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ORIGINAL ARTICLE

Measuring pragmatic competence of discourse output among Chinese-speaking individuals with traumatic brain injury

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Abstract

Objective: Discourse analysis is one of the clinical methods commonly used to assess the language ability of individuals with traumatic brain injury (TBI). However, the majority of published analytic frameworks are not geared for highlighting the pragmatic aspect of discourse deficits in acquired language disorders, except for those designed for quantifying conversational samples. This study aimed to examine how pragmatic competence is impaired and reflected in spoken monologues in Chinese speakers with TBI.

Methods: Discourse samples of five tasks (personal narrative, storytelling, procedural, single- and sequential picture description) were elicited from ten TBI survivors and their controls. Each discourse sample was measured using 16 indices (e.g., number of informative words, percentage of local/global coherence errors, repeated words or phrases) that corresponded to the four Gricean maxims. Twenty-five naïve Chinese speakers were also recruited to perform perceptual rating of the quality of all 50 TBI audio files (five discourse samples per TBI participant), in terms of erroneous/inaccurate information, adequacy of amount of information given, as well as degree of organization and clarity.

Results: The maxim of quantity best predicted TBI's pragmatic impairments. Naïve listeners' perception of pragmatics deficits correlated to measures on total and informative words, as well as number and length of terminable units. Clinically, personal narrative and storytelling tasks could better elicit violations in pragmatics.

Conclusion: Applying Gricean maxims in monologic oral narratives could capture the hallmark underlying pragmatic problems in TBI. This may help provide an additional approach of clinically assessing social communications in and subsequent management of TBI.

Keywords: pragmatics; traumatic brain injury; discourse; Chinese; Gricean maxims

Introduction

Individuals with traumatic brain injury (TBI) often demonstrate a variety of communication problems. The communication problems are suggested to result from disruptions in the complex interactions between cognitive, linguistic, and social demands (Coelho, Liles, & Duffy, 1995). Instead of showing linguistic impairments in formal language assessments, individuals with TBI are usually observed to demonstrate deficits in linguistic processing (e.g., Sarno, 1980, 1984). For example, in terms of sentence production, Ellis and Peach (2009) reported longer initiation times in the sentences produced by speakers with TBI and concluded that speakers with TBI

suffered from problems with sentence planning. Similarly, Lau, Kong, and Chan (2022) obtained language samples from Chinese-speaking participants and observed that the TBI group produced more errors, different varieties of sentence types, and lower syntactic complexity in their sentence production compared with the control group. The manifestation of language impairments of individuals with TBI is usually reported to be even more pronounced beyond syntactic measures. Coelho et al. (2005), for example, obtained narrative samples and reported disorganization of spoken output in individuals with TBI that manifest across sentential boundaries. Kong, Lau, and Cheng (2020) also reported deficits in the thematic organization of main ideas in the narratives produced by individuals with TBI. Overall, the language disruptions observed among TBI survivors appeared to be less apparent when measured in terms of syntactic forms of language, but more apparent when the use of language is quantified (e.g., Hagan, 1984; Kong, Lau, & Chan, 2019).

Pragmatic competence is the ability to use language effectively in a contextually appropriate fashion (Penn, 1999) and to communicate effectively across contexts (Dahlberg et al., 2007). Many survivors of TBI demonstrate a relatively intact language ability, but their pragmatic skills are impaired, causing considerable barriers to effective communication. For example, some recent reports examining the communicative-pragmatic disorders in speakers with TBI have suggested that both impaired cognitive performance in executive functions and theory of mind could contribute to their pragmatic difficulties (e.g., Bosco, Gabbatore, Angeleri, Zettin, & Parola, 2018; Bosco, Parola, Sacco, Zettin, & Angeleri, 2017). Rowley, Rogish, Alexander, and Riggs (2017) have also reported significant correlations between cognitive measures (e.g., declarative or working memory, attention, and executive functions) and pragmatic comprehension in adults with TBI. In addition, Carlomagno et al. (2011) and Marini et al. (2011) have previously stated that Italian and English speakers with TBI, respectively, demonstrated intact language ability in terms of the amount of information content within discourse production (elicited using a picture description task of single and sequential pictures) being comparable to healthy controls; in contrast, pragmatic deficits were found including errors of cohesion and coherence. Furthermore, individuals with TBI have been reported to demonstrate the following impairments, including overly talkative (Hagan, 1984), tangential and inappropriate (Kong et al., 2019) as well as reduced (Gao, Kong, & Lau, 2016) speech content, unable to convey sufficiently detailed information (McDonald & Van Sommers, 1993), inappropriate verbal (e.g., excessive foul language, yelling, or shouting) as well as non-verbal (e.g., difficulty perceiving personal space, limited facial expressions, or reduced prosody and intonation) behaviors (Mahar & Fraser, 2011), and excessive verbal requests (McDonald & Van Sommers, 1993) or inappropriate initiation, termination, or turn-taking during conversations (Mahar & Fraser, 2011).

To ensure appropriate and effective communication, Grice (1975) proposed the Cooperative Principle and its four maxims, namely Quality, Quantity, Relevance, and Manner, to describe how effective communication in conversation can be achieved in common social situations. Violations in Gricean maxims may result in misunderstanding and false information exchange between speakers and listeners; these violations demonstrated by those with TBI would be more apparent (i.e., more problematic communication) and lead to more devastating effects in pragmatics (Douglas, 2010). For instance, compromised maxim of quantity and quality may manifest in leaving out of important/essential details or giving false information, respectively, in TBI's output (see additional examples in Douglas, Bracy, & Snow, 2007).

