivers requires either a process manual or new training. It is expensive and I often have to do that on my own time to make sure the consistency of care is provided for the client; often misplaces device or lose data during updates; I use these devices primarily w/my high level folks so they typically continue using the device long term; found new devices that better met needs; and caregiver felt uncomfortable cueing pt to enter or change information.