Studies of discourse in individuals with compromised brain functioning offers a method for testing the interaction of multiple cognitive process involved in the production of discourse (Glosser, 1993). More importantly, an analysis of narrative discourse after stroke will provide additional insights into the manner in which cognitive-linguistic processes involved in language are impacted after sustaining a stroke. Therefore, we hypothesize that cohesion or the linkage of meaning among sentences may be influenced following stroke even in the absence of overt language disorders. Subsequently, this subtle influence on expressive language may reduce a speaker's communicative effectiveness as a minimal decrease in the use of cohesive ties could dramatically alter the meaning and clarity of discourse produced. In addition, speakers may exhibit difficulties in their ability to consistently convey information in a complete, concise and clear manner.

Cohesion analysis may be an alternate method to evaluate the natural changes in language following stroke. Disruptions in the use of cohesive markers can be evaluated across time as individuals who have suffered a stroke recover. To date there are no known studies evaluating the changes in cohesion following stroke in individuals with minor language disruptions in the absence of diagnosed language impairment. Our aim is to evaluate the use of cohesive ties and determine if the consistency and adequacy of the use of ties is influenced by stroke. Our research questions are as follows:

1. Do speakers without diagnosed language disorders demonstrate changes in the use and/or adequacy of cohesive ties in their post-stroke narrative discourse?
2. Given that a change in the use or adequacy of cohesive ties exists, what is nature or these changes and how does it change through time?

Method

Participants

13 subjects with left hemisphere stroke were included in the study. Left hemisphere stroke was defined as primarily cortical and/or subcortical involvement. Subjects with sub-cortical infarcts were included in this analysis of language, as recent studies have concluded that cortical involvement typically coexists with strokes primarily identified as subcortical (Han, Kang, Base, Oh, Jeong, & Roh, 2003; Hillis, Wityk, Barker, Beauchamp, Gailloud, Murphy, Cooper, Metter, 2002; Hillis, Barker, Wityk, Aldrich, Restrepo, Breese, & Work, 2004; Nadeau & Crosson, 1997; Radonnovic & Scaff, 2003; Weiller, Willmes, Reiche, Thorn, Isensee, Buell, & Ringelstein, 1993).

Procedure

Language samples were obtained from qualitative interviews completed as part of the larger study of stroke recovery and caregiving after discharge home (Rittman, 2001). To obtain the language samples used for analysis in this study, 5-minute samples were selected from each of the three qualitative interviews (1, 6, 12 months). Data for the language analysis was obtained from answers to the following question: "What is a typical day like for you?"

Communication unit segmentation and productivity analysis

Each five-minute sample was divided into communication units. A communication unit was defined as shortest allowable independent clause and any related dependent clauses (Hunt, 1965). The discourse samples were segmented into communication units primarily by syntax, however prosodic and semantic features were used at times when the unit could not be determined entirely by syntax (Glosser, 1993). After the communication units were identified, the total number of communication units was calculated for each participant.

Cohesion analysis

Each communication unit was evaluated for use of cohesive markers. Cohesive markers within three categories (Reference, Conjunction, and Lexical) as defined by Liles (1985) were identified. Each cohesive marker was circled in the specified transcript. Following identification of cohesive markers, each was judged for the adequacy of its cohesive tie. Cohesive ties were specified as complete, incomplete or erroneous as defined by the Liles (1985) procedure. Cohesive ties were judged complete when the referent could be easily found in the preceding discourse. Incomplete ties were defined as cohesive marker in which the referent could not be identified in the discourse or not evident in the context. Erroneous ties were judged as such when multiple referents could be identified in the discourse therefore making the marker ambiguous. The number of ties in each sample and the percentage of complete ties in each narrative sample were calculated.

Results

Communication Units

Group means and standard deviations are summarized in Table 1. A repeated measures analysis of variance (ANOVA) completed to evaluate the total number of communication units produced with time post-onset (1, 6, and 12 months) indicated that subjects did not exhibit a significant difference in the total number of communication units produced $F(2, 24) = 2.07$, $p=.148$ at the specified times post stroke onset. The means of the total number of communication units are displayed in Figure 1.

