Phones, Watches, and Apps: Engaging Everyday Mobile Assistive Technology for Adults with Intellectual and/or Developmental Disabilities

Kimberly Maich
Memorial University
Camille Rutherford and Courtney Bishop
Brock University

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Authors' Note

Correspondence concerning this article should be addressed to [Kimberly Maich, 230 Elizabeth Ave., St. John's, NL, Canada A1C 5S7]. Email: [kmaich@mun.ca]

Abstract

Twelve pilot project participants with intellectual and/or developmental disabilities used mobile devices (smartwatch and smartphone technology) and individualized apps focused on time management, coping, budgeting, exercise, and safety to support independence and community engagement. Ten participants with intellectual and/or developmental disabilities (IDD) and five front-line Coordinators participated in post-project focus groups within which common patterns of responses and salient findings were noted, including the emergence of a peer technology expert. Five themes emerged from focus group data, which were developed into five broad technological, clinical, and methodological recommendations for phase two that will follow this pilot project. Duration data showed variable change in pre–post duration of supports; related changes were part of these recommendations. A small sample size and pilot study status suggests cautious interpretation and application of results beyond the immediate context of this project; however, this pilot project has developed a foundation for a more comprehensive intervention.

[Introduction]

Social inclusion and related community supports are essential for the growing number of adults with intellectual and/or developmental disabilities (IDD; Cobigo, Martin, Lysaght, Lunsky, & Ouelette-Kuntz, 2014; Levy & Perry, 2011; Ton, Drager, & Richardson, 2017), as social isolation has been linked to increased costs in social, economic, and health domains (Wilson, Jaques, Johnson, & Brotherton, 2016). Levy and Perry (2011) definitively stated that "the major factor affecting social outcomes in adulthood is the adequacy of educational provisions and access to appropriate education for later employment and social and economic independence" (p. 1275). Although some research has identified varied benefits of using assistive technology to support the development of essential skills and decrease environmental barriers, utilization—where available—typically remains low. The purpose of this project is to develop some initial best practices on supporting adults with IDD using existing mobile devices and apps.

Literature Review

Assistive technology (AT) can be defined as devices that can enhance the "ability to perform and complete tasks with efficiency and independence" (Sider & Maich, 2014, p. 1) when their users have exceptionalities, or as "equipment, software program or product system that increases, maintains or improves academic capabilities" (Malcolm & Roll, 2017). The use of AT can be general (e.g., word processing), related to specific assistive computer technologies (e.g., Braille printer) or adaptable technologies (e.g., dictation software; Fichten, Asuncion, & Scapin, 2014) within a range of functional domains such as community inclusion and activities of daily living (Wehmeyer, Smith, Palmer, & Davies, 2004). Although augmentative and alternative devices focused on foundational skills like communication are more common, the development of skills

related to independent community-based functioning (e.g., time management) can also be supported by AT. Wehmeyer, Tassé, Davies, and Stock (2012) agreed, emphasizing that the "ubiquitousness of cell phones" (p. 18) for many ages and populations is an example of using everyday mobile technology for social and community goals. Such research is still in its early phases (Mechling, 2011; Wehmeyer et al., 2012); however, some examples exist specific to adults with intellectual and/or developmental disabilities.

Mechling's (2011) study demonstrated that only 41% of adults with intellectual disability (ID) accessed computers and 27.7% used cell phones, regardless of their potential to support independence. Some examples are: "customizing instruction and providing 'just-in-time' supports, which previously may have required constant adult presence" (Ayres, Mechling, & Sansosti, 2013, p. 266). Kuzu, Cavkaytar, Odabasi, Erişti, and Çankaya (2014) described the utility of mobile devices such as tablets: "With the use of a tablet computer, the teaching activity of brushing the teeth can be performed easily in a bathroom" (p. 16). It is tentatively evident that with affordable, accessible prompting systems on individual devices, such as hand-held mobile devices, individuals with IDD can potentially use AT and its applications (*apps*) to more safely and independently complete home and community-based activities of daily living (Mechling, 2011). Mechling concluded that:

> it is important to realize these portable electronic devices may not be appropriate for everyone … it is also possible that these innovations will create opportunities for living, work, and recreational environments that are currently not available to persons with more significant disabilities. (p. 496)

McMahon, Smith, Cihak, Wright, and Gibbons (2015) compared varied mobile technologies to support community navigation for six young adults with ID. Participants were supported in learning to navigate post-secondary environments on foot using a printed map, the Google Maps app on phone or tablet devices, and an augmented reality navigation app. Results showed greater success with the latter treatment option as well as a strong preference for its daily use. Kelley, Rivera, and Kellems (2016) used Google Glass with adults with ID and emphasized that attending to individualized teaching procedures is essential "to constantly evaluate best practices for teaching students to actually operate technological devices to increase independence" (p. 215). Davies, Stock, King, Brown, Wehmeyer, and Shogren (2015) examined Facebook and its access for those with ID as a way of "enhancing social capital" (p. 30) and decreasing exclusion, an oft-cited area of goal-setting for this population along with their family members. This pilot study of 12 adults with ID provided training on Facebook-specific tasks with a specialized interface (e.g., speech-to-text posting), and connected to wider issues foundational to the disability field:

