

**Critical Review:**  
**Do Adults with Acquired Language Disorders Perform Differently on Language Assessments Administered Through Telerehabilitation Compared with Assessments Administered in Person?\***

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This critical review examined whether language assessments administered through telerehabilitation impacted the performance of adults with acquired language disorders in comparison to traditional assessments administered in person. A literature search using computerized databases yielded five studies that matched the search criteria. Overall, the evidence revealed that language assessments performed via telerehabilitation settings are as accurate as face-to-face settings. Clinical implications and recommendations for future research are discussed.

### *Introduction*

Currently the nationwide shortage of Speech-Language Pathologists (SLPs) is a growing problem in all geographic regions especially rural areas, which are often underserved. Additionally, recruitment and retention of SLPs in remote and rural areas has been a challenge thus increasing the demand for Speech Language Pathology services in these areas (Theodoros, 2008). Furthermore, there may also be an increased need for specialist expertise due to the aging population (Theodoros, 2012). Due to this shortage of SLPs but higher demand, there is an increase in caseloads and poor availability of services (Brady, 2007).

Research has revealed that patients with acquired brain injuries in rural areas felt that physical distance between them and the specialized service was a major accessibility barrier. Other factors that increased burden included cost, time and availability of transport and communication (Fyffe and McCubbery, 1996). According to Brady (2007), the top two populations who may benefit from skilled SLP services via telerehab are those who have suffered from a cerebrovascular incident or a traumatic brain injury. These patients may be unable to access services because of physical limitations. Additionally, patients who live in rural or remote areas have the increased expense and time associated with obtaining outpatient services in a remote location (Brady, 2007).

Telerehabilitation (telerehab) can be defined as the delivery of any medical rehabilitation services assisted through information technology and telecommunication systems to patients at a distance (Rosen, 1999; Cooper et al., 2001). One of the goals of telerehab services is to increase available services to patients. These services can ideally supplement in-person visits without compromising patient care (Brady, 2007). This type of

rehabilitation can be used for patients who live far from health care facilities geographically or in remote areas where access to services may be limited (Cooper et al., 2001) as well as for patients who may have a physical disability and have difficulties traveling (Fridler et al., 2012). The use of technology to assist SLPs in the assessment and treatment of speech and language disorders is growing. Introducing telerehabilitation services can be an advantage because the SLP can provide services to patients in remote areas (Newton, Acres & Bruce, 2013). It may also have potential to alleviate pressures on staff and time constraints. Additionally, telerehabilitation has been shown in the literature to be a viable treatment modality in areas of speech and language such as fluency, voice, speech and language therapy (Theodoros, 2008).

Using technology to assess adults with communication disorders, though, has been less common and research is limited. It is important to study whether telerehab methods affect the performance on language assessments with adult with acquired brain injuries, as this method may be a useful resource for clinicians that need to assess patients but unable to be there in person for the reasons mentioned previously.

SLP services rely heavily on the ability to hear and see the patients. Telerehab methods are advancing in this technology era. Assessment technologies outlined in the research include audio and visual capabilities (Palsbo, 2007; Georgeadis, Brennan, Barker & Baron, 2004; Theodoros, Hill, Russell, Ward & Wootton, 2008), audio recordings of stimuli (Georgeadis, Brennan, Barker & Baron, 2004), and written and illustrated instructions as well as touch screen capabilities for responses (Newton, Acres & Bruce, 2013).

With the number of advancing technologies, SLPs will have the necessary resources to conduct accurate

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assessments via telerehabilitation. This critical review will underscore the relevant findings comparing performance of adults with language disorders on language assessment in both telerehab and traditional face-to-face settings. This will be important for SLP practicing in remote areas, as telerehabilitation may become a supplement to traditional face-to-face assessment and treatment methods (Theodoros, 2008).

### ***Objectives***

The primary objective of this paper is to critically evaluate the literature that has compared the performance of adults with acquired brain injuries on language assessments administered in telerehab and traditional face-to-face settings. The secondary objective is to provide evidence-based recommendations for clinical and research purposes regarding the use of telerehabilitation as an assessment method for patients with acquired brain injuries.