There are three prominent pragmatic language skills that are frequently disrupted in adults with pragmatic impairments, such as those caused by a TBI, including the interpretation of implicature, the use of reference, and the management of information (Cummings, 2021). However, relative to impaired semantics and phonology, much less research have been conducted to investigate pragmatic impairments and this has resulted in fewer evidence-based rehabilitation programs/protocols or therapy approaches readily available for clinical application (Cummings, 2021). Most existing standardized language batteries for acquired communication disorders (such as aphasia) focus primarily on language comprehension (e.g., reading or auditory

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passage comprehension tasks) and expression (e.g., naming or sentence production tasks) and do not consider one's pragmatic competence – see Comprehensive Aphasia Test (Swinburn, Porter, & Howard, 2004) or Western Aphasia Battery (Kertesz, 1982) and their Cantonese versions (Kong & Ng, 2022; Yiu, 1992). There are also assessments that are cognitive communication focused, such as the Measure of Cognitive Linguistic Abilities (MCLA; Ellmo, 1995), Montreal Protocol for the Evaluation of Communication (MEC; Joanette et al., 2015), or Birmingham Cognitive Screen (BCoS; Humphreys, Bickerton, Samson, & Riddoch, 2012) and its Cantonese version (Kong et al., 2018; Pan et al., 2015). Clinicians often need to use specific checklists or profiles targeting verbal and non-verbal pragmatic behaviors to assess one's pragmatic skills. For example, Prutting and Kirchner's (1987) Pragmatic Protocol is based on the use of a speech act theory as the means of organizing pragmatic parameters. Based on this protocol, breakdowns in pragmatic behaviors could be categorized according to utterance acts, propositional acts, illocutionary and perlocutionary acts. In another example, Bishop (2003) proposed a Children's Communication Checklist, based on results obtained from a questionnaire given to families of 87 children with pragmatic language impairments. Although these checklists vary in the number and range of pragmatic behaviors that were examined, it was concluded that corresponding results were comprehensive enough to clinically guide intervention.

On the other hand, there is an increasing number of studies that reported the use of assessments based on conversation (Angeleri et al., 2008) or discourse analysis (Steel & Togher, 2019) to characterize the pragmatic impairments of one's spoken output. These assessments tended to be labor- and time-intensive because they typically required interviews and/or running of questionnaires with a client and the communicative partner, involved language sample transcriptions, and extensive coding or annotation of appropriate verbal and non-verbal pragmatic behaviors. However, proper analyses of the final results can help reveal the comprehensive nature of pragmatic disorders, ranging from areas of speech acts (such as topic management or turn-taking) to inter-sentential cohesion and coherence (Cummings, 2009).

Kong et al. (2020) have recently reported impaired global and local coherence in Chinese-speaking TBI survivors. Specifically, two groups of speakers with neurogenic communication disorders, including one group of stroke survivors with aphasia and another group of individuals with TBI, provided language samples of single- and sequential picture description and storytelling. The elicited discourse samples were quantified in terms of global and local coherence ratings, sequence of content (e.g., main events), and informativeness. The authors found that the problematic sequence of main events produced by the TBI group correlated significantly with their reduced global coherence. Their impaired language integrity was also associated with problems of local coherence. It was concluded that secondary to the inherent linguistic and cognitive dysfunction, these speakers tended to demonstrate a greater degree of difficulties not only in maintaining and coordinating the overall organization of spoken discourse, but also the association between adjacent utterances. Note also that according to Bliss and McCabe (2006), common discourse elicitation tasks, such as the ones mentioned previously mentioned in this Introduction section, are different in terms of the linguistic and cognitive demand (and therefore the level of difficulty) they placed on a speaker. Capilouto, Wright, and Wagovich (2006) have also suggested the number of pictorial stimuli and the target information embedded in these pictures would play a role in how much lexical content one would provide in a spoken discourse task; this applied to both participants with and without a language disorder. It remains unclear if, and how, pragmatic competence (or impairments) would potentially vary across different genres in the TBI population.

Aims

In short, previous studies have highlighted the disruptions in language pragmatics among individuals with TBI (Hagan, 1984; Mahar & Fraser, 2011; McDonald & Van Sommers, 1993), but its manifestation in Chinese speakers with TBI remains unclear. As suggested by González (2005),

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pragmatic markers in discourse are essential to the organization of oral narrative, but the overall quantity, occurrence, and distribution of these markers may vary not just across text genre but also languages. The current study aimed to explore how Chinese-speaking TBI individuals are pragmatically impaired in spoken discourse as measured by violations of Gricean maxims. In addition, the current study further explored how the pragmatic performance of the Chinese-speaking TBI individuals may vary according to the cognitive and social demands (e.g., Coelho et al., 1995) by observing the significance of the effects of discourse genre and visual support in the discourse. Finally, despite being subtle, the language impairments of TBI individuals may interact with their pragmatic performance. Hence, we also intended to explore if any pragmatic impairments observed among the TBI individuals are associated with the severity of the individuals' language impairments. In particular, there were five aims:

1. To examine if pragmatic measures can be used to differentiate between Chinese speakers with TBI and non-brain injured (NBI). With reference to Carlomagno et al. (2011) and Marini et al. (2011), it was predicted that violations of Gricean maxims would be found in the Chinese TBI population.
2. To determine if there is a genre effect (i.e., different discourse tasks of storytelling, single- and sequential picture description, procedural discourse, and personal monologues) on the pragmatic ability of the TBI and NBI groups. With the reference to Bliss and McCabe (2006), it was predicted that the pragmatic competence rating would be more well-preserved in storytelling as illustrations (in)directly informing the story structure of the expected discourse output were available for the TBI group; this would be followed by personal and procedural narratives that would require planning and organization of utterances around a theme. A higher degree of wordiness in the narrative and procedural tasks was also expected which would reflect violation of the maxim of quantity. The results of this examination were anticipated to inform which of the five genres could provide the best evaluation of pragmatic ability following TBI.
3. To investigate how the existence of visual support (pictured vs. pictureless tasks), types of pictures (line-drawing, colored pictures, vs. real photos), and the number of pictures would play a role in reflecting pragmatic competence in the TBI and NBI groups. In previous studies, numbers of main events produced were found to increase with number of elicitation pictures (Capilouto et al., 2006); which would be shown by a better performance in maxim of quantity of the present study. On the other hand, speakers would tend to use pronouns with shifting reference and pay more attention to the hearer's mental representations (maxim of relation) in the absence of pictorial support (Cummings, 2021). In other words, it is anticipated that different elicitation tasks might place different cognitive demands on TBI speaker's organization, resulting in the difference in the amount of information (maxim of quantity) as well as the degree and quality of coherence (maxim of relation).
4. To examine how pragmatic performance would vary as a function of the severity of language impairment, and types of aphasia or cognitive deficits in TBI. According to Cummings (2009), pragmatic competence is highly correlated with cognition and language ability. It is predicted that the TBI group, who were comorbid with aphasia, would demonstrate poorer pragmatic performance.
5. To explore which of four pragmatic maxims would show a stronger relationship with naïve listeners' subjective rating on discourse production from Chinese-speaking individuals with TBI. It was hypothesized that the maxims of quantity and relation would best correlate with naive listeners' ratings. This is because the characteristics of pragmatic deficits associated with TBI (e.g., insufficient or too much information, poor local or global coherence) are easier to show in spoken discourse production, and these features are frequently perceived as limited output or increased verbosity and tangentiality in subjective judgment (Kong et al., 2019).

