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Cohesion in the discourse of people with post-stroke aphasia

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ABSTRACT

Aphasic discourse has been investigated through two major approaches: a micro-linguistic approach and a macro one, but the separate analysis of the micro and macro aspects of aphasic discourse has led to a noticeable gap between them. Cohesion analysis is one of the possible ways that can directly connect these two aspects. However, few studies have investigated cohesion in aphasic discourse in an integrated manner. The present study employs a mixed-methods approach to examine whether and how patients with fluent and non-fluent stroke-induced aphasia differ from normal individuals in the cohesion of their discourse, aiming to provide a more comprehensive understanding of this issue. We compared the use of cohesive devices in the discourse of 7 non-fluent aphasics (4 males, mean age = 70.9) and 9 fluent aphasics (4 males, mean age = 70.7) against 16 non-aphasic controls (NACs) (8 males, mean age = 71.0). Transcripts were analysed and conclusions were drawn based on the combination of quantitative and qualitative observations. As predicted, discourse by aphasic participants is less cohesive than that by non-aphasic participants and the three groups' discourse differs from each other in the distribution of cohesion categories, with non-fluent aphasics having more trouble in using grammatical cohesive devices while fluent aphasics more severely affected in constructing lexical cohesion. Results suggest that cohesion in post-stroke aphasic discourse may vary between different aphasia types and thus can be rather complicated. Additional work involving more aphasia types and more dimensions of discourse cohesion is needed to provide further insight into this question.

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Introduction

Aphasia is a type of language disorder that poses serious obstacles to patients' daily life, especially their social communication. Stroke is found to be a major cause of this disease and it is estimated that 30% of stroke survivors develop aphasia after their stroke (Sekine, Rose, Foster, Attard, & Lanyon, 2013). Abundant linguistic research has been conducted for a better understanding of post-stroke aphasics' language performance, with the hope of providing insight into their rehabilitation. However, traditional linguistic studies on aphasia usually focused on patients' ability to process language components below the sentence level without any context given. Regarding language use in social situations as external to the language system (Armstrong, 2005), these studies failed to give due consideration to the connection between language use and its contexts. In recent times,

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researchers have been attaching more importance to the way language in use is structured above the sentence level (Bryant, Ferguson, & Spencer, 2016) and started to shift their focus to aphasic discourse. With the purpose of extending existing studies following this line of research, the present study probed into the discourse of post-stroke aphasic patients, with a special focus on its cohesion.

Linguistic characteristics of aphasic discourse

Two major approaches have been taken to analyse the linguistic characteristics of aphasic discourse, i.e., a micro-linguistic and a macro-linguistic approach. Studies from a micro-linguistic perspective have analysed samples of aphasic discourse in terms of ‘different levels of constituency’ (Armstrong, 2000), mainly focusing on lexical and syntactic aspects of aphasic discourse. The lexical aspect has been explored from both a semantic perspective (Kiran & Thompson, 2003; Schnur, Schwartz, Brecher, & Hodgson, 2006; Vermeulen, Bastiaanse, & van Wageningen, 1989) and a grammatical one (Bates & Goodman, 2013; Kim & Thompson, 2000; Shapiro, Shelton, & Caramazza, 2000). Research from the semantic perspective has discovered and well-documented word-finding difficulties and naming disturbances in adult aphasic discourse (Dressler & Pleh, 1988; Larfeuil & Dorze, 1997; Williams & Canter, 1981). Studies from the grammatical perspective have examined word classes preferred by aphasic language users, indicating that nouns are used more often than verbs in the discourse of agrammatic aphasics, while the reverse has been observed among fluent aphasics (Bates, Chen, Tzeng, Li, & Opie, 1991; Hillis, Oh, & Ken, 2004). There has also been abundant research reporting that aphasic speakers tend to use less closed class words and to omit determiners frequently (Friederici, 1982; Hofstede, 1992; Ruigendijk & Bastiaanse, 2002). Syntactic features of aphasic discourse have been investigated in terms of syntactic complexity, syntactic accuracy, and clausal structure (Bird & Franklin, 1996; Schwartz, Saffran, Bloch, & Dell, 1994; Thompson & Shapiro, 2007; Thompson, Shapiro, Kiran, & Sobecks, 2003). On average, agrammatic aphasics have been found to form fewer syntactically complex sentences. The clauses they produce tend to be shorter and grammatically simpler than those created by normal speakers. Studies have also identified that in aphasic discourse, grammatical errors occur more frequently, with verbs used with simpler argument structures and grammatical structures such as clause subject or inflections omitted to different degrees (Braber, Patterson, Ellis, & Ralph, 2005; Kolk & Heeschen, 1992; Prins & Bastiaanse, 2004; Thompson, Shapiro, Li, & Schendel, 1995).

