AJSLP

Clinical Focus

Patterns of Conversation Trouble Source and Repair as Indices of Improved Conversation in Aphasia: A Multiple-Case Study Using Conversation Analysis

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Purpose: Social approaches to intervention for aphasia are being increasingly employed to address the functional communication barriers experienced by persons with aphasia. One specific approach is the use of conversation-based treatment in both group and two-person dyads. Although there are several methods to measure improvement for stimulation and cognitive neurolinguistic approaches, researchers have consistently indicated a need for outcome measures that can objectively demonstrate improved communication following conversation treatment. This study aims to demonstrate the utility for examining the patterns of conversation trouble source and repair as indices for improved communication as a positive response to intervention.
Method: The conversations of 20 consecutive participants, before and after 3 months, or 40 hr, of group and individual conversation-based treatment, were transcribed using conventions of conversation analysis, and sociolinguistic discourse analysis was applied. Measures of trouble source and repair were aggregated and subjected to statistical analysis.
Results: Persons with aphasia demonstrated statistically significant improvement in patterns of conversation trouble source and repair posttreatment for the rate of conversation trouble source and the length of repair. However, measures of self-initiation and self-completion of repair did not reach significance.
Conclusion: The study indicates that, following conversation-based treatment, the conversations of persons with aphasias were more efficient, experiencing fewer trouble sources and shorter repair sequences. These findings suggest that measures of conversation for the rate of trouble source and length of the repair sequence are valid indices of improved conversation.

The use of conversation as the foundation of socially oriented treatment protocols continues to grow among the rehabilitation community (Chapey et al., 2001; Damico et al., 2015; Lock et al., 2001; Simmons-Mackie et al., 2014). Forms of conversation treatment have been employed as a social component of group treatment as early as the 1950s. For example, the Veteran's Hospital–Long Beach enriched their cognitive stimulation approaches with a social component aimed at generalizing language skills. This took the form of "interview coaching" followed by an actual interview with a visiting celebrity (Agranowitz et al., 1954). However, it was not until the late 1990s that social approaches targeting conversation were beginning to proliferate with treatments such as Conversational Coaching (Holland, 1991), Communication Partners (Lyon, 1992), Supported Conversation for Adults (Kagan, 1998), situation-specific training (Hopper & Holland, 1998), and Supporting

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Editor-in-Chief: Melissa Duff
Editor: Jacqueline Laures-Gore
Received September 15, 2019
Revision received December 25, 2019
Accepted March 31, 2020
https://doi.org/10.1044/2020_AJSLP-19-00100
Publisher Note: This article is part of the Special Issue: Select Papers From the 49th Clinical Aphasiology Conference.

Disclosure: *The authors have declared that no competing interests existed at the time of publication.*

Partners of People with Aphasia in Relationships and Conversation (Lock et al., 2001). Conversation takes many forms that are shaped by the purpose of the interaction, the goals of and relationships between the participants, and the accompanying context (Armstrong & Ferguson, 2010). One such form of conversation is everyday conversation whose characteristics for turn-taking and repair are systematic and, therefore, useful for training persons with aphasia (PWAs) in strategies that promote improved communication (Booth & Perkins, 1999; Sacks et al., 1974; Simmons-Mackie et al., 2007; Wilkinson, 1999).

Conversation as a Socially Constructed Interaction

Conversation can be described as an interpsychological construct that is shaped by the social purpose, the physical and linguistic context, and sociocultural expectations (Armstrong & Ferguson, 2010; Bryant et al., 2016; Goodwin & Heritage, 1990). The context of conversation is shaped by inherent factors such as the familiarity and affinity of the conversation partners, the purpose of the conversation, and the level of interest each has in the topic of the talk. These dynamic forces can shape the structure of conversation as a formal, ritualized routine; a spontaneous and informal exchange; or somewhere in between these polar genres. Conversation is constructed by two or more persons, turn by turn, and with the shared goal of mutual understanding or intersubjectivity. Orienting to the goal of shared understanding, conversation is a collaboratively constructed interaction in which the parties orient to the establishment of intersubjectivity through the sequentiality of next responses. In other words, each turn can be recognized as tied to the previous turn (Wilkinson, 1999). Participants in a conversation rely upon both independent and shared cognitive, linguistic, and knowledge resources, as well as social strategies to achieve this intersubjectivity in a relatively expeditious manner (Damico et al., 2015; Perkins, 2007). Interlocutors strategically employ these resources only to the extent required to achieve this mutual understanding. By orienting to the forward progressivity of the conversation, both parties work collaboratively to reach intersubjectivity as quickly and efficiently as possible, as suggested by the principle of least collaborative effort (Clark, 1996). This has implications when one party has aphasia and the linguistic resources available to them are reduced.

Conversation Practices as a Systematic Endeavor

Constructing conversation is a systematic interactional achievement that orients to speaker and listener preferences for turn allocation practices, turn construction, and response-to-conversation trouble sources (Milroy & Perkins, 1992; Sacks et al., 1974; Schegloff et al., 1977). Speakers will construct their turn in response to a previous turn, demonstrating cohesion of meaning. Furthermore, speakers hold the expectation that the next speaker will do the same (Goodwin, 1995; Sacks et al., 1974). It is the expectation of this sequentiality and frequent trouble for turn construction in aphasic conversations that results in a trouble source (Wilkinson, 1999). Schegloff et al. (1977) provide a comprehensive explication of trouble sources and the patterns for their repair in nonaphasic conversation; a summary of this is presented here. First, a trouble source has consistently been identified as "that which the repair addresses" (p. 363). This means that the trouble source can be recognized by the repair sequence that follows it. Schegloff reports that common trouble sources in "normal" conversation relate to using the incorrect referent, such as in word replacement or person references, and next-speaker selection/speaker overlap. He reports that interlocutors treat trouble sources as obstacles to the sequential nature of conversation where "an appropriate 'next turn' [is] sequentially implicated by [a] prior turn" (p. 380). Second, repair of a trouble source is either self-initiated by the speaker or other-initiated by any party but the speaker. The initiation of repair can occur in four possible locations related to which party initiates the repair. Self-initiated repair occurs in three main positions, with two occurring in the first position and the third occurring in the third position of talk. Self-initiated repair can occur (a) within the same turn as their trouble source; (b) immediately following the turn but prior to a next-speaker's turn, also called the "transition space"; and (c) following another speaker's turn. Repair of a trouble source completed by another occupies one position, following the turn of the trouble source. Third, there are consistent devices used to complete the repair trouble sources with the most common of these being question words, including "Huh?", or partial repeats of the trouble source turn with a question word (e.g., He had how many tickets?). Fourth, the trajectory from initiation to completion for self-initiated repairs is most commonly completed in the same turn as the initiation of the repair, but other-initiated repair results in longer repair sequences where "repairs initiated by any other party in the next turn take multiple turns…to get accomplished" (p. 369). Fifth, Schegloff reports an overwhelming preference for self-correction by the speaker where "massively, for those [trouble sources] on which repair is initiated, same-turn and transition-space opportunities for self-initiation are taken by speakers of the trouble source" (p. 376). Related to this, when a repair is other-initiated, the speaker overwhelmingly engages in self-correction in the third position.