### ***Methods***

#### Search Strategy

Computerized databases such as PubMed, Google scholar and PsycINFO were searched using the following search strategy: ((Acquired brain injury) OR (Aphasia)) AND ((telerehabilitation) OR (telerehab) OR (telehealth)) AND ((language assessment) OR (assessment)). The search was limited to articles written in English and no restrictions on date of publication were used. Additional articles for the critical review were derived from research highlighted in the articles found during the search of databases.

#### Selection Criteria

Articles selected for this review were required to report on language assessments administered through telerehabilitation methods. Furthermore, participant population was limited to adults with acquired brain injuries. No limits were placed on assessment type (formal or informal) although assessments were required to be testing language areas. A control condition of face-to-face assessments was required to compare performance to telerehab settings.

#### Data Collection

Results of the database search generated the following types of articles which matched the above search criteria: a repeated measures cross-over study (1), randomized control trials (2), a cross-over within groups study (1), and a randomized double-crossover agreement design study (1).

### ***Results***

In a crossover study, Georgeadis, Brennan, Barker, and Baron (2004), investigated story-retelling performance in face-to-face and telerehabilitation settings with 40 adults (18–70 years) with acquired language disorders from either traumatic brain injury (TBI) or stroke within 14 months post-onset. All participants were tested in both settings, but order of setting was randomized. In the face-to-face condition, the clinician was present in the room during the assessment. In the telerehab setting, the participant was seated in front of a computer screen and used audio and visual videoconferencing methods to interact with the SLP, who was in another room. Story retells were collected using line drawings and were scored using the Percent Information Unit. Appropriate two-tailed paired samples t-tests revealed no statistical differences between the settings. Further analysis using ANOVA showed that adults with aphasia due to stroke performed the same or better in telerehab settings, whereas those with TBI performed better in the face-to-face setting.

One limitation of this study was that inter-rater reliability was only conducted on 5% of the total sample scores. Further, it was not specified how these sample scores were randomized for the inter-rater scoring. An additional statistical limitation was that no Bonferroni correction was mentioned when the one-way ANOVA was performed, potentially increasing the chance of a Type I error. Furthermore, participants were at varying levels of severity and had received various amounts of SLP treatment prior to the study. Despite the limitations, this research demonstrated methods and statistical manipulations that were valid. Methods were described clearly and in enough detail for replication. An appropriate control condition was established. Statistical power was adequate. Overall, it demonstrated a suggestive level of evidence.

In a randomized control trial, Theodoros, Hill, Russell, Ward, and Wootton (2008), examined the validity and reliability of performing standardized assessments via telerehab settings with 32 participants (21-80 years) with diagnosed acquired aphasia. Participants were randomly assigned to the face-to-face assessment or telerehabilitation assessment. Two blinded clinicians were randomly assigned to lead the assessment in either setting. The clinician that was not leading the assessment became the silent scorer and did not assist in the assessment. The Boston Diagnostic Aphasia Examination 3<sup>rd</sup> edition (BDAE-3) short form and Boston Naming Test second edition (BNT-2) were administered. Materials from the stimulus books were converted to electronic format for the telerehab setting. The Wilcoxon signed ranks test of difference with an alpha level of 0.01 was used appropriately in order to determine significant differences. No significant

differences were found between the scores of the subtests in the face-to-face and telerehab environments as well as moderate to very good agreement between the assessors across the subtests.

This study used a randomized control trial, which demonstrates an evidence level of 1 (Archibald, 2009). It is one of the most powerful of all study designs. Another strength of this study was the use of standardized assessments (BDAE-3 & BNT-2) that are commonly used by SLPs with aphasic patients. Further, researchers used a more stringent alpha level of 0.01 to ensure results were significant despite the small sample size. Inter- and intra-rater reliability was determined by randomly selecting five participants and this data was rated by four SLPs. This was a limitation as it was only a small portion of the overall sample. Overall this article provides a suggestive level of evidence that telerehabilitation settings do not differ from traditional assessment methods.

