Critical Review: Are language-specific, tablet-based apps an effective therapy tool for improving expressive language in adults with aphasia?

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The purpose of this paper was to critically review the literature to evaluate the effectiveness of language-specific, tablet-based apps on the treatment of expressive language for adults with aphasia. Six peer-reviewed journal articles were critically appraised to determine their validity and clinical implications. One study used a randomized clinical trial design, another was a systematic review, and the remaining four studies used a pre-test, post-test (quasi-experimental) design. The literature suggests that tablet-based therapy using language-specific apps may be useful in treating aphasia.

Introduction

Aphasia is a language impairment that can occur following an acquired brain injury, such as a stroke or traumatic brain injury, that currently affects approximately 100,000 Canadians (Aphasia Institute, 2015). It is most often characterized by word-finding difficulties which can make it challenging for individuals to speak, read, and/or write, and it can also involve challenges with understanding language (Aphasia Institute, 2015). People living with aphasia typically must undergo long-term therapy with a speech-language pathologist to make some recovery with their language abilities.

As new technology becomes more prevalent in the clinical setting, the use of iPad and smart tablet applications (apps) to supplement speech and language intervention is an emerging area of interest. Van de Sandt-Koenderman (2011) examined the use of computer-based therapy within the context of the International Classification of Functioning, Disability, and Health (ICF) framework (WHO, 2001). She found that computer-based apps are particularly useful for treating aphasia as they can provide greater therapy intensity, and they can also be useful from a functioning and social participation approach, although these areas are not as well explored. There are some advantages to using a tablet in therapy, such as the ability to self-administer therapy activities (including home practice), and to monitor or control the amount of cueing the client receives on these tasks (Des Roches et al., 2017). Furthermore, smart tablets can be used for early intervention in the acute stage following a stroke, and they can be motivating for the client to use (Mallet et al., 2018). Tablets can also be more accessible than computers as they are more cost-effective and portable (Lavoie et al., 2016).

There are some barriers that can make the use of tablets difficult for some patients, such as fine-motor control issues (Des Roches et al., 2017) and the fact that many patients are likely to need training or assistance using the device (Mallet et al., 2018). The increased use of tablets in therapy can even lead some clients or families to go so far as to purchase a tablet for the client to be able to practice outside of therapy sessions. It is therefore important to determine whether the use of language-based apps in therapy make it a worthwhile tool to include in clinical practice.

Objectives

The objective of this paper is to critically review the existing literature to investigate whether language-specific, tablet-based apps are an effective therapy tool for improving expressive language in adults living with aphasia.

Methods

Search Strategy

Online databases including PubMed, CINAHL, and Google Scholar were used to search for journal articles. The following search terms were used: ((aphasia) AND ((intervention) OR therapy)) AND ((ipad) OR tablet). Searches were limited to articles written in English after the year 1999.

Selection Criteria

To focus this review on language-specific apps, papers were excluded if the study did not use an app designed for therapeutic purposes. They were also excluded if they did not evaluate expressive language as an outcome measure. Other exclusion criteria included pediatric studies, and papers that did not describe an experimental study.

Data Collection

The database search and the above selection criteria yielded seven articles appropriate for review. Of these

articles, one was a systematic review, four used single-subject designs, and one was a randomized control trial.

Results

Randomized Control Trials

The randomized control trial (RCT) included in this review was the paper by Des Roches et al. (2015). In this study, 51 adults who had an acquired language impairment resulting from either a stroke or a TBI participated in a 10-week therapy program using the Constant Therapy app (Constant Therapy, Inc., 2017). The control group participated in 1-hour weekly sessions with a speech-language pathologist (SLP) in a clinic, while the experimental group completed these same 1-hour sessions in addition to six 1-hour home practice sessions per week. Both the experimental and control groups showed improvements, with the experimental group showing greater improvement in accuracy and latency on tasks overall than the control group.

The RCT design provides a strong level of evidence as it allows the researchers to measure the efficacy of the Constant Therapy app under controlled conditions and directly compare the intervention with a control group (Archibald, 2013). However, with an RCT design it is best to use blinding to avoid the occurrence of a placebo effect (Archibald, 2013), but blinding the participants was not possible for this study as the control group did not receive any home practice sessions. It is also unclear whether the clinician was blinded to the conditions of the participants, which may have impacted decisions to assign or progress tasks. Another weakness of the RCT design is that it is not always possible to control for differences between the two populations (Archibald, 2013); in this study, the experimental group had significantly better semantic access and significantly fewer months post-onset of injury than the control group, and these differences were not accounted for in statistical analysis.