Similar to nonaphasic interlocutors, PWAs orient to the inherent sequentiality of conversation where each next turn relates to the prior. Additionally, both groups orient to the principle of least collaborative effort in the coconstruction of conversation and the expedient repair of trouble sources (Clark & Schaefer, 1989; Milroy & Perkins, 1992). Also, like nonaphasic persons, PWAs overwhelmingly demonstrate a preference for self-correction and orient to an expeditious completion of the repair (Laakso, 1997; Penn et al., 2015; Wilkinson, 2015). This requires that PWAs bring to bear all available cognitive–linguistic resources and compensatory strategies and direct these toward the initiation and completion of repair (Penn et al., 2015). It is for this reason that conversation, where one or more

persons have aphasia, manifests differently from nonaphasic conversation: (a) trouble sources and their repair occur much more frequently, (b) PWAs find it more difficult to self-repair, and (c) the repair sequence can become protracted (Laakso, 1997; Wilkinson, 2015).

Patterns of Conversation Repair Among Persons With Expressive Aphasia

When one party has aphasia, trouble sources in conversation are likely to occur, and the repair sequence for these are more likely to be protracted due to the linguistic impairment (Booth & Swabey, 1999; Ferguson, 1994). Trouble sources often take the form of false starts, disfluencies, inaccurate messages due to paraphasias, and listener misunderstandings, often related to formulation problems (Whitworth, 2003). PWAs and their partners often require extended time and conversation turns for repair, with this repair accomplished through a variety of patterns (Ferguson, 1998; Laakso, 1997; Perkins, 2003; Whitworth, 2003). In describing the repair of aphasic talk, Boles (1998) provided an explicit definition: "repair was defined as an attempt to modify one's own or the other person's utterance" (p. 265). In this collaborative endeavor, each party in the conversation employs cognitive, linguistic, and social resources available to them to accomplish the repair of conversation trouble source. Typically, this will result in the nonaphasic partner assuming a larger share of the interactional work to construct conversation. Because aphasia reduces the linguistic resources necessary for the initiation and completion of repair, the dyads orient to the less preferred patterns of other-initiation and other completion of repair with increased frequency. The occurrence of other-repair carries important consequences for sequential implicativeness or forward progressivity (Booth & Swabey, 1999; Ferguson, 1994; Wilkinson, 2015). When a trouble source is repaired by another, the successful completion of the PWA's turn is delayed by one or more turns and "the repair work becomes the interactional business with current business suspended until it is resolved" (Booth & Perkins, 1999, p. 285).

Improvements in PWAs' ability to construct their turn and engage in repair should then result in fewer trouble sources and more efficient repairs in conversation to achieve intersubjectivity and forward progressivity in conversation. Increases in the efficiency of resuming and maintaining forward progressivity provide evidence of improved conversational competence (Myrberg et al., 2018).

Conversation-Based Treatment Approaches

For over half a century, conversation analysis (CA) has been utilized as "an established and respected approach to providing detailed, micro-analytic descriptions of spoken interaction" (O'Keefe & Walsh, 2012, p. 161). The development of CA as a valid research tool in the qualitative tradition eventually gave rise to conversation-based treatments. These treatments employed the characteristics ascribed to normal conversation to inform a functional approach for addressing the conversational barriers experienced by PWAs. Aphasia treatments that report using conversation as the context for treatment are as varied as the factors influencing conversation, particularly with respect to who in the conversation dyad is being treated. Many treatment approaches designed to improve communication for conversation involve treating the caregiver only (Blom Johansson et al., 2013; Booth & Perkins, 1999; Kagan et al., 2001). The guiding philosophy of training the partner with greater linguistic resources suggests that they will be able to assume a larger burden for the construction of conversation. In addition, they will be able to facilitate the expression of the PWA by providing communicative resources that enable the PWA to assume greater responsibility and autonomy in the construction of conversation turns. Still, other training programs focus on conversation treatment within the PWA–partner dyad where both parties are able to immediately practice and apply conversation facilitation strategies (Boles, 1997; Booth & Perrkins, 1999; Cunningham & Ward, 2003; Wilkinson et al., 2010, 2011). Surprisingly, very few programs have addressed training PWAs. This is problematic given the probability of communication with multiple differing partners, some of which would be unfamiliar with the PWA's competencies and compensations. However, a randomized controlled trial from Elman and Bernstein-Ellis (1999a, 1999b) demonstrated the most convincing argument for conversation-based treatment targeting the PWA. Employing a group-based treatment model, Elman and Bernstein-Ellis demonstrated the efficacious treatment of PWAs. They found significant gains in the scores for standardized measures of linguistic and communicative performance as well as reported psychosocial benefits. Four studies were found that utilized conversation-based approaches and CA-based outcome measures targeting the conversations of PWAs, three of which employed everyday conversation (Basso, 2010; Damico et al., 2015; DeDe et al., 2019; Savage et al., 2014). One, a recent randomized controlled trial, reported outcomes on "conversation tasks," but the talk was constrained by topic and the clinician's elicitation of superficial syntax elements. This was inferred from their statement, "We generated a list of conversation topics that fell under five categories (p. 1440)…. Individual goals were targeted by creating opportunities to practice the communication target within the natural flow of the conversation. For example, one participant's goal was to produce complete subject–verb–object sentences. He or she was provided with a personalized visual cue. In addition, the clinicians frequently recast sentence fragments as complete sentences or, if appropriate, cued the participant to reformulate a conversation turn as a complete sentence" (DeDe et al., 2019, p. 1443).

Although the effect of the semistructured group "conversation" tasks may differ from the other three studies, like the other studies, the researchers found improved communication. In the DeDe et al. (2019) study, the outcome measures of standardized assessments and narrative discourse elicitation demonstrated improved language and discourse ability, with the researchers noting that "it is

interesting to note that it was a discourse measure that showed persistent changes" (p. 1446). Basso (2010) reported a single-case study of a man with severe aphasia who participated in "natural" conversation treatment targeting increased participation and response shaping. Basso found that he did increase his turn-taking with his clinician and his family. She further reported increased requests for repetition, a strategy to compensate for comprehension deficits. Savage et al. (2014) reported on two persons with anomic aphasia that received "standard" and conversation-based treatment in an alternating treatment design. Conversation therapy situated the therapeutic action within the conversation; the clinician mediated within the conversation to support a PWA's success and increase the use of conversation strategies for preempting and repairing trouble sources. This involved the clinician "manipulating the immediate context preceding each turn by use of strategies…. The clinician manipulated the consequent events that followed each turn…" (p. 623). Following a course of conversation-based treatment, they found a positive response to treatment in the form of increased facilitating turns (successful initiations, responses, and continuations of talk) as well as decreasing turns that were compromised (repairs and revisions). Both studies provide evidence of increased participation in conversation, and in the case of Savage et al., there is evidence of increased communicative success. Both the aforementioned studies reported engaging in conversation-based treatment; however, the conversation was manipulated in some fashion, either through the use of repeated and revised questions to elicit multiple repetitions (Basso, 2010) or the inclusion of discourse tasks in addition to "natural" conversation (Savage et al., 2014). Damico et al. (2015) reported on conversation-based treatment employing everyday, natural conversation as the context of therapy for a man with moderate Broca's type aphasia. The treatment targeted increasing the PWA's awareness of conversation, awareness of his own facilitating as well as unproductive strategies, and the employment of productive compensatory strategies to either preempt or overcome the communication barriers related to aphasia. Following 24 sessions of treatment, the participant demonstrated decreased incidences of word-finding errors and decreased fixation on recall as the only strategy for repair. Additionally, the study found that, as the man oriented to combining modalities (gestural circumlocution) to accomplish turn construction, he increased his occurrences of lexical self-repair. Whereas the participant with severe aphasia in the study by Basso (2010) increased self-initiation for repair through clarification requests, the case studies of Savage et al. (2014) and Damico et al. (2015) report increased self-repair as evidence of improved conversation.

