Narrative Discourse Impairments in Persian-Speaking Persons with Traumatic Brain Injury: A Pilot Study

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Key Words
Acquired communication disorders · Discourse analysis · Traumatic brain injury

Abstract
Objective: Studies have shown the presence of narrative discourse difficulties in persons with traumatic brain injury (TBI), even in those who do not suffer from aphasia. Yet, there still exist inconsistencies between the results of different studies, in particular at the microlinguistic level. Moreover, a limited number of languages have been studied in this regard. Therefore, this study aimed at examining these skills in Persian-speaking individuals with TBI. The purpose of this pilot study was to analyse the microlinguistic and macrolinguistic skills of these individuals to determine impaired linguistic measures at different levels of narrative discourse.

Participants and Methods: Fourteen non-aphasic Persian-speaking persons with TBI (9 with severe TBI and 5 with moderate TBI), aged 19–40 years (mean = 25.84, SD = 5.69), and 61 age-matched healthy adults completed a narrative task. Measures of language productivity, clause density, verbal error ratio, and cohesion ratio were calculated. Also, test-retest and inter-rater reliability coefficients were analysed. Results: The TBI group was impaired in some microlinguistic and all macrolinguistic measures compared to their control peers.

Conclusion: The results of this study suggest that multi-level narrative discourse analyses of Persian-speaking individuals with TBI may be useful for speech/language pathologists wishing to evaluate communication disorders in persons with TBI.

Introduction

Discourse impairment is a frequent consequence of traumatic brain injuries (TBIs) that significantly contributes to the social isolation usually experienced by affected individuals [1]. However, they usually ’talk better than they communicate’, while the reverse holds for individuals with aphasia, who usually tend to ’communicate better than they talk’ [2]. Unfortunately, discourse skills cannot be reliably assessed by traditional aphasia testing alone.
[e.g., the Western Aphasia Battery (WAB) [3] or the Aachener Aphasia Test [4]], since these skills are too complex or on a higher level than those considered in these tests. Using such batteries for performance assessment may imply that the communicative skills of individuals with disordered discourse are intact. Nevertheless, when engaged in interactions, they give the listener the impression that they are disorganized, off target, or tangential [5–7]. In fact, their impairment in communicative behaviour is beyond the level of single words or sentences, which are not difficult for such individuals. Therefore, these traditional aphasia tests are not challenging enough to capture the full extent and nature of cognitive communication impairments in persons with TBI [7]. Thus, diagnostic and therapeutic issues in the management of language and communication disorders in individuals with brain injury remain a challenge for speech and language pathologists [8].

In consequence, it has been suggested that procedures of discourse assessment – both micro- and macro-linguistic dimensions – should be included in the standard testing of persons with TBI. In contrast to the micro-linguistic dimension, which is responsible for intrasentential functions, the macro-linguistic dimension is responsible for inter-sentential functions. Importantly, the levels of language are deeply interconnected [9]. Recently, growing attention has been devoted to the development of reliable procedures for the analysis of discourse skills in persons with communicative disorders such as those with TBI [10–15]. For example, Ehrlich [16] found that a group of adults with head injury were similar to a group of healthy control participants in terms of the amount of relevant content, narrative length, and rate of speech; however, they produced narratives with significantly slower rates of information. A study by Wilson and Proctor [17] revealed that adolescents with closed head injury used fewer words for expressing an idea in their writings, and the relationship between successive ideas was rated as less efficient than that in controls. Coelho [18] examined a group of 55 consecutive participants with TBI who were not aphasic on a storytelling task. They were not different from a group of healthy participants regarding sentence complexity and cohesive adequacy. Nonetheless, they introduced more irrelevant propositional content in their narratives, which may be indicative of problems in the organization of information at the between-sentence level.

Overall, the studies conducted so far suggest that persons with TBI might suffer from difficulties in the production of well-structured narrative descriptions. However, language is a highly complex cognitive function that rests on the interplay between different levels of processing. An interesting approach to solving the problem of narrative processing after TBI might rely on the possibility of performing narrative analysis that takes into account aspects of discourse at different levels [9]. For example, Marini et al. [13] compared the narrative discourse of 14 non-aphasic speakers with severe TBI and 14 neurologically intact individuals. While the lexical and grammatical skills of the non-aphasic group with TBI were normal, they produced narratives with increased cohesion and coherence errors. These errors were due to frequent interruptions of ongoing utterances, derailments, and extraneous utterances that made their discourse ambiguous and vague. Interestingly, errors of cohesion also affected some microlinguistic skills. Similar results have more recently been found on persons with moderate [19] and mild TBI [20].

