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Written discourse of adolescents with closed head injury

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Written discourse of adolescents with closed head injury (CHI) was compared to that of normal controls. It was expected that the writing of adolescents with CHI would be disordered on one or more of the eight measurements used (productivity, efficiency, lexical, incomplete, or elliptic cohesion, global or local coherence, and maze use). Eight adolescents with closed head injury and matched controls provided written descriptions of a pictured activity. Analysis using *t*-tests indicated that adolescents with CHI used fewer words to express each idea in writing ($p = 0.05$), and that the relationship between successive ideas was rated as less than that of controls ($p = 0.002$). Implications are that written as well as oral discourse should be assessed after CHI. Writing is a more controlled process than speaking; and, therefore, may be used clinically to structure the development of ideas after CHI.

Introduction

The evaluation of oral discourse has been identified as an important tool in assessing communication skills after traumatic brain injury (TBI) and closed head injury (CHI) [1–10]. Dennis and Barnes [4], in a study of children with TBI that included early adolescents, reported that three-quarters of their sample demonstrated difficulty with oral discourse.

Despite the prevalence of research into how oral discourse after TBI and CHI differs from controls, there has been little interest in how written discourse might be impacted. Payne-Johnson [11] explored writing and other communication skills in 20 subjects with mostly mild (CHI) and 15 control subjects (mean age 25 years). The aim was to determine which language factors were impaired after CHI. Testing was administered soon after subjects became alert and conscious, or within 1–3 days after admission to medical facilities. Performance on the written formulation task of the *Boston Diagnostic Aphasia Examination* (BDAE) [12] was among those that differentiated the group with CHI from the normal group. The written formulation portion of the BDAE assessed writing sentences to dictation and narrative writing. The narrative task required writing as much as possible about what was happening in the 'Cookie Theft' picture. Written narratives were scored according to BDAE ratings that asked for judgements about the quantity, connectedness of ideas and organization of ideas expressed.

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Speirs and Dahlberg [13] compared the oral and written output of adults with CHI to that of normal adults on descriptions of the 'Cookie Theft' picture. Adults with CHI were less productive (number of concepts) and more digressive (syllables per concept) than the normal group. The oral and written output measures of the group with CHI did not differ in productivity when compared to the normal group. When describing the picture, oral and written tasks yielded a similar number of concepts. However, written discourse digressed less than oral discourse on this task. That is, when speaking, the adults with CHI used more syllables to express a concept than the number of syllables used when writing. These authors suggested that writing may have served to provide structure and organization to the ideas generated during the picture description task, increasing the efficiency of written discourse.

Wilson [14], in a treatment program for three medically stable adults with CHI, used a cognitive hierarchy of organizational strategies to improve the expansion of ideas in written discourse. The program resulted in expanded development of ideas while writing practice alone yielded no improvement.

Wilson and Proctor [10] investigated the relationship between written discourse and cognitive skills. In descriptions about the 'Cookie Theft' picture, adolescents with CHI and controls who had higher scores on the *Profile of Executive Control System* (Pro-Ex) [15] and a measure of working memory ('Recognition Memory', RMT, subtest of the *Goldman-Fristoe-Woodcock Auditory Skills Test Battery*) [16] wrote more, used more words to express each idea, and used more semantic ties than those with lower scores.

Written discourse

Written and spoken discourse are similar in that they both serve to mediate ideas. Speaker and Grubaugh [17] have suggested that writing requires more deep, meaningful processing than does speaking. Rubin [18] discussed the production, contextual and stylistic features of oral and written communication. The production of writing and speaking vary as a function of time, distance and effort. Speech generally happens at a given time with little effort, in the presence of a listener. Writing can happen over time without a listener and requires attention and planning. Writing does not have as many paralinguistic and contextual cues as speech, and is a more independent process than speaking.

The complexity of writing continues to progress into adolescence [19]. Hunt [20] has reported that written language is more complex than oral language by the end of elementary school. Differences in the developmental and organizational aspects of written and oral discourse lead to the possibility that discourse mode may be differentially affected by CHI in adolescents.

The present study

This study isolated persons with CHI who had been injured as adolescents. The adolescent group is unique because persons in this group still have academic writing requirements in school, and by this age writing is thought to be a more cognitively demanding task than speaking. Story generation from a picture, was used because it was expected that this task would be more demanding for adolescents with CHI than controls because of the requirement to generate an organizational framework.