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Methods

Part 1: Discourse sample collection and analysis

Participants

A total of ten adults (aged 18 years or older; see Table 1) with TBI were recruited from the Guangdong Work Injury Rehabilitation Hospital. They included five native Cantonese and five native Mandarin speakers born in the Guangdong province of Mainland China. All TBI participants were diagnosed by neurologists and/or medical internists with a confirmed closed head brain injury that had occurred at least 5 months prior to the testing. Each participant was diagnosed with fluent aphasia with the Cantonese (CAB; Yiu, 1992) or Mandarin version of the Western Aphasia Battery (MAB; Peking University Health Science Center, 1988). None of the TBI participants received formal language interventions that addressed their spoken discourse. However, prior to the time this study was conducted, they had received training focusing on swallowing (primarily) and functional communication with treatment goals not overlapping with the aims of the present study (and hence posing any influences on the results). In addition, each of them received an evaluation of cognitive ability using the Chinese adaption of the Cognitive Language Quick Test (CLQT; Helm-Estabrooks, 2001).

Another ten NBI control participants (five native Cantonese and five native Mandarin speakers) matched in age (Young: below 40 years of age, Middle-age: 40–60 years, and Elderly: above 60 years) and education level (low: 0–11 years for the two younger groups, and 0–6 years for the elderly group; high: at least 12 years for the two younger groups, and at least 7 years for the elderly group) were also invited to join the study. The NBI group had no reported history of neurological deficits, head injuries, or other medical conditions that would affect their receptive and expressive language abilities.

Language samples

Elicitation of language samples followed the Cantonese Aphasia Bank Protocol (Kong & Law, 2019) modified for TBI. A total of five discourse productions with various types (i.e., line-drawing, colored pictures, real photos) and amounts of pictorial supports (i.e., 0 in the personal narrative task to 6 in a multiple picture description task), and time of display (i.e., withdrawn before or along the production) of visual support of each participant were elicited.

Specifically, for the single picture description tasks, one line-drawing of the 'Cat rescue' picture and a colored photograph of 'Flood' was presented to the participants during description. Concerning the sequential picture description task, a set of 'Refused Umbrella' line-drawing pictures with six panels was provided during the production. For the storytelling task, participants were asked to tell the story of 'The Boy Who Cried Wolf'; five colored pictures were shown and then withdrawn before production. For the procedural discourse task, everyone was asked to describe the procedures to make an 'Egg and Ham Sandwich'; photos and written text of the ingredients were provided only if a participant failed to give verbal responses. Prompts specific to the content of the above four discourse tasks were avoided. Finally, in the personal narrative task, participants were asked to recount an important event. This task was first designed as a personal monologue, but neutral prompts and conversation feedback (with or without follow up questions) were provided when participants presented limited production. All samples produced by the participants were audio-recorded.

Each discourse sample was measured using 16 indices, in terms of the four Gricean maxims, adopted and modified from Andreetta, Cantagallo, and Marini (2012), Cummings (2021), Galski, Tompkins, and Johnston (1998), and Kong and Law (2004). A detailed description of the procedure for calculating these indices is given in Table 2.

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Table 1. Background Information on Participants in the Traumatic Brain Injury (TBI) and Non-brain Injured (NBI) Groups

Participant	Language	Gender	Age (years/ group)	Education (years/group)	Months post onset	Aphasia quotient (/100)[a]	Aphasia type[a]	CLQT total score (/89)[b]
TBI								
CWF	Cantonese	M	48/Middle	9/Low	6	89	Anomic aphasia	52
HJM	Cantonese	F	23/Young	12/High	40	91	Anomic aphasia	48
LCH	Cantonese	M	64/Elderly	14/High	54	90	Anomic aphasia	57
LSH	Cantonese	F	28/Young	9/Low	9	90	Anomic aphasia	19
TYF	Cantonese	M	48/Middle	15/High	14	92	Anomic aphasia	59
CY	Mandarin	M	47/Middle	9/Low	55	90	Anomic aphasia	75
TYK	Mandarin	M	37/Young	9/Low	64	89	Anomic aphasia	62
THP	Mandarin	M	33/Young	15/High	27	88	Anomic aphasia	83
PGH	Mandarin	M	48/Middle	14/High	5.5	76	Anomic aphasia	16
HGZ	Mandarin	M	63/Elderly	6/Low	5	80	Anomic aphasia	22
NBI[c]								
LB	Cantonese	M	50/Middle	10/Low	–	–	–	–
TA	Cantonese	M	25/Young	14/High	–	–	–	–
CRR	Cantonese	F	60/Elderly	14/High	–	–	–	–
HHC	Cantonese	F	30/Young	11/Low	–	–	–	–
LSK	Cantonese	M	57/Middle	14/High	–	–	–	–
LYH	Mandarin	F	48/Middle	11/Low	–	–	–	–
WH	Mandarin	F	30/Young	10/Low	–	–	–	–
LD	Mandarin	M	35/Young	14/High	–	–	–	–
WQ	Mandarin	M	49/Middle	14/High	–	–	–	–
CYS	Mandarin	M	65/Elderly	6/Low	–	–	–	–

