A comparison of coherence in oral discourse between Cantonese speakers in Mainland China with cerebrovascular accident (CVA) and traumatic brain injury (TBI)

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Abstract

Purpose: Coherence can reflect subtle language deficits in individuals with traumatic brain injury (TBI) and cerebrovascular accident (CVA). This study aimed to investigate whether global and local coherence in Cantonese-speaking adults with CVA and TBI differ from non-brain-injured (NBI) speakers. Factors contributing to the coherence ratings and impacts of elicitation tasks on coherence were examined.

Method: Two clinical groups with fluent aphasia (7 CVA and 11 TBI) and 18 controls matched in age and education, who were Cantonese speakers living in China participated. Language samples of single and sequential picture description and storytelling were elicited, and subsequently analysed on global and local coherence, content sequence, and informativeness.

Result: TBI speakers had impaired global and local coherence, while CVA speakers had poor global coherence. Sequence of main events produced by the three groups correlated significantly with global coherence. Attention and visuospatial skills were also significantly related to global coherence in both clinical groups. Finally, impaired language integrity was associated with problems of local coherence.

Conclusion: The results were consistent with previous studies. Linguistic deficits of coherence in discourse in the two clinical groups and possible impacts of elicitation tasks on the cognitive demands and coherence ratings were discussed.

Keywords: aphasia, traumatic brain injury (TBI), assessment,

Introduction

Cerebrovascular accident (CVA) and traumatic brain injury (TBI) are two of the major causes of morbidity and mortality in China (Li, Wang, Chao, & Liu, 2015; Liu, 2015). The language impairment caused by these two conditions may manifest at the single-word, sentence, and discourse levels. The prevalence of post-TBI aphasia can be up to 33.3% among survivors who sustain a closed head injury (Luzzatti, Willmes, Taricco, Colombo, & Chiesa, 1989; Sarno, Buonaguro, & Levita, 1986) or 40% among those with a penetrating or blast TBI (Norman, Jaramillo, Amuan, Wells, Eapen, & Pugh, 2013). Current standardised aphasia batteries often neglect the language functions beyond the sentence level and fail to detect the subtle language deficits in discourse produced by individuals with TBI and/or mild aphasia, such as impaired language organization, inappropriate shifting of conversational topics and difficulty in conversational turn-taking (Graham, 2007; Hinchliffe, Murdoch, & Theodoros, 2001).

Discourse production can be analysed in terms of their micro-linguistic (e.g. lexical, phonological, and syntactic aspects of words and sentences production) and macro-linguistic features (e.g. story completeness; Lindsey, Hurley, Mozeiko, & Coelho, 2018, or cohesion, coherence, and story grammar analysis to reflect how conceptual and pragmatic organization of spoken output is maintained; Andreetta, Cantagallo, & Marini, 2012; Glosser & Deser, 1990). Discourse analysis, including the study of coherence, can provide rich information to understand the manifestation of specific language disorders and provide directions to clinicians' planning of language remediation (Booth & Perkins, 1999; Kong, 2016a).

Measures of coherence in oral discourse

Coherence refers to the ability to maintain thematic unity and the semantic connectedness

of a text at the propositional level (Glosser & Deser, 1990; Van Dijk, 1980). A discourse is coherent when propositions are connected to form a conceptually-organized discourse. Coherence can be differentiated into global and local coherence (Kintsch & Van Dijk, 1978). Global coherence reflects the ability to organize propositions into a discourse with respect to an overall goal, theme, or topic. It involves semantically relating remote ideas to establish conceptual linkages between utterances (Marini, Andreetta, del Tin, & Carlomagno, 2011). Local coherence refers to the conceptual relations between individual utterances and the immediately preceding utterances (Glosser & Deser, 1990). Previous studies evaluated degree of narrative coherence among speakers with acquired brain injury using several measures, such as (i) perceptual rating scales for individual utterances by naïve listeners (Coelho & Flewellyn, 2003; Glosser & Deser, 1990; Van Leer & Turkstra, 1999), (ii) coherence error analysis that calculated the occurrence of global and local coherence errors (Andreetta et al., 2012; Barker, Young, & Robinson, 2017), and (iii) analysis based on Rhetorical Structure Theory, in which utterances were annotated with reference to structural types and complexity (Kong, Linnik, Law, & Shum, 2018).