Cohesion

Group means and standard deviations for the total number of cohesive ties and the percent cohesive ties are summarized in Table 1. Two separate repeated measures ANOVA were used to evaluate the total number of cohesive ties and the percent complete cohesive ties produced with time post-onset (1, 6, and 12 months) as the within-subjects factor indicated that subjects did not exhibit significant differences in the total number of cohesive ties at 1, 6, and 12 months $F(2, 24) =.786$, $p=.467$. Subjects exhibited a difference in the percent complete cohesive ties $F(2, 24) = 4.837$, $p=.01$. Planned pairwise comparisons indicated significant differences between 1 and 12 months $p=.008$. Subjects had a higher percentage of complete cohesive ties at 12 months compared to 1 month. The means of total number of cohesive ties and percent complete cohesive ties for each time period are displayed in Figures 2 and 3.

Discussion

In this study we observed that as individuals progressed from one month to twelve months post-stroke, a statistically significant increase in the percentage use of complete cohesive ties was evident. This occurred in the presence of no significant changes in the number of communication units produced or total number of cohesive ties used. In addition, the percentage distribution of each type of cohesive tie (reference, conjunction, lexical) generally remained constant across time (Figure 4).

A review of all incomplete and erroneous ties revealed that the majority was of the reference type. Reference ties direct the listener to the identity of thing or class of things that the reference tie is being referred. The cohesiveness then occurs in the continuity of the specified reference (Halliday & Hansen, 1976). Ulatowska, Allard, & Chapman (1990) suggests that reference is significantly important to discourse as it connects lower and higher levels of language and that a disruption in reference words such as pronouns may result in impaired discourse. Further, they note that reference is particularly susceptible to disruption due to the complexity of the reference system.

Individuals without diagnosed language disorders oftentimes struggle with communicative effectiveness in the presence of fluent expressive output. These findings suggest that while they may exhibit fluent output, the cohesiveness of their thoughts may be decreased thus signaling a less obvious language disruption. As a result the listener is left with inadequate or incomplete information that he has to either request or attempt to infer to complete his understanding of the information presented. In conclusion, our ability to more clearly identify the influences of stroke on language will improve our understanding of language disruption and recovery. Further, we will be able to develop treatments for individuals with subtle disruptions of discourse production.

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Measure	1 month	6 months	12 months
Mean number of communication units	51 (12.3)	50 (19)	45 (13.9)
Mean number of cohesive ties	77 (26.6)	75 (40.1)	70 (33.5)
Percent complete cohesive ties	90% (7)	93% (6)	97% (3)

Table 1. Mean values for communication units, cohesive ties, and percent complete cohesive ties. Standard deviations are in parenthesis.

