

Clinical Focus

The Effects of Multimodal Communication Treatment With Discourse and Group Activities via Telepractice on People With Severe Nonfluent Aphasia: A Case Study

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ABSTRACT

Purpose: Nonfluent aphasia can be characterized by prominent difficulty with speech production. Compensatory and functional aphasia treatments, including multimodal communication treatment (MCT), have been highlighted for their support of life participation because they aim to circumvent spoken language difficulties through use of other modalities. The current study explored an expanded version of MCT, by including a discourse task and group activities on telepractice (MCT with discourse and group activities via telepractice [teleMCT+DG]) to mirror daily communication and improve communication success for people with severe nonfluent aphasia.

Method: Two participants with severe aphasia participated in teleMCT+DG for 10 weeks (two individual and one group treatment sessions per week) to practice five communication modalities (speaking, writing, drawing, gesturing, and using a communication book) during a story generation task. Participants' success of modality production for target items during the story generation task was analyzed.

Results: Participant 1 with Broca's aphasia demonstrated a trend of increasing his communication using nonspeaking modalities during story generation. Participant 2 with global aphasia demonstrated evidence of improving his nonspeaking communication skills during story generation, which helped improve the success of his communication.

Conclusions: The common trend from the two participants suggested positive evidence of increased success driven by the successful use of nonspeaking modalities. This study supported the benefits of training compensatory strategies (multimodal communication) to improve communication success in people with nonfluent aphasia, though further research is needed to identify modifications for specific aphasia profiles.

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People with aphasia experience difficulty with language expression and comprehension. Across various domains, these difficulties vary such that some people may have relative strengths or areas of need in auditory comprehension, spoken expression, reading comprehension, and written expression. Many ways to categorize people with aphasia based on their characteristics exist, including identifying people as having fluent or nonfluent aphasia (Clough & Gordon, 2020). While some overlap occurs in characteristics across the two categories, there are profiles

of people with nonfluent aphasia that are relatively salient. That is, people with nonfluent aphasia may experience spoken expression that is halting and sometimes fragmented, filled with short phrases that are inaccurate or missing grammar, and telegraphic, such that it mostly contains content words (Clough & Gordon, 2020). These characteristics can lead to miscommunication of intended meanings and frustration during communication interactions. These characteristics are even more pronounced in people with severe nonfluent aphasia, such that their spoken output may be limited to a few content words.

Many factors may influence the benefits people with aphasia derive from various treatments (Kristinsson et al., 2023), including characteristics associated with nonfluent versus fluent aphasia as well as aphasia severity. Additionally, time dedicated to aphasia and poststroke rehabilitation is limited (Cavanaugh et al., 2021; Code, 2012; Oh et al., 2017). Therefore, it is critically important that clinicians match treatments, characteristics, and predicted outcomes for people with aphasia (Brady et al., 2022). As such, the purpose of this project was to examine communication success at the discourse level following the implementation of a modified multimodal communication treatment (MCT) program with two people with severe nonfluent aphasia.

Restorative treatments targeting spoken expression in people with nonfluent aphasia include, for example, melodic intonation treatment (e.g., Haro-Martínez et al., 2021), targeted storytelling (Carragher et al., 2015), and various types of brain stimulation (Bai et al., 2020; Kapoor, 2017). Although treatment targets for people with nonfluent aphasia may vary, common targets related to spoken expression include success or speed of word retrieval in single-word or sentence-level tasks (Schlaug et al., 2010; Shah-Basak et al., 2015), the number of content information units within a passage, and elements included during story retelling (Carragher et al., 2015). However, given their often persistent difficulty with word retrieval, providing a communication intervention that also targets nonspoken communication modalities, including gesturing, writing, drawing, and pointing to a communication book, is appropriate (Weissling & Prentice, 2010), particularly for people with severe nonfluent aphasia who are keenly aware of their speech production errors.

MCT is designed to help people with aphasia improve their resolution of communication breakdowns using nonspoken modalities when they have word retrieval difficulties (Purdy & Van Dyke, 2011; Purdy & Wallace, 2016). These original descriptions of the treatment focused on communication of single words, and the findings suggested that executive functions and, in particular, cognitive flexibility may be related to the ability to use nonspoken modalities to repair breakdowns (Purdy & Dietz, 2010; Purdy & Van Dyke, 2011). Another preliminary examination focused on the feasibility of

including a semantic treatment component in a single-word version of MCT for a person with severe fluent aphasia and found that the person may have required additional practice, though he did increase his use of spoken and gesture combined modalities (Wallace & Kayode, 2017). Another pilot study identified that a person with primary progressive aphasia benefited from a combined semantic and MCT treatment focused on communicating single words (Rebstock & Wallace, 2020). Specifically, she increased her circumlocution, and communication partners experienced increased understanding of her message. People with traumatic brain injury and concomitant motor speech disorders increased their communication of single words using multiple modalities following MCT (Diehl & Wallace, 2018). Wallace et al. (2014) completed a case study with two individuals with nonfluent aphasia and found evidence to suggest improvements in multimodal communication production success with limited evidence for modality switching in single-word tasks and no evidence of generalization to discourse tasks. Of note, this study took place during acute rehabilitation, while most studies using MCT took place in the chronic stages.

Additional modifications to MCT have included administering treatment via telepractice (Park et al., 2025) and adding group treatment (Park et al., 2023) to encourage stimulus generalization and improve resolution of communication breakdowns outside of single-word tasks and into more functional communication tasks (Coppens & Patterson, 2018; Mayer et al., 2024). These studies showed feasibility of the treatment methods and some trends toward improved overall communication in single-word tasks. Similarly, previous studies have examined the feasibility and acceptability of including discourse tasks (Park et al., 2023, 2025) for generalization across levels of language production (Milman, 2016). Previous evidence from individual studies supports the use of discourse tasks, incorporation of group tasks, and flexibility of service delivery (e.g., telepractice vs. traditional) to improve the implementation of MCT for people with various types of aphasia. However, these treatment aspects have not been examined in a combined treatment protocol. Examining people with particular characteristics, such as severe nonfluent aphasia, in a small-scale initial study will allow us to best determine adjustments to treatment or assessment protocols that are a good match for this population. People with severe nonfluent aphasia are ideal candidates for an early exploration of these MCT modifications combined in a single study because of their notable word retrieval difficulties and the telegraphic nature of their spoken output (Boyle et al., 2023; Mason et al., 2020).

Current Study

The current study aimed to build on previous research by incorporating all prior modifications (e.g., discourse tasks, group sessions, and telepractice delivery) to evaluate

their preliminary treatment effects before applying them to a larger group. The current version of MCT was modified to include a discourse task and group therapy within a telepractice format (MCT with discourse and group activities via telepractice [teleMCT+DG]). This version was designed to increase opportunities for practicing the various modality strategies in an authentic communication context and environment to promote the use of the skills in daily conversations. Literature supports that group therapy helps improve communication skills comparably to individual sessions (Elman, 2007; Hoover et al., 2021), encourages social interactions among people with aphasia, and increases the quality of life (e.g., Wilson et al., 2023). Furthermore, teleMCT+DG was designed for participants with aphasia to learn and practice target words in the individual sessions and then to use the strategy in the group sessions. Group treatment may be beneficial for people with many types and severities of aphasia (Hoover et al., 2021). With this protocol, sessions were specifically designed for participants with nonfluent aphasia to prepare for the group conversations and activities, specifically using target words within discourse contexts. Finally, a previous study has shown the feasibility and benefits of offering a telepractice version of MCT allowing a greater number of participants to access the treatment regardless of aphasia type (Park et al., 2025).