Studies from a macro-linguistic perspective have focused on the overall meaning of a piece of text and the way meanings are organized within the text. With this approach, three aspects of text macrostructure have been investigated, viz., functional communication, specific interactive phenomena, and efficiency of language (Armstrong, 2000). Research on aphasic patients’ functional communication has found that although micro-structural linguistic errors have frequently been observed at the clause level, aphasic patients, especially those with mild and moderate impairment, can manage to convey meanings successfully (Coelho & Flewellyn, 2003; Holland, 1982; Ulatowska, Freedman-Stern, Doyel, Macaluso-Haynes, & North, 1983). Likewise, studies on specific interactive phenomena in conversation between aphasic speakers and their conversational partners have also demonstrated that despite the errors in lexicogrammatical form, aphasic

language users still retain the ability to repair conversation and to employ various types of turn-taking such as substantive and management moves (Ferguson, 1994; Penn, Frankel, Watermeyer, & Russell, 2010; Ulatowska, Allard, Reyes, Ford, & Chapman, 1992). As for the efficiency of language, the amount of information aphasic speakers conveyed has been estimated through measurements such as ‘correct information units’ and ‘main concepts’, with results suggesting that aphasic speakers generally produce less key information than normal speakers (Gordon, 2008; Kong, 2009; Nicholas & Brookshire, 1993).

While there has been a considerable amount of literature exploring the micro- and macrostructure of aphasic discourse, the two aspects have usually been examined separately and less is known about the links between them. Results from the separate examination of these two aspects seem to suggest that breakdowns at the lexical and syntactic level might have little impact on the macrostructure of aphasic discourse (Armstrong, 2000; Korpijaakko-Huuhka, 2008). This could lead us to the conclusion that micro- and macro-linguistic aspects of aphasic language might, to a certain extent, be independent of each other. Researchers have had mixed opinions on this issue, either supporting this hypothesis or querying it (Cahana-Amitay & Jenkins, 2018; Christiansen, 1995; Glosser & Deser, 1991; Huber, 1990; Ulatowska et al., 1983). In order to address this question, further analysis linking the two aspects of aphasic language is of prime significance (Armstrong, 2000; Marini, Andretta, Del Tin, & Carlomagno, 2011). The present study is a preliminary attempt to evaluate the links by looking at the cohesion in aphasic discourse.

Cohesion deficits in aphasic discourse

As Armstrong (2000) highlights, cohesion analysis is one of the possible ways that can directly connect the micro- and macro-linguistic aspects of aphasic discourse. In a piece of discourse, connections between clauses are crucial to its coherence, and the arrangement of clauses is as important as the content of each individual clause. Instead of focusing on words and phrases in isolation, cohesion analysis presupposes that words within a piece of text rely on the other words in the same text for interpretation. It examines the linguistic connections between clauses and in so doing explores both grammatical and semantic coherence across the discourse. Regarding aphasic discourse, cohesion analysis looks at the impact aphasic speakers’ microstructural linguistic breakdowns can have on their ability to construct text and convey meanings coherently. Therefore, analysis of aphasic discourse cohesion can bridge the gap between research solely from a micro- or a macro-linguistic perspective and thus may illuminate aphasic patients’ use of language.

The existing literature has revealed significant cohesion deficits in aphasic discourse. Aphasic patients often fail to use cohesive devices properly and the cohesive ties they create tend to be disruptive. In terms of grammatical devices, reference items are often used without antecedents (Cummings, 2019; Dressler & Pleh, 1988; Penn, 1987), and the definite article is frequently used in a wrong way, with the lexical item following it never mentioned previously (Armstrong, 2000; Menn, 2009). Research on lexical cohesion is relatively less but has discovered a restricted variety in aphasic patients’ employment of lexical cohesive devices (Harris Wright, Silverman, & Newhoff, 2003; Jaecks, Hielscher-Fastabend, & Stenneken, 2012). Studies on the narrative organization of aphasic patients have observed a greater amount of cohesion errors as well as local and global coherence errors in their discourse (Andretta, Cantagallo, & Marini, 2012; Andretta & Marini,