> Technology-mediated social networking through sites like Facebook is clearly becoming a part of day-to-day life for the majority of people in society. Promoting access to such opportunities is necessary to ensure the full participation of people with disabilities in all aspects of society, congruent with their preferences, interests, and desires. (p. 39)

Palmer, Wehmeyer, Davies, and Stock (2012) surveyed family members of people with IDD around technology—including mobile technology—examining mobility, hearing and vision, communication, independent living, and computer use.

They found that "more people with [IDD] appear to have access to technology and there are fewer people who could potentially benefit from such technology but who do not have access to it" (p. 412) but that future improvements are still necessary (i.e., ease of use and training). Kuzu et al. (2014) implemented a mediator model of software training, teaching parents and other relatives of adolescents and adults with ID how to utilize mobile technology for daily living. Software was developed and piloted with applied behaviour analytic-based strategies (e.g., task analysis), which were used to teach varied skills, including "domestic skills" (p. 17; e.g., making buttermilk). Parents and relatives (the mediators) also described it as useful and had positive attitudes about its use. Esposito et al. (2017) also noted, however, that challenges in the field continue: "Search engines allow us to find different typologies of tablet and smartphone applications … even though the efficacy of most of these has not been validated by research designs" (p. 200).

The use of mobile AT has the potential to decrease the need for high-ratio, on-site supports. Cumming, Strnadová, Knox, and Parmenter (2014) considered that "if adults with intellectual disabilities are not provided with the opportunities to learn how to use mobile technology and incorporate it into their lives, the technology could very well become a barrier rather than a support" (p. 1101). Even in the context of a "proliferation of advanced mobile technologies" (Ayres et al., 2013), underutilization of technology specific to such populations, such as adults with IDD, can be an issue (Bouck & Flanagan, 2015; Palmer, Wehmeyer, Davies, & Stock; Wehmeyer et al., 2012).

It is important to attend to *how* such instruction is accomplished, since it appears that "technology *can* improve functional abilities to support greater independence in

activities of daily living, control over one's environment, and—in the end—to enhance community integration" (Wehmeyer et al., 2012, p. 18; emphasis added)—but perhaps not replace human supports). Kelley et al. (2016) noted the scarcity of such instructional literature: "Some students with ID may acquire skills through observation, many require direct systematic forms of instruction. Determining how these forms of instruction can be applied to learn the necessary skills to specifically operate wearable/mobile technologies is relatively scant" (p. 209).

Clearly research in the field is still in flux—especially for adults with IDD who are under-represented in the relevant body of literature. One Community Living member agency in southern Ontario, Canada chose to help to fill this gap and initiated a pilot project focused on fostering financial and economic independence through the use of mobile technology and related apps (Maich, Rutherford, & Bishop, 2017). Using existing smartphone and smartwatch technology, this project focused on researching, developing, and implementing a series of location, time, and on-demand prompts to reduce or replace the need for individual Coordinators. Coordinators support community-based adults with IDD and their front-line, direct-support workers through the orchestration of service provision within a team environment, and support the work of these clients toward their personal goals, as documented in Individual Support Plans. Referencing Cook and Hussey's Within the Human Activity-Assistive Technology (HATT) model that emphasizes a framework of four interacting domains in the AT system—human, activity, AT, and context—it is clear that that "systematic consideration of all four components will reduce the probability that AT will be rejected or underutilized" (Lenker & Paquet, 2003, p. 4). In the case of this framework, the human components are the adults with IDD

who participated in this research; the activity is community-based independence; the AT comprises mobile devices and individualized apps; and, the context is the community setting. The development of initial best practices for supporting adults with IDD using existing mobile devices and apps follow from these research questions: Will the introduction of smartphone and smartwatch technology improve the skill development and independent task completion for adults with IDD living in semi-independent residential settings? And if so, what is the socio-economic impact on the independence of individuals with IDD?

Methodology

This mixed methods pilot project was developed in an embedded design (Creswell, 2015) with qualitative data as the primary form of data collection, and quantitative data as the secondary form in a "supporting role" (Creswell, 2015, p. 544) denoted as: QUAL + quan (Creswell). These data are a combination of qualitative data from post-intervention focus groups (both support staff and participants with IDD) and quantitative observational data on the duration of supports for participants with IDD while engaging in tasks of daily living.