Conversation-Based Outcome Measures

Measures for the repair of trouble sources are commonly used outcome measures in CA-based intervention. Overwhelmingly, researchers have oriented to Schegloff's and others' conceptualization of repair as dealing with problems in speaking, hearing, or understanding, and they have operationalized trouble source and repair according to the patterns and preferences in repair summarized previously (Schegloff, 2000; Schegloff et al., 1977). Patterns for who initiates and completes the repair, the frequency of repair, and the length of repair have been utilized by researchers of CA-based treatment to demonstrate either the caregiver's or the PWA's response to intervention. Boles (1998) employed rate of self-repair per minute as an index of conversation change. He reported the participants' threefold increase in self-repair as a positive response to treatment. Booth and Swabey (1999) employed indices of trouble source and repair length to document changes in the conversations of three dyads following group training for caregivers. They found a statistically significant decrease for the number of turns involved in collaborative repair, but not the rate of trouble source. Booth and Perkins (1999) analyzed a single dyad and found a reduction in the percentage of turns that were involved in repair, which related to reduced repair length. Although neither study by Booth reported it explicitly, the language of the qualitative analysis implies that their frequency of occurrence counts were for trouble source in the turns of PWAs only. Cunningham and Ward (2003) examined repair practices for PWA–caregiver dyads and found increased proportions of successful repair sequences for three of four dyads. Additionally, they observed a decreased percentage of PWA-initiated trouble sources and an increase in the self-initiation of repairs by the PWA for three of the four dyads. However, none of these reached a level of statistical significance. In a study of a PWA's response to intensive language–action therapy, Tuomenoksa et al. (2016) employed CA measures of other-initiated repair by the conversation partner for pretreatment and posttreatment conversations. They found a decreasing trend of partner-initiated repair. Savage et al. (2014) explicitly looked at the turns of PWAs and their partners when investigating two PWAs' response-to-conversation–based treatment compared with a stimulation approach. They aggregated repairs with revisions and feedback into a category of inhibiting behaviors coded as R/F, finding decreased inhibitory behaviors for only one PWA. As the aforementioned studies demonstrate, conversation-based interventions and conversation-based outcome measures are increasingly orienting to trouble source and repair as targets of treatment and indices of improved ability. This focus represents an understanding that conversation dyads orient to the forward progress of conversation for building mutual understanding through the repair of trouble sources as expeditiously as possible. Furthermore, dyads orient to conversational preferences related to "saving face" that include preferences for self-initiation and self-completion of these repairs (Goffman, 1967; Schegloff et al., 1977).

Suitability of the Selected Indices for Determining Improved Conversation

As speakers construct their turns with an orientation to forward progressivity, the occurrence of conversation

trouble sources and repairs thwarts this mutual goal. When designing a conversation-based treatment, clinicians and researchers alike are cautioned to "align the treatment objectives, tasks, projected intervention outcomes, and the actual measures used" (Saldert et al., 2018, p. 1). The authors suggest a proximal relationship between the treatment tasks and outcomes, as well as the measurement of these outcomes. They went on to suggest that measures should "capture skills and participation in actual conversation" (p. 5230). The employment of improved conversation as the treatment objective, task, and outcome, along with the use of CA-based outcome measures, provides ecological validity to any results. This was the finding of Myrberg et al. (2018), who reported that discourse occurring between the clinician and PWA during norm-referenced test sessions and the information gleaned from norm-referenced tests bared little resemblance to the same dyad's discourse demonstrated during everyday conversation. Following the model of Simmons-Mackie et al. (2014), measures of conversation trouble source and repair would appear to be more proximal to a projected outcome of decreased barriers to the forward flow of conversation. The shared resources (linguistic, social, and contextual) a dyad employs to repair conversation trouble source are varied and context dependent, but changes in trouble source, repair patterns, and length tie the outcome measure to the purpose of conversation-based treatment. The purpose of conversation-based treatment is to improve conversation ability so that both intersubjectivity and forward progressivity are achieved. The strategies trained in conversation-based techniques share the goal of reducing the threat to forward progressivity that results from conversation trouble sources and lengthy repair sequences. As stated by Beeke et al. (2011), "therapy aims to reduce the need for the partner to initiate repair in the next turn, because the speaker with aphasia's turn construction strategies will facilitate greater and more immediate mutual understanding" (p. 227). Many researchers have studied repair as an index of change, reporting on their findings qualitatively (Beeke et al., 2011; Crockford & Lesser, 1994; Ferguson, 1994; Milroy & Perkins, 1992). They have drawn on an emic perspective of CA with the details of the interaction providing the evidence of internal validity. However, CA studies often analyze data at the micro- and macrolevel simultaneously (Seedhouse, 2004). Indeed, this practice informed the research that documented the systematicity of conversation and its repair (Sacks et al., 1974; Schegloff et al., 1977). This attention to the macrostructure through the aggregation of individual occurrences provides justification for the external validity of research findings. However, Schegloff's warning about quantification must be acknowledged. He notes that premature quantification should not take the place of a fine-grained analysis of individual instances and goes on later to add, "we need to know what the phenomena are, how they are organized, and how they are related to each other as a precondition for cogently bringing methods of quantitative analysis to bear on them" (Schegloff, 1993, p. 114). This caution has been heeded by multiple researchers who, after careful analysis of individual cases, have aggregated the occurrences of patterns for repair to report quantitative findings (Beeke et al., 2011; Beeke et al., 2015; Booth & Swabey, 1999). These researchers and this study centered their internal validity on the systematic nature of conversation and repair and centered their external validity on the aggregation of "frequency counts" that were contextualized as rate of occurrences. As explicated by Saldert et al. (2018), the use of proximal measures, such as conversation trouble source and repair, represents an ecologically valid metric. In fact, CA-based research demonstrates tremendous strength in the applicability of findings to everyday life owing to the naturalistic phenomena, everyday conversation, under investigation (Seedhouse, 2004).

For this reason, we initiated a retrospective analysis of multiple cases for conversation trouble source and repair prior to and following a semester of conversation-based treatment and then submitted the frequency counts to predictive statistics. Therefore, the goal of this research was to discover whether conversation-based treatment results in statistically significant improvement in terms of intersubjectivity and forward progressivity. The specific research questions being:

1. Is there a statistically significant difference in the rate of occurrence for trouble source after a semester of conversation-based treatment?
2. Is there a statistically significant difference in the rate of self-initiation of repair after a semester of conversation-based treatment?
3. Is there a statistically significant difference in the rate of self-completion of repair after a semester of conversation-based treatment?
4. Is there a statistically significant difference in the length of repair sequences after a semester of conversation-based treatment?

Method

Based on the findings of previous research and the recurring pattern of changes to trouble source and repair that emerged for PWAs participating in conversation-based treatment, a retrospective multiple-case study was initiated by the researchers. Conversation is a complex phenomenon, and each participant's conversations required a detailed examination of trouble source and repair within the context of their sequential organization. This necessitated treating the phenomena as context bound for the individual cases and an orientation to case study research (Baxter & Jack, 2008; Yin, 2003). The multiple cases formed a larger, collective exploratory study into the relationship between forward progressivity and the repair of trouble sources (Yin, 2003; Zainal, 2007). Specifically, the detailed qualitative accounts often produced in case studies not only help to explore or describe the data in real-life environments but also "help to explain the complexities of real-life situations which may not be captured through

experimental or survey research" (Zanial, 2007, p. 4). Furthermore, the findings of a single-case study can inform a study of multiple cases as the single case "may be useful in the preliminary stages of an investigation since it provides hypotheses, which may be tested systematically with a larger number of cases" (Abercrombie et al., 1984, p. 34).