The different studies mentioned so far highlight the presence of microlinguistic difficulties in persons with TBI of different gravities. That said, studies of discourse abilities in individuals with TBI have primarily included English [5, 18, 21, 22] and Italian [6, 20, 23, 24] speakers. Various studies considered different sets of measures, and sometimes for the same measure different or incompatible results have been reported. In addition, different languages have different structures and features which may affect the result of studies. For example, in contrast to English, Persian is a pro-drop language; it has a syntactic scrambling feature that does not exist in English and also has stronger conjugation, where verbs change based on the subject of the sentence. These issues leave open the important point of the replicability and extendibility of studies’ results on individuals who speak different languages. For this reason, in this pilot study, we decided to extend the micro- and macro-linguistic analyses of narrative discourse production to a group of non-aphasic Persian-speaking individuals with TBI. To the best of our knowledge, this is the first study of this kind that performs an accurate multi-level discourse analysis in such individuals.

Subjects and Methods

Participants

Fourteen adult survivors of TBI participating in this research were serial admissions to the Trauma Research Centre of Kashan (Iran) and a rehabilitation clinic of the University of Social Welfare and Rehabilitation Sciences (Tehran, Iran) over a 5-month period. All participants were male, aged 19–40 years (mean = 25.64, SD =
Table 1. Clinical characteristics of the group of participants with TBI

<table>
<thead>
<tr>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
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<tbody>
<tr>
<td>Time after injury, months</td>
<td>1–120</td>
<td>25.75</td>
</tr>
<tr>
<td>Coma duration, days</td>
<td>0–270</td>
<td>52.14</td>
</tr>
<tr>
<td>GCS score</td>
<td>4–12</td>
<td>8.14</td>
</tr>
<tr>
<td>MMSE score</td>
<td>23–30</td>
<td>26.92</td>
</tr>
<tr>
<td>WAB quotient</td>
<td>91–100</td>
<td>94.42</td>
</tr>
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</table>

6.10), and with diffuse closed head injury. Regarding the fact that the participants were exclusively male, it is noteworthy that males are uniformly at a higher risk of TBI than females, with the highest male-to-female ratios typically occurring in adolescence and young adulthood. In emergency department studies based on a US national sample, the male-to-female ratios were 1.5:1 and 1.7:1 [25]. This ratio is much higher in Iran, that is, 4.25:1 [26]. The causes of injury were motor vehicle accidents (10 participants), falls (2 participants), and pedestrian car accidents (2 participants); all participants were injured in adulthood. None of them were apraxia, as established through performance of a score of ≥91 on the aphasia quotient of the WAB – adapted to Persian in Nilipour et al. [27].

All participants scored ≥23 in the version of the Mini-Mental State Examination (MMSE) adapted to Persian [28], thus ensuring they were oriented to self, environment, and place and could participate in the study. Their mean score on the Glasgow Coma Scale (GCS) in the acute phase had been 8.14 (9 of the participants had severe TBI, with a GCS score <9, and 5 participants had moderate TBI, with a GCS score between 9 and 12). Participants with mild TBI were excluded from the study. A hearing screening showed that participants had hearing acuity within normal limits. A review of medical records and rehabilitation reports established that visual acuity and perception were sufficient to allow for the discrimination of pictures. None of the participants had a previous history of psychiatric or neurological illness except their TBI. In summary, the inclusion criteria were the following: (1) the injury occurred between 19 and 40 years of age; (2) the age at discharge was between 19 and 40 years; (3) documented evidence of TBI existed, and (4) Persian was the first language. The exclusion criteria were (1) mild TBI, (2) any history of hearing or visual impairment, (3) co-existing aphasia, (4) cognitive impairment, and (5) evidence of pre-existing neurological or psychiatric disorder.

Applying these inclusion-exclusion criteria, 8 (out of 22) of the potential participants were excluded at the screening phase. The participants’ educational achievement ranged from 3 to 18 years (mean = 9.71, SD = 4.49). All were native speakers of Persian and had no history of previous neurological disturbances.

The control group was formed by 61 neurologically intact subjects, consisting of 16 males and 45 females (aged 19–40 years; mean = 25.84, SD = 5.69). Regarding gender, as shown by Mackenzie [29], no significant difference was revealed for discourse, a result which was also true for the control group. The two groups did not differ significantly in age. They were all native Persian speaking. Control subjects with a history of neurological disorders (e.g., stroke, traumatic head injury, Parkinson’s disease, and epilepsy), cognitive impairments, blindness, deafness, and major physical disability were excluded from our study. In sum, inclusion criteria 2 and 4, as well as exclusion criteria 2, 4, and 5, as described above, were applied to this group. The educational achievement in the control group ranged from 11 to 18 years (mean = 15, SD = 1.58). Table 1 shows the clinical features of the group of participants with TBI.