Participants. Following research ethics clearance, participants were recruited and selected from the Supported Independent Living (SIL) program targeted to adults (18 and older) with IDD, where supports and training for life skills (e.g., budgeting) are provided in person or by phone. Its goal is: "to provide community accommodation services and supports to adults with a developmental disability that promotes social inclusion, individual choice, independence and rights" (Developmental Services, 2016). To obtain a maximum variation sample (Creswell, 2018) within the SIL program, four profiles were

developed by creating quartiles of annual support hours (see Table 1 for specific ranges) utilized by each participant, with the understanding that level of support has a converse relationship to level of independence. All potential participants ($N = 43$) were categorized into the appropriate quartile. If profiles were oversubscribed, participants were randomly selected with the True Random Number Generator (Haahr, 2018). Twelve participants with IDD took part in this project ($n = 12$); five were female ($n = 5$; 41.7%) and 7 were male ($n = 7$; 58.3%) with a mean age of 43. Two target skill areas were chosen for each participant (see Table 1 for an overview). These were derived from individual discussions and documented goal areas on Individual Support Plans, legislated to include needs, preferences, and goals for those with developmental disabilities (O. Reg. 299.10, 2011, s. 5). The target skills were taught using commonly used behavioural analytic strategies for instruction such as task analysis and prompting using Natural Environment Teaching (Cooper, Heron, & Heward, 2007).

[Insert Table 1 about here]

In total, twelve clients with IDD took part in this project as research participants, including the opportunity to participate in post-intervention focus groups. The support staff members (Coordinators) participated in the project as part of their day-to-day work role(e.g., supporting the daily use of technology; skill development toward individual goals; data collection), but also briefly as research participants through a post-intervention focus group. Overall, six Coordinators participated in this pilot project; all Coordinators were female ($n = 6$; 100%). One Coordinator supported one participant with IDD; four Coordinators supported two participants with IDD; one Coordinator supported three participants.

Materials and procedure. Mobile devices for this research included smartphones and smartwatches for participants with IDD. Smartphones were Motorola's Moto G^3 (or third generation), an Android platform (Motorola Mobility LLC, 2017), paired and synched with Pebble Time smartwatches, operated through four basic buttons: "It's more of a wrist-pager than a full-blown gadget. But, it can run a lot of its basic functions, like time, alarms, and basic utility apps, without a phone being connected" (Stein, 2015, para. 8). In total, 18 phones and 14 watches were used (labelled with initials and identification numbers) along with cords and carrying cases. Each participant with IDD used two to three related apps (see Table 2) from list of five in the areas of (a) budgeting (decisions around money), (b) time management (any aspect of daily living, such as work, appointments, medications, bank visits, laundry days), (c) exercise (improving physical health), (d) coping (de-escalation as a result of anxiety or agitation), and/or (e) safety (decreasing risk in higher-risk activities of daily living such as a task analysis for locking a front door). These uses of selected apps were taught by Coordinators using a Natural Environment Teaching, in situ approach with varied behaviour analytic strategies including task analysis, prompting, chaining, and fading (Cooper, Heron & Heward, 2007). See Figure 1 for a sample task analysis.

Training. In late January 2017, Coordinators supporting participants with IDD in this project had an opportunity to familiarize themselves by using hardware and practising apps, and the project itself included ongoing collaboration and monthly meetings with the research team. During one meeting, for example, the team identified skills; chose apps; set up and assigned phones; downloaded relevant apps and removed or locked out unnecessary ones; assembled cords, phones, and watches in their carrying

cases and labelled the devices; and developed a training plan. Coordinators also participated in two days of training on baseline data collection and the related apps, facilitated by a researcher, a research assistant, and a technology coordinator. A full-day training session for staff and participants with IDD facilitated by the research team occurred in early February 2017. The morning included training on using phones, watches, apps, behaviour analytic instructional strategies, and hands-on practice for staff members. The afternoon included the same topics for participants with IDD with the addition of small group work as necessary. A behavioural skills training approach (Parsons, Rollyson, & Reid, 2012) was used to ensure that each trainee rehearsed and demonstrated target technology skills at a mastery level through observation and feedback from the training facilitators.

Data collection and analysis. Recruitment took place in January 2017, followed by approximately two weeks of pre-intervention duration data collection. In February 2017, a full-day training event took place, as well as mobile device preparation and distribution; in February–March 2017, three weeks of intervention took place. At the end of March 2017, post-intervention duration data were collected over approximately two and a half weeks.

Qualitative methods. Two audio-recorded and transcribed post-intervention focus groups occurred: one with 10 participants with IDD; another with five Coordinators. Questions focused on reflections and evaluation of the intervention and its process, including perceived effects on independence and potential for ongoing use of mobile technology (see Tables 3 and 4). Thematic analysis (Braun & Clarke, 2006) was used by one of the researchers to identify emergent themes and patterns, which were then

reviewed by the research team. Dedoose software (SocioCultural Research Consultants, 2013) was used for the organization and coding of these data. Emergent coding began with the analysis of the Coordinators' focus group; this code book (as applicable) was duplicated and applied to the focus group of participants with IDD as well, allowing cross-case comparison between Coordinators and participants with IDD. These categories were developed into five themes with strong, repeated patterns of coding.