For analysis, this study used traditional measures as well as informal ratings of coherence.

All participants in this study had sustained a CHI in a motor vehicle accident. The exclusion of other types of TBI helped to make this group somewhat similar in the nature of their brain injuries. While many studies have attempted to use a group of participants similar to the 'average' person with CHI, participants in this study did not have histories of previous neurologic or learning disorders. The inclusion of persons with such histories in previous studies has made it difficult to determine which identified differences in discourse are associated with CHI.

In research, the term CHI is frequently used instead of TBI. Although the terms are often used interchangeably, CHI is a classification of TBI that excludes penetrating injuries such as stab or gunshot wounds which result in focal brain injury [21]. Motor vehicle accidents typically result in more complicated and diffuse brain injury that is referred to as CHI.

This research asked whether the written narratives of adolescents with CHI differed from those of controls on measures of productivity, efficiency, cohesion, coherence and use of mazes?

Subjects and methods

Participants

A total of 16 individuals participated in the study, eight who had sustained CHI in adolescence and eight typically developing controls. Controls were matched for age, gender, ethnicity, dialect and socioeconomic status (SES). To successfully identify participants with CHI, ~80 medical records were reviewed from cooperating facilities. Of this total, eight individuals met the criteria on the basis of age of injury and amount of time post injury. Exclusions included prior history TBI, CHI, aphasia, neurologic diagnosis, a native language other than English, or a history of language, learning or reading problems.

At the time of injury, participants with CHI ranged between 13–19 years old with a mean age of 16 years old. At the time of the study, participants with CHI ranged from 15–22 years old (mean age = 18.9 years, SD = 2 years) and included three males and five females. All participants were Caucasian and native speakers of American English. Prior to injury, Participant 2 was left-handed while all others were right-handed. The participants with CHI had normal intelligence prior to injury and no history of receiving special education services in school.

Socioeconomic background (SES) was determined by using the general education level of the mother. According to Entwisle and Astone [22], maternal education is an acceptable means of determining SES of study participants. Mothers of four participants with CHI held high school diplomas and mothers of four other participants held college degrees (one associate degree, two masters degrees and one doctoral degree). Four of the participants were college students and classified as having very low incomes because they were self-supporting due to government disability programs. The latter also accounts for why participant income was not used as an indicator of socioeconomic status.

Each participant with CHI had a medical diagnosis of CHI and was considered medically stable, ranging from 2–5 years post-injury. The general criterion for CHI that was employed was that brain damage was due to an acceleration/deceleration

injury associated with motor vehicle accident. Each participant had sustained a single CHI. All participants had a period of coma post-injury ranging from less than 24 hours to 5.5 months. All participants with CHI had received cognitive-based speech–language therapy as part of their rehabilitation services.

Adequacy of corrected vision was judged using information from medical records on visual fields and acuity or by report from parents or staff familiar with participants' medical history and functioning. Motor skills were sufficient for independent completion of writing tasks. Individual characteristics of participants with CHI are summarized in table 1.

Controls were matched as a group to CHI participants for gender, chronological age and general maternal educational level. No control had a history of CHI, language disorder, learning disability or reading problems. Controls ranged in age from 15–22 years old (mean age = 19.3 years, SD = 2.6 years). There was not a significant difference in age between the participants with CHI and the controls ($t = -0.46$, $p = 0.6546$). The control group included three males; five females and all were right-handed, Caucasian and native American English speakers. Mothers of four controls held high school diplomas or vocational degrees and mothers of four others held college degrees. Individual characteristics of controls are also displayed in table 1.