[a]Based on Cantonese (CAB; Yiu, 1992) or Mandarin (Peking University, 1988) version of the Western Aphasia Battery. A cutoff of 96.4 and 98.4 was suggested for the Cantonese and Mandarin version, respectively.
[b]Chinese adaption of Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001). It was used as a standalone overview assessment that gives a broad perspective across relevant domains of cognition (attention, memory, executive functions, visuospatial skills) and language.
[c]Based on results of paired samples *t*-test, two groups were not significantly different for age, $t(9) = -.755$, $p = .47$, and years of education, $t(9) = -1.616$, $p = .14$.

Part 2: Naïve listeners' rating of discourse samples

A total of 25 naïve Chinese speakers were recruited to perform perceptual rating of all 50 audio files (five discourse samples per TBI participant). These listeners were, included three men and twenty-three women, all between 22 and 27 years. They were divided into four listening groups (three groups of six people and one group of seven people). The 50 files were randomized into four

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Table 2. Indices of Measuring Pragmatics

Maxims (Grice, 1975)	Measures	Definition and source(s)	Remarks and/or examples in Chinese
1. *Maxims of Quality* (be truthful and avoid saying something lacking adequate evidence)	i. Number of error (Er)	Errors at the word level included jargons, neologisms, phonemic paraphasias, and semantic paraphasias; errors at the sentence level included agrammatism (Kong & Law, 2004).	–
	ii. Index of Error (IEr)	Adapted from Kong and Law (2004), it was calculated by dividing the number of errors by the total number of informative words (see index vi).	–
	iii. Index of Syntactic Accuracy (ISA)	A newly devised index which aimed at identifying the accuracy at sentence level (since it is not covered by IEr); computed by dividing the number of erroneous productions at the sentence level by the total number of sentences.	–
	iv. Repairs and revisions of error (RE)	Numbers of spontaneous corrections of recognized errors in the use of words or phrases, grammar, syntax, and phonemes (Galski et al., 1998) were tallied.	–
2. *Maxim of Quantity* (avoid providing less or more information than is required for the current purposes of the exchange)	v. Total number of words per task (N)	This was the total number of words in a discourse sample, including: incorrect words, phonemic paraphasias, neologisms, repetitions, self-corrections, irrelevant statements, digressions, habitual statements, comments, and fragments that seem to be identifiable as broken-off words. The following was excluded from the count: hesitation noises, interjections, untranscribable mumbles, false starts on a word that is eventually produced, and subject's direct responses to questions or probes from the examiner (Kong & Law, 2004).	Complex words in Chinese included reduplication (e.g., 乾乾淨淨), affixation (e.g., 基督教). Each complex or compound (e.g., 粟米湯) word was counted as one word (Matthews & Yip, 2013).
	vi. Number of information words (I-word)	A unit or piece of information in the form of a lexeme correctly produced for describing a (key) element of the stimulus material (Kong & Law, 2004).	Each genre (i.e., storytelling, procedural discourse, a single picture, and multipicture description) except for personal narrative was first divided into different scenarios. Scenarios that did not appear at least 60 % of the time in the NBI samples were excluded. The key lexical items use in those scenarios were counted as I-words (Kong & Wong, 2018; Kong, 2006)
	vii. Number of Terminable units (T-unit)	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).	A sample transcript of a language sample ('Cat Rescue') in T-units: For example, 有 / 一 / 隻 / 狗 / 追 / 佢 (Kong et al., 2020)
	viii. Words per T-unit	Total number of words within a single T-unit.	Total number of words of this T-units 有 / 一 / 隻 / 狗 / 追 / 佢 is 6.

(*Continued*)

Table 2. (*Continued*)

Maxims (Grice, 1975)	Measures	Definition and source(s)	Remarks and/or examples in Chinese
3. *Maxim of Relation* (be relevant to the verbal exchange)	ix. Global coherence errors (GE)	Global coherence refers to the ability to organize propositions into a discourse with respect to an overall goal, theme, or topic (Kong et al., 2020). Errors of global coherence included the production of utterances that may be tangential, conceptually incongruent with the story, propositional repetitions, or simple fillers (Andreetta et al., 2012). In the present study, there were two types of errors: *tangential errors* or *conceptually incongruent errors*	In the 'Cat Rescue' picture description task: 1. Tangential error: For example, /有隻貓爬咗上樹/ 我都鍾意爬樹/我以前成日爬樹 Here, the second and the third utterances were scored as tangential, as they referred to information that was irrelevant for the task and was simply triggered by a specific idea depicted in the stimulus. 2. Conceptually incongruent error: For example, /消防員攞住爬梯 / 個天有彩虹/ 貓仔訓緊教/ In this example, the second utterance was scored as conceptually incongruent because in the picture stimulus there was no rainbow.
	x. Percentage of global coherence errors (%GE)	Calculated by dividing the number of global coherence errors by the number of utterances and multiplying this value by 100 (Andreetta et al., 2012).	–
	xi. Local coherence errors (LE)	Local coherence refers to the relationship of the meaning or content of an utterance to that of the preceding utterance. Local coherence errors included the production of words without a clear referent and topic switching (Andreetta et al., 2012). In the present study, there were two types of error: 1. *Missing referents* were counted whenever the referent of a pronoun or the implicit subject of a verb was not unambiguously clear. 2. *Topic switch* was scored whenever an utterance was abruptly stopped but the following utterance did not continue the flow of thoughts, therefore introducing new pieces of information.	In the storytelling task: 1. *Missing referent:* For example 班村民好嬲 / [個牧童]就大笑 / In the second utterance there was a missing referent because it is not clear whom the verb '大笑' ('laugh') was referring to. 2. *Topic switch:* For example, / 村民就…… / 牧童就大笑 / the first utterance remained unfinished while the second utterance introduced new information.
	xii. Percentage of local coherence errors (%LE)	Calculated by dividing the number of local coherence errors by the number of utterances and multiplying this value by 100 (Andreetta et al., 2012).	-