2015), and analysis on cohesive harmony has identified reduced interaction between cohesive elements within aphasic text (Armstrong, 1987; Bottenberg, Lemme, & Hedberg, 1985). A few studies, but not many, have specifically focused on the quantity of cohesion and the distribution of cohesion categories in aphasic discourse. These studies have all identified a significant decline in the quantity of cohesion in aphasic discourse (Behrns & Ahlsén, 2012; Glosser & Deser, 1991; Lock & Armstrong, 1997; Marini et al., 2011) but discrepancies have been reported between findings on aphasic speakers' employment of different cohesive devices (Behrns & Ahlsén, 2012; Lock & Armstrong, 1997; Piehler & Holland, 1984). Piehler and Holland (1984), and Lock and Armstrong (1997) held that aphasic speakers employed various categories of cohesive devices in a pattern quite distinct from normal speakers while Behrns and Ahlsén (2012) argued that aphasic participants produced narratives with diverse cohesive ties whose patterns were similar to those of normal participants. Apart from the discrepant findings, certain imperfections concerning participants and statistical analysis methods exist in previous research. A majority of existing studies did not have a balanced gender distribution of their participants (Andreetta et al., 2012; Behrns & Ahlsén, 2012; Lemme, Hedberg, & Bottenberg, 1984), and quite a few failed to attain a one-to-one match between participants in different groups in terms of age, gender, and other factors that might affect results. Besides, most of the studies did not take into consideration participants' aphasia types, paying little attention to the comparison between fluent and non-fluent aphasic participants. Some of the studies also showed inadequacies in the employment of statistical analysis methods. It seems that the research by Behrns and Ahlsén (2012) did not refer to any statistical method to examine the difference between different groups' proportions of cohesive devices, simply drawing conclusions based on ill-defined percentages.

Another issue worth noting in previous literature is that few studies have investigated the cohesion in aphasic discourse combining quantitative and qualitative observations. Earlier studies usually summarized their findings from single-case qualitative observations (e.g., Piehler & Holland, 1984) while a majority of recent studies drew their conclusions solely based on quantitative results (e.g., Behrns & Ahlsén, 2012), which is likely to engender a partial understanding of this topic. Quantitative results 'require explication by qualitative analysis' (Perkins, Crisp, & Walshaw, 1999), and as previous studies have pointed out, qualitative analyses are appropriate for capturing the complexity of aphasia-related issues (Sorin-Peters, 2004). This advantage of qualitative methodologies has also been reported by studies on other types of language disorders, e.g., stuttering and specific language impairment (Chen, Chen, & Zhou, 2019; Tetnowski & Damico, 2001). It is also very likely that in the same study, quantitative analysis finds no significant difference between two groups while qualitative analysis discovers distinctions, which renders the integration of results from both perspectives indispensable. In an attempt to resolve this issue, the mixed methods research approach can prove to be helpful, as it contains elements of both qualitative and quantitative methods, which enables the researcher to confirm, cross-validate, or corroborate findings within a single study (Creswell & Creswell, 2017). The two kinds of methods can be complementary in comparing the discourse cohesion of aphasic and non-aphasic participants, with quantitative analysis illustrating general differences and qualitative analysis explaining specifically how one group is different from another (Dörnyei, 2007). Therefore, using a mixed-methods approach can provide well-rounded and detailed data on the discourse cohesion of aphasic participants.

To summarize, existing studies on aphasic discourse have adopted two perspectives that focus on two different aspects of aphasic language, i.e., microstructure and macrostructure. The separate analysis of the two aspects has led to a noticeable gap between them. Cohesion analysis is one way to deal with the issue by connecting the micro and macro aspects of aphasic discourse through an examination of how microstructural linguistic errors affect the conveying of meanings and the construction of coherent text. However, our understanding of cohesion in aphasic discourse has been very limited; research on aphasic discourse cohesion is scanty and controversial (Marangolo et al., 2014), and has demonstrated certain shortcomings in terms of participants and methods, rendering this issue still open to question. Therefore, we conducted this study with the hope of further supporting the common findings of existing studies as well as revising their discrepant conclusions.

To examine this issue, we raised two research questions: (1) Do participants with fluent aphasia, non-fluent aphasia and without aphasia differ significantly in terms of the quantity of cohesion in their discourse? (2) Do the three groups of participants differ in their patterns of using cohesive devices? We hypothesized poor performance by fluent and non-fluent aphasic participants on discourse cohesion and significantly different distribution of cohesion categories among any two of the three groups.

Methods

The data

The data were drawn from the AphasiaBank database (MacWhinney, Fromm, Forbes, & Holland, 2011) located in the TalkBank System, of which all the aphasic participants were clinically diagnosed. The corpus provides careful transcripts of discourse elicited from participants with and without aphasia by assigning them certain discourse tasks. Each participant was asked to perform nine discourse tasks, seven of which (task 3 through 9) were identical for all participants while two (task 1 and task 2) varied because of the participants' different experiences of aphasia. Table 1 shows the discourse tasks participants were required to perform.

Participants

Inclusion criteria for participants with aphasia were (i) a single stroke resulting in left hemisphere lesions, (ii) an aphasia duration of at least six months, (iii) English as the primary language, (iv) at least 12 years of education, (v) monolingual speakers, (vi)

Table 1. Discourse tasks performed by participants.