In a randomized control trial, Hill, Theodoros, Russell, Ward and Wootton (2009) examined whether the severity of aphasia influenced the ability to assess language skills in telerehab settings with 32 participants (21-80 years) with acquired brain injuries. The BDAE-3 short form and BNT-2 were administered in order to determine a severity rating of the participants. Both SLPs rated the level of severity and grouped the participants accordingly (mild, moderate, severe). Percent level of exact agreement (PEA) and percent level of clinical agreement (PCA) were used on the rating scales. An appropriate Kruskal-Wallis test showed differences only within the naming and paraphasia subtests indicating that severity of aphasia may affect the ability to assess these subtests in the telerehab setting. Upon further analysis of these subtests using Kappa, high levels of agreement were found suggesting that the environment did not affect the severity rating given by the SLPs.

This study's method and statistical analysis were valid. Clinicians were appropriately randomized and blinded to the severity levels of the participants prior to scoring. Outcome measures were standardized and widely used among SLPs. One limitation of this research is the small sample within groups (mild, moderate, severe) because it is difficult to generalize results from a small sample size. Despite this, the research demonstrated that although aphasia may make assessment more challenging in telerehab settings, it does not impact the ability to assess. Considering the strengths and limitations of this study, it provides a suggestive level of evidence.

In a randomized double cross-over agreement study, Palsbo (2007), investigated whether telerehab methods are comparable to traditional face-to-face methods of assessment with 24 participants (25 to 81 years) post-stroke. Appropriate exclusion and inclusion criteria were outlined to ensure all participants were similar at baseline. Subjects were randomized to remote or face-to-face administration of the BDAE subtests (Conversational and Expository speech and Auditory comprehension) and to remote or face-to-face administration of three functional communication measures (motor speech, spoken language expression and spoken language expression) from the National Outcomes Measurement Scale (NOMS). Participants were scored simultaneously by four of SLPs (two at either the face-to-face or telerehab site). Results indicated that percent exact agreement (PEA) was lower when the assessment was administered in the telerehab setting (8–25%) although PEA was also low in the face-to-face setting (50–67%).

This study was not well formulated and methods were not clearly presented in a way that could be replicated. Further, statistical manipulations were used inappropriately. Scores may have been biased as clinicians were not randomized or blinded. Additionally, the small sample was a convenience sample that was created through personal invitations sent by the scoring SLPs. This could have created a further bias as scoring clinicians may have had prior knowledge about the participants such as type and severity of aphasia or functional abilities. Considering the poor methodology and statistical analysis, this study provides an equivocal level of evidence.

Newton, Acres, and Bruce (2013), used a within subjects design to investigate the use of computers in assessing 15 participants (39-78 years) with aphasia. Appropriate inclusion and exclusion criteria were well defined. All participants were tested in all three conditions: (1) computer assessment only, (2) computer assessment with clinician in the room, and (3) clinician only. To eliminate practice effects, conditions were appropriately randomized with a two-week period between testing. Only in the computer only condition were participants required to read the instructions independently and use the touchscreen interface to indicate responses. Sentence-picture matching stimuli were chosen from the auditory comprehension subtest of the Comprehensive Aphasia Test (CAT) and grammatical judgment stimuli were chosen for participants to listen to and determine if sentences were grammatical/ungrammatical from a set used by McDonald (2000).

Appropriate ANOVAs were performed and post-hoc Bonferroni-corrected comparisons revealed that the computer-only condition scored lower than the traditional assessment method and the computer and clinician condition. Further analysis indicated that scores from the computerized versus traditional methods were strongly correlated indicating that the telerehab assessment is comparable to traditional assessment methods.