In addition, the previous treatment studies included various types of aphasia, which may have masked its unique effects on people with specific aphasic characteristics. While all people with aphasia may have difficulty with expression, people with nonfluent aphasia may have more delayed word retrieval and halted speech and may experience many of the language characteristics that result in communication breakdowns. Examining this population specifically may lead to understanding how this treatment might be tailored to best address the challenges faced by this population.

As a preliminary study evaluating the effectiveness of teleMCT+DG in people with severe nonfluent aphasia, we aimed to answer the research questions of (a) whether teleMCT+DG improves the percentage of success in communicating trained and untrained items at a discourse level using any modality and, if so, (b) whether success rates improved more for spoken or nonspeaking modalities. The ultimate goal of the treatment study was to determine whether “total” communication skills could be improved through the implementation of multimodal communication strategies (Pierce et al., 2019).

Method

Participants

The University of Mississippi Institutional Review Board (IRB) approved the study (IRB No. 22-040), and

participants provided informed consent. Participants were recruited via distribution of study fliers on social media and via e-mail to people connected to aphasia community groups. People with aphasia interested in the study contacted the research team to determine if the study was a good fit for them. Two participants with severe chronic nonfluent aphasia were recruited as part of a larger cohort of individuals completing an MCT via telepractice.

Inclusion criteria for the study included participants who were 18 years or older, spoke English as a native speaker, and had a stroke at least 6 months prior to enrollment that led to a diagnosis of aphasia. Additionally, we used the Western Aphasia Battery–Revised Aphasia Quotient (WAB-R AQ; Kertesz, 2006) to classify participants with severe nonfluent aphasia. As a preliminary means to ensure that the participants had adequate auditory comprehension to follow study tasks, we used a score of at least 4/6 on the first three items of the Sequential Commands subtest of WAB-R AQ. A score of 4/6 indicated that the participant could follow the majority of the simple commands. We included additional standardized tests to measure participants’ cognitive abilities (Cognitive Linguistic Quick Test Plus [CLQT+], Helm-Estabrooks, 2017; Pyramids and Palm Trees [PPT], Howard & Patterson, 1992), but we did not use results as inclusion criteria. We also did not exclude potential participants with motor speech disorders (apraxia of speech or dysarthria) because previous literature suggests that MCT and other multimodal focused interventions are appropriate for this population (Ballard et al., 2015; Diehl & Wallace, 2018). Both participants also reported normal vision and hearing with or without aids (e.g., glasses, hearing aids).

Participant 1 (P1), a 50-year-old White man, presented with chronic aphasia resulting from a left-hemisphere stroke approximately 4 years before participation. Findings from his initial WAB-R AQ score revealed severe chronic aphasia with characteristics consistent with Broca’s type. During his initial session, P1 reported that he was diagnosed with apraxia of speech. He demonstrated difficulty initiating speech with groping, and his speech was noted to be slowed and segmented with prosodic errors. Participant 2 (P2), a 68-year-old White man, presented with chronic aphasia resulting from a left-hemisphere stroke approximately 1.5 years prior to participation. Findings from the WAB-R AQ revealed very severe global aphasia. P2 requested to discontinue the CLQT+ due to his frustration with the level of difficulty. See Table 1 for detailed demographic information and standardized assessment results.

Materials

Study materials included word lists, multimodality materials, and standardized tests. The primary outcome measure was the success of producing trained and

Table 1. Demographics and standardized test scores for language and communication.

Variable	P1	P2
Age	50 years	68 years
Gender	Male	Male
Etiology	CVA in left hemisphere	CVA in left hemisphere
Months postonset	46 months	17 months
Years of education	16	16
Former occupation	Computer engineer	Farmer
WAB-R AQ (pre to post)	32.3 to 38.9/100	12.4 to 10.6/100
Spontaneous speech	7 to 8/20	3 to 4/20
Auditory verbal comprehension	5.65 to 5.95/10	3 to 1.3/10
Repetition	1.6 to 1.1/10	0 to 0/10
Naming and word finding	1.9 to 2.4/10	0.2 to 0/10
WAB-R aphasia classification	Broca's type	Global type
Boston Naming Test–Short Form (pre to post)	1/15 to 1/15	0/15 to 0/15
CLQT+ overall	2/4 (moderate)	Requested to discontinue
Attention	3/4	
Memory	1/4	
Executive function	2/4	
Language	1/4	
Visuospatial	3/4	
Clock drawing	1/4	
Nonlinguistic	3/4	
SAQOL-39	2.43/5 to 2.14/5	1.14/5 to 2.3/5
Communication subset		
Pyramids and Palm Trees (pre only)	47/52	30/52

Note. P1 = Participant 1; P2 = Participant 2; CVA = cerebrovascular accident; WAB-R AQ = Western Aphasia Battery–Revised Aphasia Quotient; CLQT+ = Cognitive Linguistic Quick Test Plus; SAQOL-39 = Stroke and Aphasia Quality of Life Scale-39.

untrained items from the word list in a spoken or non-spoken modality.

Word Lists

We developed a list of 100 common object nouns and listed them based on their frequency using SUBTLEX-US word frequency database (Brysbaert & New, 2009). Word frequency was used as a major criterion for selecting words to enhance the treatment's functionality by training targets useful for daily communication. Frequency is a commonly used measure for balancing word lists in anomia treatment studies (Nickels & Howard, 1995). Also, frequency can be a less biased criterion across various modalities. Other psycholinguistic properties, such as word length or concreteness, can impact specific modalities (writing or drawing) more than others. For each participant, we selected the word (i.e., exemplar word) with the highest frequency rate among the words that the participant missed on the WAB-R AQ Object Naming subtest and Boston Naming Test–Second Edition Short Form (BNT-2 SF; Kaplan et al., 2001). Then, we selected the word from our list of 100 common items that had the closest frequency rate to the exemplar word. For each participant's word list, we included the next 30 words with a lower frequency as our target words. Among the selected 30 target words, 20 words were randomly selected as trained items, and the remaining 10 words were selected

as untrained items. The number of syllables and frequency between trained and untrained items were matched.

Object cards. The picture cards for 20 trained items were represented as a photograph image, a black-and-white line drawing, or a colored drawing as a picture card. Each picture was printed out on a 4 × 6-in. index card with a white background and laminated.

Story generation assessment task stimuli. We developed 15 picture scenes each depicting two of the target items, with at least one person and one action. Ten picture scenes contained trained items, and five picture scenes contained untrained items. The 10 picture scenes with trained items were divided into five sets for treatment sessions as described below. Picture scenes were developed through staged photography using the target items or artificial intelligence-generated photographic images, and all appeared in color. Pictured scenes were manipulated in Microsoft PowerPoint Slides to add red circles or arrows highlighting the target items.

Multimodality Materials

Modality chart. Clinicians used the modality chart devised by Purdy and Wallace (2016) several times during each session to prompt participants in different ways to

communicate trained and untrained items. The modality chart provided a written cue (i.e., text) and depicted a person using the five targeted modalities of drawing, writing, gesturing, speaking, and finding the item in a communication book. The researchers provided participants with their own modality charts (Appendix 1 in Purdy & Wallace, 2016) for home use.

Communication book. We provided participants with a 25-page communication book containing all trained, untrained, and other filler items, divided and labeled by semantic categories (e.g., clothing). All images were in color and were either photographic or color images of the items, and all images were sized to 3 × 2 in. for uniformity, with a total of six items per page.