This retrospective multiple-case study sought to test the findings of previous qualitative studies that examined the repair of trouble source as part of a language intervention program. Furthermore, the quantification and subsequent comparisons that are often attendant to more experimental designs were carried out for this investigation to test the utility of the proposed measures for making group inferences. As such, this investigation involved reviewing the transcripts of video-recorded conversations that occurred between PWAs and their clinicians before and after 3 months, or 20 group and individual sessions (40 hr), of conversation treatment in a university-based clinic. Participants provided consent, and their identifiable (video) and de-identified data were kept confidential consistent with guidelines set forth for the protection of human subjects (Committee on Revisions to the Common Rule for the Protection of Human Subjects in Research in the Behavioral and Social Sciences et al., 2014).

Case Sampling Strategy

Twenty cases were selected consecutively from PWAs that attended treatment at a university-based clinic. To achieve 20 unique cases, sampling extended over a 5-year period. Participants were excluded if a video record was not available for the transcribed conversation, either pretreatment or posttreatment, or if they had been diagnosed with any complicating physical or psychological condition such as moderate or greater hearing loss or schizophrenia, respectively.

Participant Description

Of the resulting participants, there were 10 men and 10 women who averaged 54 years of age (range: 18–69 years) and were an average of 45 months postonset (range: 4–132 months). The participant's pertinent characteristics are detailed in Table 1.

It is noted that the severity for 18 of the 20 participants was established using the Porch Index of Communicative Ability (Porch, 1981). The remaining two, M. R. and S. S., were assessed using the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983) and the Western Aphasia Battery (Kertesz, 1982), respectively. The Aphasia Quotient for M. R. is reported in place of a Porch Index of Communicative Ability score. The Boston Diagnostic Aphasia Examination does not yield an overall score or percentile. As determined by a standardized test, the severity of the participants was mild (8), mild-to-moderate (4), moderate (8), moderate–severe (1), and severe (1). Although the validity of any classification system for aphasia has been demonstrated to be problematic, the labels utilized serve as shorthand to describe the participant's relative strengths and weaknesses across the categories of fluency, comprehension, expression, and repetition abilities (Davis, 2014). Using this system of classification, the participant's label for aphasia type included anomic (4), Broca's (12), Wernicke's (2), and transcortical motor (2).

Treatment Context

Student-clinicians were trained to elicit and analyze conversations as well as engage in conversation-based treatment through classroom-based instruction (approximately 4 hr) and assigned readings (Chapey, 2001; Damico et al., 2015; Kagan, 1995; Simmons-Mackie et al., 2007; Simmons-Mackie & Damico, 2008) as well as 3 hr of guided video-taped instruction prior to the elicitation, analysis, and treatment of conversation for PWAs. In addition, over the course of one academic semester, the researchers provided feedback with regard to facilitation and documentation of the PWA's conversation behaviors as the clinicians engaged in conversation-based treatment for PWAs. Sessions took place in clinic rooms where the clinician provided writing materials and occasionally artifacts such as magazines or maps. Conversation-based treatment was provided according to Facilitating Authentic Conversation (FAC; Damico et al., 2015) in a contiguous sequence of group and individual treatment sessions, both 50 min in length. Individual sessions of a student-clinician and PWA dyad either preceded or followed the group session. Group treatment sessions were facilitated by a single student-clinician for four to six PWAs.

FAC is a constructivist-oriented treatment that situates clinician mediation within everyday conversation wherein topic and turn-taking patterns are not specified in advance. The focus of treatment is on the reduction of inhibitory conversation behaviors such as abandoning repair or fixating on a single method of repair; it does not focus on the production of specific grammatical forms. FAC targets the increased occurrence of facilitatory behaviors such as the strategic use of gestural and contextual resources. This is accomplished by collecting an authentic "everyday" conversation (Sacks et al., 1974) and analyzing it for trouble sources (a) relating to forward progressivity and intersubjectivity; (b) inhibiting client behaviors, such as abandoning topic or fixation on exact word production; and (c) facilitating client behaviors, such as using alternate modalities and requesting assistance in repair (Wilkinson & Wielaert, 2012). Treatment is planned to reduce inhibiting patterns and increase, or even introduce, facilitating patterns. The clinician accomplishes this through the use of therapeutic techniques that include conversational contingencies, calibrating the use of corrections, positive conversational reactions, and providing bracketed critiques. Conversational contingencies are employed by the clinician in response to an inhibitory conversation behavior and would include routine conversational consequences, such as the need for clarification or repetition. A more overt technique to address inhibiting behaviors is calibrated correction, which occurs along a continuum of subtly, embedded

Table 1. Participant characteristics.

Participant	Age (years)	Gender	MPO	Aphasia type	Aphasia severity	PICA score	PICA percentile
B. D.	34	M	11	Broca	moderate–severe	9.57	36th
M. A.	61	M	4	Broca	mild-to-moderate	12.23	66th
M. N.	37	M	32	Broca	moderate	11.15	53rd
S. Sa	18	F	6	Broca	moderate	11.66	59th
M. R.	67	M	7	Broca	moderate	63.4[a]	—
G. C.	69	F	5	Anomic	mild	13.12	78th
R. Sa.	53	F	476	Anomic	mild	13.95	89th
L. F.	61	M	15	Broca	moderate	11.69	59th
P. D.	56	F	4	Anomic	mild	13.51	83rd
G. L.	62	F	8	Broca	mild-to-moderate	12.59	71st
R. A.	71	M	11	Wernicke	severe	7.7	19th
M. M.	64	F	12	Broca	mild-to-moderate	12.69	72nd
D. D.	64	M	12	Trans. motor	moderate	10.9	50th
B. R.	58	F	3	Trans. motor	moderate	11.74	60th
M. S.	49	M	78	Anomic	mild	13.44	82nd
R. Y.	48	M	132	Broca	moderate	11.24	54th
P. B.	55	F	28	Broca	moderate	11.55	58th
D. M.	59	M	19	Broca	moderate–severe	10.08	41st
R. Sb.	62	F	29	Broca	mild	13.87	88th
S. Sb.	45	F	9	Wernicke	moderate	—	—

Note. Em dashes indicate information not available, see participant description. MPO = months post onset; PICA = Porch Index of Communicative Ability (Porch, 1981); M = male; F = female; Trans. motor = transcortical motor.
[a]Western Aphasia Battery Aphasia Quotient.

correction to overt, exposed correction (Simmons-Mackie & Damico, 2008). Calibrated corrections are carried out by the clinician through multiple channels that include verbal, gestural, tactile, and even body position and gaze. For example, a client who fixates on an exact replacement that results in a protracted noncollaborative repair might elicit a clinician response that employs multiple modalities and becomes increasingly exposed. The clinician's attempt to collaborate in the repair may initiate with gaze aversion to alert PWAs that their behavior inhibits the coconstruction of conversation. If this is unsuccessful, the clinician may then add facial expression, continuing with a body lean, then a discourse marker to attempt to insert a turn at talk, and then culminate in a touch on the hand to physically alert the PWA of the clinician's offer of assistance. Positive conversational reactions are employed to encourage facilitating patterns of conversation, including repair strategies. Clinicians respond to the PWA's use of alternate modalities and repair strategies with more overt demonstrations of alignment, which can include forward body leans, facial displays of interest and affiliation, gestural mirroring, and other-repetition of successful client turns. Bracketed critiques are the most overt of the conversational shaping strategies employed by a clinician and are used to provide specific feedback on facilitative client strategies and sometimes inhibitory patterns. The feedback is inserted briefly, and then the clinician re-establishes the forward progressivity of the conversation. Client instruction in specific facilitating strategies are addressed within three stages of each treatment, which include (a) an initial discussion of conversation patterns in general and the PWA's conversational strategies in particular, (b) the actual conversation where the above strategies and conversation-shaping techniques are modeled and employed, and (c) discussion subsequent to the conversation during which time the PWA reflects on their success and opportunities to apply conversation strategies.