(*Continued*)

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Table 2. (*Continued*)

Maxims (Grice, 1975)	Measures	Definition and source(s)	Remarks and/or examples in Chinese
4. *Maxim of Manner* (avoid obscurity of expression, avoid ambiguity, be brief, and orderly)	xiii. Repetition of words and phrases (Rep)	Redundancy in the use of words and phrases that the speaker simply repeated ideas that had already been provided. Typically, the speaker did not add any new information (Andreetta et al., 2012).	For example, 個牧童覺得好悶 / 佢好悶 / The second utterance simply repeated what had already been stated in the previous one; this was counted as a repetition.
	xiv. Index of lexical efficiency (ILE)	Adapted from Kong and Law (2004) and Hilger et al. (2014). It was computed by dividing the total number of words by the number of I-words. Hence, a lower score on this measure indicated a more efficient transmission of information.	–
	xv. Index of Communication Efficiency (ICE)	Adapted from Kong and Law (2004) and Hilger et al. (2014). This index reflected the rate of I-words produced. It was calculated by dividing the number of I-words by the duration of recording in minutes.	–
	xvi. Number of cohesive devices per T-units (CD)	This aimed at measuring the cohesive adequacy (Liles, Coelho, Duffy, & Zalagens, 1989) and included various types of connectives, such as temporal, causal, hypothetical, adversative connectives.	In Chinese, there are different types of connectives, including temporal (e.g., 首先、最後), causal (e.g., 因為), hypothetical (e.g., 如果), and adversative (e.g., 雖然).

Table 3. Statements and Corresponding Categories for Naïve Listeners' Perceptual Rating of Audio Files

Statement (English/Chinese)	Types of Maxims
1. This person's discourse contained a lot of errors/inaccurate information.	Maxim of Quality
這個人的話語內容有很多錯誤資料。	
2. This person provided an adequate amount of information, neither too much nor too little.	Maxim of Quantity
這個人的話語能提供適當的資訊,不會過多,也不過太少。	
3. This person told an organized and pertinent discourse.	Maxim of Relation
這個人講述了一段有組織和貼題的話語。	
4. This person's discourse was clear and concise.	Maxim of Manner
這個人的話語是清晰和簡潔的。	

different sets of sequences, one for each listening group, before the participants were asked to listen and rate each file independently. Each naïve listener was asked to refer to the four statements (see Table 3) and to rate the quality of each TBI production using a 5-point Likert scale (5: strongly agree, agree, neutral, disagree, to 1: strongly disagree) immediately after listening to each audio recording. The four statements were presented simultaneously in both English and Chinese to the raters, and they could not communicate with other listeners when rating the samples.

The listening session lasted for around 1.75 h, including a 15-min introduction and training, and a 5-min break. At the beginning of the rating session, the third author first introduced and explained the definition of the four rating statements, followed by a mock scoring using two different audio files, to ensure that all listeners fully understood the rating procedures and a common rating standard was established. The raters could also raise any inquiries in these practice trails.

Statistical analysis

To address Aim 1, pragmatic deficits consistent with previous research studies (e.g., errors of cohesion and coherence or violations of Gricean maxims) were measured. Independent sample *t*-tests were conducted between the TBI and NBI groups across all objective pragmatic measurements.

For Aim 2, in order to investigate the effect of group and genres (single picture description, multiple picture description, storytelling, procedural discourse, and personal narratives), the means of the ratings from naïve listeners were compared between the four Gricean maxims. To determine whether and how the existence of visual supports and types of pictorial stimuli would influence the pragmatic performance of individuals in the TBI group (Aim 3), the naïve listener ratings were compared with the pragmatic measures.

As for Aim 4, Pearson's *r* correlations were conducted to examine the relationship between pragmatic competence and TBI severity. In addition, correlations between the unit-weighted composite score of the five cognitive domains in CLQT (attention, memory, language, executive functions, and visuospatial skill) and each discourse measure were administered. Finally, a Pearson's r correlation was conducted to examine the relationships of the 16 pragmatic measures and naïve listeners' ratings (Aim 5).

Results

Measures of maxims

Descriptive results of the TBI and NBI performance across all 16 pragmatic measures are summarized in Table 4. Correlation results between the pragmatic measures and the corresponding maxim are displayed in Table 5.

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Table 4. Pragmatic Performance in the TBI and NBI Groups

Maxims	Pragmatic measures	TBI	NBI
Maxims of Quality	i. Number of errors (Er)	1.52 (2.17), 0–10*	0.62 (1.41), 0–7
	ii. Index of Error (IEr)	0.17 (0.36), 0–2	0.18 (0.04), 0–0.26
	iii. Index of Syntactic Accuracy (ISA)	0.005 (0.24), 0–0.125	0.22 (0.14), 0–1
	iv. Repairs and revision of errors (RE)	0.06 (0.24), 0–1	0.50 (0.76), 0–2
Maxims of Quantity	v. Total number of words per task (N)	41.30 (27.66), 3–132	105.40 (92.30), 10–403
	vi. Number of information words (I-word)	18.16 (15.04), 0–65	45.94 (54.47), 0–310
	vii. Number of terminable units (T-unit)	8.72 (4.87), 2–31	26.58 (12.70), 2–71
	viii. Words per T-units	4.47 (1.56), 1.33–8.25	6.54 (1.70), 2.50–10.40
Maxims of Relation	ix. Number of global coherence errors (GE)	0.78 (1.30), 0–7	1.74 (3.21), 0–16
	x. Percentage of global coherence errors (%GE)	12.07% (20.74%), 0%–100%	11.79 (21.39%), 0%–100%
	xi. Number of local coherence errors (LE)	0.36 (0.78), 0–4	0.67 (1.33), 0–5
	xii. Percentage of local coherence errors (%LE)	4.58% (10.51%), 0%–50%	5.22 (11.01%), 0%–41.67%
Maxims of Manner	xiii. Repetition of words and phrases (Rep)	0.68 (1.06), 0–4	0.54 (0.97), 0–4
	xiv. Index of Lexical Efficiency (ILE)	2.73 (1.45), 1–7	2.78 (1.63), 1.06–10.20
	xv. Index of Communication Efficiency (ICE)	20.54 (21.25), 0–108.33	50.26 (30.05), 0–118.18
	xvi. Number of Cohesive devices per T-units (CD)	0.18 (0.23), 0–0.86	0.28 (0.23), 0–0.84