A complete spoken discourse is composed of different events, that is the interrelationships between discrete actions and ideas (Wright et al., 2005). Apart from direct measures of global and local coherence, McCabe and Bliss (2003) proposed that problematic event sequencing (i.e. the chronological or logical presentation of events) and informativeness (i.e. the sufficiency of information presented by a speaker in order for one to understand a message; Bliss & McCabe, 2008) can also compromise the overall coherence of a discourse. Ulatowska et al. (2013) suggested that coherence was attributed to logical temporal-casual sequencing of events. Further supports based on both unimpaired speakers (Marini & Urgesi, 2012) and those with CVA

(Andreetta & Marini, 2015) showed a significant negative correlation of lexical informativeness and violations of global coherence. Interestingly, an opposite view of a dissociation between micro-linguistic processes and coherence has also been proposed by Glosser and Deser (1990), as shown by the deficits in syntactic and lexical measures but normal performance on coherence among their participants with CVA. Carlomagno, Giannotti, Vorano and Marini's (2008) also described preserved informativeness but impaired local and global coherence in adults with acquired TBI.

Coherence of spoken output in speakers with CVA versus those with TBI

Some reports have indicated that speakers with CVA showed relatively well-preserved coherence (e.g. Huber, 1990; Olness & Englebretson, 2011), implying that they generally communicate better than they talk (Holland, 1977). Glosser and Deser (1990) found no difference in maintaining global coherence between healthy controls and those with CVA, indicating a relatively preserved communicative functioning. Ulatowska et al. (2013) further supported this notion and claimed that speakers with CVA demonstrated correct logical and chronological sequencing of events that could yield to highly coherent narratives. However, several investigations have proposed an opposite view that individuals with CVA suffered from impaired coherence, especially on maintenance of global coherence (e.g. Coelho & Flewellyn, 2003; Wright & Capilouto, 2012). In particular, Christiansen (1995) hypothesized that adults with milder forms of aphasia produced more coherence violations because they tended to be less impaired and could better compensate for their word retrieval difficulties. Weinrich, McCall, Boser and Virata (2002) attributed the poor coherence in CVA speakers to failures at the micro-syntactic level, i.e. lexical and syntactic deficits.

Concerning the potential relationship between discourse impairments and underlying cognitive dysfunction, Rogalski et al.'s (2010) study using speakers with CVA indicated that global (instead of local) coherence strongly correlated with cognitive function measures. More recently, Barker et al. (2017) investigated the role of attention and executive functions in discourse coherence in speakers suffering from left- versus right-CVA; it was concluded that better performance on attention and executive functions tasks were related to fewer propositional repetitions and hence better global coherence in both CVA groups.

Coherence of spoken output in survivors of TBI

In contrast to speakers with CVA, TBI survivors have been claimed to talk better than they communicate (Milton, Prutting & Biner, 1984). Glosser and Deser (1990) directly compared the micro- and macro-linguistic performances between individuals with CVA and TBI. Both groups were found to exhibit impairments in micro-linguistic measures, but the TBI group was also impaired in global and local coherence. The vast majority of studies on the TBI populations affirmed the deficits in coherence, with greater difficulty with global than local coherence (Galetto, Andreetta, Zettin, & Marini, 2013; Hough & Barrow, 2003). However, it remains inconclusive as to whether the impaired coherence was attributed to the underlying cognitive dysfunctions, language impairment or impacts of elicitation tasks. The relationship between discourse impairments and underlying cognitive dysfunction in the TBI populations has been emphasised (Glosser & Deser, 1990). For example, dysfunction of executive control over cognitive and linguistic organizational processes can lead to discourse impairments following TBI (Ylvisaker, Szekeres, Feeney, & Chapey, 2001).

Note that apart from the above-mentioned effects of cognitive impairments on discourse

coherence, previous studies have also been examined how coherence varied as a function of elicitation tasks. Specifically, different discourse genres may place different linguistic demands on a speaker with aphasia and affect the integrity of coherence (Olness, 2006). Picture description often involves listing of actors and actions with little connectivity between them, while story-telling could display a temporal-causal interrelationship. Ulatowska, Allard and Chapman (1990) pointed out that narrative and procedural discourse differ in terms of their primary pragmatic function. Narrative mainly serves to entertain, but procedural discourse aims to inform or instruct a listener and, thus, has a greater demand for explicitness and clarity. Information units, also noted as steps, were important in reflecting the discourse ability in a procedural discourse. Meanwhile, Van Leer and Turkstra (1999) suggested that poorer coherence in speakers with TBI would be a result of a greater demand on spontaneous organization. They pointed out that memory demands, creativity demands, and familiarity of topic also affected coherence. For instance, on-line procedures such as visual support in narration may reduce the demand for short-term memory and creativity, leading to better coherence. In terms of visual support, the number of pictures provided may also have an impact. Capilouto, Wright and Wagovich (2007) suggested that speakers with aphasia were able to tell significantly more main events in response to sequential pictures (relative to single pictorial stimuli) In other words, sequential pictures acted as a scaffold, by providing participants with temporal and casual information about the story and the underlying relationships between the events. In summary, different elicitation tasks may place different cognitive demands on the speaker's organization, resulting in the difference in the degree and quality of coherence.