Whiteboard and markers. Participants received a 10 × 13-in. dry-erase whiteboard and four markers with attached erasers for use during the sessions. The whiteboards were identical to the ones used by clinicians during training for the modalities of writing and drawing. Clinicians additionally used an external document camera to model drawing and writing and asked the participants to hold their whiteboards up to the web camera to communicate the item.

Gesture dictionary. The research team established a dictionary of agreed-upon gestures that could be completed with one hand as needed. These gestures served as a starting point or a reference for clarification when participants worked with clinicians to determine gestures they would use during the treatment. The dictionary was referenced by clinicians only for examples of how they might model gestures or cue for gesture modifications during treatment sessions.

Drawing dictionary. The research team also established a dictionary of agreed-upon drawings that could be completed with the nondominant hand using a few simple lines. Clinicians referred to the drawings when needed to provide a starting point or clarification to aid the participants in devising their own drawings.

Standardized Tests

We used several standardized assessments to measure participants' speech, language, and cognitive abilities. We included the assessments based on their common use in aphasia clinical practice and in aphasia treatment research. We administered the WAB-R AQ, BNT-2 SF (Kaplan et al., 2001), and Stroke and Aphasia Quality of Life (SAQOL; Hilari et al., 2003) Communication subtest before and after the treatment to capture changes during the treatment period. These standardized tests, when administered prior to treatment, can provide valuable information for future studies, as they provide important descriptive information about the participants. In addition, the WAB-R and BNT-2 were administered pre- and post-treatment to observe potential generalization to overall

spoken communication and naming skills. The WAB-R and BNT-2 are well-established tests both in research and clinic with their high validity and reliability (Kaplan et al., 2001; Kertesz, 2006). The SAQOL was also administered pre- and posttreatment to evaluate potential changes in participant's feelings about communication after learning multimodality strategies from the treatment. We asked participants questions in the communication domain (seven questions) of SAQOL to minimize the time and effort of participants with communication difficulty and to specifically focus on the treatment impact on communication. SAQOL is also known for its high reliability and validity (Hilari et al., 2003). Additionally, we used the following assessments to collect further descriptive information about participants' language and cognitive abilities at the beginning of the study: CLQT+ (Helm-Estabrooks, 2017, 2021) and PPT image version (Howard & Patterson, 1992).

Procedure

The study followed a case study design. Before treatment, participants completed four baseline sessions (over 2 weeks); each session included a story generation assessment task and at least one standardized assessment. P2 required WAB-R administration over two sessions due to fatigue. We broke up the administration between subtests without extending any single subtest in the assessment over the two sessions. Once the four baseline sessions and all standardized assessments were completed, clinicians provided the teleMCT+DG treatment over 10 weeks. Treatment began the week following the final baseline session. Trained items were targeted in five sets of four items across 2 weeks (four individual sessions and two group sessions). Following the training of 20 target items, participants completed four posttreatment sessions for measurement of treatment-related changes (over a 2-week period). Posttreatment sessions occurred the week following the final treatment session. All sessions were video-recorded for data analysis. See Figure 1 for the sample treatment procedure.

Assessment and treatment sessions were conducted by trained graduate student clinicians under the supervision of the first, second, and fourth authors. The lead authors also conducted some participant sessions. Thus, "clinician" refers to supervised student clinicians and experienced clinicians interchangeably. The clinicians conducted all sessions by telepractice using Health Insurance Portability and Accountability Act-compliant Zoom, due to its availability of privacy settings, familiarity, and ease of use. One-hour individual sessions were conducted twice per week for each participant, and 1-hr group sessions were held once per week, following the completion of all individual sessions for all participants that week. Participants were freely able to involve care partners to the level of their own preference

Figure 1. Sample treatment procedure. This figure describes a sample of the first 4 weeks, and additional trained items continue through 10 weeks within the same procedure. Tx = treatment.

	Individual Session	Individual Session	Group Session
Week 1 Trained Set 1: key, cat, computer, camera	Tx 1-1 Modality Production Task	Tx 1-2 Story Generation Task	Ice Breaker Trivia Story Sharing
Week 2 Trained Set 1: key, cat, computer, camera	Tx 1-3 Modality Production Task Story Generation Task	Tx 1-4 Modality Production Task Story Generation Task	Ice Breaker Trivia Story Sharing
Week 3 Trained Set 2: cup, knife, bridge, fan	Tx 2-1 Modality Production Task	Tx 2-2 Story Generation Task	Ice Breaker Trivia Story Sharing
Week 4 Trained Set 2: cup, knife, bridge, fan	Tx 2-3 Modality Production Task Story Generation Task	Tx 2-4 Modality Production Task Story Generation Task	Ice Breaker Trivia Story Sharing

in individual and group sessions. P1's care partner was not involved in the treatment. P2's care partner sat next to him during sessions, held the communication book, and turned the pages when he instructed her to do so.

Baseline Sessions

Baseline sessions included the administration of the BNT-2 SF, CLQT+, SAQOL, PPT, and WAB-R AQ, as well as a story generation assessment task.

Story generation assessment task. The primary outcome was measured during a story generation assessment task (i.e., development and telling of a story based on the picture presented) during baseline and posttreatment sessions. This task was selected because it is structured to encourage the participants' use of the target words in connected speech. Clinicians used PowerPoint and the share screen feature of Zoom to present task stimuli. First, clinicians began the task by visually (i.e., using the modality chart) and verbally reminding participants of the different ways to communicate items. Clinicians presented each picture scene with two target items circled or indicated by an arrow. Clinicians then prompted participants to "Tell a story about the picture with a beginning, middle, and end. Be sure to include in your story the items that are circled or indicated by an arrow." Clinicians used active listening techniques such as sharing verbal and nonverbal cues to encourage the participants to continue communicating, reflecting back, and summarizing what the participants communicated. Furthermore, clinicians used contingent open-ended questions to encourage the participants to continue communicating about the picture scene (e.g., "Is there anything else to add?"). If the participants did not spontaneously communicate the target items, clinicians prompted them to do so by asking direct questions, such as "What is this item?" or "What is the man holding?" No

other cues were provided to elicit the target items. A total of 15 picture scenes (10 with trained items and five with untrained items) were presented individually in each baseline and posttreatment session.

Individual Treatment Sessions

Individual treatment sessions included the modality production task and story generation task. Twenty items were trained across a total of 20 sessions. The 20 items were divided into five treatment lists (with four trained items each). A feasibility study conducted with a limited number of participants demonstrated that the original modality production task and story generation task portions of the treatment protocol may have been too intensive in nature for some participants. We found that this was particularly true for participants with more severe chronic aphasia related to participants' fatigue and the length of sessions (Park et al., 2025). Therefore, we modified the treatment plan prior to the study initiation as follows. For each of the five sets of trained items, participants completed four sessions. The first session included the modality production task. The second session included the story generation task. The third and fourth sessions included both the modality production task and the story generation task (see Figure 1). In addition to the summary of the treatment procedure below, Appendix provides the detailed treatment procedure.

Modality production task. The modality production task allowed the participants to practice the five modalities at the single-word level. Clinicians followed the procedures as described by Purdy and Wallace (2016), in which clinicians used errorless training for the first introduction of the items in that set and a cueing hierarchy for each subsequent treatment session.