Quantitative methods. Pre- and post-intervention duration data on the amount of time Coordinators spent supporting participants in tasks of daily living were collected with the assistance of the StopWatch Deluxe app. The data were collected for the amount of time participants were individually supported in one or two of the target skill areas (see Table 1) both pre- and post-intervention.

Results

Qualitative Results

Post-intervention focus groups for both Coordinators and participants with IDD were facilitated by a research assistant. The focus group for Coordinators was 103 minutes long; for participants with IDD, the focus group was 95 minutes long. Following thematic analysis, four themes emerged, as described below. NOTE: All names used throughout are pseudonyms.

Fit, form, and function are essential for success. Participants with IDD reported varied levels of success with the smart technology and apps provided; the matches between individuals and the fit, form, and function of mobile devices and their apps appeared to be a precursor for success. Participants with IDD were quite clear that either the fit worked—or didn't. Participant Jeramiah indicated that, "I do the breathe one …

press the thing and breathe … it helped me more than anything." Participant Stefan noted about another app: "Get rid of it … I never use it." Even the physical form of the devices appeared to be impactful, according to multiple Coordinators:

> I found they wouldn't use the case. I couldn't work with the phone in it. It was frustrating 'cause they would drop the phone. And it was too risky for them to be breaking the phone, so they just didn't use it … we had to carry it around. It was ginormous." (Coordinator Kerry)

Even the keys made a difference: "Size wise … some people, with their coordination, were having a hard time. They wanted to input information on their own but they [couldn't] because of the coordination" (Coordinator Elaine). Jeremiah added a similar remark: "I was in my room half an hour and I tried and failed trying to put the lid on this phone."

Multiple Coordinators mentioned the need for choice and diversity: "Some don't want a watch; some just want a phone. [Or they want] different apps. Specific apps for them" (Coordinator Samantha). In terms of watches, she further suggested "mak[ing] the watch a little bit more individualized, different straps … or maybe a necklace." Stefan, a participant with IDD concurred: "I'm going to change the case … there was nothing wrong with it; I just want my own case, for instance." Changing the bands, cases, and stickers could also help—and maybe even make the technology more accessible, according to Coordinator Lu-Ann: "I would change the case colour because it's black and that's black and the phone is black, right? So, people might have trouble seeing it 'cause it's all black." Or, the apps—"Having settings on it where it can be more accessible. Larger print. Brighter screen. Different screens. For people who have visual issues." Even

varied modality options are a possibility: “I think that if the phone spoke to them, they’d probably be a little bit more responsive, like if it was sitting on a night stand and it said to you: ‘Dentist in 15 minutes’” (Coordinator Samantha). Daisy, a participant with IDD, shared positive reactions to having the right fit between their needs and a particular app, including Daisy’s example:

> [I] can just put the timer on so then I know … when laundry is done so I don’t have a couple hours later and forgot to put it in and then go get it. Or just cooking so I can just time it and I don’t have to keep on checking on it.

Success and level of effort are related. Coordinators felt that, at times, participants would take a more familiar or less complicated route given the opportunity: “[since he] cannot be bothered with [tasks] like putting on socks, cleaning up shoes, he’s not going to take the time to put any the energy into using a phone or watch. Just can’t be bothered with things” (Coordinator Kerry). Extra steps on mobile devices and/or apps could decrease movement toward success, such as an app measuring exercise steps: “They had to have it with them” (Coordinator Bonnie) or the phone/watch pairing: “One would never really use the watch. In fact, [he] didn’t pair the watch with the phone. And never used the phone. Like I said, [he] couldn’t be bothered” (Kerry). Another example is a calendar app. In more detail, Coordinator Samantha explained:

> It was just hard to get them to use the app, compared to what they’ve always used. I would be the one inputting the stuff on the schedule in the calendar because they’ve always physically written it on their calendar. So they continued to just write it on their calendar.

Coordinator Bonnie contrasted this outcome with the app that helped with calming: "You watch it and you just go along with it, you don't even have to think about it." She added:

> I thought the safety app was great myself, and the breathing one … I used it a few times, and it does, it makes you breathe with it just by watching it … it's very, very easy to use. Just one button and it's there, in one step to follow.