Coherence studies in Chinese

According to Linden, Rauch, and Crothers (2005), survivors of TBI are found to experience psychosocial problems, which tended to be associated with societal perceptions or stigma (rather than just the severity of brain injury). Language use and communication style, both of which are manifested and reflected by spoken discourse, are highly related to one's cultural background (Liu, 2016; Neuling, 1999). Examining whether and how the findings on discourse disruptions demonstrated by native English speakers can be applied to the Chinese linguistic and cultural context (see Yu, Tam, & Lee, 2015), therefore, has important implications to rehabilitation. Nevertheless, there were only very few reports on coherence in CVA and TBI speakers in Chinese literatures. Chow, Kong and Lau (2016) examined listeners' perceptual ratings of global and local coherence in personal narrations and description of one single picture and one sequential picture set by Chinese speakers with TBI. Coherence was revealed to be significantly impaired in all Chinese TBI survivors of this investigation. It was further argued that this finding was culturally related to a higher proportion of implicit statements in eastern narratives. Similar results have been found in Cantonese speakers with CVA in which their discourse, elicited by story-telling and procedural description, was rated as significantly less coherent than their control counterparts (Kong et al., 2018). In particular, disordered discourse was rated as significantly less coherent due to a higher degree of dysfluency, larger amount of structural disruptions, simpler semantic relations to create discourse, and lower extent of elaboration. However, these two investigations on the potential task effect on discourse coherence were inconclusive. Although Chow et al. (2016) reported an overall higher rating of global coherence in descriptive than personal narratives, significant genre difference was absent in Kong et al. (2018).

Research questions and predictions

In light of the limited reports on discourse coherence in Chinese speakers, this study aimed to answer the following four research questions. Predictions based on results from reports in the English literature are given following each question.

Q1: If and how local and global coherence differs across Cantonese-speaking non-brain-injured (NBI) individuals, speakers with CVA, and those with TBI? According to Glosser and Deser (1990), it was predicted speakers with TBI would be more impaired in coherence than those with CVA, and both clinical groups would be inferior than NBI.

Q2a: If and how sequence of main events and informativeness differs across the CVA, TBI, and NBI groups? As both the CVA and TBI groups are speakers with aphasia, reduced informativeness is expected (Andreetta & Marini, 2015; Marini, Zettin, & Galetto, 2014).

Q2b: Does sequence of main events and informativeness in the CVA and TBI groups correlate with the perceptual ratings of local and global coherence? The sequence of main events was hypothesized to be more impaired in the TBI group as a result of cognitive dysfunction (Glosser & Deser, 1990).

Q3: Is there any effect of genre (upon different elicitation tasks including single-picture-description, multiple-picture-description, story-telling, and procedural discourse) on coherence in the oral discourse of the CVA, TBI, and NBI groups? With reference to Olness (2006), Van Leer and Turkstra (1999), and Capilouto et al. (2007), it was predicted that coherence ratings would be more well-preserved in procedural discourse, followed by story-telling, multiple- and single-picture description.

Q4: For the two clinical groups of CVA and TBI, whether and how their global and local coherence differs as a function of language impairment and/or cognitive deficits

(including domains of attention, executive functions, memory, language and visuospatial skills)? According to Barker et al. (2017) and Chow et al. (2016), significant correlations between global coherence and language impairment as well as between global coherence and cognitive domains of attention and executive control were expected.