The researchers adequately defined their objectives and their methods were appropriate for investigating their hypotheses. They clearly described the participants and any inclusion or exclusion criteria. Participants were randomly allocated to each condition, and the control condition was appropriate. The methods of this study were mostly described in sufficient detail, except that the researchers did not specify how many clinicians were involved in the assessment and treatment of the participants. This can have implications on inter-rater reliability; it was not clear whether inter-rater reliability was evaluated as it was not reported in this paper.

Des Roches et al. (2015) provide highly suggestive evidence that the use of language-based iPad apps can benefit adult clients with acquired brain injuries. However, the pre-treatment differences between the two groups and lack of blinding are reasons to use caution when implementing this evidence into clinical practice.

Systematic Reviews

The systematic review included in this review was the paper by Lavoie et al. (2017) investigating the efficacy of technology-based therapy in the treatment of post-stroke anomia. In this systematic review, two researchers searched for articles using three databases and assessed them for eligibility according to their exclusion and inclusion criteria. Twenty-three articles were evaluated for methodological quality and level of evidence. They found that, while there was a great deal of variation in methodology among the studies, all studies showed significant improvements with trained words, and maintenance was shown for up to a few weeks post-treatment using smart tablets. They also found mixed results regarding generalization to untrained words. The reported level of evidence for all studies using smart tablets included in this review was Class III.

A systematic review is a strong study design as it examines findings from multiple primary studies (MacGill, 2019). It can reduce experimenter bias because results are examined from a variety of researchers (MacGill, 2019), which was exemplified in this study where the authors reported that there were mixed findings around generalization.

The inclusion and exclusion criteria were well defined by the researchers. The methods for gathering articles were adequately described. The researchers indicated that they retrieved articles from three databases, so their review included only published research. This is a potential weakness of this systematic review because research findings may be biased towards positive outcomes, as articles with significant findings tend to be published more frequently than articles with neutral or negative findings (MacGill, 2019). Another weakness is the fact that only two of the 23 studies included were Class I studies, both of which used computers for intervention, and the rest were Class III, including all studies using smart tablets. When forming clinical recommendations, the authors indicated that Class III studies should only used to support recommendations for treatments as a practice option rather than a practice standard. Therefore, the use of smart tablets in the treatment of aphasia is not supported by strong evidence in this review.

Overall, the systematic review by Lavoie et al. (2017) provides suggestive evidence for the use of smart tablets to treat anomia in individuals living with aphasia. While the methods employed by the authors were sound, they simply were not able to find sufficient

evidence with strong methodologies that examined the use of smart tablets in therapy.

Pre-test, post-test (quasi-experimental) design

The following four studies all used a pre-test, post-test (quasi-experimental) subject design in their methodology. This is a strong experimental design because it allows for the researchers to systematically manipulate variables (Archibald, 2013). It also eliminates differences in participants between conditions as each subject can act as their own control (Archibald, 2013). A weakness of this study design is that it does not often employ randomization, which means there is a greater chance that a group allocation bias may be introduced (Archibald, 2013). In fact, of the four quasi-experimental design studies in this review, only one randomly allocated participants to one of two conditions.

Stark & Warburton (2018) examined the effectiveness of self-directed iPad-based therapy in patients with aphasia following a left hemisphere stroke. In this crossover design study, ten participants were allocated to one of two groups, each one first using either the Language Therapy app (Tactus Therapy Solutions Ltd., 2011) or Bejeweled (PopCap, 2014) and switching to the other app after 4 weeks. Results showed significant improvements in expressive language for all participants when comparing post-therapy measures to baseline. A very large effect size was found for Bejeweled compared to baseline when it was administered after therapy, but no significant improvement when it was used before therapy, leading the researchers to conclude that the language app was effective, but mind games may be effective only as a post-therapy maintenance task.

In this study, the researchers clearly defined the inclusion and exclusion criteria for participants. There was a significant difference between groups in severity of expressive language impairment scores on the Comprehensive Aphasia Test (CAT; Swinburn, Porter, & Howard, 2004), but not on any other outcome measures. The methods of this study were described in enough detail that the procedure could be replicated by another researcher, and the methods were appropriate to answer the research question. Compliance was measured appropriately via self-report and automated emails sent by the therapy app, but the control app did not send automated emails. Thus, the researchers could not be certain how compliant the patients were with using Bejeweled, and this weakens the validity of the results for this condition. The researchers noted that Tactus Therapy Solutions donated the app free of charge for this study, which presents a potential conflict of interest that may compromise the reliability of the study results.