Task	Participants with aphasia	Participants without aphasia
Task 1	Free Speech: <i>Speech</i>	Free Speech: <i>Communication</i>
Task 2	Free Speech: <i>Stroke Story</i>	Free Speech: <i>Illness or Injury</i>
Task 3	Free Speech: <i>Important Event</i>	
Task 4	Picture Descriptions: <i>Broken Window</i>	
Task 5	Picture Descriptions: <i>Refused Umbrella</i>	
Task 6	Picture Descriptions: <i>Cat Rescue</i>	
Task 7	Picture Descriptions: <i>Flood</i>	
Task 8	Story Narrative: <i>Cinderella</i>	
Task 9	Procedural Discourse: <i>Peanut Butter and Jelly Sandwich</i>	

Table 2. Summary of participants' demographic information.

	Age	Gender
Non-fluent (n = 7)	70.7 (66.3–76.9)	4 males 3 females
Fluent (n = 9)	70.9 (66.1–75.9)	4 males 5 females
NAC (n = 16)	71.0 (66.1–77.0)	8 males 8 females

vision and hearing adequate for testing, and (vii) premorbidly right-handed. Exclusion criteria included (i) multiple strokes, (ii) dysarthria, (iii) dementia/brain trauma/brain tumour, (iv) any history/presence of depression or other neurological condition(s), (v) any history of drug abuse/alcoholism, and (vi) no control counterpart strictly matched for age, gender, language status, and years of education. Data of aphasic participants were collected only when provided by examiners with at least 15 years of clinical aphasia experience. Thirty-two transcripts of discourse produced by 7 non-fluent stroke-induced aphasic participants (4 males, mean age = 70.7), 9 fluent stroke-induced aphasic participants (4 males, mean age = 70.9) and 16 NACs (8 males, mean age = 71.0) were included for cohesion analysis. Table 2 presents details of the participants' demographic information.

Data coding

We followed general principles and coding schemes of cohesion analysis proposed by Halliday and Hasan (1976) and coded each transcript for six main types of cohesive devices, including three grammatical devices, two lexical devices, and one special category of device on the borderline, i.e., conjunction. Grammatical devices include reference, substitution, and ellipsis. Reference means that the semantic interpretation of an item is not based on its own properties but through making reference to something else (e.g., personals such as *he* and demonstratives such as *this*). Substitution refers to the replacement of one item by another (e.g., *one* in '*My pencil is too short. I must get a longer one.*'). Ellipsis is a special case of substitution and can be viewed as 'substitution by zero' (e.g., the omitted *coat* in '*The beige coat was beautiful. Why did you buy the pink (coat)?*'). Lexical devices include reiteration and collocation. Reiteration occurs when vocabulary selected to refer back to the preceding lexical item is the same lexical item, or a synonym, a near-synonym, a superordinate, or even a general word (e.g., the second *book* in '*There was a book on the desk. She fetched the book and started to read it.*'). As for collocation, cohesion is achieved via the association of lexical items that regularly co-occur (e.g., *girls* in '*Why do these boys mess around all the time? Girls do not mess around.*'). The last type of cohesive device is conjunction, a borderline category relatively difficult to define in clear-cut terms (Halliday & Hasan, 1976). Conjunctive elements create cohesion by expressing certain meanings that presuppose other components' presence in the discourse. Common examples of words and phrases expressing conjunctive meanings are *and*, *yet*, *so*, and *then*.

We printed all the transcripts out and coded them by hand. Only those cohesive ties that were formed completely were coded. Twenty percent of the transcripts were randomly chosen and checked for inter-coder reliability. Two raters coded the use of cohesive devices

in the transcripts and the inter-coder agreement was assessed using Cohen's kappa (Bakeman & Gottman, 1997). The interrater correlation coefficient between the two coders was 0.88. Disagreements were resolved through discussion, with a consensus reached by both coders.

Data analysis

In our research, we adopted a mixed-method approach to analyse the data, using both quantitative and qualitative methods. A more detailed description of how we employed these two methods in this study is presented as follows.

Quantitative analysis

In our quantitative analysis, we took into consideration the quantity and the diversity of cohesion. The former was reflected by the number of cohesive ties and the latter by proportions of cohesive devices. The data obtained were analysed via R (version 3.5.1). For the number of cohesive ties, an ANOVA was conducted with the evaluation of normality and homogeneity of variance for all groups revealing adequate fulfilment of assumptions, while for proportions of cohesive devices, since the covariance matrices of each group were not equal, a robust MANOVA was performed using Munzel and Brunner's method (Munzel & Brunner, 2000). All statistical analyses were run at an alpha level of 0.05 and $p < .05$ was deemed to indicate statistical significance.