Clinicians modeled all five ways to communicate each item for the first introduction. For the communication book, clinicians discussed and demonstrated the semantic category for each item and where to locate the target item in the book and waited for the participant to imitate locating the item in the book. Clinicians then asked the participants to locate the item independently four more times. For the spoken modality, clinicians stated the word aloud and asked the participants to repeat the word five times. Clinicians then provided a sentence cue for participants to state the name of the item in context (e.g., “We tell time with a . . .”). For the written modality, clinicians wrote the word on a whiteboard visible to the participant using an external document camera and asked participants to imitate by writing the word on their own whiteboards three times, erasing between each attempt. For the gesture modality, clinicians prompted participants to consider ways to communicate the item with their hand(s) and/or asked the participants to demonstrate how they might use that item. If needed, clinicians modeled a gesture from a list of agreed-upon gestures (gesture dictionary). Clinicians then asked participants to imitate it four more times. Clinicians described the rationale for the gesture as they modeled it to aid the participants in learning and completing the gesture accurately. For the drawing modality, clinicians prompted participants to draw a picture of the item. If needed, clinicians modeled a simple drawing (drawing dictionary) using the whiteboard and document camera and asked participants to imitate the drawing three times on their own whiteboard, erasing between each attempt. Similar to the gesture modality, clinicians described the rationale for the drawing as they modeled or drew along with participants to aid participant learning and imitation.

Clinicians encouraged independent production of each modality for the target words during the subsequent two sessions. If a participant was unable to complete any modality independently, clinicians then modeled the modality and retrained using the same steps as the initial presentation of the item in the modality production task. Clinicians provided as many cues as needed for the participants to produce all five modalities accurately for each object in the set.

Story generation task. For each target picture scene, participants were guided through the creation of their story with written and verbal prompts from the clinician. For example, clinicians verbally acknowledged and communicated words and messages and typed the words the participants communicated in a textbox on the picture scene. The clinicians and participants then cocreated a sentence including the two target words for practicing the five modalities.

Clinicians and participants read the sentences together in a choral reading task (Cherney, 2004), and then they practiced each modality to communicate the two target items

embedded in the sentence. The participants were encouraged to “choose a different way to communicate the items” to repeat the sentence. The sentence was repeated at least three times with each communication modality by replacing the target items with the new modality being practiced. For example, if the modality being practiced was a gesture, the participant and clinician would verbally produce the nontarget words with choral reading and pause reading to produce the gesture for the target items when indicated in the sentence. If the participant experienced a communication breakdown or had word retrieval difficulty during a target item, the student clinician used a set of hierarchical communication support cues: (a) Remind the participant of the modalities, (b) cue the participant to use a specific modality, and (c) model the specific modality.

Once each picture scene had been practiced for each communication modality, the clinician returned to the picture scene and provided verbal cues for the participant to expand the story using any communication modality. Clinicians used open-ended questions to encourage participants to communicate other words/sentences to explain the scene (e.g., “What do you think might happen next? Where are they? How do they feel?”) and typed participant productions in a textbox within the scene. When the participant had determined that they were finished expanding on the story, the clinician again led the participant through a choral reading task with the original sentence and expanded narrative.

Group Treatment Sessions

Each group session was facilitated by a lead clinician and lasted about 60 min. Group sessions were held on different days from individual sessions and after individual sessions had been completed for that week. The weekly group session included two additional people with aphasia enrolled in a larger study on multimodal communication, for a total of four participants in each group session.

Ice breaker. Group sessions began with group members listening and watching a music video from a song selected by one of the participants earlier in the week. Each group session focused on a particular theme to guide participants in sharing their personal interests and histories (e.g., favorite sports teams, best vacation). The themes were presented visually and verbally by the clinician leading the group, and participants were cued one at a time to communicate about the theme using picture supports and any of the five communication modalities.

Multimodal communication trivia. Before each session, the clinician sent a list of trained items for each participant to the lead group clinician. The lead clinician then presented each target item one at a time in a random order, alternating modalities. Thus, the clinician ensured that all four target items for each participant were modeled using

at least one modality for each group session, for a total of 16 items communicated per group session. For example, if one participant was practicing the word “banana” that week, the clinician would communicate the word “banana” using any of the five modalities. Participants were asked to guess the item being communicated by demonstrating the same or a different modality.

Story sharing. Each participant selected one of the picture scenes that they practiced during the individual sessions to present to the group. The picture scenes were compiled into a PowerPoint presentation. All picture scenes included the textboxes constructed during the individual treatment session to assist the participants in communicating the story of the scene. During group sessions, the participant shared the story, while group members listened and viewed the picture scene. The clinician provided the same types of hierarchical cues from individual sessions as needed. After the participant finished sharing their story, the clinician invited all participants to share their similar experience or reaction to the story, using any modality.

At the end of the group session, the clinician asked a participant to pick the song and music video for the next week. Additionally, the clinician announced the theme for next week’s group session.

Posttreatment Sessions

After treatment, participants completed four post-treatment sessions, which included the story generation assessment task and at least one standardized assessment, over a period of 2 weeks.

Data Management

The success of communicated target items was rated by the clinicians based on the research team’s established criteria for each modality. Spoken responses were considered successful when the production (a) was clear to the clinician, (b) was understandable with a minor phonemic error (i.e., one phoneme in error), or (c) was produced as an interchangeable word within the culture (e.g., *tap* for *faucet*). Written responses were considered successful when the spelling was (a) correct, (b) understandable with minor errors (no one more than one letter missing or incorrect), or (c) produced with poor handwriting due to weaknesses or limb apraxia. Drawing responses were considered successful when the main shapes of the items were accurately produced, though a few missing minor lines were considered acceptable if the clinician judged it as interpretable. Gesture responses were considered successful when the gesture described the motion associated with the use or shape of the item. Last, responses using the communication book were considered successful if the participant successfully

pointed to the item on the page independently or with assistance for flipping pages and showed the pictured item to the camera. Participants were permitted to point to the real item in their environment instead of the picture in the communication book, and the pointing modality was calculated in the results.

Participant responses from the story generation assessment task were transcribed by trained research assistants who coded target items for success and modality type on a Microsoft Excel spreadsheet. A randomly selected 30% of the transcriptions and codes were verified by another research assistant.

Data Analysis

Outcome Measures

The ultimate goal of the treatment was to improve “total” communication skills by implementing multimodal communication strategies (Pierce et al., 2019). As a preliminary study, we evaluated how the target items were communicated at a discourse task. A case study design with four pre- and four posttreatment assessments was implemented. Table 2 presents the outcome measure variables (percentage of success, percentage of spoken modality, and percentage of nonspoken modality) and how they were calculated. An additional analysis calculated the mean frequency of each nonspoken modality. This is to identify how often each nonspoken modality was used and whether the distribution of modality use may change with treatment (e.g., one may use one modality dominantly before treatment but use various modalities after treatment). Though they were not the most important outcome measures, we also included scores from the standardized assessments that were administered pre- and posttreatment (i.e., WAB-R AQ, SAQOL-39, and BNT-2 SF). These standardized measures were included pre- and posttreatment to provide information about how the participants’ language (WAB-R AQ, BNT-2 SF) and quality of life related to communication (SAQOL-39) may have changed during the course of treatment.

Analysis

The participants’ communication of trained and untrained items was analyzed by Tau-U. Tau-U is a nonparametric statistical analysis for a single-subject design to measure data between two phases (Lee & Cherney, 2018; Parker, Vannest, Davis, & Sauber, 2011). Tau-U is especially beneficial when undesirable baseline trends or no variations are present at the baseline (Parker, Vannest, & Davis, 2011). We evaluated the success and modality of communicated trained and untrained items. Also, the mean frequency of nonspoken modality use across four sessions of pre- and posttreatment assessments was calculated for trained and untrained items. Then, the chi-square was conducted to

Table 2. Outcome measure variables during story generation probe.