The evidence from Stark & Warburton (2018) is suggestive of the efficacy of home practice with tablet-based language apps in treating expressive language deficits in aphasia. However, the presence of a conflict of interest is a major caveat to the reliability of the evidence.

Choi et al. (2016) conducted an AB single-subject study in which eight stroke patients used the iAphasia app (developed by the researchers) at home for four weeks. Results related to expressive language included significant improvements in verbal fluency and overall language function post-treatment, and marginal improvements in naming. The researchers stated that their findings suggest this program may be effective in improving language outcomes for individuals with aphasia.

The researchers used an adequate sample size as they reported that eight participants would be needed at the 80% power level. The exclusion and inclusion criteria were specific and clearly outlined. The age range of the participants was 37-62 years (mean 50.75 years). According to the Canadian Institute of Health Information (CIHI), the incidence of stroke and other chronic conditions is higher in adults age 65+ (CIHI, 2011). Therefore, the evidence from this study for the use of tablet-based therapy may not be applicable to the majority of stroke patients.

The methods of this study were sound based on the researchers' objectives, but there were important details missing from the procedure description, which limits replicability. The researchers only reported the total number of hours patients spent using the app over four weeks. A better representation of dosage would have been the mean number of hours per day or per week the app was used, as this would take into account the fact that practicing in smaller chunks of time over consecutive days (spaced practice) results in better outcomes than practicing for several hours at once (massed practice) (Donovan & Radosevich, 1999). Another weakness of this study was the lack of multiple baseline measures, which means that there was a lack of control data as the baseline measures would have shown how the clients were progressing without the treatment (Archibald, 2013). Instead, participants were assessed once before treatment, once halfway through treatment, and twice post-treatment, so it is unclear whether they would have made the same progress without the intervention.

This study by Choi et al. (2016) provides somewhat suggestive evidence that individualized iPad-based therapy can positively impact expressive language in stroke patients with aphasia. It is important to consider the above weaknesses, especially the age of the client, when applying this evidence to clinical practice.

Lavoie et al. (2016) investigated the use of tablet-based, self-administered therapy for improving written verb naming abilities. An ABA multiple baseline design was used with a single participant, a 63-year-old female with chronic aphasia following a stroke. Over the course of four treatments per week for three weeks, the participant wrote the names of verbs corresponding to action pictures presented via the Keynote app (Apple Canada Inc., 2010). Results showed significant improvements in written verb naming on trained words post-treatment compared to baseline, and generalization to a noun-to-verb naming task. The researchers concluded that these findings were promising evidence for the efficacy of tablet use in improving written expression.

The study was conducted using only one participant. This allowed the researchers to describe her case in great detail, but it compromises the generalizability of the findings to the general population. Furthermore, this participant had concomitant apraxia of speech; although the researchers were evaluating her written expression rather than verbal expression, it is unclear whether her apraxia would have an impact on her overall expressive language.

The study objectives were clearly stated, and the outcome measures were appropriate for the research question. Two baseline measures were completed over two consecutive weeks before treatment so that a representative measure of the subject's abilities was established. Baseline, post-treatment, and follow-up measures were completed by two independent raters. Inter-rater reliability was excellent (95-100%). The methods for this study were described in sufficient detail that they are replicable. However, the researchers used still pictures as stimuli for naming verbs, which may not be generalizable to real-life situations in which verbs refer to moving actions. Perhaps the intervention would better facilitate transfer to real-life situations if videos had been used as stimuli instead.

The evidence from Lavoie et al. (2016) is highly suggestive of a benefit from tablet-based therapy in written expression for stroke patients. Further evidence is needed with a larger sample size to determine whether these results are generalizable to all stroke patients living with aphasia.

The study conducted by Lavoie et al. (2018) examined the use of the iTSA app developed for this study in the treatment of anomia in four participants. Functional pictures were taken around each participant's home and imported into the app to be used as stimuli, and a Semantic Feature Analysis approach (Boyle & Coelho, 1995) was used to facilitate naming of treatment and control stimuli. Generalization was evaluated in short conversations. The researchers found that all participants significantly improved in their naming abilities and maintained these improvements 2 months post-treatment, and two participants generalized these improvements to conversational speech. The researchers concluded that smart tablets are an effective therapy tool to improve post-stroke anomia.