Data Collection and Qualitative Analysis

Employing the ethnographic traditions of CA, the "everyday" conversations between 20 PWAs and their clinician prior to and after a semester of conversation-based treatment were compared for patterns of turn construction and repair. Specifically, we were interested in how often conversation trouble source occurred, the number of turns required to complete the repair, and who was initiating and completing the repair. The transcribed conversations had initially been extracted from conversations of 20 min or greater. As part of standard CA practices, the middle 10 min were transcribed orthographically, and then CA conventions were applied to capture unique features of the talk in addition to alternate communication modalities. The clinicians coded the transcript for the PWA's instances of facilitating and inhibitory behaviors along with trouble source, the number of turns involved in the repair, and who initiated and completed the repair. Across all transcripts, a total of 613 repairs were identified. The coding of repair for trouble source was derived from Ferguson (1994) with codes for who initiated, who repaired, and where in the turn sequence; a complete description of codes for the repair of trouble source can be found in Appendix C. It was amended from Ferguson's model in that the number of turns involved in the repair was also included. For example, a code of "RT4-4" indicated that the repair of a speaker's

trouble source was other-initiated but self-completed, taking four conversational turns for completion. As part of student-clinician training for service delivery, the supervisor and clinician viewed the transcripts and recoded until they reached agreement on coding behaviors. Most instances of nonagreement arose from contextual variables known to the clinician. Therefore, the agreement building sometimes resulted in expanding the transcription to include previously omitted features such as gesture or writing. In order to aid in the interpretation of the CA conventions represented in excerpts, a table of the conventions as advanced by Atkinson and Heritage (1984) appears in Appendix A. Definitions of trouble source and repair, consistent with previous CA literature, were applied across the 40 transcripts to support consistent coding where conversation trouble source was identified with regard to forward progressivity and intersubjectivity (Booth & Swabey, 1999; Savage et al., 2014; Schegloff et al., 1977; Wilkinson, 2015). Trouble sources halted the forward movement of conversation as a next-turn, coconstructed endeavor where each subsequent turn builds upon the next; these included false starts, revisions, and repetitions that did not serve an evaluative or affiliative function. Progressivity forms the foundation for intersubjectivity, where shared understanding is slowly amassed turn-by-turn. Threats to the achievement of intersubjectivity involve the loss of meaning that occurs with word searches, lexical errors, and grammatical errors (Lesser & Milroy, 1993). Determination of self-repair and other-repair involved the attribution of restored intersubjectivity to either the PWA or clinician, respectively (Schegloff et al., 1977). Turns involved in the repair included the initial turn in which the trouble source occurred and continued until the pair appeared to achieve intersubjectivity (Schegloff et al., 1977). Therefore, other-repetition responses produced by the clinician were not included unless there occurred an upward inflection indicating the second form of other-initiation for repair, a partial repeat of the trouble source turn. This criterion was placed because, according to Clark and Schaefer (1989), there is a hierarchy of levels for accepting a repair, including repeating all or part of the presentation or even a lack of acknowledgment, prior to resuming the forward progressivity of the conversation. A coded transcript sample is provided in Table 2 to illustrate this decision-making process.

The transcript in Table 2 represents the orthographic transcription that has been enriched with CA conventions. In the first collaborative repair, the participant P. B. encounters a trouble source, in the form of a semantic paraphasia, when attempting to communicate the volume of medications she is prescribed. She engages in repetition and revision behaviors in an attempt to self-correct, but when she pauses midturn, the clinician offers a candidate repair. This repair attempt is unsuccessful, and P. B. completes her repair via writing, effectively completing the repair in the third position or three turns. By the lack of upward inflection, we can infer that the clinician acknowledges P. B.'s successful repair and uses an expanded other-repetition. P. B.'s next turn at talk also encounters a trouble source, which is identified by her; repair is initiated by her through the use of discourse markers, partner direction in the form of "let me see now," and requests for assistance. P. B. has initiated the repair, and the clinician completes it, with the repair sequence requiring two turns.

Data Extraction and Quantitative Analysis

Similar to the procedure employed in Booth and Swabey (1999), the occurrences of trouble source and its repair were tallied and then divided by the appropriate unit of measure, as follows:

1. dividing the total trouble sources by the total turns to yield the percentage of trouble sources by turn;
2. dividing the total instances of self-initiation by total repairs to yield the percentage of self-initiated repair;
3. dividing the total instances of self-completion by total repairs to yield the percentage of self-completed repair; and
4. dividing the total number of turns involved in a repair by the total of repairs.

The resulting values, recorded for each participant, are reported in Appendix B. The aggregated data were

Table 2. Coded transcript sample.

Client: P. B.	Clinician	Turn	Problem seen	Strategy	Repair type
I'm on some medicine. I'm on some medicine. 3 different kinds, 3. I'm mean I'm-(.)		1	Word finding	Repetition Revision Pause initiates self-repair	
	3?				
(writes 13)		2		Writing completes self-repair	RT3-3
	13 different kinds of medicine				
Yeah Um:, it's um:, How you say it? Let me see now, Um (.) How you call this?		3	Word finding	Conversational markers Partner direction to wait ask for assistance	
	You're talking about your medicine?				RT6-2
Yeah (.) Um:,					

then submitted to statistical analysis using IBM SPSS, Version 24. All data sets were subjected to the assumptions of parametric statistics, including the Shapiro–Wilk test for normality of distribution, the inspection of plots to identify outliers, and Levene's test for homogeneity of variance. When the assumptions were not met, the researcher used the nonparametric equivalent of the paired-samples *t* test (i.e., Wilcoxon rank sum test). Additionally, to prevent an overinflated alpha level, a Bonferroni adjustment was made by dividing the alpha level by the number of comparisons. The application of a Bonferroni adjustment yielded an adjusted alpha level of .0125 (.05/4). Findings from this procedure resulted in four pre- to posttreatment comparisons using paired-samples *t* tests.

Results

When measures of trouble sources and repair were subjected to statistical analysis, the analyses of the rate of trouble source and length of repair sequences were statistically significant. This indicated improvement in the occurrence of conversation trouble source and repair length posttreatment. The result for each measure is reported below, and in keeping with the emic, illustrative tradition of CA, where applicable, the statistical results are accompanied by one or more illustrative excerpts.

Decreased Trouble Sources

The conversations of PWAs and their partners, following conversation treatment, demonstrated fewer PWA-initiated trouble sources in conversation as a function of the proportion of turns. Whereas there occurred a total of 365 troubles sources in pretreatment conversations, there were 248 trouble sources occurring in posttreatment conversations. The rate of PWA-initiated trouble sources was reduced from 0.49 occurrences in pretreatment conversations to 0.32 in posttreatment conversations. The inspection of the plot indicated two outliers; therefore, the results stated are for the Wilcoxon rank sum test. There was a statistically significant difference in the rate of trouble source per turn pretreatment versus posttreatment: $z = -3.180$, $p = .001$, $d = 0.50$. As can be seen in Table 3, participants experienced decreasing occurrences of trouble source in their conversation.