Method

Participants

A total of 36 individuals participated in this study. They included 18 speakers with fluent aphasia, seven of which induced by CVA and 11 induced by TBI, as well as 18 control participants of non-brain-injured (NBI) individuals. All were recruited from the Guangdong Work Injury Rehabilitation Hospital, with the TBI or CVA diagnosed by neurologists and/or medical internists (see the corresponding neuroimaging results, i.e. lesion sites, in Table I), and were native speakers of Cantonese who were born in the Guangdong province of Mainland China[1]. There were nine male and two female speakers in the TBI group. They all suffered from a closed head brain injury that occurred at least six months (with an average of 12.18 months, SD = 4.62, range = 6-22) prior to the testing. All of them were diagnosed with anomic aphasia with the Cantonese version of the Western Aphasia Battery (CAB; Yiu, 1992). Their age ranged from 28 to 52 years (mean = 37.73, SD = 9.13) and they had an education between six to twelve years (mean = 9.09, SD = 1.76). As for the CVA group, there were five male and two female speakers. They have suffered from a cerebrovascular accident which occurred at least one month (with an average of 9.7 months, SD =8.3, range = 1-22) prior to the testing. Based on the CAB, six of them were diagnosed with anomic aphasia and one with conduction aphasia. Their age ranged from 38 to 69 years (mean = 56.29, SD = 11.15) and they had an education between nine to 15 years (mean = 12, SD = 2.45).

Background information of the TBI and CVA groups are given in Table I. While Yiu (1992) did not specify the ranges of aphasia quotients (AQ) for various aphasia severity, only participant LYF (the only one with a Conduction aphasia) demonstrated a lower AQ of 60.8, which clinically was judged as moderate degree of aphasia severity. The majority of the anomic participants had a mild-to-moderate or mild degree of aphasia.

Insert Table I about here

The NBI group included six males and twelve females with no reported history of neurological deficits, head injuries, or other medical conditions that would impact their expressive language. All NBI participants were administered the Main Concept Analysis (MCA; Kong 2009, 2011, 2016b) to rule out any spoken discourse impairments. They were matched in age (young: 18 to 39 years; middle: 40 to 59 years; elderly: 60 years or older) and education level (low: 0-13 years for the two younger groups, and 0-6 years for the elderly group; high: at least 14 years for the two younger groups, and at least 7 years for the elderly group) with each speaker with aphasia.

Data collection

The Cantonese AphasiaBank protocol (Kong & Law, 2018) was administered to elicit the production of single-picture description, multiple-picture description, story-telling and procedural discourse. The single-picture-description involved two tasks, namely “Cat Rescue” and “Flood”, in which participants were provided with a line-drawing picture and a coloured photograph, respectively. For multiple-picture-description, participants were presented with a set of “Broken Window” line-drawing pictures with four panels and another set of “Refused Umbrella” with six panels pictures. For story-telling, everyone was asked to tell the stories of

traditional fables “The Tortoise and the Hare” and “The Boy who Cried Wolf”. Five coloured pictures were shown to the participants and were withdrawn before the production. For procedural discourse production of “Egg and Ham Sandwich”, participants were asked to describe the procedures to make a sandwich. Photos and written text of the ingredients were provided if the participant gave no response. The order of these discourse tasks was randomized and the production was elicited upon neutral prompts and natural conversation feedback, such as “Please tell me when happened in the pictures” and “Is there anything you want to add?”. Prompts specific to the content of the discourse tasks were avoided. All language samples produced by the participants were audio-recorded[2] for later transcription, segmentation, and analysis.

The two clinical groups (CVA and TBI) were administered the CAB to obtain the syndrome and severity of aphasia, as reflected by the aphasia quotient. The Chinese adaption of Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001) was implemented to examine the deficits of cognitive domains including attention, memory, executive functions, language, and visuospatial skills[3].

Data analysis

Global and local coherence ratings.

Each transcribed language sample was segmented into terminable units (T-units). A T-unit was defined as a main clause and all subordinate clauses and non-clausal structures attached or embedded within it (Scott & Nippold, 1988; see Appendix A for an illustration of T-unit segmentation). Each T-unit was rated and assigned using a five-point scale of 1 to 5 (a higher score indicated a greater degree of coherence) developed by Van Leer and Turkstra (1999) for both global and local coherence. As shown in Appendix B, higher global coherence corresponded to a

T-unit that provided substantive information related to the general topic, whereas a lower score was given to a T-unit that was unrelated to the general topic. Concerning the local coherence, a higher score was assigned when the topic of a T-unit was continued, elaborated, or coordinated with the topic of the immediately preceding T-unit. Lower degree of local coherence was given to a T-unit with a topic radically shifted or with a comment on the discourse.

Sequence of main events.

