Assistive Technology for Cognition Following Brain Injury: Guidelines for Device and App Selection

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Disclosure: Michelle R. Wild has written a book related to the use of smart devices as cognitive prosthetics and receives royalties from the sales of the book.

Abstract

The widespread use of mobile technologies and applications (apps) among the non-disabled population in the past several years to stay connected, track appointments, stay organized, etc., has had profound implications for those with cognitive disabilities following acquired brain injury. Assistive technology for cognition (ATC) includes the use of these same systems to compensate for common cognitive challenges following ABI. And although the use of mainstream technologies in this population is a potential boon, it can be difficult for rehabilitation professionals to keep up with the changing world of devices, operating systems, and applications (apps). This article provides an overview of devices and apps currently used as ATC and provides guidelines for device and app selection and a framework for facilitating meta-cognition and generalization through the ATC instruction process. (Note: The devices and apps described in this article are not intended to be an endorsement of any particular system.)

What Is Assistive Technology for Cognition?

Assistive technology for cognition (ATC; external aids, cognitive prosthetics) describes a range of tools used to provide support for individuals with compromised cognitive ability (Cole 1999; Gillespie, Best, & O'Neill, 2012; LoPresti, Bodine, & Lewis, 2008; LoPresti, Mihailidis, & Kirsch, 2004; Sohlberg & Turkstra, 2011). ATC includes (a) low-tech systems (calendars, Post-it notes, clocks, timers); (b) specialized high-tech systems (Planning and Executive Assistant and Trainer [PEAT]); and (c) mainstream high-tech devices (personal digital assistants [PDAs], tablets, cell phones, smart phones) and apps (calendar, contacts, Google calendar, Evernote).

ATC devices/apps effectively compensate for common cognitive challenges following brain injury, including those related to memory, attention, organization, planning, and time management (Gillespie et al., 2012; LoPresti et al., 2004; Sohlberg & Turkstra, 2011). High-tech ATC systems have several advantages over non-electronic systems, including portability and the potential for repeated entries and external cues (alerts/reminders) to help individuals remember upcoming events, tasks to complete, etc. (de Joode, van Heugten, Verhey, & van Boxtel, 2010; LoPresti et al., 2008).

Mainstream ATC devices and apps, the focus of this article, have become commonplace. In fact, Nielsen (2012) reported that 54.9% of U.S. mobile phone owners have a smart phone,

and more than 22 million tablets have been sold in the United States. The ubiquity of smart devices among the business and general populations helps to destigmatize their use by individuals compensating for the cognitive effects of brain injury, who have access to the same applications for remembering and tracking information as the non-disabled population (de Joode et al., 2010; LoPresti et al., 2008; LoPresti et al., 2004; McDonald et al., 2011).

Among other trends in brain injury rehabilitation, Sohlberg and Turkstra (2011) accord technology special significance: "The increasing use of technology to help individuals compensate for cognitive impairments is one of the most notable advances in neuropsychological rehabilitation in recent years" (p. 142). Furthermore, the incorporation of external memory aids/ATC into cognitive rehabilitation is considered a Practice Standard for individuals with mild memory impairments and a Practice Guideline for those with moderate–severe memory impairments, according to the American Congress of Rehabilitation Medicine (Cicerone et al., 2011; Haskins, 2012.

Although these broad developments are very encouraging, two major challenges preclude widespread use of mainstream devices as ATC among individuals with acquired cognitive disabilities. 1) Cost: In most cases, medical insurance does not cover these devices; thus many individuals living on fixed incomes are unable to purchase ATC devices and/or service contracts and data plans (de Domingo, 2013); 2) Clinician knowledge & experience: Research reports indicate that clinicians in a position to assess and train ATC lack confidence in their own knowledge of ATC systems as well as in assessment and training processes and techniques (de Joode, E. A., van Boxtel, M. P., Verhey, F. R., & van Heugten, C. M. 2012; O-Neil-Pirozzi, Kendrick, Goldstein, & Glenn, 2004). This article will provide clinicians with a basic overview of mainstream high-tech ATC devices and apps.

What Are Mainstream ATC Devices?

Common mainstream high-tech ATC devices include cell phones, PDAs, smart phones, and tablets. Confusion regarding the differences among these devices is compounded because their various features have merged over the past several years. The most significant differences are between the basic features of a cell phone and the more advanced features of all the other devices. The basic cell phone requires a contract and has limited functionality: calling capability, basic calendar features (appointment title, time, and alarms), and basic contact features (name, number). Additional features may be available for a fee, including text messaging and Internet access.