Increased Self-Initiation and Self-Repair

The PWA's initiation of repair was increased from 0.720 for the pretreatment conversation to 0.791 for the posttreatment one. Inspection of the plot indicated three outliers. In addition, the Shapiro–Wilk test indicated that the distribution was not normal ($p < .05$); therefore, the results stated are for the Wilcoxon rank sum test. However, the change pretreatment to posttreatment was not a statistically significant difference: $z = -2.430$, $p = .015$. Similarly, PWAs demonstrated an increased self-completion rate for the posttreatment conversation, escalating from 0.654 to 0.749, but the change was not a statistically significant difference: $t(19) = -2.362$, $p = .029$. The rate of self-initiation and self-repair as a portion of the total repairs is reported in Table 3. The multiplicity of ways trouble sources can be repaired may account for these nonsignificant findings; this will be addressed in the discussion. To provide context for this discussion, examples of the multiple trajectories that repair can take are illustrated in two excerpts. In this section of talk, the PWA and his clinician (C) are discussing hunting trips.

1. C: …but I have killed a hog. We shot him and um he took off.
2. L. F.: Yeah?
3. C: I was terrified. And so um when we finally found him he was dead.
4. L. F.: Yeah?
5. C: He was huge…. I was very excited.
6. →L. F.: Uh Canla- uh Canada um ((*writes 1 5*)) uh 50 arms.
7. C: Wow! 15?
8. L. F.: No.
9. →C: 155?
10. →L. F.: ((nods)) Yeah.
11. →C: The uh points?
12. L. F.: Yeah.

As is characteristic of everyday conversation, the clinician is giving information as much as she is getting information; this distinguishes a conversation from an interview. L. F. demonstrates his interest through producing

Table 3. Trouble source, initiation, completion, and repair length before and after treatment.

Conversation indices	Pretreatment	Posttreatment	Change	*p* = .0125
Total occurrence trouble source	365	248	n/a	n/a
Rate of trouble source	0.49	0.32	↓.17	.001
Rate of PWA self-initiation	0.720	0.791	↑.071	.015
Rate of PWA self-completion	0.654	0.749	↑.095	.029
Repair sequence length	2.33	1.87	↓.46	.002

Note. PWA = person with aphasia; n/a = not applicable.

two occasions of an upward inflected "yeah" as continuers, and this signals his understanding or acceptance of her turn. His use of continuers also encourages her to continue her turn at talk. When L. F. initiates his turn at talk in Line 6, he uses a framing strategy of producing the keyword "Canada." However, owing to his aphasia, he has difficulty producing it and demonstrates the preference for self-initiation and self-correction. He initiates and completes this repair within the same turn, coded as RT1-1. He continues to construct his turn at talk employing writing as a verbal cue, but when there is a mismatch between the written "1 5" and his production of "50 arms," intersubjectivity is compromised. The clinician's next turn, in which she attributed meaning to his written message, makes L. F. aware of the trouble source. Her response is an other-initiation for repair, and similar to repair patterns in nonaphasic conversation, the other-initiation results in a longer repair sequence than is usually seen in self-initiated repair (Schegloff et al., 1977). The two begin the collaborative repair sequence represented in Lines 7 through 10 where L. F. self-completes the repair in the fifth position by answering her second "guess" (Laakso & Klippi, 1999). This is coded as RT4-5. There is an additional repair that has been other-initiated and other-completed in Line 11. However, given the context of discussion where both parties are hunters and the unlikelihood that the animal he was hunting had 155 arms, the lexical target of "points" could be assumed through shared knowledge (Clark, 1996). L. F. may have been orienting to this shared knowledge as part of the principle of least collaborative effort and strategically chose not to self-initiate correction of the semantic paraphasia. He treated the lexical item as understood with intersubjectivity intact and so not a trouble source. In fact, Schegloff et al. (1977) point out that repair can occur without the presence of a trouble source, and this may be the case that would make the clinician's clarification question a dispreferred, "exposed correction" (Simmons-Mackie & Damico, 2008).

In the second excerpt, we see another gentleman, D. D., self-initiating and self-repairing when telling the clinician why he bought a new RV.

1.	D. D.:	//and// now I got the kind you drive so Donna can drive it (.) I don't have to worry about rr– (.)always rr– ((sound effect for lurching vehicle))
2.	C:	Oh no see (.) they have the kind that you can pull on the tr//uck//
3.	→D. D.:	//See// when I got this uh: what you call this? ((motioning toward chest)) uh: (1) heart attack.

The above conversation demonstrates the creative compensations that PWAs will engage in to ensure their listener has understood. In D. D.'s case, he employs sound effects to convey to the clinician that his girlfriend could not drive the pull-behind truck/trailer without lurching. The substitution of a sound effect preempts any trouble source. The clinician demonstrates her understanding with a sequential next turn at talk, so it is not until Turn 3 that a halt to the conversation's forward progressivity is encountered. D. D. self-initiates the repair of this trouble source by asking the clinician "What do you call this?" but signals his intent to self-complete by gesturing toward his heart. This gesture and the linguistic nonfluency "uh" alert the clinician to his preference to self-complete, which, after a 1-s pause, he successfully achieves. The above sequences both illustrate the same preference for self-initiation and self-repair that has been seen in other studies (Beeke et al., 2011; Boles, 1997; Booth & Perkins, 1999; Cunningham & Ward, 2003; Wilkinson & Wielaert, 2012).

Decreasing Length of Repair Sequences

PWAs and their partners demonstrated reduced length for repair sequences, with an average repair sequence length of 2.33 for pretreatment conversations and 1.87 for posttreatment conversations. Comparisons were made using a paired-samples *t* test; however, the assumptions of the model were not met. The assumption of normal distribution was not met, and there were two outliers. The dyads of B. D. and S. Sb. demonstrated reduced length of repair by 3.58 and 1.33 turns, respectively. These outliers were removed, and under this condition, the assumption of normality and no outliers was met. The remaining 18 cases were reanalyzed with the paired-samples *t* tests. Statistically significant differences were noted for the number of turns to complete repairs, $t(17) = 3.621$, $p = .002$, $d = 0.26$. There was a statistically significant difference between pre- and postconversation treatments. In order to further verify these results, all 20 cases were compared using the nonparametric equivalent of the paired-samples *t* test, that is, the Wilcoxon rank sum test. The results again yielded a statistically significant difference ($z = 3.136$, $p = .002$). The average number of turns to complete a repair from pre- and posttreatment conversations is represented in Table 3.

A single excerpt of conversation will not illustrate the change in the number of turns that were involved in repair sequences. However, the following segment of pretreatment conversation illustrates that, unlike repair sequences in conversation between unimpaired individuals as explored by Sacks et al. (1974), the trouble sources in aphasic conversation often result in protracted repair sequences. If conversation partners orient to forward progressivity, then decreasing repair sequence length is a positive achievement to that end. In the conversation below, we revisit D. D. and his clinician discussing a common topic of conversation, camping in an RV. D. D. is telling his clinician where he hopes to travel next.

1.	→D. D.:	//There's a place// back Lafayette umm nice one too. Can't remember the name of it.
2.	C:	KOA?
3.	→D. D.:	Nuh-uh Its just 2– 2– uh (.) 2–3 hr ago (.) they opened it up (.) what was iz name (.) huh I'd have to look at it.

4. C: It's in Lafayette?
5. →D. D.: No. uh (.) the other side of Baton–UH (.) Abbeville.
6. C: Huh. I'm not sure which one that is.
7. D. D.: Between Abbeville and uh (3) there's a name ((unintelligible)) to find–to find it (1) but it's–it's uh (.) it's a nice place too.
8. →C: It's nice? Well you know they opened up one. Is it in Henderson? Umm. Cajun Palms, maybe?
9. D. D.: Cajun Palms Yea.