Outcome measures	Calculation
Percentage of success	Successfully communicated trained/untrained items in any modality, divided by the total number of trained/untrained items probed $\times 100$
Percentage of spoken modality	Successfully communicated trained/untrained items in spoken modality divided by the total number of trained or untrained items probed $\times 100$
Percentage of nonspoken modality	Successfully communicated trained/untrained items in any nonspoken modality divided by the total number of trained/untrained items probed $\times 100$

analyze changes in trend between pre- and posttreatment assessments.

Results

For this case study design, we present results from both descriptive and statistical analyses. Both participants attended all scheduled sessions or had makeup sessions. Participants engaged for the full duration of each session and took breaks as needed. Occasionally, P1 was late for group sessions (typically no more than 5 min).

P1

The mean of P1's general success percentage changed from 50.6% to 92.5% ($\tau = .875$, $SD = 6.928$, $z = 2.021$, $p = .043$) for trained items. Although his spoken modality percentage did not increase, the percentage of nonspoken modality was increased for trained items (47.6%–80.0%, $\tau = .9375$, $SD = 6.928$, $z = 2.165$, $p = .030$). Untrained items showed some similar increases, though those changes were not significant (see Tables 3 and 4).

Specific to the nonspoken modality, P1 used various modalities at the pre- and posttreatment assessments to

communicate the target words. The frequency of P1's total nonspoken modality uses and of each individual nonspoken modality increased from before to after treatment, which reflects the increased percentage of nonspoken modality results. The distribution of modality production was consistent. However, his preferred modalities stayed consistent. Gesturing and writing were the two most frequently used modalities, and this trend was consistent from before to after treatment, $\chi^2(4) = 3.56$, $p = .468$, for trained items, and $\chi^2(4) = 3.19$, $p = .527$, for untrained items (see Figure 2).

P1's WAB-R AQ changed from 32.3 to 38.9/100. Considering a 5-point change in standard scores is considered a significant improvement (Gilmore et al., 2018), this result suggests that his overall spoken language skills may have improved after the treatment. Minor increases in each area on the WAB-R AQ were noted with the exception of the Repetition subtest. However, his BNT-2 SF and SAQOL-39 Communication subtest scores did not show similar changes.

P2

P2 never attempted to use spoken communication during assessment tasks. However, his success percentage increased from 0% to 100% for trained items ($\tau = 1.000$,

Table 3. Discourse accuracy and modality rates in both participants.

Task	Measure	Items	Pretreatment assessment					Posttreatment assessment				
			1	2	3	4	M (SD)	1	2	3	4	M (SD)
P1	Success	Trained	60.0%	30.0%	40.0%	72.2%	50.6% (19.1)	100.0%	90.0%	90.0%	90.0%	92.5% (5.0)
		Untrained	20.0%	40.0%	70.0%	58.3%	47.1% (2.2)	90.0%	100.0%	100.0%	100.0%	97.5% (5.0)
	Spoken modality	Trained	5.0%	0.0%	0.0%	27.8%	8.2% (13.3)	25.0%	20.0%	15.0%	30.0%	22.5% (6.5)
		Untrained	10.0%	20.0%	10.0%	8.3%	12.1% (5.3)	30.0%	10.0%	20.0%	10.0%	17.5% (9.6)
	Nonspoken modality	Trained	55.0%	40.0%	40.0%	55.6%	47.6% (8.8)	85.0%	75.0%	85.0%	75.0%	80.0% (5.8)
		Untrained	20.0%	30.0%	60.0%	50.0%	40.0% (18.3)	60.0%	90.0%	90.0%	90.0%	82.5% (15.0)
P2	Success	Trained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	100.0%	100.0%	100.0%	100.0%	100% (0.0)
		Untrained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	89.5%	100.0%	100.0%	95.0%	96.1% (5.0)
	Spoken modality	Trained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	0.0%	0.0%	0.0%	0.0%	0.0% (0.0)
		Untrained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	0.0%	0.0%	0.0%	0.0%	0.0% (0.0)
	Nonspoken modality	Trained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	100.0%	100.0%	100.0%	100.0%	100% (0.0)
		Untrained	0.0%	u/a	0.0%	0.0%	0.0% (0.0)	89.5%	100.0%	100.0%	95.0%	96.1% (5.0)

Note. u/a indicates that data are unavailable. P1 = Participant 1; P2 = Participant 2.

Table 4. Discourse accuracy and modality rates Tau-U statistics results.

Task	Measure	Items	τ	τ_b	VARs	SD	SD_{τ}	z	p
P1	Success	Trained	.875	.875	48	6.928	.433	2.021	.043*
		Untrained	.750	.750	48	6.928	.433	1.732	.083
	Spoken modality	Trained	.563	.563	48	6.928	.433	1.299	.194
		Untrained	.625	.741	48	6.928	.433	1.443	.149
	Nonspoken modality	Trained	.9375	.9375	48	6.928	.433	2.165	.030*
		Untrained	.6875	.7097	48	6.928	.433	1.588	.112
P2	Success	Trained	1.000	1.000	48	6.928	.433	2.309	.021*
		Untrained	1.000	1.000	48	6.928	.433	2.309	.021*
	Spoken modality	Trained	.000	.000	48	6.928	.433	00.000	1.000
		Untrained	.000	.000	48	6.928	.433	00.000	1.000
	Nonspoken modality	Trained	1.000	1.000	48	6.928	.433	2.309	.021*
		Untrained	1.000	1.000	48	6.928	.433	2.309	.021*

Note. Bold values with an asterisk indicate statistically significant by Tau-U analysis. VARs = variance of the S statistic; P1 = Participant 1; P2 = Participant 2.

$SD = 6.928$, $z = 2.309$, $p = .021$) and from 0% to 96.1% for untrained items ($\tau = 1.000$, $SD = 6.928$, $z = 2.309$, $p = .021$). These changes were reflective of changes only in the nonspoken modality (see Tables 3 and 4).

Regarding his nonspoken modality frequency comparison, he did not use any nonspoken modality successfully used in the pretreatment assessment. At the posttreatment