Technical issues are impactful. Coordinator Kerry mentioned that technical issues were immediate for her: "Well, it didn't start off good, we had a phone that didn't work … it wouldn't hold a charge." She also wondered if a lack of exposure related to technology (i.e., generational history) was impactful on this pilot project: "Like the older gentlemen that I have. You know he's in his late 50s, he doesn't really have the technology or interest; didn't grow up with cell phones, computers and stuff." In addition:

> When he went to charge the phone, he was all proud when I came in the room, like "I charged my phone all weekend" [and] when I came in the room, I'm like, "Well, that's great!" Well, [he put the] the cord in the wall but didn't hook it to the phone, or vice versa and just let it hang down. [He] thought he was charging but didn't have the concept.

Teaching how phones and watches work together and synch together was another challenge: "Knowing that the two of them are paired together and you need both. That was a little bit [hard]" (Coordinator Elaine). Coordinator Darlene mentioned that unexpected technical glitches were off-putting. For example, two of the participants "did something to their watches and it went right to factory reset … I had to contact and go

with back and forth [to] try to set them back up. Then I had to just go onto Google and look for the instructions myself."

Participants with IDD did not share many detailed reflections related to technology issues, but those that were shared related to difficulties with synching (e.g., time, wifi), resetting and charging, settings (e.g., off–on), buttons (e.g., function), and noises, like "The beeping sound … it beeps all the time. Beep, beep, beep" (Grace). Participant with IDD, Daisy, however, mentioned no such difficulties: "It's really easy that way. I really loved it … I [will] do another study if you want. I'll do another one." It is important to note that this latter participant was pleased to be informally nominated as a "resident techie" when the Coordinators were busy: "Yeah 'cause she asked me (she needed some help) and I said 'Yeah, if your coordinator can't help you then, yeah, sure'" (Daisy).

Independence is (somewhat) a function of motivation. One Coordinator explained the intersection of independence and motivation as unsuccessful in this pilot project: "She thought it was going to be something else … that she was going to get full access of everything [financial] again, and that's just not what it was for" (Coordinator Elaine). Yet Elaine also called such intersection "inspiring," reflecting that

> I have one of the individuals [who] is going to college in September. So now that this is all done, now he knows, "I have to start budgeting to go to school in September," so, this could be the timeframe that maybe [he will realize], "I need to use this app and this phone," right? And maybe it'll come afterwards; maybe he'll use it while he's at college.

When motivation and independence did come together during this project, the difference was clear. One participant with IDD, from the point of view of Coordinator Lacey, seemed to be motivated to use these new tools from their intersection with his job responsibilities:

> His job really relied on being given certain guidelines for appropriateness. You do have to come in, you have to be showered, you have to be clean … it's important for him to keep that job. And he loves it. He wants it. But he needed to do those things that he might forget to do, or needed reminders for that.

Coordinator Kerry reflected on another participant with IDD, Daisy:

> She's just very happy. Things that I used to go in and do with her or prompt her to do, she's got it programmed in, and she's done it, she's recorded stuff … she's just very proud of herself, and she's even come out of her shell even more.

In more detail:

> She's just more confident in herself. One of her things was to work on decluttering, right? Well, I used to always pick her up, she had to get items gathered up, but she never had them ready. Then she'd get them ready, and then we'd have to go take them and drop them off and stuff. Well now it's programmed in her phone, that she knows, "Okay I got to have this done, and this." She lists articles that she's going to take … and she'd have them ready.

Missed opportunities are future potential. During the course of the project, Coordinator Elaine noted frustration around attempts to use a new app, as the need for that app lay in the future; however, the participant with IDD did not yet understand its necessity: "There wasn't a huge difference, just because she still is doing it the old way.

But maybe in time she'll go over to there." She continued, "I tried explaining that that is not what it's [the budget app] for. It wasn't going to change how things happen. It was just going to change her independence of doing it." Coordinator Darlene suggested that some areas of change appeared currently "flat" but future potential remained: "I did not see any financial independence … nothing has increased or decreased." Darlene continued with her consideration of independence in general as an area of future potential. She shared that she had three clients who already had fairly high levels of independence, with a caveat:

> But they rely on staff support to give the verbal cues, "Okay, we're leaving at such [and] such time for your appointment." We thought maybe adding this [reminder] app would definitely alleviate, you know, staff giving the reminders, [but] maybe they enjoy having the staff checking with them, giving them reminders. I think maybe they enjoy [it]. They need that.

Participants with IDD also looked at the future—even if a skill, item, or an app did not help as much within the introductory context of this project. Participants talked about budgeting, trips, time management, writing, reading, social media, social communication, games, music, photography, with an interest in not only letting apps help them, but with an expression of the desire to keep learning skills beyond the apps:

> It would be good eventually to find something to maybe help learn to time stuff … I obsess and that's why I rely on [the app] right now. Which is good; it helps me a lot. But … I know how to learn; I know how to tell time. It's just timing things. I don't know how to time things. (Daisy)

Quantitative Results

These quantitative data below are of secondary importance to the above qualitative data, were analyzed separately, and are part of the methodological and technical exploration for the second stage of research following this pilot project. Table 5 summarizes duration data (dependent variable) of one skill areas for each of the 12 project participants with IDD (n = 12).

