Technology-Based Strategies to Teach Communication Skills to Individuals with Intellectual and/or Developmental Disabilities: A Review of the Literature

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Abstract

Handheld electronic devices in the form of speech generating devices (SGD), have become increasingly prevalent in today's society for individuals with intellectual and/or developmental disabilities (I/DD). These tools have been demonstrated to be effective through various research studies, promoting its development of attaining its status as an evidence based practice. This literature review encompasses ten research studies evaluating the effects of handheld mobile technological devices (e.g., iPad, iPad Mini, iPod), as SGDs by means of fostering functional communication skills such as madding, responding, commenting and discriminating between stimuli in individuals with I/DD. The research question imposed for this literature review involves the effectiveness of technological devices as a form of teaching communication skills to individuals with I/DD who have little to no speech abilities. Through the findings in this review, the results suggest an overall increase in communication through various forms for all participants involved. This suggests continued support for the use of handheld computing devices as SGDs for individuals with I/DD. Future directions in research can include advancements in teaching of more complex forms of communication such as requesting using full sentences, independently asking questions, in addition to inclusion of social factors for communication such as eye contact, smiling, and body posture.

Technology-Based Communication Strategies: A Review of the Literature

With recent advances in technology over the decades, the use of handheld electronic devices have become more and more apparent in today's society. Many individuals with intellectual disabilities (ID) and/or developmental disabilities (DD), are utilizing the power of technology as a means to increasing their independence while decreasing their dependence on others for assistance (Van Laarhoven, Carreon, Bonneau, & Lagerhausen, 2018). Many individuals with I/DD fall under the category of autism spectrum disorder (ASD) as well, being those who present little to no use of functional speech (Xin & Leonard, 2015). They rely on gestural behaviors such as pointing, reaching, and facial expressions to communicate their wants and needs. However, through the use of technological devices, we can instead teach these individuals to learn functional communication skills and therefore empower them to speak their desires through an output produced by a speech generating device (SGD). Lorah (2018) stated these devices use pictures, words, or other symbols that represent aspects of speech including nouns, verbs, adjectives, and adverbs. When the respective symbol is selected on the screen of the device, an audible output is projected, which is the form of communication that is used to display the message. These devices have become more and more apparent in today's society with the recent developments in technology and handheld computing devices (i.e., the iPad and iPad Mini) and portable multimedia players (i.e., the iPod), which can thus be formed to function as a SGD through use of relevant tools and applications.

In a review of the literature, 10 studies examining the use of technological devices as a method of communication strategies for individuals with I/DD have been selected and identified as published within between 2014 and 2018. The parameters around the methods in obtaining relevant studies were primarily attained through search engines such as Google Scholars and

Capilano University's library database known as Academic Search Complete. The focal point of this literature review was to gather evidence for technology-based communication strategies for individuals with I/DD. The 10 studies found highlight the significance of teaching functional communication strategies to individuals who possess little to no forms of communication. Thus, this paper will review various forms of mobile technological procedures for teaching individuals with I/DD relevant communication skills.

Dependent Variables

A total of ten studies were included in this literature review which addressed technology-based communication as a method to teach functional communication skills to individuals with intellectual and/or developmental disabilities. These studies included a total of 32 participants with an age range of 1.8-18 years of age for nine of the ten studies. These studies involved children and adolescents with ASD, ID, DD, Asperger's Syndrome, attention deficit disorder (ADD), bipolar disorder, obsessive compulsive disorder (OCD), and/or seizure disorder. The remaining study included 3 individuals within the age range of 31-44 years old who had diagnoses of ASD, OCD, ID, attention deficit hyperactivity disorder (ADHD), and schizoaffective disorder. The dependent variables in these studies incorporated the use of several technology based SGDs consisting of iPad, iPad Mini, iPod, and HP slate devices. Independent manding behaviors were targeted in (Copple, Koul, Banda, & Frye, 2015; Gervarter et al., 2014; Hill & Flores, 2014; Lorah, 2018, Nepo, Tincani, Axelrod, & Meszaros, 2017; Strasberger & Ferreri, 2014; Xin & Leonard, 2015) using SGD's to teach communication. Responding to questions was also targeted using an iPod, iPad, and HP slate device in research conducted by (Strasberger & Ferreri, 2014; Van Laarhoven et al., 2018; Xin & Leonard, 2015). Independent comments made by participants using an iPad were measured also measured in Xin and Leonard

(2015). Unprompted use of nouns and verbs following a question on an iPad as a SGD was measured through (Ganz, Boles, Goodwyn, & Flores, 2014). Finally, identifying and discriminating between photos using an iPad is a necessary component to any intervention related to the use of technological devices as SGDs. The individual must be able to correctly identify their wants and needs onto the represented picture accurately, as targeted through (Ganz, Hong, Goodwyn, Kite, & Gilliland, 2015).

