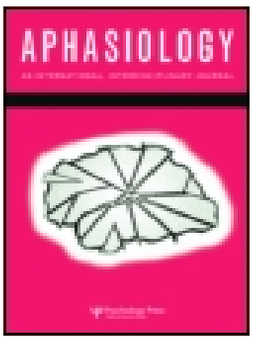

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Discourse characteristics of closed-head-injured and non-brain-injured adults misclassified by discriminant function analyses

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Background: In a previous study, discriminant function analyses (DFA) were employed to determine the accuracy of various story narrative and conversational discourse measures in classifying non-brain-injured (NBI) and closed-head-injured (CHI) adults (Coelho, Youse, Le, & Feinn, 2003). The DFAs correctly predicted group membership with 70–81% accuracy.

Aims: The present study re-examined the performance of the CHI and NBI participants who were incorrectly classified in an effort to determine what aspects of their discourse performance contributed to the misclassifications. It was hypothesised that the misclassifications were due to the relatively broad range in performance on the discourse measures, resulting in considerable overlap between the NBI and CHI participants.

Methods & Procedures: Scores for the story narrative and conversational discourse measures that made the largest contribution to the correct classification of the two participant groups were re-examined for the CHI and NBI participants who were misclassified by the DFA in the previous study (Coelho et al., 2003).

Outcomes & Results: Results indicated that there was considerable overlap in the discourse performance of the two participant groups for several of the story narrative and conversational discourse measures.

Conclusions: The performance overlaps occurred on many of the same discourse measures that were noted to be fairly good discriminators of CHI versus NBI discourse performance in the original study. Consequently, recommendations regarding elimination of certain measures to streamline the discourse analysis procedure could not be made. Other factors such as sampling discourse acontextually and specific participant characteristics undoubtedly influenced these findings as well. In addition, the DFA procedure utilised in the original study did not take into account the heterogeneity of discourse data. Nonparametric procedures such as classification and regression trees (CART) (Breiman, Friedman, Olshen, & Stone, 1984; Johnson & Wichern, 2002) may be better suited for the classification of non-homogeneous populations such as individuals with CHI.

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The examination of pragmatic deficits and discourse impairments following acquired brain injuries has been hampered by the lack of published normative data and the diversity of normal performance (McGann & Werven, 1995; Snow, Douglas, & Ponsford, 1995). In spite of this, numerous studies have utilised discourse analyses to study cognitive communication disorders following closed head injuries (CHI) (e.g., Coelho, Liles, & Duffy, 1991, 1995; Hartley & Jensen, 1991; Mentis & Prutting, 1987; Snow, Douglas, & Ponsford, 1997; Togher, Hand, & Code, 1999). It has been difficult to compare the findings of these studies because of the broad array of discourse elicitation and analysis procedures employed. However, all investigators have unanimously advocated the use of discourse analyses to study the often-subtle communicative deficits in CHI.

In a previous study, Coelho et al. (2003) examined a variety of analysis procedures thought to be sensitive to the communicative disruption following CHI. The authors applied discriminant function analyses (DFA) to several commonly used measures of story narrative and conversational discourse performance to determine which of them were most effective in predicting group membership for adults with CHI and those without brain injuries (NBI). The broader objective was to facilitate the clinical application of discourse analyses; by identifying measures that best discriminated participant groups, more consistent and clinically efficient discourse analysis procedures could be recommended.

Results indicated that the DFA correctly predicted group membership on the basis of the story narrative analyses and conversational analyses with 70% and 77% accuracy respectively. Those findings were not surprising, given that previous investigations of discourse in individuals with CHI had documented a variety of impairments across discourse genres analysed at different levels. Therefore, the likelihood of delineating the nature of communicative impairment secondary to CHI using a single discourse genre or a limited number of measures was poor, given the assortment of cognitive, linguistic, and psychosocial sequelae that characterise CHI. Support for this contention was noted in a follow-up DFA. When selected story narrative and conversational discourse measures were combined, the accuracy of group classification increased to 81% (Coelho et al., 2003).

The purpose of the present study was to further investigate the clinical utility of monologic (i.e., story narratives) and conversational discourse analyses for assessing adults with cognitive-communicative disorders secondary to CHI. This study re-examined the story narratives and conversations of the CHI and NBI participants who were incorrectly classified in the Coelho et al. (2003) study, in an effort to determine what aspects of their discourse performance contributed to the misclassification. It was hypothesised that due to the relatively broad range of ''normal'' performance that has been observed for discourse production (Armstrong, 2002; McGann & Werven, 1995; Snow et al., 1995), considerable overlap between the NBI and CHI participants would result. This blurring of the distinctions between the groups accounted for the classification errors. The clinical implications of such a finding are important. Discourse measures that are distinguished by wide-ranging performance in NBI individuals are probably not well suited for use in assessing individuals with brain injuries. Such measures have not previously been identified.