This study used a small sample size of only four participants. Detailed descriptions were included for each participant since there were so few, but the generalizability of this study to the population is fair at best. Two participants completed all therapy tasks in one session each day, while the other two spaced their tasks into 2 or 3 smaller sessions throughout each day to minimize fatigue. In fact, the amount of time clients were asked to spend on each task was not specified by the researchers, who instead quantified therapy by reporting the number of trials required for each task. The same two participants who spaced their therapy sessions also did not show generalization to conversation; it is unclear whether generalization was impacted by the difference in practice distribution. Two of the participants in this study were assisted by their spouses in completing the therapy tasks due to reading challenges resulting from their stroke, while the other two completed the tasks independently. This inconsistency in therapy administration procedures reduces the validity of the findings.

The procedures followed for this study were mostly described in sufficient detail that the study could be replicated. The researchers thoroughly described the recruitment method, the measures used for baseline, the intervention procedures, and the methods for follow-up evaluation. However, the timing of the two baseline measures was not reported, so there is little evidence that these measures were an accurate representation of the client's performance before treatment was implemented as it is not known whether they were already improving over time.

The findings from the study by Lavoie et al. (2018) highly suggest that tablet-based therapy using language-specific apps is an effective way to improve expressive language outcomes. The validity of this evidence was compromised by inconsistencies in therapy administration between participants. Recommendations for the duration of app use cannot be made based on this evidence.

Discussion

The results of this critical review suggest that the use of tablet-based apps may be effective in the treatment of aphasia. All of the studies reviewed found statistically significant improvements in expressive language outcomes. Four of the six studies consisted of a small sample size, which makes the results difficult to

generalize to the population. Both of the studies by Lavoie et al. (2016; 2018) which evaluated trained and untrained items found significant improvements on trained items for all participants, but generalization to untrained items and tasks did not occur for half of the participants in the 2018 study. Maintenance of progress was found for all studies from anywhere between 2 weeks to 2 months post-treatment, but no studies conducted follow-up measures for longer periods of time post-treatment.

One common theme throughout most of the studies was uncertainty around the actual frequency and duration of tablet app usage in intervention. No two studies gave the same recommendations for frequency and duration of sessions using the apps, so there is currently no identified minimum time for which tablet apps should be used. Moreover, the only study to objectively quantify dosage successfully was Des Roches et al. (2015) because the Constant Therapy app was capable of tracking task completion and emailing usage reports to the researchers. The Tactus Therapy app used in the study by Stark & Warburton (2018) had similar capabilities, but there was no way to objectively quantify the usage of the Bejeweled control app. Instead, for this app and for several other studies (Choi et al., 2016; Lavoie et al., 2016), patient compliance data was gathered via self-report. In clinical practice, speech-language pathologists often must rely on client self-report to evaluate compliance with home practice. Furthermore, the need for training to use technology in therapy is prevalent in the older adult population (Mallet et al., 2018). Therefore, to ensure that patients are receiving adequate intervention, it may be preferable for the iPad apps to be used with a clinician or a trained facilitator.

The use of tablets in intervention for aphasia is still an emerging area of research. All of the studies relevant to tablet app-based therapy reviewed in this paper were published within the last four years. One limitation in this critical review was the fact that there were a number of studies conducted by the same researchers; for example, Lavoie was the first author of three of the six studies included in this critical review. The researchers who conducted the Des Roches et al. (2015) study also published another paper that was not suitable for this review but was related to the topic (Kiran et al., 2014). The great overlap in researchers in this area of study can lead to the presence of experimenter bias in a large proportion of the literature. Another limitation in the research is the use of small sample sizes, which makes it difficult to implement the findings in clinical practice with the general population.

Conclusions

There is suggestive evidence for the use of tablet-based, language-specific applications in the treatment of expressive language impairments related to aphasia. Further research is needed by a wider variety of researchers using larger sample sizes and stronger study designs, such as randomized control trials.

Clinical Implications

Clinicians may cautiously consider incorporating language-specific tablet-based apps into intervention sessions to work on expressive language for clients living with aphasia. Clinicians should use their best judgement to determine frequency and duration of app use on an individual basis as the research does not provide clear guidelines for this.

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