A main event was defined as an event that was (a) of sufficient importance to the story as a whole and (b) independent from the other story events (Capilouto et al., 2006). Ten NBI transcripts were first randomly selected from Cantonese AphasiaBank Database (Kong & Law, 2018) to establish normative data for the basis of analysis[4]. First, main events mentioned by at least 25% of the NBI speakers were listed for each task. The common order of events presented in at least seven of these speakers were then treated as the standard for scoring, i.e. the sequential order of mentioning main events was determined. For the language samples from the TBI and CVA groups, each main event was evaluated using a three-point scale of 0 to 2, as shown in Appendix C.

Informativeness.

With reference to the same set of normative data, content words in each task with at least 25% of occurrence were tallied and this listed (hereafter named as “informative word”) was subsequently utilized to be the scoring basis of informativeness. degree. For the language samples from the two clinical CVA groups, each informative word present was rated on a four-point scale of 0 to 3, as illustrated in Appendix D.

Statistical analysis

Two-way ANOVAs were conducted to investigate the effect of group (CVA, TBI, and NBI) and task (single-picture description, multiple-picture description, story-telling, and procedural discourse) on the measure of global coherence and local coherence. One-way ANOVAs were used to study the group and task effects on sequence of main events and informativeness. To examine how coherence, sequence of main events, and informativeness varied as a function of aphasia, Pearson correlations between these scores and the aphasia quotient of CAB were conducted. Another round of Pearson correlations was run to examine the relationships of these measures and CLQT scores of attention, memory, executive functions, language, and visuospatial skills.

Scoring reliability

Inter-rater and intra-rater scoring reliability were conducted using 25% of the language samples (n=9). These samples were randomly selected and re-analysed to estimate the agreement, calculated by the formula [total agreements/ (total agreements + total disagreements) × 100%]. Based on the results of an independent rater analysing these transcripts, there was an inter-rater agreement reaching 93% for global coherence, 91% for local coherence, 96% for sequence of main events, and 96% for informativeness. The intra-rater agreement conducted by the third author at two weeks later revealed a 95% for global coherence, 94% for local coherence, 94% for sequence of main events, and 97% for informativeness.

Result

Group effects on global and local coherence, sequence of events and informativeness

The results of two-way ANOVAs revealed the NBI group was significantly better than both clinical groups in global coherence [$F(2, 11)=24.57$, $p=.000$], local coherence, [$F(2, 11)=10.44$, $p=.000$], and sequence of events, [$F(2, 33)=15.12$, $p=.000$] (Table II). Post hoc tests with Bonferroni

correction (0.05/4 or 0.0125) indicated significant differences between TBI and NBI (p=.000) as well as between CVA and NBI (p =.000) on global coherence. Similar significant differences existed for sequence of events: between TBI and NBI (p=.003) as well as between CVA and NBI (p=.000). For local coherence, significant differences were only found between TBI and NBI (p=.000). As for the degree of informativeness, there seemed to be a lack of significant difference across our speaker groups (Table III).

Insert Table II about here

Insert Table III about here

Genre effects on global and local coherence

As shown in Table II, the results of two-way ANOVAs suggested a lack of a genre effect for both global coherence [F(3, 11)=1.64, p=.184] and local coherence [F(3, 11)= 2.54, p=.059]. That is, different elicitation tasks (i.e. single-picture description, multiple-picture description, story-telling, and procedural discourse) did not seem to influence the performance of global and local coherence respectively in both clinical groups.

Relations between language/cognitive deficits and coherence

The descriptive statistics of the language impairments, as reflected by aphasia quotient of the CAB, and deficits of various cognitive domains, as reflected by CLQT scores, in our TBI and CVA groups are displayed in Table IV. The results of Pearson correlations (Table V) revealed that the scores of attention and visuospatial skills from CLQT were positively and significantly correlated with global coherence in both clinical groups. In addition, significant positive correlations were found between the language score from CLQT and local coherence in both CVA and TBI groups. The aphasia quotient of the CAB also correlated positively with CVA group's local

coherence. Finally, a significant positive correlation existed between the sequence of events and global coherence rating for all three speaker groups.

Insert Table IV about here

Insert Table V about here

Discussion

To the best of our knowledge, this study is the first among the few reports in the literature that examined global and local coherence of spoken discourse among two different clinical groups of Chinese speakers with CVA and TBI. While most previous studies individually examined a specific narrative type, such as story-telling (e.g. Coelho & Flewellyn, 2003; Lindsey et al., 2018) or picture descriptions (e.g. Galetto et al., 2013), the present investigation have considered a range of elicitation tasks with reference to AphasiaBank protocol. Our findings revealing the lack of a genre effect on global and local coherence in both clinical groups was novel. Given that more researchers interested in spoken discourse either have followed or are starting to follow the standard AphasiaBank protocol in terms of elicitation tasks and procedures, comparing findings across these studies becomes easier and more meaningful.