Pre–post duration change. A paired-samples t-test was conducted to compare pre- and post-intervention duration data in the conditions of budgeting (n = 9) and time management (n = 6). No significant differences were found in these areas of time management (pre-intervention [M = 3.71; SD = 5.43]; post-intervention [M = 5.73; SD = 4.29]; $t(8) = -1.06$; $p = .320$), budgeting (pre-intervention [M = 3.93; SD = 4.69]; post-intervention [M = 3.20; SD = 3.13]; $t(5) = .325$; $p = .759$) or for overall duration data (n = 12; pre-intervention [M = 4.14; SD = 5.34]; post-intervention [M = 5.08; SD = 3.89]; $t(11) = -.567$; $p = .582$).

Overall, these results do provide initial levels of insight related to the purpose (to develop some initial best practices on supporting adults with IDD using existing mobile devices and apps) of this project and its specific research question (Will the introduction of smartphone and smartwatch technology improve the skill development and independent task completion for adults with IDD living in semi-independent residential settings? And if so, what is the socio-economic impact on the independence of individuals with IDD?). Such emergent insights are detailed below in the discussion, and promising practices are outlined in the recommendations, below. It is tentatively evident that some participants are more engaged in supporting task completion with technology (e.g., time management), which aligns with growing independence; however, these data

show a higher level of engagement that is not statistically significant. It is also somewhat evident that many participants are engaged with skill development independence through mobile AT for areas of everyday task completion, using preference and choice, demonstrating independence and/or leadership. Changes to prompting and motivation can also relate to increased independence. With increased independence come possibilities such as less reliance on human supports and increased opportunity for community involvement (e.g., employment possibilities); thus, socio-economic opportunities.

Discussion

Everyday task completion. Ayres et al. (2013) stated that:

> most adults engage with mobile technology on a daily basis to complete essential daily living tasks … there already exists a general awareness concerning the capabilities of technology. It now becomes a matter of seeing how that technology can assist with instruction or provide aid with daily supports. (p. 269)

This pilot project examined the use of everyday mobile technology beyond the above-noted everyday engagement. Yet these above comments do still hold true. This group of participants with IDD certainly "engage[d] with mobile technology on a daily basis to complete essential daily living tasks" but this mobile technology was typically novel for this group of participants with IDD. It could also be true that the significance of accessing such technology for what others may see as an everyday task can create progress toward independent functioning for adults with IDD.

Preference and choice. Ayres et al. (2013) reflected that technology is a tool like other tools; that its power emerges from its usage rather than its form. Similarly, Leer and Ivanov (2013) stated that it is the utilization of technology that contributes to success—

and not its presence. However, this group had specific preferences in their technology use in what seemed to be a love–hate binary approach. Since the needs of adults with IDD are complex, devices and programs perhaps need to be a more immediate best-fit to provide equally immediate positive feedback and must include choice, or provide an exploratory period for choice making (i.e., modalities, settings, stylistic elements).

Prerequisites and binaries. In the case of these participants with IDD, a discussion around digital natives versus digital immigrants is warranted. Digital natives are described as a homogenous, age-defined group (Smith, 2013); however, "little work fully considers the impact of digital immigrant discourse within the fields of adult learning" (p. 1). With an average age of 43, participants with IDD can be considered digital immigrants: entering the digital world following their early or formative years and knowing (or having known) the pre-digital world, also called the "analogue world" (Smith, 2013, p. 3). Smith stated that "in relation to technology, aspects of language, literacy, and communication are often used as important distinguishers between natives who purportedly possess fluency and immigrants who are learning something foreign" (p. 5). If these assumptions are even somewhat valid, narrowing the age range of participants and/or grouping digital natives and immigrants separately may decrease variability in resulting data. Johnson (2014) noted that "clearly, teachers/assistants who are less technologically capable may have very different perceptions." Since attitudes, beliefs, and dispositions all relate to the successful movement from technology use to technology teaching (Courduff, Szapkiw, & Wendt, 2016; Maich, Hall, van Rhijn, & Henning, 2017) this could be also relevant for involved Coordinators as well.

Independence and leadership. One of the most salient findings of the focus groups was the in-house nomination of an informal technology expert—one of the participants with IDD. Tobin, Drager, and Richardson (2014) emphasized that "informal social support was shown to be an important contributor to both social functioning and QoL [Quality of Life]" (p. 228). The resident technology expert nomination in this study is a strong example of such an informal social support that arose spontaneously, showing movement from a "'horizontal' mode of transferring knowledge to a given context, to a 'vertical' mode, developing collective, on-site knowledge" (Webb, 2011, p. 19).