Independent Variables

The independent variables used throughout these studies incorporated various instances of differential reinforcement through the participants individual preferences. These preferences were determined by Preference Assessments which established which specific object, food, and/or drinks the participants preferred. Three studies, (Lorah, 2018; Nepo et al., 2017; Strasberger & Ferreri, 2014), integrated two part preference assessment, starting with a structured format by using the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD). This consisted of an interview with the participants' parents, staff members and/or caregivers who were familiar with the participants. During the interview, these individuals were asked questions regarding the items the participant's seemed to enjoy in order of preferences. Once there were a few items selected in the RAISD, they were then evaluated in a multiple stimulus without replacement preference assessment (MSWO) for the studies conducted by Lorah (2018), and Nepo et al. (2017), and through use of a paired choice assessment for Strasberger and Ferreri (2014). A similar procedure was conducted for Gervarter et al. (2014) where parents were asked about their child's individual preferences which were then ranked and selected as reinforcers for the study. In another study, (Copple et al., 2015), conducted a preference probe assessment by administering a Likes and Dislikes Checklist the results of which

were then used to determine the qualifications of the participants preferred items. Van Laarhoven et al. (2018) also used differential reinforcement however, in the form of verbal praise (e.g., "good job," and "nice work"). These methods used aided in the correct implementation of the dependent variables but also helped determine experimental effectiveness for the studies.

Reliability

Interobserver agreement (IOA) data was collected for 9 of the 10 studies included in this review. This was done by having two or more trained and qualified observers review and record the same data independently and subsequently report their findings afterwards. IOA data are measures used to ensure the reliability of the treatment procedures that are in place. This is calculated by taking the number of agreements and dividing that number by the number of agreements and disagreements and then multiplying it by 100. Thus, this gives us an overall percentage of agreement within the data that collected for each study. In order for a procedure to be deemed reliable, it must achieve an IOA of 80% or higher. For 9 out of the 10 10 studies in this review, IOA data was collected for a mean of 48% of sessions, with a range of 23-100%. Of this sample, the mean percentage of IOA was 98% with a range of 95-100%. These suggests highly reliable and trustworthy results from these studies. However, for one study, (Xin & Leonard, 2015) there was no form or measure of IOA data stated. This represents a limitation in this study's quality of observational data. Without IOA data, we cannot confidently analyze the results of the data thus, suggesting a question of potential data subjectivity.

Social Validity

Social validity is a meaningful part of any research study as it highlights the significance of the effects on the dependent variable(s) based on its implications with the independent variable(s) used. The significance of social validity lies on its dependence of social acceptance, value, and importance to the client and their families lives. With this description, social validity can be a potentially ambiguous or subjective factor to measure, however, using Wolf's (1978) study this concept is broken down into levels, making this notion much more structured, objective, detailed, and measurable. Through this, Wolf quantifies social validation at 3 levels, which include and describe social significance of the goal, social appropriateness of the procedures, and finally the social importance of the effects it produces. The first level, social significance of the goals, defines whether or not the behavioral goals in question are truly those that society wants. The second level, social appropriateness of the procedures, describes the acceptability of the treatment procedures based on the individuals participating, caregivers, and/or other associated consumers. Finally, the third level, social importance of the effects represents whether or not the consumers involved are truly satisfied with the overall results of the study. Through these three levels, we can ensure objective and reliable measurement of social validity while avoiding the potential for subjective information.