A major limitation to this study was the small sample size because it is challenging to generalize to a larger population. Although randomization of participants was clearly stated, it was not adequately outlined how clinicians were blinded or randomized between conditions. Despite the limitations this research demonstrated an appropriately control condition (face-to-face assessment) to directly compare to the telerehab settings. Additionally, outcome measures were valid and reliable as well as methods were clearly described enough for replication. Overall the research provides a suggestive level of evidence and important information for clinical considerations when using telerehab methods of assessment.

### *Discussion*

Language assessments performed in telerehabilitation settings with adults with acquired brain injuries is an emerging area of interest in the literature. Taken as a whole, the research provides a suggestive level of evidence that assessments conducted in telerehab settings are comparable to traditional face-to-face methods. The studies concluded that there were no significant differences between settings (Georgeadis, Brennan, Barker, and Baron, 2004; Theodoros, Hill, Russell, Ward, and Wootton, 2008). Additionally, the research indicated that telerehab settings are as sensitive to the same factors as traditional settings (Newton, Acres, and Bruce, 2013). Research outlined in this review had common strengths in the methodologies such as strong research designs and randomization of scoring clinicians and participants. Adequate control environments were used in all research studies reviewed. Furthermore, outcome measures in three studies were standardized language assessments such as the BDAE-3 that is reliable and valid (Hill, Theodoros, Russell, Ward, and Wootton, 2009; Palsbo, 2007).

However, research was limited by small sample sizes and convenience samples. This makes it difficult to generalize to a larger population. Further, participants were at varying times post-onset and differed on type of acquired brain injuries (TBI versus stroke). It was indicated that the TBI participants performed poorer in the telerehab setting and were resistant to the method of

assessment (Georgeadis, Brennan, Barker, and Baron, 2004). This may be due to the poor attention in these patients. Palsbo (2007), utilized the NOMS as an outcome measure, which is not well-known clinical assessment tool therefore scoring clinicians had varying levels of familiarity with its rating scale. This study was the only one out of five that provided only an equivocal level of evidence due to the decreased validity of the methods. It was selected for review as it provided important methodological improvements for future research.

### *Conclusion*

Overall the literature provides suggestive evidence that language assessments performed in the telerehabilitation setting are as accurate as assessments performed face-to-face with patients with acquired brain injuries.

### *Clinical Implications*

The evidence base provides support for language assessments conducted in telerehab settings for patients with acquired brain injuries. Speech-Language Pathologists should use telerehab as a secondary method of assessment when patients live in rural and remote areas. Face-to-face methods of assessment should be the primary method as a clinician is present in the room to make informal observations such as the patient's physical or visual limitations. Additionally, the clinician is unable to ensure that equipment is functioning properly on the patient's end. A potential solution would be to have a trained assistant or communication disorders assistant present with patient during the telerehab assessment. Further research should be conducted to investigate whether a trained assistant would positively influence assessments in the telerehab setting. Additionally, research should explore the feasibility of having trained assistants in these remote and rural areas.

Based on the limitations of the studies reviewed, it is recommended that future research be conducted and include:

- a) Subject recruitment that is randomized and have participants that are similar at baseline (i.e. level of severity and time post-onset)
- b) Larger sample sizes to increase ability to generalize results
- c) Scoring clinicians that are randomized and blinded
- d) Outcome measures that are commonly-used assessments of language by practicing SLPs

Furthermore, there are other factors that should be taken into consideration in future research. In the study conducted by Georgeadis, Brennan, Barker, and Baron (2004), TBI patients performed poorly in the telerehab setting. Research should be conducted on the specific types of acquired brain injuries and telerehab assessments to further investigate the differences within each population. For example, telerehab settings may not be appropriate for TBI patients in comparison to stroke patients. Secondly, all telerehab settings in the reviewed literature were experimental environments for the comparison purposes. In the study by Newton, Acres, and Bruce (2013), the telerehab assessments were conducted in a sound-proof room. More research should focus on telerehab settings in the patients home or other non-controlled to give a more realistic picture. Distractions such as the phone ringing or family member present could be potentially influence the assessment. Lastly, with advancing technology, research should continue to be current as audio and visual quality is constantly advancing.

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