Hearing acuity of all participants was within normal limits as determined by a pure tone hearing screening administered to each individual. *The Scales of Cognitive Abilities for Traumatic Brain Injury* (SCATBI) [23] was administered to participants

Table 1. Participant characteristics

Participants	Gender	Education of mother (SES)	Length of coma	SCATBI score	Age at injury (years)	Age at testing (years)
CHI						
1	M	PhD	<24 hours	15	17	19
2	F	HS	5.5 months	15	17	22
3	F	AS	1 week	13	16	19
4	F	HS	21 days	13	15	18
5	F	MS	4 days	11	18	20
6	F	MS	1.5 weeks	10	16	19
7	M	HS	3.5 weeks	9	16	18
8	M	HS	10 weeks	6	13	15
Mean = 18.9 years						
SD = 2 years						
Controls						
9	M	MS	___	___	___	22
10	F	Voc	___	___	___	21
11	F	HS	___	___	___	18
12	F	BS	___	___	___	18
13	F	HS	___	___	___	22
14	F	MS	___	___	___	19
15	M	HS	___	___	___	19
16	M	PhD	___	___	___	15
Mean = 19.3 years						
SD = 2.6 years						

HS = High School Diploma; Voc = Vocational Degree; AS = Associate Degree; PhD = Doctorate; SD = Standard Deviation; SCATBI = Scales of Cognitive Ability for Traumatic Brain Injury

with CHI. This measure provided a mechanism for identifying level of cognitive–linguistic functioning. The SCATBI tests the cognitive and linguistic abilities of persons with head injuries and measures performance in five areas, perception/discrimination, orientation, organization, recall and reasoning. The highest possible score on the SCATBI is 17 and none of the CHI participants scored in the normal range for this test. Table 1 presents data on length of coma and SCATBI scores for participants with CHI.

Experimental stimuli and procedures

All participants were asked to provide written narratives to a stimulus picture, the 'Cookie Theft' picture from the Boston Diagnostic Aphasia Examination [12]. The 'Cookie Theft' picture depicts a hectic kitchen scene. A mother is washing dishes and daydreaming; while the water is running over in the kitchen sink, and her children are swiping cookies from the cookie jar. Using a picture stimulus to elicit written discourse was considered a relatively demanding task. The task may be considered demanding because there is no model for how to initiate and temporally organize ideas generated by the picture. Since there is no specific instruction regarding desired length, the participant must determine when s/he has written a sufficient amount of discourse.

Participants were given ruled, white paper and a ball-point pen and were encouraged to provide as much information as possible. The first author or an assistant was present during the task to answer participants' questions. During the first 15 minutes, encouragement was provided, e.g. 'Give/tell as much information as possible'. All discourse samples were obtained during a single session. No time limit was placed on the completion of written tasks.

Written discourse samples were transcribed (typed) verbatim from the original sample and analyses were completed from the typed transcripts. All writing was designated as a part of a CU (communication unit), part of a maze or a comment about procedures. Analyses were completed for measures of productivity, efficiency, cohesion (lexical, incomplete, ellipsis), coherence (global, local) and use of mazes and included procedures suggested by Hughes *et al.* [24]. Complete transcription procedures were as follows:

Transcription and analysis procedures

Productivity

Productivity was measured according to the amount of language produced in the speaking and writing. Productivity was reported as the number of CUs per narrative. CU analysis (or the equivalent, *T*-Unit) has been used as a measure of productivity in previous research studies [7, 9, 25].

Efficiency

Efficiency of discourse measured the amount of speech (in words) used to convey a CU. The average number of words per CU, or the mean length of CU (MLCU), provided an index of efficiency for each narrative, with smaller averages representing greater efficiency. The MLCU was computed by dividing the number of combined words for all CUs per narrative by the number of CUs per narrative.

Various measures of efficiency of verbal narration have been investigated by previous researchers [5, 13, 14, 25].

Cohesion

Cohesion measured the degree of interdependence of words used in narratives. Words serving as cohesive ties were semantically related to other words in the narrative. Halliday and Hasan's system (as described by [6, 8] was used for analysis of cohesion. Cohesive ties were reported as number of ties per CU. Ties per CU were computed by dividing the total number ties in a narrative by the number of CUs in that narrative. The following categories of cohesion have been investigated in earlier studies [6–8, 14] and were selected for analysis because they have been identified as clearly differentiating CHI from normal subjects [8].

(1) *Lexical cohesion.* (a) personal pronouns (excluding *I* and *you*) which refer to a noun within the last three CUs, (b) demonstrative pronouns (excluding *the*) which refer to a noun in the last three CUs, (c) definite articles which refer to nouns, (d) nouns which are an exact repetition, a synonym, a superordinate or subordinate referent to a noun or pronoun in the last three CUs.
(2) *Ellipsis.* Missing information which must be assumed from an earlier reference that is a noun, verb or clause.
(3) *Incomplete ties.* A pronoun that is used without a referent in last three CUs.