Two studies (Copple et al., 2015; Van Laarhoven et al., 2018), included direct measures for social validity through use of five question surveys and social validation surveys, respectively. These surveys were given to participants, parents and/or teaching staff and included questions such as the value of the research being conducted as well as the importance of the skills being taught to the participants in (Copple et al., 2015). Furthermore, (Van Laarhoven et al., 2018) indicated if the participants liked using the SGDs, if it helped them perform their job and whether or not they would continue using them in the future. These surveys will give us a

clear representation of whether or not social validity was established in these two studies. However, for the remaining eight studies who did not include direct social validation measures, we can implement Wolf's (1978) article and analyze the findings using the three levels. The goals presented within all of these studies are concurrent with the goals society wants for the best outcomes of the students and their families which was clearly outlined in each study. Next, the procedures used were scientifically sound and used evidence based practices which promotes the most reliable and trustworthy research. Finally, the outcomes were also socially valid in which all of the studies resulted in an increase of communication and mobile technology use in comparison to their levels at baseline. These outcomes are definitely socially significant as they promote overall independence for the participants and allows them to have an overall better quality of life.

Including sufficient measures for social validity is a shortcoming within this literature review. Majority of the studies included did not demonstrate direct measures of social validity within their findings. However, through Wolf's (1978) measures and understanding that communication is such an important factor of any individual's life, we can positively conclude that social validity was established within this review.

Evidence Based Practice Status

A research paper is confidently deemed to be an evidence based practice based on its demonstration of experimental control across an adequate range of studies, researchers, and participants, based on Homer et al. (2005). In order to qualify for an evidence based practice, there should be documentation of multiple instances of single-subject studies. Thus, the researchers proposed three standards in order to consider a practice as evidence based. Firstly, there must be a minimum of five single-subject studies that meet acceptable criteria while

documenting experimental control through publications in peer reviewed journals. Next, the studies must be conducted by a minimum of three separate researchers across a minimum of three different geographical locations. Finally, the third aspect being that the studies must include a total of 20 participants or more. By utilizing this standard of 5-20-3, we have an objective way to measure the status of evidence based practices confidently and accurately.

The current literature review meets the guidelines to be deemed an evidence based practice using Homer et al. (2005) evidence based practice standards. This review includes a total of ten single-subject research studies that have documented experimental control and been published in trustworthy, prestigious and most importantly, peer-reviewed journals. In these ten studies, there have been a total of 33 different researcher that have been involved in conducting the studies over 3 different geographical locations. Finally, these studies combined include 32 participants with a wide age range demonstrating a comprehensive representation of different populations.

For these reasons stated above, the status of this literature review is in fact an evidence based practice. This status of an evidence based practice holds value in allowing practitioners to make informed and confident decisions in apply the findings of this literature review to the individuals they work with.

Conclusions / Futures Directions / Implications for BCaBAs

The purpose of this literature review was to examine the effects of teaching individuals with intellectual and/or developmental disabilities, methods of communication strategies through use of handheld mobile technology devices. The findings suggest handheld devices such as iPads, iPad Mini's, iPods and other SGDs are effective ways to promote functional communication learning in individuals with intellectual and developmental disabilities. The

forms of communication that was taught includes independent manding for preferred items, responding to questions, making appropriate comments, as well as discrimination between various picture symbols. These communication skills taught were also administered in novel, natural settings promoting generalization between different places and people. There may be several reasons why the use of SGDs such as iPads as a platform are advantageous. As reported by (Ganz, Boles, Goodwyn, & Flores, 2014), they can hold a collection of visual scripts that can be easily carried from one place to another. On the other hand, cards, papers, and other forms of sentence strips may be much less convenient, visually obtrusive, and can also easily be lost. One of the most compelling pieces of evidence for SGDs is the fact that they are much less conspicuous in comparison to a notebook, or binder than contains paper scripts. For the general population, iPads and other handheld technological devices are used for different purposes including note taking, accessing online reading materials, and calendar and schedule uses, all of which are becoming increasingly ubiquitous within today's society. Therefore, a student carrying a technological device holding their communication abilities would not stand out from their peers in the slightest. Furthermore, practitioners and family members have expressed preferences for portable devices such as the iPad for communication related interventions because they are easily transported amongst different forms of activities and developing pictures and scripts on these devices are much less time consuming in comparison to constructing and laminating them onto physical cards.