D. D. and his clinician have been recounting several places close to town where they have been RV camping with their families. When D. D. attempts to tell his clinician about a new campground, he experiences difficulty with either recall or lexical retrieval and self-initiates the repair, asking the clinician to assist, through the phrase "can't remember the name of it." This begins the "hint and guess" sequence (Laakso & Klippi, 1999), which continues for nine turns until the clinician provides the repair, other-completed, with "Cajun Palms," coded as RT6-9. D. D. then accepts her repair with a repetition followed by an acknowledgment token (Clark & Schaefer, 1989; Milroy & Perkins, 1992). This excerpt provides a wonderful example of the "messy" nature of trouble source and repair, with trouble sources arising during the repair sequence. Frequently, conversation is halted by repairs within repairs where the dyad must orient to the business of repair within the business of repair in order to resume forward progressivity. This occurs in Line 5 during which time D. D. is attempting to repair the initial trouble source through circumlocution, providing the location of the campground. The referent of Baton Rouge is in error, and he quickly substitutes the town of Abbeville, which remains an error in word replacement (Schegloff et al., 1977). The clinician repairs both the original trouble source and this embedded trouble source with an "embedded correction" (Simmons-Mackie & Damico, 2008). The self-initiated and other-completed repair for this second trouble source requires four turns to complete, coded as RT6-4.

The significant findings of trouble source and repair sequence length stand in contrast with the nonsignificant findings of self-initiation and self-repair. The above excerpts and their explication illustrate why who initiates and who repairs may not be sensitive indices for an event that is coconstructed. In the following section, these findings will be discussed in greater detail.

Discussion

This research was motivated by previous research and the frequent calls for ecologically valid methods for documenting the outcome of conversation-based treatment from aphasiologists (Beeke et al., 2011; Blom et al., 2013; Damico et al., 2015; Saldert et al., 2018; Savage et al., 2014; Simmons-Mackie et al., 2014; Wilkinson, 2015). Perhaps the strongest call came from Wilkinson and Wielaert (2012), who, in their conclusion, stated, "Future studies should move beyond single case designs, include more robust, quantifiable evidence of change" (p. S70). This research is an attempt to promote the priorities of PWAs who report the desire "to reduce communication breakdown and stress… and to be able to communicate independently and be understood by others" (Wallace et al., 2017, p. 1370). This is not the first study of conversation that has analyzed CA-based outcomes in a quantifiable fashion, applying inferential statistics (Beeke et al., 2015; Booth & Swabey, 1999; Cunningham & Ward, 2003; Crockford & Lesser, 1994). To the authors' knowledge, however, it is the largest study of CA-based measures for trouble source and repair that has been submitted to inferential statistics. There is a compelling reason for this. As an ethnomethodology, CA has traditionally focused on an emic perspective, contextualizing interaction through the microstructure of conversation. Many researchers are hesitant to employ quantification with regard to CA due to the complex and context-bound nature of everyday conversation. However, Saldert et al. (2018) referenced conversation behaviors that carried meaning tied to a context and not the turn-taking structure of the interaction. They went on to indicate that "the validity of frequency counts is dependent upon the reliability of the measure, which in turn depends on how well the target behaviors are defined" (Saldert et al., 2018, p. 12). Beeke et al. (2011) asserted the value of frequency accounts when they stated, "By counting behaviors that are firmly rooted in the turn-by-turn sequential structure of an interaction, we are attempting to address the issues of validity and in the quantification of conversation over time" (p. 227).

CA has been ascribed the "twin features of being context-free and capable of extraordinary context sensitivity" (Sacks et al., 1974, p. 699). The use of inferential statistics in the verification of turn-taking and repair practices seems less implausible given the context-free aspect of Sacks et al.'s (1974) definition. It is with reference to these features that patterns of trouble source and repair were analyzed at the micro- and macrolevel simultaneously in an attempt to provide a generalizable description of these patterns (Seedhouse, 2004). The employment of CA to identify the initial patterns of trouble source and repair defines the target "behavior." The employment of frequency counts for well-defined behaviors and across multiple participants, as well as the significant findings, demonstrates the external validity for those measures reaching significance.

The findings, namely, that changes in the rate of trouble source and the length of repair were significant whereas the pattern of repair initiation and repair completion were not, seems to support these issues of target behavior selection and the importance of a proximal outcome measure that will be sensitive to actual change but remain stable across dynamic events. It has been well documented that trouble sources occur at a greater rate in conversations among PWAs and that conversation treatment of the caregiver, the dyad, or the PWA results in reduced trouble source (Beeke et al., 2015; Boles, 1997; Booth & Perkins,

1999; Crockford & Lesser, 1994; Damico et al., 2015; Lock et al., 2001; Savage et al., 2014; Tuomenoksa et al., 2016). The significant changes in the rate of trouble source and the length of repair can be influenced by a myriad of conversational forces including (a) improved linguistic capacity and/or improved compensatory ability within the PWA, (b) improved facilitation abilities in the conversation partner, (c) the presence of environmental resources, (d) increasing familiarity, and—related to this—(e) increasing shared knowledge. Therefore, the decreases in the rate of trouble source and repair length can indicate only that conversation-based treatment results in coconstructed conversations that are more efficient and more closely approach the desired forward progressivity that is observed in nonaphasic conversation. These findings also indicate a reduction in the loss of intersubjectivity that would require repair, but they can make no claims as to the amount of conversational work carried out by the PWA versus the conversation partner to preempt repairs or to complete them. This is evident by the nonsignificant findings for self-initiation and self-repair. Whereas the sequential implicature of turn-taking within a conversation forms a more obligatory action, the repair of a trouble source is optional with persons often treating trouble sources as shared knowledge, as in the conversation between L. F. and his clinician. Furthermore, a multitude of strategies for repair exist with regard to who initiates and who completes the repair (Ferguson, 1998). Previous research has presented mixed findings with Boles (1997) reporting an increased rate of self-repair per minute and Cunningham and Ward (2003) reporting increased self-initiation for three out of four dyads. As was seen in the conversation excerpts, the PWAs with aphasia would often choose to leave a trouble source unrepaired and they made choices as to who would complete the repair. Orienting to the principle of least collaborative effort, the PWAs would often request assistance (RT6) from the conversation partner who they believed had access to either the information or linguistic capacity necessary to complete the repair. They sacrificed autonomy for expediency in the repair. The optional repair strategies and their trajectories made in response to trouble sources are too varied to be captured by a single metric. Therefore, looking at the dyad as a unit appears a more appropriate unit of analysis. Measuring their collaboration to preempt trouble sources and efficiently repair them satisfies the need for a proximal, ecologically valid measure that can be applied across multiple dyads to achieve external validity. This was the finding of Beeke et al. (2011), who stated that one cannot "separate out the effects of therapy on the behaviors of the person with aphasia and the conversation partner, as the sequential nature of turn-taking in conversation means that they are inextricably intertwined."

When considering collaborative repair, great care must be taken when drawing conclusions. The importance of the clinician on the authenticity of conversation and the changes that can occur in a dyad cannot be discounted. However, the consistency of these patterns to the level of statistical significance as well as the qualitative evidence from previous studies support the utility of trouble source rate and length of repair in conversation as tools for measuring improvement at both a local explanatory level and at a statistically significant level.

Implications of Findings

The use of these measures for treatment decisions and demonstration of treatment efficacy aligns well and proximally with conversation-based treatment in that the measure directly relates to the phenomena of interest (Saldert et al., 2018). The evidence from this study provides further support to the excellent body of qualitative research that points to conversation-based treatment as a socially valid therapy for the rehabilitation of communication for PWAs. Additionally, it supports the use of select CA-based measures to demonstrate the efficacy of this treatment.