Discourse coherence as a function of language integrity in TBI and CVA

Our results regarding both impaired global and local coherence in TBI were largely consistent with previous findings in the English literature (Galetto et al., 2013; Glosser & Deser, 1990; Hough & Barrow, 2003), albeit the lack of statistically significant differences on coherence between the CVA and TBI groups. We argue that these findings further supported the view that speakers with TBI exhibited a great compromise in maintaining and coordinating the overall organization of the discourse and the relation between adjacent utterances. The organizational demands of

discourse production posed additional challenges for them to maintain coherence, given their existing difficulty in linguistic and cognitive functioning (Lê, Mozeiko & Coelho, 2011).

Contrary to the widely-accepted notion of impaired coherence in the TBI population, there has been considerable debate on whether such a deficit existed in speakers with CVA. The results of this study were consistent with findings of impaired global coherence in CVA (Coelho & Flewellyn, 2003; Christiansen, 1995; Wright & Capilouto, 2012). It is argued here that this disruption was largely attributed to the decreased content and incorrect sequencing of events. Specifically, we demonstrated a significant positive correlation between the sequence of main events and global coherence in all three speaker groups. The measure of event sequence was also found to be significantly poorer in the two clinical groups, i.e. the problematic sequencing of events in the discourse yielded to the disturbance in these speakers' global coherence. The above extended the Ulatowska et al.'s (2013) conclusion of coherence being attributed to the logical temporal-casual order of events. It is not difficult to understand why listeners might perceive a discourse to be reduced in the degree of coherence (and in more severe case, listeners misinterpreted a message) if events were not adequately presented in an accurate temporal-casual sequence.

Finally, language score from CLQT was found to be significantly correlated with local coherence in both CVA and TBI groups. This finding was in line with Marini et al.'s (2014) study on TBI survivors that semantic appropriateness correlated with local coherence. It is believed that the better use of linguistic markers, such as connectives and grammatical morphemes, may promote the conceptual relationship between adjacent utterances. It is also worth mentioning that informativeness was significantly correlated with coherence ratings in the TBI group, but not

the CVA and NBI groups. There was also a lack of significant group effect for informativeness in comparison with the NBI controls. It, therefore, remains unanswered if micro-linguistic deficits contributed to incoherent discourse because the participants in this study were milder in their aphasia severity and did not show a great amount of lexical deficits in the discourse tasks. Further studies involving speakers with more severe aphasia is warranted.

Discourse coherence as a function of cognitive function in TBI and/or CVA

Consistent with the findings in Chow et al. (2016), the cognitive domains of attention and visuospatial skills were found to be associated with global coherence ratings in both CVA and TBI groups. In other words, our results supported a shared-systems hypothesis in which attention, visuospatial, and linguistic systems support coherence establishment in oral discourse. Note that previous studies have also supported the view that attention was of great significance in maintaining coherence (Barker et al., 2017; Glosser & Deser, 1990). Specifically, intact divided attention, or the ability to simultaneously process more than one response or to simultaneously react to more than one demands for multi-tasking, is crucial for speakers to coordinate and integrate their planning of conveying a message (as well as considering of listeners' perspective to understand the message). In order to achieve a higher global coherence, the speakers would need to concentrate on the general topic throughout the production of discourse. Extending this argument to a conversational context, Frankel, Penn, and Ormond-Brown (2007) also suggested that speakers would need to pay attention to recently stated information and integrate with new utterances to achieve coherence. Attention also plays a crucial role in speakers' monitoring of own irrelevant comments and derailments in discourse production (Marini et al., 2011). As for visuospatial skills, there are currently limited reports on its relationship with coherence. Here we

hypothesized that visuospatial skills would support online visual parsing and inference generation for discourse production. Failure to perceive the events outlined in picture stimuli may compromise the verbal output or content relevant to the general topic.