Coherence

In addition to analysis of the use of cohesive ties, narratives were rated according to global and local coherence. Each narrative received one global and one local rating on the whole narrative. These measures have been proposed by Glosser and Deser [6] as more informal assessments of topic maintenance than cohesion analysis. Global coherence refers to the relationship of information that CUs collectively provide to the current topic. Local coherence refers to the relationship of the information that CUs provide to the immediately preceding or following statement. The following guidelines for coherence were used in this study to aid in the reliability of global and local ratings: 5 = coherent, 4 = loosely associated ideas, 3 = at least one idea strays, 2 = more than one idea strays, 1 = generally off target.

Global ratings referred to the relationship of information that was provided to the current topic. Generally, if all CUs were related to the topic of the picture, ideas were rated as 5 (coherent) or 4 (loosely associated ideas). Ideas were considered to stray if they were off topic and did not relate to the pictured activity. To obtain a global rating for each narrative, CUs that were not related to the topic of the picture were identified. If all ideas were related to the pictured activity, a subjective judgement was made as to whether the ideas expressed were coherently (rating of 5) or loosely associated around a theme (rating of 4). Typically, the difference between a rating of 4 and a rating of 5 was that a narrative with a rating of 5 developed a story; while a narrative with a rating of 4 just listed ideas expressed in the pictured activity.

An example of an idea that strayed from the topic of the 'Cookie Theft' picture was, '... and they need to mow their lawn'. If a narrative contained only one CU that strayed from the topic, the narrative received a global rating of 3. If a narrative contained two CUs that strayed, it received a rating of 2. Narratives containing more than two CUs which strayed from the topic, they were considered to be generally off target and received a rating of 1.

Local coherence, in this analysis, referred to the relationship of the information that was provided to the immediately preceding or following statement. Generally, if CUs followed in a progressive manner, ratings were 5 (coherent). If ideas followed progressively but were loosely associated, a rating of 4 was assigned. To obtain a local rating for each narrative, CUs that were not related to the preceding or following CU were identified.

If all successive CUs were related to either the preceding or following CU, a subjective judgement was made as to whether the ideas were closely related conceptually (a rating of 5) or loosely related (a rating of 4). Relationships that were considered closely related conceptually are expressed in the following CUs: 'The preoccupied mother is washing dishes while the sink is overflowing', 'and she has no idea what is going on', 'Behind her are the two kids', and 'The daughter is telling the son to be quiet and to steal lots of cookies'. Loosely associated conceptual relationships are expressed in the following CUs: 'and he's going to hit his head on the counter and git [get] a brain injury and be at AI', 'They are pale', 'and they need to moe [mow] there [their] lon [lawn]', and 'The grass is tall'. In the first example, the ideas expressed are directly related to the preceding or following concepts. In the latter example, all ideas expressed are related either to the CU before or after, but the concepts expressed are only loosely related.

Ideas were considered to stray if an idea was introduced that did not follow the preceding or failed to be developed (unless the sentence was the last in the narrative). In the CUs (a) 'The grass is tall', (b) 'The little girl wants a cooky [cookie]', and (c) 'The certons [curtains] are old and ugly', the second CU was considered to stray because it did not relate to the CU before or after. If a narrative contained two CUs that strayed, it received a rating of 2. Narratives containing more than two CUs which strayed from the topic, were considered to be generally off target and received a rating of 1.

Mazes

Exact repetitions of words or phrases, false starts or revisions, abandoned utterances and audible pauses and non-linguistic vocalizations (*uh*, *um*, *hmm*, *oh*, etc.) were counted as mazes. In written discourse samples, each marked out word or phrase was counted as a maze. The number of mazes used was reported as mazes per CU. Mazes were counted for each narrative, and that number was divided by the number of CUs in that narrative. Loban [26] did not find mazes to be a discriminating measure of oral language ability, but mazes have been reported as an indication of verbal decision-making behaviour [27]. Examples of transcribed and coded narratives are presented in Appendix A.