METHOD

Participants

The term CHI will be used throughout this paper as a designation for the brain-injured participants. Just as traumatic brain injury (TBI) is a subset of the broad category acquired brain injury (ABI), CHI or closed head injury and open (penetrating) head injury

denote specific subsets of traumatic brain injury (TBI). There are distinct differences between these subtypes of TBI, in terms of both array of deficits and recovery (Sohlberg & Mateer, 2001), the discussion of which is beyond the scope of this paper. In the interest of clarity and accuracy, the more explicit term CHI is used in this paper.

Participants have been thoroughly described in previous reports (Coelho, 2002; Coelho, Youse, & Le, 2002; Coelho et al., 2003); therefore their characteristics will only be highlighted here.

CHI participants. A total of 32 native speakers of English who had sustained a CHI were studied. All had recovered a high level of functional language; that is, they had achieved fluent conversation and did not demonstrate appreciable deficits on traditional clinical language testing—i.e., an aphasia quotient (AQ) above 93 on the Western Aphasia Battery (Kertesz, 1982). There were 8 females and 24 males ranging in age from 16 to 69 (mean = 31.7). Years of education ranged from 10 to 21 (mean = 13.2). All of the participants' injuries were rated as either moderate (duration of coma less than 6 hours) or severe (duration of coma greater than 6 hours) on the basis of criteria established by Lezak, Howieson, and Loring (2004). Time post-onset ranged from 1 to 99 months (mean = 12.8). Characteristics of the participants with CHI who were misclassified by the DFA procedure are summarised in Table 1.

Non-brain-injured participants. A total of 43 hospital employees ranging from 16 to 63 years old (mean = 31.9 years) comprised the NBI group. All NBI participants were native speakers of English. There were 30 males and 13 females studied. Level of education ranged from 11 to 24 years (mean = 15.3). As reported previously by Coelho (2002), the CHI and NBI groups did not significantly differ on the basis of age or level of education. Characteristics of the NBI participants who were misclassified by the DFA procedure appear in Table 2.

TABLE 1
Characteristics of participants with CHI misclassified by the DFA procedure

	Gender	*Age*	*MPO*	*EDU*	*Severity*
CHI 17	M	30	2	12	Severe
CHI 26	M	47	2	18	Severe
CHI 29	M	27	2	12	Moderate
CHI 33	F	24	9	13	Severe
CHI 37	F	16	1	11	Moderate
CHI 40	M	17	4	11	Moderate
CHI 46	F	18	8	12	Severe
CHI 47*	F	69	75	13	Severe
CHI 48	M	34	99	13	Severe
CHI 49*	F	40	26	16	Moderate
CHI 50	M	17	2	12	Severe
Range	6 M, 5 F	16–69	1–99	11–18	4 Moderate, 7 Severe

MPO = months post-onset; EDU = years of education; * denotes participants who were misclassified on both narratives and conversation

TABLE 2
Characteristics of NBI participants misclassified by the DFA procedure

	Gender	*Age*	*EDU*
NBI 4	M	18	12
NBI 8	F	46	18
NBI 9	F	22	17
NBI 11*	F	56	13
NBI 17	M	43	12
NBI 19	M	26	12
NBI 20	F	26	12
NBI 23	F	19	12
NBI 24	M	25	14
NBI 26	M	18	12
NBI 28	F	26	16
NBI 31	M	59	18
NBI 34	F	52	22
NBI 37	M	24	16
NBI 39	F	26	18
NBI 40	M	30	16
NBI 42	M	38	17
NBI 44*	M	16	11
NBI 46*	M	18	12
NBI 49*	M	16	11
Range	12 M, 18 F	16–59	11–22

EDU = years of education; * denotes participants who were misclassified on both narratives and conversation.

Discourse elicitation and analysis procedures from the original study

Narrative and conversational discourse samples were elicited from all participants. The discourse elicitation and analysis procedures utilised in this study, including reliability measures, have been explained in detail previously (see Coelho et al., 2002, 2003) and are only briefly summarised here.

Narrative discourse tasks

Story retelling task. Participants were presented with the picture story *The Bear and the Fly* (Winter, 1976), by filmstrip projector on a 23 cm × 30.5 cm screen. After viewing the filmstrip, the participants were given the following instruction: ''Tell me that story.'' When a participant stopped retelling the story, the examiner waited 10 seconds then asked, ''Is that the end of the story?'' If the participant answered affirmatively, the task ended.

Story generation task. Participants were given a copy of the Norman Rockwell painting ''The Runaway''. They were instructed: ''Tell me a story about what you think is happening in this picture.'' The picture remained in view until the task was completed. When the participant stopped telling a story, the examiner waited 10 seconds and then asked, ''Is that the end of the story?'' If the participant answered affirmatively, the task was ended.

Conversation

Each participant was individually engaged in a 15-minute conversation with the examiner. Conversations were initiated by the examiner who asked, ''Why are you here at the hospital/rehabilitation centre today?''