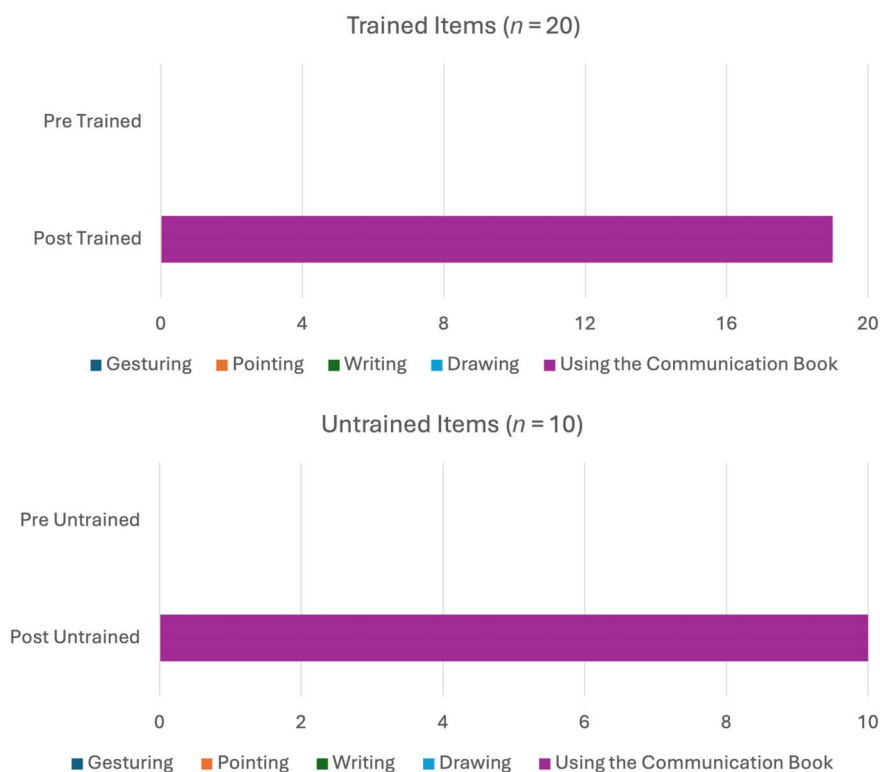
assessments, however, he heavily relied on using the communication book but did not successfully use any other modality (e.g., speaking, writing, gesturing, or drawing) to communicate trained or untrained items (see Figure 3).

P2's WAB-R AQ changed from 12.4 to 10.6/100, his SAQOL-39 Communication subtest score changed from 1.14 to 2.3/5 at the posttreatment assessment, and his BNT-2

Figure 2. Participant 1's nonspoken modality frequency average across pre- and posttreatment assessments. The frequency of nonspoken modalities can exceed the number of stimuli when the participant uses multiple nonspoken modalities per item.



Figure 3. Participant 2's nonspoken modality frequency average across pre- and posttreatment assessments.



SF score did not change. On the WAB-R AQ, the area of greatest decrease was in auditory comprehension (3/10 to 1.3/10), particularly on the Yes/No Questions subtest with abstract concept questions (e.g., “Will paper burn in fire?”), though he continued to have high success with personal questions (e.g., “Is your name Brown?”).

Discussion

The goal of this case study project was to evaluate the effect of teleMCT+DG on the use of various communication modalities during discourse tasks performed by two people with severe nonfluent aphasia. We evaluated the percentage of spoken or nonspoken production of target items and the frequency of each nonspoken modality used during a story generation task. Additionally, we also collected information about changes in standardized test scores. Given the case study design and preliminary nature of this project, the results should be interpreted with caution. Both participants showed some positive changes in the production of nonspoken modalities during the target discourse task. While there were some similarities in response to treatment, participants' results suggest some differential outcomes, potentially based on their individual profiles. Thus, we will discuss each participant individually below.

P1 With Severe Broca's Aphasia

Overall, a positive trend of treatment-related improvement was observed in P1. The results showed evidence of improved successful communication production and the use of nonspoken modalities as a successful compensatory strategy. In addition to the measures related to the target items, the increased WAB-R AQ score suggests that the treatment-related changes may have generalized to spoken language on standardized tasks (i.e., increases in spontaneous speech and word finding subtests).

P1's discourse task (story generation assessment task) performance demonstrated mixed results between trained and untrained items. Although the positive trend of success was demonstrated in both trained and untrained items, Tau-U suggested significant improvement only for trained items, not untrained items. Despite the positive trend of success of untrained items, the insignificant result could be possibly due to variability of the pretreatment performance or the reduced power of the study design with a small number of untrained items (i.e., 10 vs. 20 trained items). Despite the insignificant Tau-U statistical result, the posttreatment performance ranged from 90% to 100% success of untrained items, which may support the potential of treatment generalization

effects on untrained items. The positive trend of success was mostly driven by the improved nonspoken modalities as expected given the purpose of the treatment (total communication) and the severity of his impairments in spoken communication. Conversely, the spoken modality rates remained at a lower level, which contributed minimally to the changes in success.

Previous research suggests that P1's relatively preserved auditory comprehension may account for his relative success with treatment (Wallace & Kayode, 2017). His ability to understand the goal of the treatment and follow instructions without difficulties allowed efficient learning and practicing of nonspoken modalities. Additionally, before he began treatment, he was observed to use some written communication to support his spoken expression, though it was not often successful. His use of another modality prior to treatment suggests an openness to using other communication modalities that may have facilitated his success when during treatment he was introduced to other nonspoken communication modalities (Howe et al., 2023).

While during treatment P1 used some combination of all four nonspoken modalities (writing, drawing, gesturing, and using a communication book), not all nonspoken modalities were equally used. Rather, he preferred a few modalities (gesturing and writing) and used them more frequently than the others, consistently from pre- to posttreatment. Although the trend of frequently used modalities was not changed, Figure 2 depicted an increased frequency of the nonspoken modalities overall, which potentially contributed to the increase of his successful communication of the target words. Furthermore, future studies can evaluate the relationships among the strength in specific nonspoken modality, previous use of a communication modality, and cognitive-linguistic skills. This future direction could also include evaluating a modification to MCT to reduce the number of treatment modalities so that the practice can be intensified for those most promising modalities.

Unlike nonspoken modalities, P1's spoken modality did not show evidence of improvement. Speaking was one of the five modalities that were practiced during treatment. All five modalities were practiced equally during the modality production task and discourse tasks. Therefore, it is worthwhile to navigate the reasons for the limited improvement of the spoken modality. Potential reasons include that his primary aphasia symptom was difficulty with spoken language production, he reported a diagnosis of apraxia of speech, and he was already interested and willing to use another nonspoken modality. In addition to word finding difficulties, the apraxia of speech severely interrupted his naming. Because our treatment did not aim for intensive naming treatment with specific protocols to remediate or compensate for the apraxia of speech, several

repetitions of naming may not be sufficient to improve his spoken output. These findings will assist with designing future studies that can target motor speech disorders, which often present in people with aphasia. That is, we can add a motor speech assessment to our protocol and modify the spoken language tasks to better align with motor speech treatment principles (Bislick, 2020).

P2 With Very Severe Global Aphasia

P2 showed significant improvements in the successful use of trained and untrained items using the nonspoken modality during the discourse task. Of note, P2 did not produce the target items in the spoken modality before or after treatment. Instead, he learned to use the communication book during the discourse tasks across trained and untrained items. It is a strategy that can typically be generalized across items with ease because, rather than learning a specific gesture for an item or practicing writing a specific item, the treatment focuses on looking for items within the communication book. As treatment continued, he also incorporated more gestures with high iconicity and familiarity, including using gestures for *car* and *phone*, although they were not always successful (e.g., he held up his thumb and pinky but was unable to move his hand near his ear for a *phone*). During discourse tasks, he demonstrated marked improvements in initial success and nonspoken modality production, suggesting an improved ability to communicate target items within a scene, again mostly relying on the communication book. A future goal could be for him to use a variety of nonspoken modalities beyond the communication book for times when items are not included in the book or the book is unavailable.