Motivation. When difficulties arise with the adoption of novel mobile technology skills, consider whether such challenges represent difficulty with acquiring the related skills for success—or performing those skills (Bellini, Peters, Benner, & Hopf, 2007). Difficulties with the adoption of novel mobile technology skills may be compounded when challenges associated with on-task behaviour are related to deficits in the performance skills. Wright (2015) noted that benefits must be perceived as outweighing efforts in order to persist with the adoption of technology. It appears that ease of use is part of the form, fit, and function that leads to success. Wehmeyer et al. (2006) would agree, differentiating between avoiding devices that are overly complex and choosing devices that are simple, intuitive, multimodal, and flexible. An additional option is referring problem solving through an emerging role, such as the above-noted resident technology expert. Bouck, Okolo, Englert, and Heutsche (2008) explained this as best practice where "learning is embedded within authentic problem-solving activities" (p. 22).

Time management. It appeared that the time management app was a particularly impactful tool. Multiple participants with IDD mentioned its use in varied domains of daily living (e.g., social, self-care, employment), as it appeared to support perceived increased efficiency and effectiveness with time management. However, neither time management nor "budgeting" conditions exhibited statistically significant quantitative differences, perhaps due to sample size (n = 9 and n = 6, respectively), variability, and project time limitations.

Levels of prompting. Levels of prompting by Coordinators could be included in future research to examine change in levels of independence, as such changes can be indicators of growing independence. Hall, Maich, and Hatt (2014) included varied levels of prompting (full physical, partial physical, shadowing, gestural, proximity, and verbal prompts) in their mobile technology-based research. When the means of more intrusive prompts (full and partial physical) were analyzed, changes to less intrusive prompting levels demonstrated such growing independence.

Duration of supports. It is possible that greater post-intervention duration levels, in some participants with IDD, demonstrated more engagement with the skill areas. It is interesting that for all participants with IDD who had pre–post data for two skills areas (n = 4), both skill areas either consistently increased or consistently decreased, demonstrating a pattern to watch in future iterations beyond this pilot project. Scaffolding and prompting might change form (i.e., direct to indirect support) or change in intensity (i.e., time) and directedness (i.e., prompting levels) but is likely to continue; it is unlikely that human supports will be replaced, in totality, by electronic ones; rather, it is likely that smart hardware and related apps will play a digital scaffolding role (Dennen & Burner,

2007) in the context of helping professions and professionals supporting the independence and socio-economic status of adults with IDD.

Limitations

As with any small sample size, this research is focused on qualitative outcomes, context-bound, and not intended to be widely generalizable (Creswell, 2018). In addition, this project's status as a pilot project involved initial trialing not only of hardware and software but also of methodologies. In future follow-up studies, it would be helpful to have an alternate, reliable method of recording app usage data that successfully differentiates between how long an application is open and how long it is in active. Collecting level-of-prompting data around Coordinator support for adults with IDD could add another layer of understanding around the development of independent skills during pre- and post-intervention duration data (Cooper, Heron, & Heward, 2007). Other options include increasing the number of participants, additional training and ongoing support for individuals with IDD and their support workers, increased intervention time, and the collection of generalization and maintenance data. Even though this study was a pilot that will provide the foundation for a more comprehensive intervention, the limited amount of training provided must be taken into account when considering further study. Previous research has noted limitations related to training as one of the leading factors that can inhibit the positive impact of AT. Bausch, Ault, & Hasselbring (2015) noted that a lack of sufficient training resulted in individuals not being able use the AT properly. The importance of sufficient training also applies to the persons responsible for supporting the individual with their AT use. Gentry, Kriner, Sima, McDonough, & Wehman (2015) similarly concluded that desirable results

would not be expected from clinicians who lacked training in the use of assistive technologies.

Recommendations

While this project is not generalizable for all adults with IDD, in the context of this group of adults with IDD utilizing supervised independent living services some promising practices have emerged that may help to inform future projects beyond this initial pilot project, such as a planned phase two follow-up research project. Five broad recommendations follow from the above discussion and related to both methodology and clinical decision making:

1. Begin with prerequisite assessments for technology skills, hardware, software, and attitudes in order to support individualized teaching. Then, teach and practise any missing and/or necessary prerequisite skills to fluency prior to being trained to use mobile AT. Consider using most-to-least prompting or backward chaining before other possible types of prompting while teaching skills of using mobile AT to ensure immediate successes.
2. Explore, discover, or develop single-function apps that are straightforward to access, navigate, and use, including the use of a time management app for each adult with IDD. Consider implementing these on an "as needed basis or just-in-time" (Schlosser et al., 2017, p. 222).
3. Provide some choice in individualized apps, where possible. For example, provide two choices of apps for a given goal area and allow the adult with IDD to choose which one to utilize for day-to-day community functioning. Similarly, build in

some choice for hardware, design (e.g., colour), and/or accessories (e.g., size), if possible and/or necessary.