Potential clinical implications

In addition to enhancing our understanding of how coherence is impaired in speakers of the two clinical groups, our findings have important clinical implications by providing more insights to the clinical management of narrative deficits in speakers with aphasia. The significant correlation between global coherence and sequence of events indicated the importance of having correct logical and chronological event ordering to establish global coherence; this can be treated as a possible component of discourse treatment. For instance, Snow and Douglas (1999) proposed an exercise of listing and discussing story grammar elements so as to illustrate to patients the logical and sequential relationships between the parts of a story and improve narrative discourse. Apart from sequence of events, the cognitive domains of attention and visuospatial skills were also found to be strongly correlated with global coherence. It is suggested that clinicians shall consider the possible impacts of impaired attention and visuospatial skills on coherence during assessment and management. Indirect or compensatory strategies can be implemented by manipulate the environment of a clinic room to avoid distractions or by selecting appropriate stimuli (e.g. coloured pictures versus black-and-white line drawings) for evaluating or treating discourse tasks.

Limitations and directions for further extension

There were three major limitations of the current study. First, the small sample size might have hindered the homogeneity of our speaker groups. Subsequent to the impact of small sample

size, some possible factors on the subjects' performance, e.g. the effect of age, educational level, and lesion sites, were and could not be investigated. Second, the somewhat different range of post-onset time between the CVA and TBI groups was not ideal and might have limited one to interpret the results. Specifically, one of the individuals with CVA was only one-month post injury. At that time, a great deal of natural improvement would be seen, and the results might not be as useful for informing disorders typically seen in chronic aphasia. Further studies including a higher number of participants who are more homogenous in their demographic characteristics is recommended. Finally, only four tasks of the monologue genres were examined in this study. There was also a lack of lower-level functioning or non-fluent speakers with aphasia in the present investigation. Thus, one may criticize the scope of this examination being too small to be representative enough for addressing coherence deficits in the two clinical groups, i.e. how well the present findings on coherence may extend to the wide range of performance levels in speakers with TBI or CVA is questionable. Further extension may consider investigating a more diverse range of discourse, such as personal narratives and conversations, with more pathological and control participants. The age, educational level, and lesion sites of the clinical groups are also suggested to be controlled.

Conclusion

To conclude, this study investigated the group and genre effects on global and local coherence among speakers with TBI and CVA. Beyond the exploration of how discourse coherence was related to the sequence of producing content events, the authors have considered its relationship with attention and visuospatial skills. Future research involving a larger sample size and diverse types of discourse is warranted.

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Footnote

1. None of the participants received formal language interventions that addressed the coherence and/or cohesion of spoken discourse. However, prior to the time this study was conducted, they had received training focusing on swallowing (primarily) and functioning communication, with or without group interventions mediated by occupational therapists and/or physiotherapists. In other words, the treatment goals of these participants did not overlap with the aims of the present study and should not have any influence on the results.

2. The language samples were audio recorded for analysis. Examination of the use of non-verbal language, such as gestures (e.g. Kong, Law, & Cheung, 2018; Kong, Law, Wat, & Lai, 2015) or facial expressions (e.g. Kong, Law, & Lee, 2010) is clinically useful and should be considered in the future.

3. The total time needed to conduct all assessments and to collect all narrative samples was 120 to 150 minutes. Each participant completed the experimental tasks on two consecutive days.

4. This method followed the methodology of Kong and Wong (2018). Specifically, the total number of ten NBI participants was about 30% of the total sample size of 36 participants. In other words, the selection of ten NBI participants was not arbitrary.

Table I. Background information on participants with traumatic brain injury (TBI) and cerebrovascular accident (CVA)

Subject	Gender	Age	Years of education	Post-onset (months)	Lesion sites	Aphasia type	Aphasia quotient (out of 100)	CLQT total score (out of 89)
TBI group								
CHF	M	48	9	6	xxx	Anomic	89.1	xxx
CYC	M	35	9	18	xxx	Anomic	95.0	xxx
DRF	M	48	12	14	xxx	Anomic	92.5	xxx
GHL	M	28	9	12	xxx	Anomic	93.1	xxx
HCH	M	52	12	22	xxx	Anomic	92.4	xxx
HJL	F	46	6	11	xxx	Anomic	75.6	xxx
LPM	M	38	9	10	xxx	Anomic	96.6	xxx
LSH	F	28	9	9	xxx	Anomic	90.1	xxx
PHF	M	31	7	14	xxx	Anomic	77.6	xxx
STB	M	32	9	10	xxx	Anomic	80.4	xxx
ZWP	M	29	9	8	xxx	Anomic	91.8	xxx
CVA group								
HPT	M	69	12	1	xxx	Anomic	92.5	xxx
LRJ	F	53	9	5	xxx	Anomic	80.6	xxx
LYF	F	65	12	7	xxx	Conduction	60.8	xxx
LYL	M	47	15	1	xxx	Anomic	81.9	xxx
SGT	M	57	12	22	xxx	Anomic	95.9	xxx