PDAs, smart phones, and tablets share many advanced features, including advanced calendar features (multiple calendars, alerts, notes), advanced contact features (multiple addresses and customizable fields), Wi-fi capability, navigation, music players, e-mail, downloadable apps, etc. Although many smart devices support voice and video communication via Skype and/or FaceTime, the smart phone is the only smart device to allow basic phone-calling. In addition, at this time, the smart phone is the only smart device that requires a monthly data contract. The various smart devices vary in screen size from approximately 4 inches (smart phones and PDAs) up to 10 inches (tablets).

The increasing popularity of smart devices, the vast number of apps available for them, and their relatively low cost (compared to specialized ATC devices) all work together to increase their viability as ATC devices. Currently, devices running the Apple iOS and Android operating systems compose more than 85% of the smart device market and are therefore the most common smart devices used for ATC. Apple iOS and Android devices share many common features and apps, such as Internet access, Bluetooth, calendar, contacts, maps, clocks, etc. Each of these features can significantly help an individual with issues related to memory, organization, time management, etc.

Although they share some common features, the hardware and corresponding operating systems differ from each other in significant ways. The most significant differences between iOS

and Android devices involve the hardware design and user interface (UI), or the way the user interacts with the device. iOS devices share a common hardware design and a consistent UI across all Apple devices (iPod Touch, iPhone, iPad, and iPad mini) and wireless companies. In contrast, a wide variety of Android devices (phones, tablets, the Kindle Fire HD, and the Nook HD) are available from a number of manufacturers and wireless companies. Each Android device is slightly different. For instance, the physical buttons vary from device to device, and the opening screen typically looks different from device to device, manufacturer to manufacturer, and carrier to carrier.

The consistency of the hardware and UI is extremely important for those living with brain injury or other cognitive issues as well as for the professionals charged with training ATC. For instance, an individual who has learned to use an iPhone should have an easy transition to an iPad. Likewise, a person with an iOS device who upgrades faces a small to non-existent learning curve because the devices look and act the same. Thus, at this time, iOS devices may be easier and more efficient for both the individual and the trainer. The variety and flexibility of Android devices (an advantage in the general population) is generally a disadvantage within the brain injury community.

What Native Apps Are Commonly Used for Individuals With ABI?

Although smart devices vary in size, storage capacity, number of available apps, and price, they all provide some similar features and come with several native apps that can assist with cognitive issues resulting from brain injury. *Native apps* are those that come pre-installed on a device, typically part of that device's operating system. Native apps common to most smart devices include a calendar, contacts (address book), camera, maps, task lists, e-mail, browser, notes, etc. These apps can assist with a variety of daily activities such as scheduling an appointment, storing contact information (including pictures of the contact), and creating to-do lists. Schwartz & Wild (in press) provide the following table of native apps and suggestions on how they can help compensate for common cognitive issues after brain injury.

Table 1. Examples of Common Native Apps

Native App	**Examples of ATC Uses**
Calendar	Schedule appointments, including date, time, reminder alarms, and notes Identify available times for future appointments Monitor fatigue by identifying time commitments per day and week
Contacts	Keep phone numbers, addresses, social network information, etc. Store birthdays, anniversaries, etc. Include notes that might help with remembering specifics about a person or company (My boss's dog's name is Daisy.) Associate a picture with a contact
Camera	Take pictures of people, places, or things to aid memory Organize pictures into folders Sequence pictures (steps to do laundry)
Reminders	Create to-do lists Create shopping lists Create a task analysis (sequence of steps) related to a job
Notes	Take notes at doctor's office, work meetings, etc. Make notes to prepare for an upcoming conversation with a friend, co-worker, family member, etc. Track books read, movies seen, etc.

What Non-native Apps Are Commonly Used for Individuals With ABI?

Although native apps are free and come standard on the devices, they may lack features of particular benefit to those with brain injury. There are literally hundreds of thousands of free and for-pay non-native or add-on apps available from the Apple App Store and the Android Google Play store. In fact, Apple recently approved its millionth app. Several non-native apps can be used to compensate for cognitive challenges (Week Calendar, Evernote, Pocket Money) as well as for addressing other related issues such as nutrition, stress reduction, meditation (Breathe 2 Relax), and cognitive stimulation (Brain Challenge). There are also non-native apps for very specific functions, such as referencing (Dictionary), and alternative inputs and outputs (Speak It!, My Talk Tools).