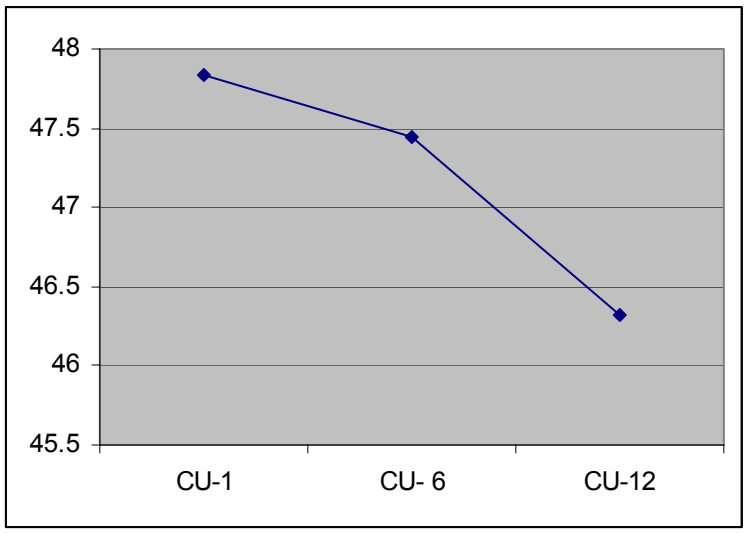

Figure 1. Mean number of communication units at 1, 6 and 12 months

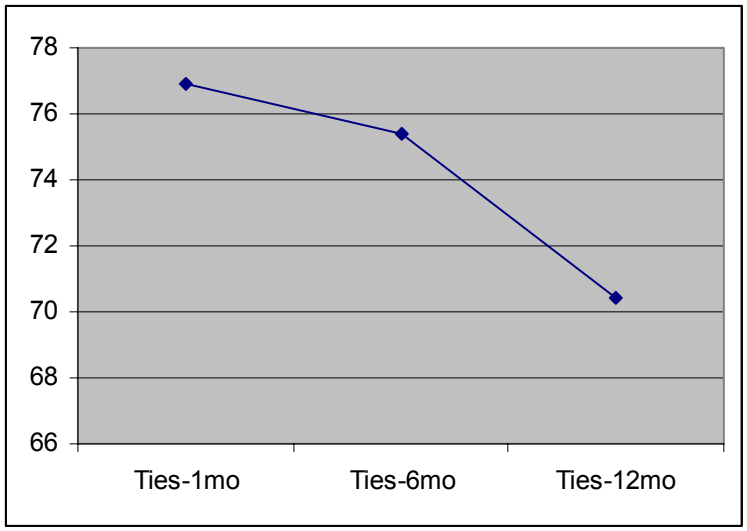

Figure 2. Mean number of cohesive ties at 1, 6 and 12 months

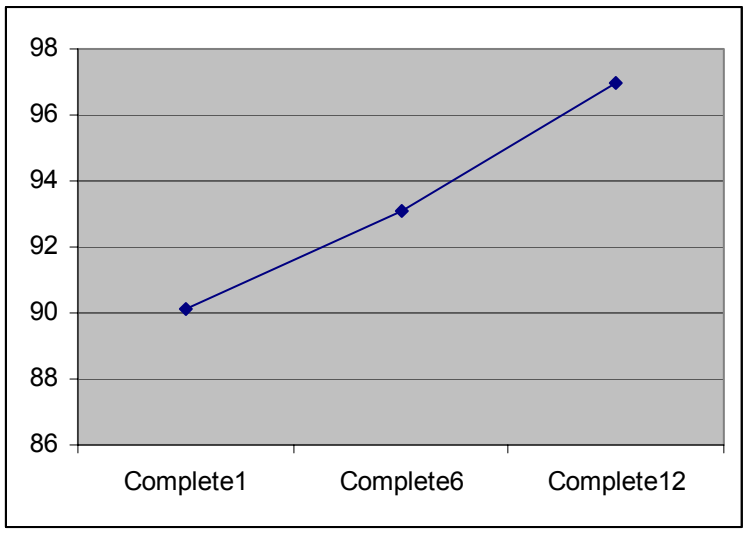

Figure 3. Mean percent complete ties at 1, 6, 12 months

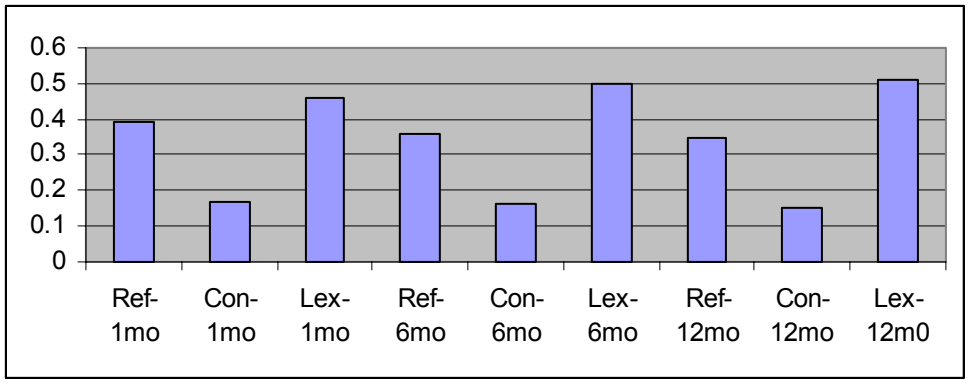

Figure 4. Percentage distribution of all cohesive ties at 1, 6 and 12 months