4. Build in additional transition time to explore and evaluate choices in apps, hardware, and/or accessories and consider what works well (and what does not) before making final decisions with respect to individual preferences, skills, and usability.
5. Seek out natural supports for the introduction, comprehensive training, and maintenance of technology including (where possible) a peer trainer—someone who exhibits leadership abilities and strength with the use of technology.

The purpose of this project was to develop initial best practices for supporting adults with IDD using existing mobile devices and apps. From these initial explorations, it is evident that the introduction of smartphone and smartwatch technology improved the skill development and independent task completion for adults with IDD living in semi-independent residential settings—somewhat—and also in unexpected directions. It is clear that such devices and their related skills can produce some further independence in targeted skills; however, it is not yet clear what the overall socio-economic impact will look like. Overall, the best answer to the utilization of mobile technology for these adults with IDD is—"it depends." Regardless of any labels, the success of technology use depends on each individual's strengths, needs, wants, likes, and motivation. Within this fast paced, ever-changing landscape of technology, the experiences of technology use are each as unique as the individuals using it.

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Table 1

Demographics of Participants with IDD

Name*	Gender	Age	Annual Hours of Support**	Target Skill Areas
Alan	M	58	371-2550	Time Management, Budgeting
Jeremiah	M	32	2551-8760	Time Management, Budgeting
Matthew	M	42	2551-8760	Time Management, Budgeting
Max	M	19	2551-8760	Time Management, Budgeting
Micah	M	50	228-370	Coping, Exercise
Stefan	M	35	371-2550	Time Management, Budgeting
Terry	M	42	228-370	Safety, Budgeting
Daisy	F	29	128-227	Time Management, Budgeting
Grace	F	51	128-227	Time Management, Budgeting
Jane	F	43	228-370	Budgeting, Time Management
Lu-Ann	F	62	2551-8760	Budgeting, Time Management
Tracey	F	52	371-2550	Budgeting, Time Management

*pseudonyms
**these ranges represent identified quartiles

Table 2

Apps Used

Purpose	App Name	Company Name
Budgeting	Simple Budget	Jimmy Winters
	Canadian Activity Coins & Bills	BloomingKids Software
Time Management	Google Calendar	Google LLC
Exercise	Google Fit	Google LLC
Coping	Breathe	Jatra
Safety	Magnus Cards	Magnusmode

Table 5

Pre–Post Duration Measures (One Skill per Participant)

Participant with IDD	**Pre-Intervention** (min.)	**Post-Intervention** (min.)	**Mean Change** (min.)
Alan*	1.6	8.3	+6.7
Jeremiah	0.1	12.9	+12.8
Matthew*	4.9	1.6	-3.3
Max	2.5	7.0	+4.5
Micah	2.4	4.1	+1.7
Stefan*	1.0	0.7	-0.3
Terry	1.6	1.5	-0.1
Daisy*	3.1	5.1	+2.0
Grace	0.9	3.4	+2.5
Jane	1.6	1.9	+0.3
Lu-Ann*	17.7	10.7	-7.0
Tracey	12.3	3.8	-8.5

*For participants with more than one set of data, the first listed skill area was utilized for paired *t*-tests

Charging Directions

Insert the charging cable into a USB charger.	
Turn the Pebble over.	
The **charger** connects magnetically with the **charging port** on the back of the watch. Put charging cable on the charging holes on the back of the Pebble.	
The screen will show that it is **Charging** if the cable in on correctly.	
It can take up to 3 hours for the Pebble to be fully charged. The screen will show when it is **Fully Charged.**	

Figure 1: **Task Analysis for Charging the Smartwatch**

Table 3

Post-Intervention Semi-Structured Focus Group Questions (Participants with IDD)

Questions
1. Was your participation a positive experience? Why or why not?
2. Will you continue using the: a. watch? b. phone? c. apps?
3. If the equipment and apps helped you, how did they help?
4. Would you like to have more apps added to help you with other activities? Which ones?
5. Do you think others should have the chance to the use the: a) watch? b) phone? c) apps? Why or why not?
6. Do you feel the project has helped to increase your independence? How?
7. Do you feel the project has helped to increase your financial independence? How?

Table 4

Post-Intervention Semi-Structured Focus Group Questions (Coordinators)

Questions
1. Did you feel the use of the equipment and apps provided an opportunity for the participant to complete tasks with less support?
2. What do you think the value of this is to people you support?
3. Do you see how this support method could be used more broadly in supporting people with intellectual disabilities?
4. What challenges did you encounter in providing supports using the equipment and apps?
5. Did you find the data collection process requirements too onerous for practical application in the support process?
6. How would this electronic app-based support be incorporated into support plans for people with Intellectual Disabilities?
7. Do you feel the use of the equipment and apps has improved the participant's financial independence?