Table 2. Examples of Common Non-native Apps

Non-native App	**Examples of ATC Uses**
Week Calendar	Schedule appointments, including date, time, reminder alarms, and notes Identify available times for future appointments Monitor fatigue by identifying time commitments per day and week Prevent double-booking appointments Color-code appointments for easy categorization
Evernote	Keep notes that might help one remember specifics about a meeting, movie, or online purchase Take pictures of receipts to eliminate unnecessary clutter Record audio notes as a memory aid Sync all notes across smart devices and personal computers
Quick Password Manager	Organize online passwords for easy and efficient retrieval Save and organize secure notes, such as information related to taxes or employee ID numbers, etc.
Breathe2Relax	Reduce and monitor stress Track stress and its causes over time
Pocket Money	Track income and expenses Review monthly reports to track expenses by category (groceries, auto fuel, entertainment)

What Are Some Guidelines for Evaluating Apps?

Hundreds of thousands of non-native apps are available for smart devices. So many apps are available within each category (games, productivity, etc.) that finding the best app based on individual needs quickly becomes confusing and overwhelming. In fact, it is not uncommon for an individual to download multiple options (note taking apps) to try. As a result, many users with brain injuries give up on note taking on their device altogether because they have too many options and don't know how to effectively choose the best app for their particular purpose. Often users keep unwanted apps on their device because they are afraid that deleting the app will cause them to lose it forever. In fact, it is wise to eliminate or delete unused or rejected apps from the home screens to reduce screen clutter, which can lead to feelings of being visually overwhelmed. Deleting an app from a home screen will not delete it from the device, and deleting it from the device won't remove it from iTunes; in other words, the app will still be available to download again, if desired.

Given the sheer number of possibilities and the potential of being overwhelmed to the point of indecision, how can we as professionals help our clients find and evaluate apps?

Reviews are available from a variety of Web sites, but they seldom provide enough information to determine the appropriateness of an app for individuals with cognitive challenges. What type of questions should we, as professionals, be asking about the apps we review and ultimately recommend? I propose the following questions to help spark a dialogue among professionals.

Question 1: What is the compensatory **purpose** for the app?

Question 2: What **features** should we be looking for in such an app?

Question 3: What **other cognitive skills** will this app help to work on or develop?

Question 1 — Purpose

Identifying the compensatory purpose for using an app is an important first step in evaluation. It helps focus attention on specific issues the potential user has that the app might address. In addition, helping the user understand the purpose of the recommendation can help with overall motivation and compliance using the app (Table 3).

Table 3. Examples of Cognitive-Behavioral Challenges; Purpose for Using ATC

Challenges
Remembering to do future things (acting on intentions)
Recalling past events
Recalling newly learned information and skills
Recalling important information/facts
Planning ahead
Getting and staying organized
Performing multi-step tasks, sequencing
Multi-tasking (doing several things at once)
Problem solving, making decisions
Finding one's way (route finding)
Time management (including estimating and tracking time, pacing, etc.)
Concentrating in the midst of distractions

Question 2 — Compare Features

Identifying the purpose for using an app leads to the second question — what features should be present? It is important to know the features included in an app and whether those features are beneficial and/or necessary to help individuals with brain injuries. For instance, although the native calendar app on iOS and Android devices might be the default calendar app for many users, it has several major limitations that can significantly affect its overall effectiveness for an individual with a brain injury — the limited number of repeat options, limited number of alert options, lack of notification when overlapping appointments are scheduled, and no ability to color-code appointments other than assigning them to a specific calendar. The absence of these features could cause significant scheduling issues and frustration unless the user can use higher order thinking skills to recognize and find work-around solutions. In fact, some users with brain injuries might find and apply a work-around to these issues; however, it is not optimal and does not reliably work for everyone.

Question 3 — Other Cognitive Skills

The last proposed question — what other cognitive skills will this app help to work on or develop? — is useful in several ways. Once an app has been selected for the identified compensatory purpose (Table 3), meta-cognition and generalization can be facilitated through the training process.

Facilitating Meta-Cognition

Teaching an individual about the cognitive skills (attention to detail, sequencing, critical thinking, etc.) involved in learning and using an app can facilitate not only his or her understanding of the purpose and usefulness of the app itself but other cognitive skills as well. For example, explicitly teaching the concept of "sequencing" while instructing the specific steps for recording a reminder enhances the individual's awareness of his or her own learning and cognition.