Number of cohesive ties. A cohesive tie is a single instance of cohesion, meaning 'one occurrence of a pair of cohesively related items' (Halliday & Hasan, 1976). To ensure appropriate comparisons, the length of each participant's discourse was taken into account and ratios of total cohesive ties by total T-units were calculated. The dividing of T-units was based on principles proposed by Young (1995), which point out that a T-unit includes a single clause, a matrix clause plus its subordinate ones, and fragments of clauses produced by ellipsis. Coordinate clauses should be counted as two T-units, while back-channel cues such as 'I see', 'Uh-huh' and 'yeah' as well as discourse boundary markers like 'okay', 'thanks' or 'good' are not viewed as T-units.

Proportions of cohesive devices. Following Halliday and Hasan (1976), we classified the six types of cohesive devices into three major categories, i.e., grammatical devices, lexical devices, and conjunction, as illustrated in the previous section. Proportions of each category were calculated by dividing the number of occurrences of a single category by total occurrences of all the three categories. Since the total of the three proportions was 100%, if no difference was found in two of them, it followed that the third one would also be the same. That is, the proportion data of the third category could be regarded as redundant. Therefore, we conducted the MANOVA with proportions of two categories, i.e., grammatical and lexical, being dependent variables.

Qualitative analysis

In the qualitative analysis, we adopted the qualitative approach to discourse analysis (Lazaraton, 2002). We employed the constant comparative method (Glaser, 1965) as an inductive data-driven analysis to search for recurring patterns across cases. The analysis consisted of comparison within a single transcript, comparison between transcripts within

the same group and comparison of transcripts from different groups (Boeije, 2002). The comparison and analysis were cyclical. For example, we examined the content of a transcript and labelled the problems we discovered concerning the construction of cohesion with an adequate code (e.g., inappropriate use of reference). If one problem was identified and labelled, we studied the transcript for other fragments that should be given the same code. During the comparison, codes that appeared frequently formed a pattern. If the same pattern were found in other transcripts within the same group, it was identified as a common pattern of that group. Qualitative results were expected to cohere with quantitative results and furthermore, to explain why statistical results turned out to be the way they were. We also expected to discover certain characteristics of aphasic discourse cohesion that were not revealed by the quantitative analysis. Qualitative results, together with quantitative results, served to justify the research conclusions reached at the end of the study.

Results

Quantitative results

Descriptive findings are presented in Tables 3 and 4. Statistical results revealed that the number of cohesive ties per T-unit was significantly smaller in the fluent and the non-fluent group (with no difference between these two groups), and that proportions of cohesive devices showed different distributions among different groups. Additionally, it was found that the difference between the non-fluent group and NACs regarding the distribution of cohesion categories was in grammatical and conjunctive devices while that between the fluent group and NACs was in lexical and conjunctive devices, and that the fluent and the non-fluent group showed no significant difference in their proportions of cohesive devices.

Table 3. Mean of total cohesive ties, mean of T-units and mean (with standard deviation in parentheses) of cohesive ties per T-unit in discourse of the three groups.

	Non-fluent	Fluent	NAC
Total Cohesive Ties	59.14	106.44	353.19
Thematic-units	58.86	110.89	154.38
Cohesive Ties Per T-unit	1.00 (0.144)	0.94 (0.166)	2.28 (0.090)
ANOVA Statistics	F(2, 29) = 426.71, $p = .000$		

Table 4. Mean (with standard deviation in parentheses) of proportions of cohesive devices (relative to total number of cohesive devices) in the discourse of non-fluent, fluent, and NAC groups.

	Non-fluent	Fluent	NAC	ANOVA statistics
Cohesive devices				
Grammatical devices	44.79% (0.05)	47.16% (0.11)	52.53% (0.05)	F(2, 29) = 3.39, $p = .048$
Lexical devices	16.96% (0.04)	11.08% (0.09)	19.07% (0.03)	F(2, 29) = 6.32, $p = .005$
Conjunction	38.25% (0.07)	41.76% (0.11)	28.40% (0.05)	F(2, 29) = 10.01, $p = .000$
MANOVA statistics	F = 2.79, $p = .033$			

Number of cohesive ties

Table 3 presents information about each group's number of cohesive ties. Results of the ANOVA revealed a significant difference among the three groups' cohesive ties per T-unit ($F(2, 29) = 426.71, p < .05, \eta_p^2 = 0.97$). We then performed post hoc tests and found a significant difference between NACs and either the non-fluent or the fluent group ($p < .05$), while a non-significant one between the fluent and the non-fluent group ($p > .05$).