Procedures

All participants met personally with the examiner to carry out the narrative task using a serial picture description. The examiner did not impose any time limit, and recorded all sessions for later analysis. With the exception of 2 participants who were visited at their home, all others were visited at the clinic.

Following a brief introduction and explanation of the session, two standardized tests were administered. The WAB was used in order to rule out aphasic persons. This battery is an instrument for assessing language skills in adults and allows clinicians to determine the presence, degree, and type of aphasia. If a subject scores ≥91 on the WAB, (s)he is not considered aphasic [27]. The overall cognitive functioning of all participants was evaluated by administering the MMSE to ensure that the presence of residual deficits in cognition did not prevent meaningful participation, including the capacity to attend to the task and to comprehend and follow instructions. The MMSE is a brief 30-point questionnaire used to screen for cognitive impairments. The maximum score is 30. Cognitive impairment is diagnosed for scores <23 [28].

When an individual met the inclusion-exclusion criteria, an assessment of narrative abilities was performed using story generation. Each participant was asked to produce a narrative elicited via a serial story with 6 pictures, all presented on the same page, which remained in front of the participant until the task was completed to avoid the effects of memory limitations.

The topic of the serial picture story was familiar to the Persian subjects in such a way as to enable participants to produce episodes which, according to Stein and Glenn [30], consist of an initiating event that prompts a character to act, an attempt related to the initiating event, and a direct consequence of the attempt. These features were confirmed by a panel of 7 experts (4 speech and language pathologists and 3 linguists).

The participants were instructed to tell a story about what they thought was happening in the pictures. During a participant’s narration, the examiner provided feedback only to encourage the subject to continue (e.g., ‘anything else?’) and other natural conversational acknowledgements. A narrative was considered complete when a participant indicated that (s)he had no more to add. Ethical considerations of this study were approved by the Ethics Board of the University of Social Welfare and Rehabilitation Sciences. All participants signed an informed consent form. None were paid for their participation.

Linguistic Measures

Story narrative performance was analysed at two levels: micro-linguistic (i.e., productivity, clause density, and verbal errors) and macro-linguistic measures (i.e., inter-sentential cohesion and global coherence).

Productivity was measured according to the amount of language produced in the spoken discourse. In this study, productivity was considered in terms of the number of communication units...
was then calculated by dividing the total number of verbal errors

According to Halliday and Hasan

ongoing flow of the narrative

1 The C-unit is completely unrelated to the stimulus; it may

be a comment or tangential information on the discourse

(C-units) per narrative [17, 31]. A C-unit is ‘an independent clause with its modifiers’. It includes one main clause with all subordinate clauses attached to it [32].

Clause density was taken as a measure of syntactic complexity and was calculated as the total number of dependent and independent clauses divided by the total number of C-units [33].

Verbal errors include mazes, phonological errors, and verbal or semantic paraphasias [1]. Mazes are words, initial parts of words, or unattached fragments that do not contribute meaning to the ongoing flow of the narrative [32]. They can be fillers, repetitions, or revisions [34]. Phonological errors include phonological and phonetic paraphasias and neologisms [9]. A ratio of verbal errors was then calculated by dividing the total number of verbal errors by the total number of C-units in each discourse sample.

Cohesion allows the linkage of utterances produced in a narrative by means of lexical, conceptual, and grammatical ties [35]. According to Halliday and Hasan [36], cohesive ties can be classified into 5 categories: substitutions, ellipses, references, conjunctions, and lexical markers. Substitutions include the use of different words to make reference to a specific concept without introducing repetitions (e.g., ‘I have a pair of shoes but I want to buy a new one’). Ellipses are established by omitting unnecessary words (e.g., ‘the older shirt is red but the newer ___ is blue’). References make use of pronouns to refer to a specific item or concept (e.g., ‘the red pen is hers’). Conjunctions establish logical connections between utterances (e.g., ‘the game was over at three. After the game, we went for an ice cream’). Lexical markers make use of words to refer to concepts previously introduced in the preceding utterances (e.g., ‘I heard a sound, but I couldn’t figure out where that noise came from’). In this study, we included a measure of cohesion per C-unit in which the cohesion is the total number of all cohesive ties counted in each narrative sample.