Reliability

A total of 16 discourse samples were analyzed using eight discourse measures. Discourse samples were randomly selected to establish reliability and interrater, point-to-point reliability was completed on 40% of the written discourse samples. On the cohesion analyses, 89% point-to-point agreement was achieved. For coherence, agreement of 88% was achieved and 94% agreement was achieved for local coherence ratings.

Results

The major focus of this research was to describe the written discourse of a group of adolescents with closed head injury (CHI) as compared with the written discourse of matched controls. A picture stimulus was used to elicit written discourse. A total of eight formal and informal discourse measures were used for analysis. It was expected that a difference would be found between the two groups on some or all of these measures.

Relationship of discourse to closed head injury (CHI)

The research question asked whether the written narratives of adolescents with CHI differed from those of controls on measures of productivity (number of CUs per narrative), efficiency (words per CU), cohesion (lexical, incomplete, elliptical, coherence (global, local)) and use of mazes. The performance of participants with CHI and controls was compared by computing independent *t*-tests between the group means on the above-mentioned measures for written discourse samples. A significance level of < 0.05 was used.

Productivity and CHI

Productivity refers to the number of CUs produced when writing about a picture. In written discourse tasks, participants with CHI were as productive as controls. For the CHI group, the range of CUs was 4–20 whereas the range was 5–21 for the controls. It is interesting to note that the means for the two groups was the same, 10.00 CUs, (CHI SD = 5.13, control SD = 6.26). Data on productivity are shown in table 2.

Efficiency and CHI

In written discourse tasks participants with CHI produced fewer words per CU than controls. The mean length of communication unit (MLCU) for written samples of the CHI group was 8.19 (range = 2.21–14.50, SD = 4.47). For controls, the MLCU was 11.70 (range 9.14–14.00, SD = 1.55). This difference was significant ($t = 2.10$, $p = 0.05$). The efficient use of discourse, when indicated by writing fewer words per CU about a picture stimulus, clearly differentiated adolescents with CHI from controls. Table 2 displays efficiency results.

Cohesion and CHI.

Lexical

In written discourse tasks, participants with CHI used fewer lexical ties per CU than controls. These differences were not significant ($t = 1.74$, $p = -0.10$). All participants in CHI and control groups connected ideas in closely approximated CUs with noun, pronoun and article referents. The mean number of lexical ties per CU was similar (CHI mean = 2.220, range = 10–3.78, SD = 1.27; control mean = 3.06, range = 2.21–3.76, SD = 0.58).

Table 2. Written discourse measures for participants with closed head injury and controls

Discourse measures	Mean	Range	SD	*t*	*p*
Productivity				0.00	1.00
CHI	10.00 CU	4.10–21.00	5.13		
Control	10.00 CU	5.00–21.00	6.26		
Efficiency				−2.10	0.05★
CHI	8.19 MLCU	2.21–14.50	4.47		
Control	11.70 MLCU	9.14–14.00	1.55		
Lexical cohesion				−1.74	0.10
CHI	2.22 ties per CU	0.10–3.78	1.27		
Control	3.06 ties per CU	2.21–3.76	0.58		
Incomplete cohesion					
CHI	$n = 0.00$				
Controls	$n = 0.00$				
Elliptical cohesion					
CHI	$n = 0.00$				
Controls	$n = 0.00$				
Global coherence rating				−1.00	0.33
CHI	4.00[a]				
Controls	4.38	2.00–5.00	1.06		
Local coherence rating				−3.86	0.002★
CHI	2.25	1.00–4.00	0.89		
Controls	4.25	2.00–5.00	1.17		
Mazes				0.53	0.61
CHI	0.21 per CU	0.00–0.80	0.11		
Control	0.14 per CU	0.00–0.60	0.20		

SD = standard deviation; CHI = closed head injury; CU = communication unit; MLCU = mean length of communication unit;
★ Significant at 0.05;
[a] All CHI received a rating of 4.00 on written discourse samples.

Incomplete

No incomplete pronoun referents were identified in the writing of CHI participants or controls.

Ellipsis

Elliptical cohesion, reference to a previously used noun, verb or clause which must be assumed, was not found in the written samples of either the CHI or control group. Cohesion data are provided in table 2.