We attributed P2's heavy reliance on a single modality to his early treatment success using that modality and the relative ease of that modality, given his physical limitations. P2 did not demonstrate any successful use of nonspoken modalities in the baseline sessions; however, once he was introduced to those communication modality options in treatment, it provided him with an immediate tool for successful communication. Furthermore, the use of the communication book did not require him to formulate any gestures, written words, or drawings, which require higher cognitive loads such as memory skill to recall the trained spelling, drawings, and gestures, or abstract thinking to come up with gestures for untrained items. The communication book allowed him to simply match pictures, which may have supported communication success despite relatively lower cognitive and auditory comprehension functioning. When compared to P1, P2 evidenced difficulty with the CLQT+ and lower scores (3/10 before treatment and 1.3/10 after treatment) on the auditory comprehension subtests of the WAB-R AQ. Specifically, P2 demonstrated significant frustration during attempts to complete the

CLQT+, and we granted his request to discontinue all attempts to minimize his frustration. We suspect that his frustration was related to his cognitive challenges. The participant eligibility for the treatment did not identify a specific level of cognitive function, which emerged as a potential secondary goal during the study. Thus, more investigation of cognitive skills tied to the success of this treatment is needed.

In addition, previous studies, some of which have included people with nonfluent aphasia, have suggested that cognitive flexibility in particular is an important skill for learning to switch among communication modalities to repair communication breakdowns (Purdy, 2002; Purdy & Dietz, 2010; Purdy & Koch, 2006; Purdy & Van Dyke, 2011). Additionally, metacognitive skills are needed to identify breakdowns and the need to switch to a nonspoken modality (Mikola, 2010; Nicholas et al., 2011; Purdy, 2002; Purdy & Wallace, 2016; Zinn et al., 2007). It is yet unknown how those cognitive skills mediate the multimodal treatment effect. The findings from the current and previous studies suggest a potential impairment and the need to explore the potential interactions with cognitive functions in future studies. Additionally, people with notable cognitive deficits may benefit from supplemental treatment to gain the same benefits as other people with nonfluent aphasia.

Similar to the current study, previous MCT studies provide evidence of improving communication success at the single-word level, such as an intensive treatment setting for people with Broca's aphasia (Purdy & Wallace, 2016) and combining MCT with nonverbal semantic treatment for a person with severe fluent aphasia (AQ = 19.7; Wallace & Kayode, 2017). However, individual variability in the treatment effects have also been observed across and within studies. For example, one participant (Broca's aphasia, AQ = 20.8) in Purdy and Wallace (2016) showed improvement in speaking when the other two participants (both with severe Broca's aphasia with a WAB-R AQ of 27.8 and 18.2) improved their gestures. In the current study, although the two participants showed a similar trend of improving nonspoken modalities but not spoken modality, their adoption of nonspoken modalities was distinct, as one adopted various modalities, while the other preferred one particular modality (communication book). This is considered an advantage of MCT by providing several options and allowing the person with aphasia to select the option(s) that work best for them.

Limitations and Future Directions of the teleMCT+DG

One of the limitations of the study is related to its methodological aspects of a case study design. A case study design is advantageous for exploring how people with a particular type of aphasia receive this new intervention program (Crowe et al., 2011). Our use of multiple time points

provided some information about performance overtime, which can be useful for designing future studies. Additionally, our use of trained and untrained items provided insight about generalization to other similar items, though it does not include generalization to all real-life situations. However, we also acknowledge that a lack of control conditions hinders determining the true treatment-related changes by controlling potential confounding variables. Additionally, concerns with a small sample size and a lack of scientific control may cause a potential threat to external validity. Therefore, the results in the current study should be interpreted with caution, and further studies with a tightly controlled study design (e.g., experimental randomized controlled trial) are needed to support the treatment-related changes. Additionally, future study designs could facilitate evaluating different modifications and elements of teleMCT+DG with careful consideration of control and treatment conditions.

Another limitation of the teleMCT+DG was related to the use of telepractice, despite the modifications we made to support this service delivery approach. First, P1 often attempted to scribble on a whiteboard but abandoned and erased them without showing clinicians. This limited our data on which modality he was trying (i.e., writing or drawing) and our ability to establish particular patterns of breakdown (e.g., producing partial spelling, or paraphasia). Second, P2 demonstrated physical limitations related to his stroke and comorbid conditions. The inability of the clinician to provide physical assistance, such as holding his whiteboard or aiding his gesture production, may have limited his consideration of modalities other than the communication book.

Of note, all five modalities were practiced equally during the modality production task and discourse tasks. However, the scoring system grouped all nonspoken modalities together, which may have inflated the scores as compared to increases in spoken modality production. Given the purpose of the study, it was important to consider multiple nonspoken modalities, as these are most often used to resolve communication breakdowns when they occur (Purdy & Van Dyke, 2011).

Several future directions for this research have emerged from these findings. The scope of the current study was to evaluate the successful communication of participants during a discourse task; thus, we only reported their successful responses. However, anecdotally, P2's attempts in other modalities than using the communication book to resolve communication breakdowns increased toward the end of the treatment period. Although they were not successful, this type of data could suggest that, with additional or modified instruction, he may increase his communication effectiveness. In addition, we focused this study on the production of target items during story generation assessment tasks; however,

observations suggest that participants increase their generation of other ideas, and future examination of discourse production is warranted. Clinicians also noted that participants' communication engagement in the group sessions increased, which was not evaluated in the current study. These data can support how teleMCT+DG increased their confidence level in communicating with others and social engagement activity. Last, it is valuable to explore participants' perspectives on the treatment, how acceptable it was to them, and how it affected their real-world communication. Further data will provide greater insight into the benefits of teleMCT+DG regarding the generalization of the treatment in an authentic communication environment.

Clinical Implications of teleMCT+DG and Discourse Treatment

People with severe nonfluent aphasia demonstrate characteristically notable difficulty with spoken language production. While the current study demonstrated difficulty improving spoken naming using multimodal treatment for two participants with severe nonfluent aphasia, nonspeaking modality appeared to be more amenable to improvement, allowing for successful communication of their target words. Therefore, the purpose of teleMCT+DG may be well suited to the needs of this population; however, due to the individual variabilities, modifications may be needed and studied for people with various profiles, including impaired cognitive and/or auditory comprehension abilities.

As aphasia treatment targeting severe aphasia is scarce, teleMCT+DG provides a functional tool for this population, primarily with evidence regarding increases of single target words produced during discourse tasks. One of the strengths of teleMCT+DG is its promotion of ecological validity, including discourse tasks and group interactions, to promote the participant's functional communication skills in a more realistic communication environment. Moreover, learning and practicing multimodal communication in individual sessions and exercising the skills in the group may strengthen the participant's confidence and engagement. In addition, despite the minor issues reported above, implementing the treatment via telepractice and supporting the platform is another advantage to promote accessibility. Further studies with more data from people with various types and severities of aphasia will advance evidence of this treatment and provide suggestions to polish the treatment protocols.

Data Availability Statement

The data sets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix (p. 1 of 4)

Protocols of Multimodal Communication Treatment With Discourse and Group via Telepractice (TeleMCT+DG)

Individual Session

Preparation: a communication partner (optional for individual sessions), 4 target picture cards, 2 scenes, data recording sheet, pen/paper or marker/whiteboard, communication book, and modality chart

Greetings

- Greetings and small talk about today or the week
- Checking and troubleshooting (if needed) sound, video, connection, etc.