Facilitating Generalization

Becoming aware of, focusing attention on, and understanding the cognitive skills involved in learning one app can provide a foundation for learning other apps. For example, once an individual is introduced to the concept of *sequencing* with the reminder app, this concept can be applied when learning the steps for entering information into the calendar app. This approach (Wild & Heck, 2013 can provide insights into how cognitive skills such as sequencing can be used in other, less technology-related aspects of one's life. Wild & Schwartz (2008) found that systematic training, with an emphasis on the cognitive skills involved in learning and using the smart device, helped even those with significant memory impairment. Table 4 lists several cognitive skills, how they apply to multiple apps, and how they apply in daily life. (See also Daly and Ehlhardt Powell, Glang, & Ettel in this issue for more on generalization.)

Table 4. Examples of Cognitive Skills: App and Life Examples

Cognitive Skill	**App Examples**		**Life Examples**
Native Apps			
Recognizing visual similarities and differences	Calendar: distinguish among the calendar's list, day, week, and month views	Reminders: distinguish between list and calendar views	Distinguish between two similar but unmatched socks; distinguish among closely sized drill bits
Sequencing	Calendar: follow the correct steps to record a calendar event/appointment	Reminders: follow the correct steps to record a reminder or task	Decide which bills to pay first; figure out the most efficient order for running errands
Decision-making	Contacts: decide what fields are appropriate for each contact	Reminders: decide to which list a new reminder belongs	Decide whether to fix your transmission or buy a new car
Non-native Apps			
Categorization	Pocket Money: assign a credit card charge to an appropriate category, such as groceries	Evernote: assign a new note to an appropriate notebook	Sort mail into bills, junk mail, things to read later, etc.
Planning	Evernote: establish a list of folders so new notes can be correctly categorized	Quick Password Manager: establish a list of sites, passwords, or notes you might want to access regularly	Check store hours before traveling to shop there
Time management	Week Calendar: determine an appropriate lead time to allow when setting a custom alert	Pocket Money: establish scheduled transactions as a reminder of upcoming due dates for bills	Determine how long it will take you to shower and get dressed so you can leave the house on time

A Note on Repair Strategies, Maintenance, and Troubleshooting

No discussion of ATC devices and apps would be complete without acknowledging the critical role of training individuals to use repair strategies when they get stuck as well as addressing maintenance (charging, system updates, backing up contents) and troubleshooting (forgetting password and device becomes disabled). Table 5 provides a list of common repair strategies and technical problems and solutions.

Table 5. Common Problems

Problem	**Troubleshooting**	**Sample repair strategies**
User gets lost in an app and doesn't know what to do.	Observe when this occurs while using the app. Does it occur across apps?	Teach a key phrase "go home" paired with pressing the home button to return to the home screen or "go back" paired with pressing the back arrow. Teach the use of the "Cancel" button within the app.
User can't move an app from one home screen to another.	Watch the steps the user takes to move the app icon. Typically, the user will not hold the app on the edge of the screen long enough. Letting go too early will simply drop the app where it is on the screen.	1. Tap and hold any app icon until the icons on the home screen begin to wiggle. 2. Tap, hold, and drag the desired app icon to the edge of the screen and hold there until the next home screen appears. 3. Lift finger to drop the app in the desired location.
The calendar alert displays with the title of the event (Doctor Appt.).	This event title does not provide sufficient details.	1. Review importance of attention to detail. 2. Tap calendar event to open the event details screen. 3. Tap edit. 4. Modify title field information. 5. Tap done to save.
User sets password, but forgets it, and the device becomes disabled.	Reset device to factory settings, which will restore the device to when you first received it.	1. Plug device into computer. 2. Wait until device is recognized by iTunes. 3. Tap on summary at top of iTunes screen. 4. Tap on restore iPad/iPhone/or iPod Touch. 5. Follow onscreen instructions.

Summary

Although research supports the idea that individuals with brain injury can benefit from the use of smart devices, service providers do not yet routinely introduce such devices into their clinical practice; thus, PDAs and other portable electronic systems are under-used by people with brain injuries. Sohlberg (2011) clarify the problem: "Despite the rehabilitative potential of technological devices and the growing number of affordable, accessible devices, clinicians may not implement them, in part because they may be uncomfortable or inexperienced with technology" (p. 1).

As the use of smart devices within the brain-injured community becomes more prevalent, it will become more important for rehabilitation facilities, counselors, therapists, and

caregivers to support the use of such devices as ATC. Systematic instruction for both professionals and persons with brain injury will encourage such use and prepare them for the cognitive and social benefits associated with device use (Ehlhardt Powell, Glang & Ettel, this issue; Ehlhardt Powell, Wallace, & Wild, this issue).

Biosketch

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