Global coherence refers to the relationship of the meaning or content of an utterance to the general topic of the story [37]. In other words, discourse coherence reflects the listener’s ability to interpret the overall meaning conveyed by the speaker. In the current study, we used a 4-point scale introduced by Wright et al. [37] (table 2) for scoring the participants’ ability to establish global coherence. Each C-unit was given an individual score, and then the mean global coherence score was computed.

### Data Analysis

The recorded speech samples of all participants were transcribed verbatim. At first, the analysis involved the identification of C-units, dependent and independent clauses, verbal errors, cohesive ties, and coherence scores. Then, a computation of productivity, clause density, verbal error ratio, cohesion ratio, and coherence score was performed.

The narrative performance of the participants was analysed via the non-parametric Mann-Whitney U tests (for verbal error ratio and coherence) and parametric t tests (for productivity, syntactic complexity, and cohesion ratio) to examine statistical differences between quantitative variables with abnormal and normal distribution. The normality of the variable distributions was monitored by the Shapiro-Wilk test. The a level was set at p < 0.01 after Bonferroni correction for multiple comparisons (0.05/5).

### Reliability of Analysis

To evaluate test-retest reliability, 13% of the participants (n = 10) were selected randomly to be examined 3 weeks after the initial test. The test-retest reliability for each variable was determined by the intra-class correlation coefficient. The reliability coefficients for productivity, syntactic complexity, verbal error, cohesion, and coherence were 0.84, 0.83, 0.89, 0.75, and 1.00, respectively.

The inter-rater reliability of the linguistic analyses was calculated by measuring all variables in a second-round discourse analysis of 13% of randomly selected samples (n = 10) by a trained independent researcher. The inter-rater reliability for each variable was determined by the intra-class correlation coefficient, resulting in scores for productivity, syntactic complexity, verbal error, cohesion, and coherence of 0.99, 1.00, 0.99, 1.00, and 1.00, respectively.

### Results

Table 3 indicates the range, mean, and SD of each measured value for the individuals with TBI and the control participants. Overall, the statistical analysis showed that the participants with TBI produced narratives with significantly lower levels of productivity [t(73) = 3.74, p < 0.01] and clause density [t(73) = 4.52, p < 0.01]. Furthermore, their narrative samples were characterized by fewer cohesive ties for each C-unit [t(73) = 3.73, p < 0.01] and lower coherence scores (U = 55.5, Z = -6.6, p < 0.01) than those of the control participants. However, no group-related differences were found in the verbal error ratio after Bonferroni correction for multiple comparisons (U = 266, Z = -3.81, p < 0.03).
Discussion

The current study examined narrative discourse in a group of Persian-speaking adults with TBI compared to a group of healthy control participants. The results showed that the narrative samples produced by individuals with TBI, while normal in terms of the production of verbal errors, differed from those produced by the group of control participants in 2 microlinguistic measures (i.e., productivity and clause density) and 2 macrolinguistic measures (i.e., cohesion and coherence ratios). Note that the level of education was not fully matched in this pilot study, which might be considered as a limitation, and the results should be interpreted cautiously.

Subjects with TBI produced narrative descriptions with lower levels of productivity compared to the control group. This finding is partially consistent with the literature. It is coherent with some findings \([10, 12, 14, 38]\) but not with others \([13, 17]\). For example, Marini et al. \([13]\) considered different aspects of productivity (words, speech rate, and mean length of utterance), showing that a group of non-aphasic participants with severe TBI produced narratives with a normal number of words and an adequate mean length of utterance but suggesting that these individuals might experience problems with the speech rate. Interestingly, in that study, the reduced speech rate was found to be associated with the production of errors of cohesion. Instead, in our study, productivity was measured in terms of C-units. Therefore, the discrepancy in results might be explained in terms of the different measures used to assess productivity. Of note, the latter study that did not find significant problems in productivity \([17]\) investigated this aspect of narrative production in samples of written discourse, suggesting that the difference in results may depend on the different modality of administration of the task.

Our participants with TBI showed reduced clause density compared to healthy control participants. As mentioned before, clause density was taken as a measure of syntactic complexity. This result indicates that the individuals with TBI produced fewer dependent clauses in each C-unit. On the other hand, since a syntactic complexity measure demonstrates language proficiency \([39]\), it could be considered that individuals with TBI have less language proficiency than participants in a control group. Consistent with the current study, children and adolescents with acquired brain injury have been shown to produce speech samples with fewer complex syntactic structures than normal \([38]\). Campbell and Dollaghan \([40]\) found that syntactic complexity remained a problem for 6 of the 9 subjects with TBI included in their study. Also, a group of TBI participants produced significantly more syntactic errors compared to a group of healthy controls \([41]\). In another study \([42]\), no significant differences in syntactic complexity (calculated as a percentage of complex T-units) were found between three studied groups (healthy participants and individuals with mild and moderate TBI); however, in this study, the speakers were not generating new narratives, as they were requested to retell a previously presented story. It is then likely that what they had provided them with significant cues for producing more complex utterances \([42]\). In some other studies, the sentence complexity-related discourse of individuals with brain injury did not differ from that of a group of healthy controls \([10, 18, 43]\). The disparity in syntactic performance between studies might be due to differences between the type of scaling complexity or task differences \([42]\).