*Values are presented in 'mean (standard deviation), range'.

Relative to Measures of Quality, results of independent sample *t*-tests indicated that the TBI group made significantly more errors than the NBI group [$t(98) = 2.46$, $p < .05$], scored significantly lower in the Index of Error (IEr) [$t(98) = 2.96$, $p < .01$], and demonstrated significantly fewer repairs and revision of errors [$t(98) = 3.89$, $p < .001$]. However, the two groups did not differ in terms of syntactic accuracy. The results of Pearson's *r* correlation (Table 5) further indicated that the ratings of the maxim of quality were significantly correlated with the number of errors produced, but not with IEr and number of repairs.

In terms of Measures of Quantity, results of independent sample *t*-tests indicated that the TBI group produced significantly shorter discourse than the NBI counterpart [$t(98) = 4.70$, $p < .001$], produced significantly fewer information words (I-words) [$t(98) = 3.48$, $p < .001$], terminable units (T-units) [$t(98) = 3.57$, $p = .001$], and words per T-unit [$t(98) = 6.35$, $p < .001$]. The results of Pearson's *r* correlation (Table 5) also indicated that the ratings of the maxim of quantity were significantly correlated with all the four measures (v–viii).

Regarding Measure of Relation, the results of independent sample *t*-tests indicated that the two groups did not differ in terms of number of global and local coherence errors ($p > .1$). There was also a lack of significant correlation between the ratings of the maxim of relation and both global and local coherence errors (Table 5).

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Table 5. Correlation (Pearson's *r*) Among the Objective Measures Under the Four Maxims

	Objective measures			
	Er	IEr	ISA	RE
Maxim of Quality	.323*	.234	.201	−.036
i. Number of errors (Er)	–	.522**	.026	−.022
ii. Index of Error (IEr)		–	−.043	−.066
iii. Index of Syntactic Accuracy (ISA)			–	.330*
iv. Repairs and revision of errors (RE)				–
	N	I-word	T-units	Words per T-units
Maxim of Quantity	.696**	.737**	.737**	.473**
v. Total number of words per task (N)	–	.795**	.857**	.700**
vi. Number of information words (I-word)		–	.634**	.631**
vii. Number of terminable units (T-unit)			–	.309**
viii. Words per T-units				–
	GE	LE		
Maxim of Manner	.116	−.025		
ix. Number of global coherence errors (GE)	–	−.001		
xi. Number of local coherence errors (LE)		–		
	Rep	ILE	ICE	CD
Maxim of Manner	.063	−.060	.468**	.203
xiii. Repetition of words and phrases (Rep)	–	.082	−.127	−.071
xiv. Index of Lexical Efficiency (ILE)		–	−.436**	−.084
xv. Index of Communication Efficiency (ICE)			–	.269**
xvi. Number of Cohesive devices per T-units (CD)				–

*$p < .05$; **$p < .01$.

Finally, concerning Measure of Manner, the results of independent sample *t*-tests indicated the TBI group scored significantly lower in the Index of Communication Efficiency (ICE) [$t(96) = 5.63$, $p < .001$] and used significantly fewer cohesive devices per T-unit [$t(98) = 2.21$, $p < .05$] than the NBI group. However, the two groups did not differ in terms of Index of lexical efficiency (ILE) and the number of repetitions of words and phrases ($p > .1$). The results of Pearson's *r* correlation (Table 5) further revealed that the ratings of the maxim of manner were significantly correlated with ICE only, but not the other three measures (ix, x, and xii).

Effect of genre, pictorial supports and language-cognitive deficits on pragmatic performance

Table 6 summarizes the means of the subjective ratings obtained from the naïve listeners by elicitation tasks. The results revealed a trend of increasing violation of maxims as visual supports during the elicitation decreased. Specifically, the personal narratives by the TBI speakers that contained the least amount of visual support were judged to contain the highest degree of violation of three out of four maxims. Interesting, the most violation in terms of the maxim of quality was found in the storytelling task, in which five picture cards were first provided and then removed

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Table 6. Means of the Results of Naïve Listeners' Rating

	Discourse tasks[a]				
	Personal narratives	Procedural discourse	Single picture description	Storytelling	Sequential picture description
Maxim of Quality[b]	1.92	2.07	2.00	**2.78**	2.08
Maxim of Quantity	**2.48**	2.82	2.85	2.67	3.05
Maxim of Relation	**2.72**	**2.72**	3.31	2.85	3.32
Maxim of Manner	**3.09**	**3.09**	3.34	3.02	3.52

Ratings in **bolded** indicates the highest degree of violation found in the corresponding maxim.
[a]The least amount of visual support on personal narrative task to the most support on sequential picture description.
[b]The higher the rating was, the more violation of the Maxim of Quality was found.