Proportions of cohesive devices

Table 4 summarises the proportions of cohesive devices in the discourse of three groups. A MANOVA was conducted on the ranked data using Munzel and Brunner's (Munzel & Brunner, 2000) method, implemented in R using the `mulrank()` function (Wilcox, 2005). There was a significant difference between the proportions of cohesive devices among the three groups ($F = 2.79, p < .05$). Separate univariate ANOVAs on proportions of each category were performed following up the MANOVA, indicating significant differences between the three groups in grammatical devices ($F(2, 29) = 3.39, p < .05$), lexical devices ($F(2, 29) = 6.32, p < .05$), and conjunctive devices ($F(2, 29) = 10.01, p < .05$).

Post hoc tests revealed that for the proportion of grammatical devices, a significant difference existed between the non-fluent group and NACs ($p < .05$); for that of lexical devices, the difference was between the fluent group and NACs ($p < .05$); for that of conjunctive devices, the fluent and the non-fluent group differed from NACs, respectively, ($p < .05$) but not from each other ($p > .05$).

Qualitative results

We found that aphasic participants tended to produce simple clauses, rarely forming complex clauses as their normal counterparts usually did. It was also noticed that fluent and non-fluent aphasic participants generally employed cohesive devices less frequently than NACs. With the focus of the qualitative analysis on the individuals' specific performance, comparison and analysis were conducted between each pair of groups. We first compared the non-fluent group with NACs and found two patterns of non-fluent aphasic discourse cohesion worth mentioning. The first pattern is concerned with non-fluent aphasic participants' inadequate use of grammatical devices. Example (1) may serve to illustrate this noticeable phenomenon.

- (1) Cat is up the tree. And father is no help. And father is [unrecognisable word] the tree too. And dog is barking. And ladder fell. And two firemen is [unrecognisable word] to [unrecognisable word] cat and father. (non-fluent group)

Example (1) is the narrate given by a non-fluent participant for the task 'Cat', in which participants were presented pictures making up a story about the rescue of a cat. It can be seen that the non-fluent aphasic participant had a strong tendency to omit determiners such as articles or demonstratives. The nouns *cat* and *father*, when uttered again, stood alone with determiners absent from the positions they were expected to be in, which led to the failure of forming complete referential cohesive ties.

The second pattern is related to the non-fluent group's monotonous use of lexical devices: they tended to use repetition rather than other devices in the same or another category. This can be illustrated by the following examples.

(2) A mother was reminding her son that the weather forecast looked like it was going to be rain today, and she handed her son an umbrella. And he said, “no, it won’t rain today, and I don’t wanna.” So off he went to school with his backpack on. (NAC group)

(3) Rain ... rain ... rain. And ... rain. Mother looking at son. And son [unrecognisable word] umbrella. (non-fluent group)

In Example (2), the NAC constructed a referential cohesive tie by using the pronoun *he* to refer to the son when it was mentioned again in the second sentence, while in Example (3) produced by a non-fluent aphasic participant, he linked the second *son* to the first *son* simply by reiterating the same word. This simple repetition can be observed in Example (4) as well.

(4) Cinderella poor child in [unrecognisable word]. Child in stepchildren. Stepchildren wanted to ... to dance and clothes beautiful. Cinderella weren’t sure about dance. (non-fluent group)

(5) Cinderella’s father has apparently been widowed, and is now remarried, and brought his new wife with two ugly daughters to live in her home. They never get along. The mother thinks Cinderella oughta be her servant. And the ugly stepsisters of course soon pick up on that. This goes on for years. As they get older, the prince of the land is ... time to be married, and about the same age as these three young women now. And so he invites all the people in the land to a big ball. The stepmother and her daughters have spent hours and days getting prepared for this. And Cinderella’s not been invited. (NAC group)

The NAC linked the clauses together by employing various cohesive devices, such as collocation (e.g., *widowed ... remarried; father ... daughters ... mother; stepsisters ... step-mother*) and reference (e.g., *they* in the second sentence, *that* in the fourth sentence, *this* in the fifth sentence), whereas the non-fluent aphasic participant mainly depended on repetition to create cohesive ties (e.g., *child ... child, stepchildren ... stepchildren, dance ... dance*).

We then compared the fluent group with NACs and observed two important characteristics different from those found in the non-fluent group. Unlike the non-fluent group who tended to omit determiners, the grammatical ties formed by the fluent group remained largely intact, with determiners such as articles correctly presented. However, the fluent group often failed to construct complete lexical cohesive ties. Words and phrases unrelated to each other were frequently observed in their discourse, making what they said seem ‘messy’ and confusing. For these two characteristics, consider Example (6).