ZX	M	38	15	15	xxx	Anomic	92.5	xxx
ZYC	M	65	9	17	xxx	Anomic	91.8	xxx

Table II. Descriptive statistics and results of two-way ANOVAs for between-group and between-task differences for global and local coherence

	Global coherence						**Local coherence**					
	CVA		**TBI**		**NBI**		**CVA**		**TBI**		**NBI**	
Tasks	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD
Single-picture description	3.08	0.73	3.16	0.65	3.94	0.43	3.35	0.85	3.05	0.91	4.00	0.31
Multiple-picture description	3.07	1.01	3.75	0.73	4.22	0.36	3.63	1.03	3.41	0.83	4.03	0.28
Story-telling	3.58	0.78	3.17	1.12	4.32	0.37	3.52	0.80	3.49	0.59	3.99	0.35
Procedural discourse	3.35	0.92	3.74	0.58	4.04	0.51	4.13	0.75	3.74	0.65	3.87	0.67
Mean value	3.30	0.78	3.44	0.71	4.17	0.24	3.59	0.62	3.42	0.47	3.98	0.24
Source	SS		df		MS	F	SS		df		MS	F
Group	20.77		2		10.38	24.57*	8.47		2		4.23	10.44*
Task	2.07		3		0.69	1.64	3.10		3		1.03	2.54
Group x Task	4.16		6		0.09	1.64	3.71		6		0.62	1.52

Note: CVA = cerebrovascular accident; TBI = traumatic brain injury; NBI = non-brain injured. Gp $\bar{x}$ = Group mean; SD = standard deviation. * $p<.001$.

Table III. Descriptive statistics and results of one-way ANOVAs for between-group and between-task differences for sequence of events and informativeness

Measures	F	CVA		TBI		NBI	
		Gp $\bar{x}$	SD	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD
Sequence of events	15.12***	0.29	0.16	0.40	0.17	0.58	0.07
Informativeness	2.68	0.37	0.13	0.45	0.13	0.68	0.46

Note: CVA = cerebrovascular accident; TBI = traumatic brain injury; NBI = non-brain injured. Gp $\bar{x}$ = Group mean; SD = standard deviation. * p<.05; ** p<.01; *** p<.001

Table IV. Descriptive statistics of the AQ of CAB and scores of different cognitive domains from CLQT for CVA and TBI groups

	CVA		**TBI**	
Measures	Gp $\bar{x}$	SD	Gp $\bar{x}$	SD
CAB: Aphasia Quotient	85.14	12.19	88.56	7.24
CLQT: Attention	62.43	63.52	113.45	67.56
CLQT: Memory	81.86	26.48	92.18	22.13
CLQT: Executive Functions	10.57	9.66	15.64	9.09
CLQT: Language	19.21	3.76	19.32	3.55
CLQT: Visuospatial Skills	33.57	31.81	57.00	27.76

Note**:** CVA = cerebrovascular accident; TBI = traumatic brain injury. Gp $\bar{x}$ = Group mean; SD = standard deviation. CAB = Cantonese version of the Western Aphasia Battery; CLQT = Cognitive Linguistic Quick Test.

Table V. Results of Pearson Correlation between different variables and coherence in CVA, TBI and NBI groups

	Global coherence			**Local coherence**		
	CVA	**TBI**	**NBI**	**CVA**	**TBI**	**NBI**
Variables	r	r	r	r	r	r
Sequence of events	.83*	.90***	.54*	.51	.80**	.43
Informativeness	.70	.86**	-0.06	.42	.75**	-0.27
CAB: Aphasia Quotient	.53	.55	--	.90**	.37	--
CLQT: Attention	.91**	.69*	--	.77*	.45	--
CLQT: Memory	.68	.75**	--	.50	.72*	--
CLQT: Executive Functions	.85*	.59	--	.70	.43	--
CLQT: Language	.62	.67*	--	.89**	.78**	--
CLQT: Visuospatial Skills	.90**	.70*	--	.68	.45	--

Note: CVA = cerebrovascular accident; TBI = traumatic brain injury; NBI = non-brain injured. * p<.05; ** p<.01; *** p<.001. CAB = Cantonese version of the Western Aphasia Battery; CLQT = Cognitive Linguistic Quick Test.