Table 7. Correlations (Pearson's *r*) Between the Language-Cognitive Deficits of TBI Individuals and Their Pragmatic Performance by Maxims

	Quality	Quantity	Relations	Manner
CAB or MAB Aphasia quotient	−.302	.656*	.615	.252
CLQT overall score	−.016	.582	.464	.406
Attention	−.016	.582	.464	.406
Memory	−.361	.346	.259	.037
Executive Function	.480	.557	.521	.193
Language	−.419	.638*	.516	.071
Visuospatial	−.175	.411	.347	.256

CAB/MAB: Cantonese/Mandarin version of Western Aphasia Battery; CLQT: Cognitive Language Quick Test.
*$p < .05$.

during the participants' production. As displayed in Table 7 a significant correlation was found only between the maxim of quantity and language ability (but not other cognitive domains).

Naïve listeners' ratings

Results of the curve estimation (Fig. 1) indicated that Total Number of Words per task [$F(2,47) = 26.452$, $p < .001$], Number of I-word [$F(2,47) = 33.931$, $p < .001$], Number of Terminable Units [$F(2,47) = 26.629$, $p < .001$] and words per T-unit [$F(2,47) = 6.997$, $p < .01$] produced significantly predicted maxim of quantity in a quadratic model. Results of Pearson's *r* correlation (Supplementary Table 1) also showed significant correlations of all ratings of maxims, but that between the maxims of quantity and manner.

Inter-rater and intra-rater reliability

Of the samples, 20% were randomly selected and re-analyzed by the third author to estimate the degree of intra-rater reliability. The same samples were also independently analyzed by a second independent examiner blinded to this study to obtain inter-rater reliability. The results of Cronbach's alpha (see Supplementary Table 2) indicated good to excellent inter-rater and intra-rater.

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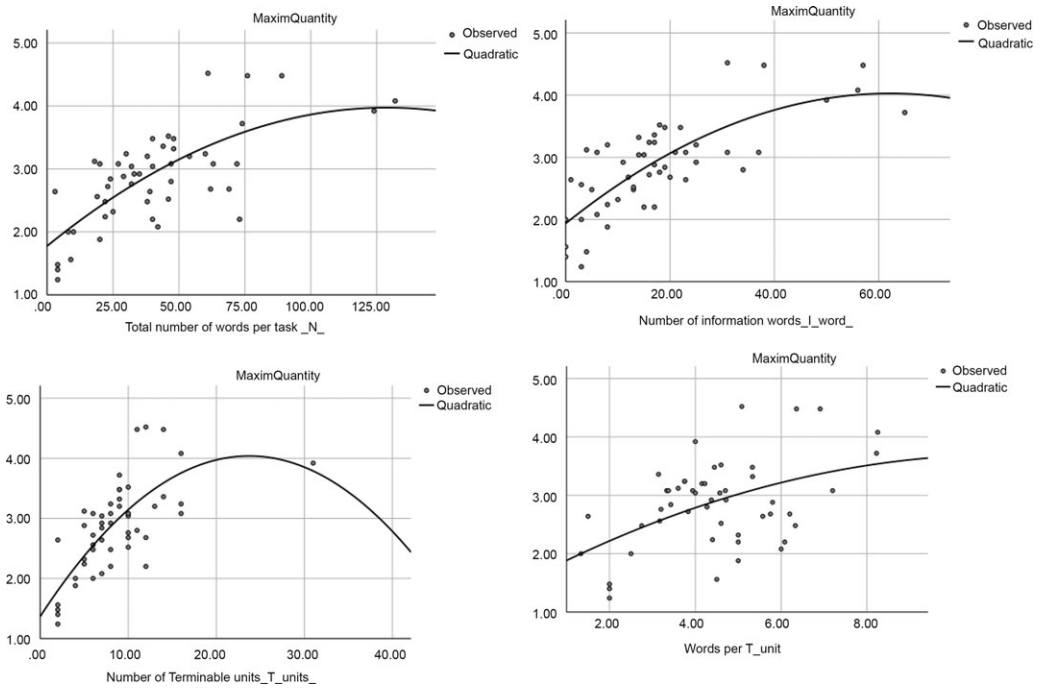

Figure 1. Quadratic models analyze among the indices of Maxims of Quantity.

Discussion

TBI and pragmatic impairments

The current study compared discourse production between Chinese speakers with and without TBI from the perspective of pragmatics with reference to the four maxims of quality, quantity, relevance, and manner (Grice, 1975). The results supported our prediction of significantly more maxim violation in the TBI group. In particular, the two speaker groups differed the most in terms of the maxim of quantity and the Index of Communication Efficiency (ICE). This finding extended earlier conclusions by Carlomagno et al. (2011) and Marini et al. (2011) regarding the distinctive discourse feature of inadequate informativeness but relatively intact language ability in the TBI population of Indo-European languages; here we argue the same difficulty exists in TBI survivors (in our case, to be more specific, TBI speakers with anomic aphasia) in the East. A recent neurophysiological study to examine speech act and lexico-semantic processing in healthy adults (Egorova, Shtyrov, & Pulvermuller, 2013) has suggested parallel activation of pragmatic and linguistic processing; the behavioral evidence from the present study also seems to be in line with that.

Moreover, the discourse measures related to maxim of quality were highly correlated to the listeners' ratings on the appropriate amount and informativeness with discourse production in adults with TBI. Interestingly, the quadratic relationship (in Fig. 1) suggested that the amount of information provided in a discourse and one's judgment of a 'good' production was not in a linear relation. This observation, in line with Steel and Togher (2019), confirmed the uniqueness of successful social communication which only requires the right amount of information to convey appropriate content (in a way that urges the communication partner to sustain an exchange of messages). Similarly, the two groups' significant differences in ICE and usage of cohesive ties were also consistent with previous reports that listeners relied on the rate (of how quickly) the information was provided and whether it was presented in an organized way (Cummings, 2021) to judge spoken discourse naturalness.