(6) Little boy is going to [unrecognisable word]. And the mother tried to give him a hick. And he wouldn’t take it. He said, “goodbye, I’m leaving.” And he goes out in the car. And he’s [unrecognisable word] rain in the car. And he’s getting wet. And it work more again. And it got worse. So he went back to see his mother. He said he needs a [unrecognisable word]. He liked to wear a [unrecognisable word]. He couldn’t [unrecognisable word] this ball. So he went home. And his mother gave him another pall. And he wear a capital. And that’s what he wore. (fluent group)

In Example (6), the participant was presented a set of pictures where a boy refused to take the umbrella given by his mother and thus was soaked in the rain. In this narrative, the fluent aphasic participant frequently uttered words unrelated to the task, e.g., *hick, car, ball, pall, and capital*. These words were semantically unconnected to each other either, and thus failed to constitute any complete lexical cohesive tie.

Moreover, the distribution of cohesion categories in the fluent and the non-fluent group was compared with each other. The results were similar to what we have found:

the non-fluent group performed relatively better than the fluent group regarding lexical cohesion while the fluent group seemed to outperform the non-fluent group concerning grammatical cohesion, as have been illustrated by Example (1) and (4). It is also worth noting that when constructing conjunctive cohesion, both the fluent and the non-fluent group had a tendency to form additive conjunctive cohesion by using the conjunctive *and*, as can be observed in the above examples.

Discussion

Cohesion plays an important role in the construction of effective discourse and demonstrates certain significance in the study of links between the micro- and macrostructure of aphasic discourse (Armstrong, 2000). However, only a few studies have probed into the cohesion of post-stroke aphasic discourse and existing literature on this topic have reported mixed findings. One major objective of the present study is to shed some light on the cohesion in the discourse produced by post-stroke aphasic patients, through a comparison of how participants with stroke-induced fluent or non-fluent aphasia and their normal counterparts employed cohesive devices. Considering the quantitative and qualitative results, we have found that overall, the discourse by aphasic participants in the present study was less cohesive than that by non-aphasic participants and the three groups' discourse differed from each other in their distribution of cohesion categories. We observed both consistency and discrepancies between quantitative and qualitative results. In terms of the quantity of cohesion, quantitative results indicated poorer performance in both types of aphasic participants than non-aphasic ones. Qualitative results reinforced this idea by illustrating that this could be accounted for by two characteristics of aphasic discourse. One is that aphasic participants in the present study employed cohesive devices to a lesser extent than NACs did, which resulted in their smaller number of total cohesive ties, and the other is that aphasic participants tended to produce single clauses or coordinate clauses rather than subordinate clauses, leading to a bigger number of total T-units. The number of cohesive ties, being the ratio of total cohesive ties to total T-units, was therefore much smaller in aphasic groups than in the NACs. This is consistent with the findings of Lock and Armstrong (1997), who observed that aphasic patients generally formed fewer cohesive ties and made more cohesive errors than normal controls. Although there were no statistically significant differences between the fluent and non-fluent group, the number of cohesive ties per T-unit for the fluent group in this study were slightly lower than that of the non-fluent group. As previous literature has pointed out, fluent aphasic speakers are notorious for using convoluted tangential language (Armstrong, 2000). We speculate that the slightly lower scores for the fluent group might have resulted from the fluent aphasic participants' tendency to make long-winded utterances constituted by words with little semantic association, which increased the number of T-units but not the quantity of lexical cohesive ties.

As for the diversity of cohesive devices, quantitative results showed that the proportions of conjunctive cohesion were much bigger in aphasic discourse. However, this does not necessarily suggest aphasics' preference for conjunctive cohesive devices. According to qualitative results, the relatively bigger proportion of conjunctive cohesion in aphasic discourse may be because aphasic participants' abilities to construct successful grammatical and lexical cohesion were impaired more severely than their ability to form

conjunctive cohesion. Qualitative analysis further revealed that the conjunctive cohesive ties constructed by aphasic participants, especially fluent aphasic participants, largely expressed additive relations, while the other three types of conjunctive relations, i.e., adversative, causal and temporal, were very rarely formed. This confirms the findings of previous literature in which participants with fluent aphasia were reported to produce many simple concatenations *and* but few causal clauses or other complex sentences (Gleason et al., 1980). It is also mentioned by Edwards (2002) that this problem is one of the typical symptoms of fluent aphasia. Sherratt and Bryan (2012) suggest that the overuse of *and* to construct additive conjunctive relation may indicate participants' difficulty in providing a proper conjunction to 'reflect the relationship between the propositions', which causes their frequent resort to the least marked conjunction *and* (Halliday & Hasan, 1976) and thus renders the relationship unclear.