Table 3. Ranges, means, and SDs for individuals with TBI and healthy control participants on the 5 measures of the narrative analysis

<table>
<thead>
<tr>
<th>Measure</th>
<th>Individuals with TBI</th>
<th>Healthy controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivitya</td>
<td>5–30 15.50 7.30</td>
<td>9–59 27.97 11.91</td>
</tr>
<tr>
<td>Clause densitya</td>
<td>1–1.80 1.17 0.20</td>
<td>0.20 1.42 0.18</td>
</tr>
<tr>
<td>Verbal error ratio</td>
<td>0–2.83 0.37 0.72</td>
<td>0–1.30 0.40 0.29</td>
</tr>
<tr>
<td>Cohesion ratio</td>
<td>0.33–1.42 0.96 0.34</td>
<td>0.64–2.1 1.33 0.33</td>
</tr>
<tr>
<td>Coherence</td>
<td>3–4 3.60 0.32</td>
<td>3.60–4 3.98 0.07</td>
</tr>
</tbody>
</table>

a The group-related difference was significant after Bonferroni correction for multiple comparisons.
Fagan [44] considered mazes as a factor of language planning which occur at various grammatical points inside the utterances. As table 3 shows, the range of verbal error ratios was larger in the individuals with TBI (0–2.83) than in the control subjects (0–1.30), whereas the means of the two groups were very close and not significantly different. The difference between the ranges in the two groups is mostly due to the high rate of errors produced by one of the persons with TBI. Regarding the production of mazes in the two groups, the order of using various types of mazes could be interesting (from ‘most used’ to ‘least used’): filled pauses, revisions, and repetitions in the control group versus repetitions, filled pauses, and revisions in the TBI group.

The concept of cohesion, proposed by Halliday and Hasan [36], refers to the connection of semantic and lexical relations between segments of a discourse narrative or text. According to this model, cohesion occurs when meaning is related across sentences by the use of specific cohesive ties. In the current study, participants with TBI produced narrative samples with significantly fewer cohesive ties per C-unit than the control group. This may suggest that they had difficulties in conceptually and linguistically linking the ideas embedded in their utterances. Consistent with our study, individuals with TBI have been shown to produce significantly more cohesion errors than a control group [13], as well as fewer cohesive ties in their narrative tasks [45].

We measured coherence using the 4-point scale presented by Wright et al. [37]. The ratings of the speech samples produced by the group of individuals with TBI were significantly lower than those obtained by the healthy participants. Also, this finding is consistent with previous studies showing the presence of massive difficulties in the global organization of information within a narrative discourse in these individuals [13, 41, 43, 46]. Conversely, in the study by Wilson and Proctor [17], global coherence was similar for the two groups of healthy controls and individuals with TBI. However, as already noted, they investigated coherence in written language. We may hypothesize that coherence depends – at least partially – on intact access to semantic memory representations of real-world concepts, facts, and their relationships, and to maintain the overall plan and organization of discourse, conceptual as well as perceptual integration are required. Furthermore, in order to coordinate and integrate the speaker’s plan and the listener’s perspective aiming to generate a coherent discourse from the listener’s point of view, an intact ability for simultaneous attention and mental manipulation of several chunks of information is also needed [41]. Individuals with TBI might have disordered cognition in this process, and this could affect their ability to sustain a coherent discourse.

Conclusions

The current research question arose from a clinical demand for finding materials which could be used for the assessment of communication skills in adult individuals with TBI. The task introduced in this study – a narrative discourse using a serial picture story – may be useful for speech and language pathologists willing to assess discourse production in adults with TBI. As this was the first exploratory study on the narrative skills of Persian-speaking individuals with TBI, it is desirable that future studies further analyze microlinguistic and macrolinguistic aspects of narrative processing in a higher number of Persian-speaking individuals, considering the relative weight of factors such as trauma severity, post-onset time, and lesion site.

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Disclosure Statement

The authors report no conflicts of interest.

References

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