Coherence and CHI

Global

Global coherence for the two groups was similar ($t = 1.00$, $p = 0.33$). Ratings assessed the relationship of statements to topic. All participants with CHI received a rating of 4.00 on written tasks. The mean for controls was 4.38 (SD = 1.06).

Local

On written discourse tasks, participants with CHI received lower ratings of local coherence than controls. Ratings assessed whether CUs were conceptually

connected to preceding or following CUs. The differences were significant for written tasks ($t = 3.86$, $p = 0.002$). The mean coherence rating for the CHI group was 2.25 (range 2.00–5.00, SD = 1.17). Controls received an average rating for 4.25 (range 1.00–4.00, SD = 0.89). Local coherence measures clearly differentiated the writing skills of adolescents and controls with and without CHI, while global ratings were similar.

Mazes and CHI

In written discourse tasks, participants with CHI demonstrated more verbal decision making behaviour (mazes) than controls (CHI mean = 0.21, control (mean = 0.14). This difference was not significant ($t = 53$, $p = 0.61$). Four participants with CHI and five controls exhibited maze behaviour (CHI group range = 0.00–0.80, SD = 0.11; control group range = 0.00–0.60, SD = 0.20). About half of the participants with CHI and controls exhibited revisions in writing when assessed by maze use. If maze behaviour can be taken as an indication of verbal decision making, this was not evident in the discourse of participants and controls to any great degree when describing the 'Cookie Theft' picture. Maze data for written tasks are provided in table 2.

Comment

Implications

The overall objective of this research was to compare the written discourse of adolescents with CHI to that of normal controls on a picture description task. Findings indicated that written narratives of adolescents after CHI differed significantly from those of controls on the measures of efficiency and local coherence. The CHI group expressed a similar number of ideas as controls when writing about a picture, but expressed each idea in fewer words. Semantic ties were used to a similar degree by both groups; but, while writing pertained to the topic of the picture, ideas were less likely to be related to those preceding or following. CHI and control groups both demonstrated very little verbal decision-making behaviour in written narratives.

Since there are no other studies of written discourse with adolescents with CHI, it is useful to explore written productivity results relative to previous work on productivity in oral discourse. In studies that explored adolescent performance as a part of a larger sample of children and adults [1, 5, 25, 28], oral productivity was found to be similar to or greater than that of controls. Data from the present study of written discourse are consistent with findings from oral discourse research, regardless of the nature of injury or the time post-injury.

Again, due to lack of comparative data on written discourse, the present results for written efficiency are similar to those reported previously for oral discourse [25]. Hartley and Jensen [25] used an estimate of oral efficiency (reported as a measure of productivity) which was derived by dividing the number of words used into the number of communication units used when telling a story based on a comic strip and retelling an auditorily presented story. For their group with diffuse CHI, fewer

words were used to express ideas orally. This finding is similar to the current indication that written ideas are expressed in fewer words after CHI.

Analysis of lexical cohesion was chosen for inclusion in this study because this measure had been shown to clearly differentiate oral discourse after CHI [8]. Earlier findings were that the oral discourse of participants with CHI contained fewer lexical ties than that of controls. Previous findings for oral discourse and the results for written discourse in this study produced different findings on the measure of lexical cohesion for adolescents. Results may be due to differing demands for oral and written discourse, or may be accounted for by the differing tasks used for elicitation. Mentis and Prutting [8] used a combination of descriptive and procedural narratives, while a picture generation task was used in the present research.

Writing of adolescents produced no incomplete pronoun referents by CHI participants or controls. In an earlier investigation of cohesion in the oral discourse of normal and head injured, medically stable adults, Mentis and Prutting [8] found incomplete ties to be a differentiating discourse measure. Participants with CHI used more incomplete ties when speaking about a combination of descriptive and procedural narratives. As with lexical cohesion, the difference in performance on this measure may be due to varying demands of the mode of discourse, or due to characteristics of the participants or method of elicitation.

Elliptical cohesion, reference to a previously used noun, verb or clause which must be assumed, was not used in written samples by adolescents in either the CHI or control group. This measure has also been identified as one which differentiated the oral discourse of adults with CHI in narrative production [8]. As with lexical and incomplete cohesive ties, the use of elliptical ties in written discourse failed to produce the group differences which have been observed for oral discourse.