Regarding the distribution of grammatical and lexical cohesion, the fluent and the non-fluent group exhibited different patterns when they were compared to NACs, respectively. For the non-fluent aphasic participants, quantitative results showed that they differed significantly from NACs in the proportion of grammatical cohesion. This concurs well with what we observed in a qualitative analysis that non-fluent participants tended to have trouble constructing reference cohesion due to their inappropriate use of articles and pronouns, which contributed to the low frequency of grammatical cohesive ties. The results also accord with previous studies reporting non-fluent aphasics' serious grammatical deficits such as the omission of determiners and their poor grammatical cohesion capacities (Marangolo et al., 2014; Piehler & Holland, 1984). In terms of lexical cohesion, although quantitative results did not detect a disparity between the non-fluent and NACs, qualitative results showed that the non-fluent group used lexical cohesion in a way much less flexible and diverse than NACs. We presume that the pseudo-similarity between the two groups' lexical cohesion in quantity may be explained by the non-fluent group's option to use the lexical device reiteration rather than grammatical devices like reference to refer to aforementioned items as a communicative strategy to compensate for their inability to avoid anaphoric ambiguity (Leiwo & Klippi, 2000; Linnik, 2016). As for the fluent group, quantitative results demonstrated their significant distinction from NACs in the proportion of lexical cohesion. This was supported by the qualitative analysis which reported the fluent group's constant failure to form intact lexical cohesive ties. These results together provide consistent evidence for the consensus among previous literature that lexical and semantic impairment is predominantly observed in fluent aphasic patients (Edwards, 2002). Despite the absence of a significant difference in quantitative results between the fluent group's and the NACs' proportion of grammatical cohesion, it is worth noting that certain grammatical deficits did exist in the discourse of fluent aphasic participants in the present study, as has been argued by Bastiaanse, Edwards, and Kiss (1996). However, we believe that these errors did not serve to greatly undermine their grammatical cohesion, since the errors mainly occurred in the use of inflections and verb arguments, which were not regarded as grammatical cohesive devices, and therefore played very little role in constructing grammatical cohesive ties.

Furthermore, we compared the distribution of cohesion categories between the two types of aphasic participants. Quantitative analysis reported a non-significant difference between the two groups' distribution of cohesion categories, which is in line with the findings of Cahana-Amitay and Jenkins (2018). However, qualitative analysis reported the

opposite results, showing that non-fluent aphasic participants behaved worse in employing grammatical cohesive devices whereas fluent aphasic participants had more problem constructing lexical cohesion. Part of the reason why this discrepancy was not reflected in quantitative results may be attributed to the predominant overuse of ellipsis by non-fluent aphasics (Edwards, 2002), which raised the proportion of grammatical cohesion.

The present study provides some preliminary information about cohesion in the discourse of patients with post-stroke aphasia. As far as the results have shown, its cohesion can be rather complex and may demonstrate certain variations between different aphasia types. However, some potential limitations need to be considered. Since the aphasia types this study focused on were those most commonly known, with the types more delicately classified left largely undiscussed, we should be cautious to draw any final conclusion on differences in discourse cohesion based on aphasia type, but rather believe that this question still remains undetermined and waits for further research. Secondly, the present study covered three types of discourse genres, but different types of discourse can impose different cognitive and linguistic demands on aphasic patients, which may lead to different patterns of language impairment in different genres (Ulatowska, Allard, & Bond Chapman, 1990). Thus, aphasic individuals' use of cohesion may vary in different types of discourse, resulting from dissimilar discourse characteristics. In future research, it would be important to take into consideration the distinction between different discourse types and further explore the impact of discourse genres on the patterns of using cohesive devices by patients with different aphasia types. In addition, adopting a holistic view of aphasic discourse cohesion, this study categorized cohesive devices in three major dimensions. It is thus necessary for future studies to look into each specific cohesive device and find out more subtle characteristics.

Conclusion

The results of the present study enhance the understanding of cohesion in aphasic discourse. In our study, patients with post-stroke aphasia behaved worse than normal participants did in terms of forming enough cohesion in discourse construction, and their employment of cohesive devices was quite different from that of normal participants. Non-fluent aphasics performed particularly poorly in constructing grammatical cohesion while fluent aphasics in lexical cohesion. This is largely consistent with existing research in aphasic language from micro-linguistic perspectives, which highlights the typical phenomenon of non-fluent aphasics' grammatical deficits and fluent aphasics' lexical problems (Boye & Bastiaanse, 2018; Edwards, 2002; Friederici & Schoenle, 1980; Gordon, 2008; Martínez-Ferreiro, Ishkhanyan, Rosell-Clari, & Boye, 2019). Therefore, we believe that our results would provide further evidence for the contention that macro-linguistic impairments might be related to micro-linguistic difficulties, as argued by Andreetta and Marini (2015). Since this study is a springboard for later research, more efforts will be paid in the future to further explore the distinct performance of aphasic patients on constructing discourse cohesion across genres with consideration of more aphasia types and more dimensions of discourse cohesion.

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