Modality Production Task (4 targets)

Trial 1

- Make sure that the participant has all of their materials in front of them (communication book, pen, paper, and modality chart). “Do you have your materials in front of you?”
- Present the modality chart through the camera to the participant. Remind the participant that they have a variety of communication options. “Look at the communication chart. There are many different ways for you to communicate, as we have reviewed earlier in the session. You can draw, write, gesture, use your communication book, or speak verbally.”
- Present the first target noun of the session to the participant via the camera and demonstrate how to communicate that noun using all five modalities.
 - a. Communication book
 - (a) Look through the book with the participant.
 - (b) Explain and go through the categories on the tabs.
 - (c) Ask the participant to think about the category that the target belongs to.
 - (d) Search the tabs to find the category and then flip the page to find the item. The clinician may cue to determine the category of the target. However, if the participant is impaired in reading, the participant may go through all pages to find the target.
 - (e) Close the book and ask the participant to find the target again. Repeat Step (d) 5x.
 - b. Naming
 - (a) Say the target name and ask the participant to repeat. Provide placement/phonemic cues as needed.
 - (b) Ask the participant to repeat the noun 5x.
 - (c) Show the participant the picture and orally provide the corresponding sentence for the participant to complete; e.g., if the target word was “ball,” you could use the sentence, “He bounced the ____.”
 - (d) Show the picture to the participant to spontaneously name.
 - c. Gesture
 - (a) Show the target picture and say, “Let’s think about how you would gesture this” or “Think about how you use this item.”
If the participant has difficulty gesturing it, the clinician provides a demonstration of the target gesture for the item. The clinician and participant discuss whether the gesture is understandable. If not, they discuss revising to make it sense to the participant.
 - (b) Ask the participant to repeat the gesture 5x. If the participant has difficulty and a caregiver is present, the clinician can ask the caregiver to provide hand-over-hand support.
 - (c) Show the picture to the participant to spontaneously gesture the target.

d. **Drawing**

- (a) Show the target picture and say "Let's think about how to draw this."
- (b) Allow the participant to try drawing, and the clinician cues or models with a suggestion. Similar to a gesture, the participant and clinician discuss whether the drawing is understandable and simple enough. Revise the drawing if needed, depending on participant mobility.
- (c) Ask the participant to copy the target drawing 3x.
- (d) Cover the drawing and ask the participant to write the item again.
- (e) Show the participant the picture to draw the item spontaneously.

e. **Writing**

- (a) Say and write the name of the target. If the participant has difficulty, break it down letter by letter or line by line.
- (b) Ask the participant to copy the target word 3x.
- (c) Cover the word and ask the participant to write it again.
- (d) Show the participant the picture to write the name spontaneously.

- When completed, present a new target object picture and repeat steps.

Trials 2, 3, & 4

- Present the modality chart through the camera to the participant and ask them to look at their own. Remind the participant that they have a variety of communication options. "Look at your communication chart, like the one I am showing you now. There are many different ways for you to communicate, as we have reviewed earlier in the session. You can draw, write, gesture, use your communication book, or speak verbally."
- Present the first target object picture and ask the participant to communicate the items in different ways. "Please communicate this item to me in the five ways we practiced before."
- If all modalities are not elicited, specifically request each modality not elicited, such as "Say it," "Write it," "Draw it," "Gesture it," or "Use your communication book."
- If the participant is still unable to provide the correct production, repeat the modality training hierarchy described in Trial 1.

Discourse

Screenshare on Zoom to present scenes. Each scene includes 2 trained items that were circles or have an arrow pointing to.

- Review the modality chart and remind the participant of the materials that they can use to communicate: "There are things that can help your communication. You can use anything you need to communicate."
- Present a scene picture and ask "Please tell me a story about what's going on in this picture with a beginning, a middle, and an end. Be sure to include the items that an arrow is pointing to or that are circled." Cue if the target item is not produced: "What are they using to do xxx?" or "What are they holding?" The clinician writes down what the participant produces.
- The clinician and the participant develop a sentence together for modality practice. If the participant produced a good sentence/phrase/words earlier, use them and expand. If the participant did not produce enough, the clinician can assist in developing a sentence; e.g., if the participant produced cat, ring, and wedding, an example sentence can be "The cat delivers a ring at the wedding."
- The clinician writes a developed sentence on the screen and highlights the two trained words with a different color.
- Using the developed sentence, the clinician requests to read the sentence while incorporating the 5 modalities for the trained items.
 - a. "Please repeat after me. The **cat** delivers a **ring** at the wedding." Ask the participant to repeat 3 times.
 - b. "Let's combine gestures. The (use cat gesture) delivers (use ring gesture) at the wedding." Ask the participant to repeat 3 times.
 - c. "Let's combine writing. The (write 'cat') delivers (write 'ring') at the wedding." Ask the participant to repeat 3 times.
 - d. "Let's combine drawing. The (draw cat) delivers (draw ring) at the wedding." Ask the participant to repeat 3 times.
 - e. "Let's combine with finding them in the communication book. The (find a cat in the communication book) delivers (find a ring in the communication book) at the wedding." Ask the participant to repeat 3 times.

Appendix (p. 3 of 4)

Protocols of Multimodal Communication Treatment With Discourse and Group via Telepractice (TeleMCT+DG)

- If the participant has difficulty reading the full sentences independently, the clinician can read them in unison.
- After completion of the modality training, the clinician encourages the participant to create a story. “Let’s expand to make a whole story of this picture, using *wh*-questions. For example:
Participant: “drive”
Clinician: “Who is driving?” or “Drive what?”
- If the participant has a word-finding difficulty, the clinician encourages the participant to use nonspoken modality, following the cueing hierarchy below.
 - a. “Remember, you can use different ways to communicate.”
 - b. If an attempt with one modality is made but incorrect, a clinician provides multiple options, e.g., “Will you draw or gesture?”
 - c. If no response, a clinician randomly picks on modality, e.g., “Will you draw?”
 - d. If an attempt is made or refused, follow the specific steps of each modality below.
 - (a) Speaking
 - i. “Think about the first sound.”
 - ii. Provide the first phonemes/syllable, if known.
 - iii. Modeling, if known
 - iv. Syllable-by-syllable modeling
 - (b) Writing
 - i. “Think about the sound.”
 - ii. Provide the first phonemes/syllable, if known.
 - iii. Modeling, if known
 - (c) Gesture
 - i. “Think about how to use it.”
 - ii. Modeling, if known
 - iii. If present, the caregiver can assist by providing hand-over-hand support.
 - (d) Communication book
 - i. “Can you find it in the book?”
 - ii. “Think about the category.”
 - iii. Modeling, if known
- After the story is complete, the clinician shows the written/typed utterances to the participant and asks them to read it aloud (or read along with the clinician if having a reading difficulty).

Group Session

Preparation: 12 target picture cards (ask the participant to prepare 4 picture cards they practiced the current week), pen/paper or marker/whiteboard, communication book, and modality chart

Greetings

- Greetings and small talk about today or the week
- Checking and troubleshooting sound, video, connection, etc., if needed
- The clinician presents the theme (e.g., favorite holiday) and asks all participants to talk about the theme. The clinician encourages participants to use any communication modalities if they experience word finding difficulties.

Trivia: Review target items

- Introduce the modality chart to explain the five modalities a participant can use.
- Explain and demonstrate the game to the participants
- A clinician gestures or draws one of the target items of the week.
- Participants guess what the item is by communicating in another modality. The participant should use another modality to answer; e.g., if a clinician gestured, the participant can say the name, draw, write, or show an item in the communication book.
- All participants try their attempts, and the clinician should provide an acknowledgment of all attempts made

Story presentations

- Before the group session, each participant selected one scene they practiced during individual sessions of the week. They were asked to practice presenting the story using any modalities to the group.
- Each participant presents their scene.
- After each presentation, a clinician encourages all participants to share their thoughts about the scene, relate the scene to their personal story, or expand the story beyond the scene as a group.

Wrap up and announce the theme for the following week

- The clinician wraps up the session and announces the theme for the following week.
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