Limitations of Findings

This study was an initial investigation into the utility of CA measures of trouble source and repair as a reliable measure of conversation change. Limitations in the ability to generalize these findings exist in the form of the sample, the dynamic nature of conversation, and additional unforeseen influences. However, treatment methodology and philosophy were controlled as much as possible through training of clinicians, consistency of supervision and setting, and adherence to a well-defined treatment protocol. This sample contained a large representation of PWAs of mild and mild-to-moderate severity. It is possible that the inclusion of more severe PWAs would not yield the same results because the interaction between the capacity of linguistic, social, and pragmatic resources available to PWAs and their conversation abilities is not established. It is possible that milder severity level relates to greater linguistic resources that can be employed for decreasing repair sequence length. Additionally, because conversation is a locally and collaboratively constructed interaction that is shaped by topic and external variables, issues such as the actions of the conversation partner, time pressure, or environmental distractions that could occur in conversations might yield differing results. Related to this, measures of conversation were taken at a single time pretreatment and posttreatment, which makes the results more vulnerable to the aforementioned influences. The study would be improved by taking multiple measures before and after treatment, as well as measures taken at a midpoint. Lastly, coding by another researcher not associated with this investigation would improve the reliability of these findings. These limitations should be considered when drawing conclusions and the application of findings.

Future Research

The cautions addressed in the above discussion provide an agenda for future research. To improve the strength of these findings through a measure of interrater reliability, a portion of transcripts should be coded by a researcher that

is well versed in CA but not associated with this investigation. Future investigations of these data should analyze the changes in repair patterns by the partner and the dyad as a whole, examining partner conversation behaviors in relation to the changes in conversation for the PWA. Exploring the conversations between PWAs and varied conversation partners would further contribute to a growing body of research for CA-based measures that may be valid indices of conversation improvement. To ensure the reported indices are truly ecologically valid, ratings of conversation satisfaction should accompany each conversation sample. Additional large sample studies through either multiple-case study design, randomized controlled studies, or meta-analyses should be pursued toward the development of outcome measures that will provide a reliable and valid indicator of a PWA's or a PWA–partner dyad's conversation ability.

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Appendix A

CA Transcription Notation, Based on Atkinson and Heritage (1984)

1) Notations referencing timing of utterances:

[ ]	Simultaneous or overlapping utterances
=	Contiguous utterances where latching occurs
//	interruption of another's utterance in progress
(.)	A fleeting pause between or within an utterance, less than one second
(2)	A pause of specified length between or within an utterance

2) Characteristics of speech delivery

:	colon indicates the extension of a sound or syllable, as in No:::::
.	period indicates a stopping fall in tone, not the end of a sentence
,	coma indicates continuing intonation, not clausal delineation
?	question mark indicates rising inflection, not necessarily a question
?,	combined, the above indicate rising intonation weaker than ? alone
!	exclamation point indicates an animated tone, not always exclamation
-	dash indicates an abrupt cutoff or, in multiples, a stammering quality
↑ ↓	marked rising or falling intonation placed immediately prior to event
° °	degree signs bracket passages of talk quieter than surrounding talk
hhh	audible aspirations/exhalations
•hhh	audbile inhalations
(( ))	double parentheses bracket descriptions of events not easily transcribed as well as descriptions of gestures, facial expression, and gaze trajectory

3) Other transcript symbols:

→	right facing arrow indicates the feature(s) of interest in a segment of transcribed conversation
…	horizontal ellipsis indicates that an utterance is being reported only in part, with additional speech coming before, in the middle of, or after the reported fragment.

Appendix B

Pre- and Posttreatment Values of Turns, Trouble Sources, Repair Initiations, Repair Completions, and Lengths of Repair for Each Participant

PWA	Preturns	Posttotal turns	Pretrouble source	Posttrouble source	Diff. trouble source	Pre-initiation repair	Post-initiation repair	Diff. initiation repair	Precomplete repair	Postcomplete repair	Diff. self-repair	Prerepair length	Postrepair length	Diff. repair length
B. D.	109.00	134.78	0.12	0.07	0.05	0.77	0.78	0.01	0.77	0.89	0.12	9.23	5.65	3.58
M. A.	26.03	45.00	0.31	0.04	0.26	1.00	1.00	0.00	0.88	1.00	0.13	1.125	1	0.125
M. N.	46.21	36.13	0.17	0.14	0.03	0.63	1.00	0.38	0.50	0.60	0.10	2.42	1.8	0.62
S. Sa.	52.24	45.00	0.19	0.27	–0.08	0.90	0.92	0.02	0.80	0.92	0.12	1.25	1.08	0.17
M. R.	51.12	49.18	0.41	0.47	–0.06	0.71	0.74	0.02	0.67	0.74	0.07	1.64	1.17	0.47
G. C.	39.04	40.00	0.28	0.05	0.23	0.73	1.00	0.27	0.64	1.00	0.36	1.875	1.33	0.545
R. Sa.	29.02	35.00	0.21	0.17	0.04	0.67	0.67	0.00	0.50	0.83	0.33	1.16	1	0.16
L. F.	51.26	53.06	0.23	0.02	0.22	0.50	0.00	–0.50	0.42	0.00	–0.42	2	2	0
P. D.	64.00	32.00	0.22	0.16	0.06	0.71	0.80	0.09	0.71	0.80	0.09	1.2	1	0.2
G. L.	34.04	26.01	1.00	0.88	0.11	0.53	0.48	–0.05	0.35	0.43	0.08	1.55	1.4	0.15
R. A.	69.31	61.07	0.22	0.31	–0.09	0.67	0.84	0.18	0.80	0.79	–0.01	2.16	1.52	0.64
M. M.	32.06	35.03	0.56	0.20	0.36	1.00	1.00	0.00	1.00	1.00	0.00	1	1	0
D. D.	80.00	43.13	0.28	0.16	0.11	1.00	1.00	0.00	0.77	0.86	0.08	1.86	1.42	0.44
B. R.	38.10	40.00	0.58	0.40	0.18	0.68	0.81	0.13	0.55	0.44	–0.11	2.11	2.33	–0.22
M. S.	44.22	24.52	0.54	0.45	0.09	0.96	1.00	0.04	0.96	1.00	0.04	1.2	1.07	0.13
R. Y.	83.19	40.87	0.25	0.24	0.01	0.33	0.90	0.57	0.52	0.90	0.38	3.93	3.22	0.71
P. B.	47.18	59.21	0.53	0.22	0.31	0.68	0.77	0.09	0.56	0.54	–0.02	2.45	2.58	–0.13
D. M.	54.05	54.03	0.24	0.19	0.06	0.54	0.60	0.06	0.54	0.80	0.26	4.16	4	0.16
R. Sb.	24.02	34.10	1.62	1.06	0.57	0.92	0.94	0.02	0.92	0.94	0.02	1.03	1	0.03
S. Sb.	15.77	33.65	1.84	0.92	0.92	0.48	0.58	0.10	0.24	0.52	0.27	3.2	1.87	1.33

Note. PWA = person with aphasia; diff. = difference.

Appendix C

Description of Coding for Repair of Trouble Source

Codes	Pattern of repair
RT1	Self-initiated, self-completed within the same turn.
RT2	Self-initiated, self-completed within the transition space.
RT3	Self-initiated with self-completion at a later turn in the repair sequence.
RT4	Other-initiated with self-completion at a later turn in the repair sequence. This often appears as a request for clarification or prompt by the partner.
RT5	Other-initiated with other-completion at a later turn in the repair sequence. This often appears as a correction by the partner.
RT6	Self-initiated with other repair at a later turn in the repair sequence. This often appears as a request for assistance.
–#	The number of turns from trouble source to repair completion.