Glosser and Deser [6], using a variation of the global coherence measure used in this study, analyzed the oral discourse of adults with severe CHI and found significant group differences on this measure. Findings in this research found that local coherence ratings clearly differentiated the writing skills of adolescents and controls with and without CHI, while global ratings for the two groups were similar. As with earlier discrepant findings, the written versus oral nature of the tasks may account for findings, or a variety of other subject or task variables.

About half of participants and controls exhibited revisions in writing when assessed by maze use. If maze behaviour can be taken as an indication of verbal decision-making, this was not evident in the discourse of participants and controls to any great degree when describing a picture. These findings are consistent with those of Hartley and Jensen [25], which indicated a low maze usage in their CHI group with diffuse brain injury.

This research suggests that written discourse is an important assessment tool in discriminating differences in communication abilities after CHI. Although oral discourse is typically analyzed for individuals with CHI, the data in this study indicate the need to evaluate written language as well. Due to the varying demands of speaking and writing, analyzing both modes of discourse may provide supplemental information which is pertinent to the identification of treatment goals. The increased need for attention, planning, and development of context in the generation of ideas when writing may result in increased or different cognitive demands than when speaking.

Future directions

These preliminary findings confirm that written discourse is an important area of investigation when describing the changes which take place in the communication skills of medically stable adolescents after diffuse brain injury due to CHI. Future investigations may wish to compare speaking and writing performance of the same participant population to determine how discourse measurements vary according to mode of expression. Resulting discrepancies may be evaluated by considering the cognitive demands inherent in oral versus written discourse tasks. Differences in discourse performance which are unique to adolescents may be identified by comparing their performance to that of groups comprised of only adults and only children.

Study limitations

Limitations of this study include small sample size. When comparing the discourse performance of adolescents with head injury, results are generally confounded by pre-existing factors [21]. The strict exclusionary criteria implemented in the current research produced preliminary results which described the performance of adolescents with no identified learning problems prior to CHI, rather than the performance of the typical adolescent after CHI. Since discourse has been shown to be impacted by cognitive skills [10], controlling for conditions associated with learning problems was deemed necessary. Verification of normal pre-injury learning skills through test scores or an analysis of grades in school may have strengthened this assumption, rather than relying on exclusionary criteria alone.

An additional weakness of this study, was the difficulty encountered when comparing results to previous discourse studies. Previous research has varied greatly according to subject, injury, elicitation task, and measurement variables. While the current study utilized a variety of previously identified discourse measures, only one elicitation task was employed. Ideally, similar research could investigate discourse elicitated by several elicitation procedures in child and adult populations with similar exclusionary criteria.

A final suggestion is that many of the variations in discourse performance may be accounted for by yet unidentified cognitive skills. As more is learned about discourse performance, it is important to more completely assess the cognitive skills of participants in order to help to account for the variations that are evident.

Appendix: Discourse samples

	Words
Participant written	
(1) (The . . .) She's washing dishes and overflowing the sink	7
(2) Little boy giting cookes	4
(3) The stool he is on is about to fall over	10

(4) And he's going to hit his head on the counter and git a brain injury and be at AI 19
(5) They are pale 3
(6) The grass is tall 4
(7) And they need to moe there lon 7
(8) The little girl wantes a cooky 6
(9) The certons are old and ugly 6
(10) Their (an't) are'nt many dishes 4
(11) No carpet or paint 4
11 CUs Total words 74
74/11 = 6.73 MLCU
2 mazes (*M*)
12 lexical ties (A = article, PP = personal pronoun, N = repeated noun)
4 incomplete ties (IC)
0 elliptical ties
global coherence rating = 3
local coherence rating = 2

Control written
(1) The mother is washing dishes on a sunny afternoon 9
(2) Something is on her mind and preoccupies her 8
(3) She doesn't even realize that the sink overflowing or that her children are stealing cookies from the cookie jar 19
(4) The little girl is telling the boy to be quiet 10
(5) And he, the son, is falling off the chair 9
5 CUs Total words 55
55/5 = 11 MLCU
0 mazes
16 lexical ties (A = article, PP = personal pronoun, N = repeated noun)
0 incomplete ties
1 elliptical tie (E)
global coherence rating = 5
local coherence rating = 5

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