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One unexpected finding, however, was that the two groups did not differ in terms of the maxim of manner which was associated with local and global coherence. Global and local coherence were related to the maxim of relation as they concern how well each sentence relates to the overall theme or to adjacent sentences, i.e., the aspect of relevancy in discourse as defined by Grice (1975). Unlike previous findings specific to discourse impairments in Chinese-speaking TBI survivors, in terms of microstructural (e.g., across-sentence analysis of cohesion and coherence; Kong et al., 2020; Mok, Kong, & Lau, 2016) as well as macrostructural (e.g., local and global coherence; Chow, Kong, & Lau, 2016) deficits, the current study did not find any significant differences between the TBI and NBI groups. All language samples presented in this study were monologic discourse while communication problems were suggested to be more readily apparent in a conversational interaction (Van Leer & Turkstra, 1999). It was unclear if the lack of conversational samples considered or the current pool of TBI participants being milder in terms of aphasia severity impairment (average aphasia quotient of 87.5, ranging from 76 to 92; Worrall et al., 2016) might have contributed to this phenomenon. Similar to earlier reports that had failed to identify differences of coherence competency between individuals with and without TBI (Biddle, McCabe, & Bliss, 1996; Chapman et al., 1992), conversational samples may be essential to allow a more holistic examination of coherence performance in TBI.

Of the four Gricean maxims, our results indicated that a significantly higher correlation was found between pragmatics indices and listeners' rating in terms of Quantity. Compared with the other three maxims, the definition of this aspect (focusing on content, length, and depth) is more objective, concrete, and possibly easier for naïve listeners to rate. One may also argue that the other maxims are not entirely mutually exclusive to each other. For example, violation of maxim of quality (i.e., truth) may lead to perception of a lower degree of relevance (maxim of relation) and/or clarity (maxim of manner).

With the use of carefully selected pragmatic measures to compare differences between the TBI and NBI groups, the current study added support to the notion that pragmatic impairments are observed in speakers with TBI. However, one potential limitation here was the small sample size. One may also notice the relatively large variation in months post onset among the participants with TBI in this study. Due to the small sample size of two subgroups (i.e., speakers with a recent TBI vs. those with a longer time post TBI), group difference on pragmatic problems was not compared here; future extension involving this systematic comparison with a larger pool of participants is warranted. Considering the uniqueness of pragmatics (e.g., highly individualized for which proper and objective quantification is far from simple), assessments containing only monologic discourse tasks without conversation samples may not be comprehensive enough to provide a holistic picture of the pragmatic problems in TBI. There is need for the further investigation of theoretically based evaluation of discourse pragmatics in TBI.

Discourse stimuli and pragmatics

It was clear that the presence of picture stimuli, their characteristics, and how they were utilized in a discourse task influenced our TBI speakers' performance, which was in turn identified by naïve listeners. While the different types of images used in the present study varied in terms of the levels of cognitive support (i.e., number of visual stimuli provided, the duration of presentation, and presence vs. retraction during a speaker's production), it was found that personal narratives (elicited with the least amount of visual supports among the five tasks) had the most violations of pragmatic maxims. In contrast, the sequential picture description task yielded the best listeners' perception (Table 6). It is believed that the picture series presented an ongoing story with connections between the events, which could better elicit a more organized and efficient discourse from speakers in the TBI group (Potechin, Nicholas, & Brookshire, 1987). The cognitive demand in planning and organizing the information was also lower on the part of the speakers when the pictures were present, freeing up mental buffer for the pragmatic aspects during the production

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and hence reducing the violation in maxims of quantity, manner, and relation. In line with the hypothesis that the visual stimuli manipulated the speakers' level of cognitive load and arousal, it was also believed that the visual supports with the extralinguistic context embedded in the sequential pictures also made it easier to analyze and determine the content and accuracy of the production (Potechin et al., 1987).

When interpreting the current results, it is worth mentioning that comparing (and controlling) the complexity across spoken discourse tasks is not straightforward. It was found that there were more violations the maxim of quality in the storytelling task, which contained the second largest amount of pictorial support (five picture cards). However, since the TBI participants were actually required to provide the story after these pictures had been removed, the higher degree of violations could be attributed to the increase memory loading induced by withdrawal of visual stimuli during the production. In order to tell the story, the speakers would need to create mental representations to understand, remember, and organize details. Hence, the overall performance could have been compromised by their difficulties with sustained attention, memory, and planning. On the other hand, the task of personal narratives contained the least amount of visual support and yielded the lowest degree of violations of maxim of quality. A possible explanation for this was the higher personal relevancy of this task to the speakers, for which they could select the information they were confident to share and avoid making errors (Lai, Law, & Kong, 2017; Law, Kong, Lai, & Lai, 2015).

Clinical implications

Discourse analysis is one of the clinical methodologies that is commonly used to assess TBI speakers' language ability. However, the majority of published analytic frameworks are not geared for highlighting the pragmatic aspect of discourse deficits in acquired language disorders, except for a small number of investigations that attempted to quantify samples of picture description (e.g., Snow, Douglas, & Ponsfordoe, 1999) or procedural discourse (e.g., Snow, Douglas, & Ponsfordoe, 1997). The fact that we applied Gricean maxims in monologic oral narratives and revealed its clinical feasibility to capture the hallmark of pragmatic problems underlying TBI may help provide an additional approach of clinical assessment.

With reference to our results, personal narration (albeit of its high personal relevancy to the speaker) and the storytelling task (that taps and requires a higher level of information planning) seemed to better elicit violations in pragmatics. Specifically, it was observed that the participants with TBI demonstrated more violation of maxims than their NBI counterparts. Such violations may be particularly prominent in discourse tasks that provide less visual support and/or pose a higher demand of organizational and cognitive skills. As suggested by Coelho (2007), discourse impairments in TBI may persist for years after its onset, which can pose a negative and long-lasting impact on quality of life. It is hoped that the finding of this study will render clinicians additional evidence on assessing social communication among adults with TBI and to support their decision-making on informative management of TBI.

Discourse analysis is one of the clinical methodologies that is commonly used to assess TBI speakers' language ability (Kong, 2009).

Supplementary materials. For supplementary material for this article, please visit https://doi.org/10.1017/BrImp.2022.36

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Conflicts of interest. None.

Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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