Based on the findings of this literature review, future research directions can look to addressing the need to teach individuals with intellectual and developmental disabilities a greater expansion of vocabulary using SGDs, (Strasberger & Ferreri, 2014). This expansion can include manding for more items, discriminating between a cluster of items and finally working on more

forms of responding to different social variables and questions. Further directions can also look at including more comprehensive peer training packages. These skills can include measuring skills such as eye contact, body position, smiling, and giving praise. Future research should also include more instances of direct measures for social validity data from the participants, parents, and teachers perspectives to demonstrate the acceptability of SGDs as effective methods for communication. Social validity measures are crucial components of any research study and should be prioritized more by researchers in the future. Finally, future directions in research can look at evaluating the effectiveness of teacher and parent implementation and training of the use of SGDs. The operation of such technological devices can potentially be difficult to novel users without extended knowledge and practice with the device and/or its applications. Therefore, this may make troubleshooting problems such as countering glitches troublesome for inexperienced users. For this reason, this type of training can potentially lead to an increase in the use of and effectiveness of SGDs as methods for communication for individuals with intellectual and developmental disabilities.

Communication skills are fundamental skills that are critically important for every individual to possess, particularly those with intellectual and/or developmental disabilities who currently have little to no repertoire for functional speech (Xin & Leonard, 2015). Such individuals are ideal candidates to utilize the benefits of mobile technology in the form of SGDs as a means to replace or supplement natural speech. These methods will allow individuals the incredible opportunity to be able to express themselves and display their wants and needs, in addition to being able to interact with people in their lives such as their family members, friends, and teachers. As future BCaBA's we understand the need to teaching individuals with intellectual and developmental disabilities functional communication strategies. In this day and

age, with the advances in technology we should strive to incorporate the tools that are out there to the best of our ability in order to make positive changes to the lives of the individuals we work with. Technology will keep advancing and with that, so must our teaching strategies. By being up to date with recent advances, we are encouraging and promoting the best practice for our clients and their individual needs.

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Table 1. SUMMARY OF RESEARCH ARTICLES

Study	N	DV	IV	IOA	Results
1: Copple et al., 2015	3	Manding using a SGD	VM + least-to-most prompting	30% session; mean >:98%	Combination of VM + least-to-most prompting strategies resulted in an increase in manding using a SGD with a PND of 75-100%
2: Ganz et al., 2014	3	Unprompted use of nouns and verbs using an iPad	DRO	33% session; mean >:96%	Use of DRO resulted in a 61-100% increase in unprompted usage of verbs and nouns using an iPad
3: Ganz et al., 2015	1	Identification of photos using an iPad	DRO	100% session; mean: 100%	Use of DRO resulted in a slight increase in identification of photos using an iPad
4: Gervarter et al., 2014	3	Manding using Scene and Heard application on iPad or GoTalk SGD	DRO	33% session; mean >:97.5%	Use of DRO resulted in increase of manding using both devices however, results were most prominent using the iPad Scene and Heard application
5: Hill & Flores, 2014	5	Requesting using PECS and iPad	DRO	43-83% sessions; Mean: 96%	Use of DRO resulted in an increase of requesting behaviors through use of PECS and iPad
6: Lorah, 2018	3	Manding using an iPad Mini	Time delay and full physical prompting	36% sessions; mean: 99%	Combination of time delay and full physical prompting procedure resulted in an increase in manding behaviors using an iPad Mini
7: Nepo et al., 2017	3	Manding using an iPod Touch	DRO	67% session; mean >:99.9%	Use of DRO resulted in a 93.5-96.7% increase in manding using an iPod Touch
8: Strasberger & Ferreri, 2014	4	PACA training on manding and responding to questions using an iPod	Time delay, graduated guidance, and least-to-most prompting	30% session; mean >:95%	Combination of time delay, graduated guidance, and least-to-most prompting resulted in an increase in manding and responding to questions using an iPod

9: Van Laarhoven et al., 2018	4	Correct responses and media options selected using an iPad and HP slate device	DRO (verbal praise)	23% session; mean >:98%	Use of DRO resulted in an increase in correct responses using an iPad and HP slate device with a PND of 100%
10: Xin & Leonard, 2015	3	Requests, responses and comments made using an iPad	DRO	Not represented in the study	Use of DRO resulted in an increase in requests, responses and comments using an iPad