Analyses

Each story and conversation was audiotaped and transcribed verbatim. Prior to analysis, transcriptions of the stories were distributed into T-units (i.e., an independent clause plus any subordinate clauses associated with it), following the conventions described by Liles (1985). Segmenting narratives into sentences can be problematic because of the tendency of speakers to link sentences with conjunctions such as *and*, *or*, and *then*, making it difficult to delineate sentence boundaries. Use of T-units, which are clearly defined, solves the problem (Hughes, McGillivray, & Schmidek, 1997). For the conversations, each utterance was assigned to one of the speakers (examiner or participant).

Story measures. Within- and between-sentence analyses were examined and compared across tasks and groups. Within-sentence measures included Number of Words per T-unit and Number of Subordinate Clauses per T-unit. Between-sentence measures included Percent Complete Ties out of Total Ties, Number of Total Episodes, and Proportion of T-units within Episode Structure. All measures are described in detail in Coelho (2002) and are summarised in Table 3.

Conversation. The middle 6 minutes of each conversation were analysed. Following procedures described by Blank and Franklin (1980), two categories of analyses were employed, Appropriateness and Topic Initiation. Number of conversational turns was also tallied. These procedures have been described in detail in Coelho et al. (2002) and are summarised in Table 4.

Reliability. Reliability measures were based on point-to-point scoring. For the measures of story narrative ability, inter- and intra-examiner reliability scores ranged from 90% to 98%. Intra-judge reliability scores for the conversation measures ranged from 80% to 99%, inter-judge reliability scores ranged from 80% to 97%. Judges experienced difficulty in identifying Smooth Shifts—instances in which the topic of conversation was subtly shifted to another topic. Determining these shifts was often subjective and consequently yielded the lowest intra- and inter-judge reliability scores.

Re-analysis of DFA data. Scores for the story narrative and conversational discourse measures that contributed the most to the correct classification of the two participant groups were re-examined for the CHI and NBI participants who were misclassified by the DFA in the previous study (Coelho et al., 2003). The story narrative measures included: Number of Words per T-unit, Number of Subordinate Clauses per T-unit, Percent Complete Ties out of Total Ties, Number of Total Episodes, and Proportion of T-units Contained Within Episode Structure. The conversational discourse measures included: Number of Comments and Number of Adequate Plus Responses. These scores were converted to *z*-scores for the purpose of comparing each individual's performance on a given measure to the average performance of the members of their group who were correctly classified using that same measure (z = individual's score for a given measure – group mean score for the same measure/standard deviation for the group).

TABLE 3
Measures used to analyse story narratives

Discourse measure	*Domain*	*Description*
Number of Words per T-Unit	Sentence length	Total number of words divided by the number of T-units Example: 125 words/7 T-units = 17.9
Number of Subordinate Clauses per T-unit	Complexity of sentence-level grammar	Total number of subordinate clauses in each story divided by the total number of T-units Example: 4 subordinate clauses/7 T-units = 0.6
Percent Complete Ties out of Total Ties	Cohesive adequacy	Percentage of complete ties out of total ties in each story Examples: Complete tie: The dog was tired. *He* slept in the sun. Incomplete tie: The kids travelled home from school. They spent the night at *his* uncle's house. Erroneous tie: Chris and Alex walked to the concert. *He* lost his wallet.
Number of Total Episodes	Content organisation	Number of complete and incomplete episodes in a story Examples: Complete episode: [Initiating event] and this fly comes in and the Father's bothered by this [Attempt] so he decides to swat or hit the fly and he hits his wife [Direct consequence] and she goes down Incomplete episode: [Attempt] and he hits his daughter [Direct consequence] and the daughter goes down to the floor
Proportion of T-units within Episode Structure	Ability to use story grammar as an organisational plan for language	Number of T-units in episode structure divided by total number of T-units in each story Example: 14 T-units in episodes/18 total T-units = 0.78

RESULTS AND DISCUSSION

Results and discussion for each of the analyses are presented in four sections: Individuals with CHI misclassified as NBI on conversational measures; NBI individuals misclassified as CHI on conversational measures; Individuals with CHI misclassified as NBI on story narrative measures; NBI individuals misclassified as CHI on story narrative measures.

Individuals with CHI misclassified as NBI on conversational measures

Results. Four participants with CHI were misclassified as NBI on the conversational measures (see Table 5). It appeared that *z*-scores of at least one standard deviation above the CHI group mean led to misclassification. The measure Number of Comments yielded such scores for all four of the individuals who were misclassified. In addition, three of the four CHI participants who were misclassified scored at least one standard deviation above the group mean for Obliges. One other conversational measure, Number of Adequate Plus Responses, yielded a *z*-score greater than one standard deviation below the group mean for one participant.

TABLE 4
Measures used to analyse conversations

Category	*Measure*	*Definition*	*Example*
Appropriateness: Speaker Initiations	Obliges	Utterances containing explicit requirements for a response.	''Where do you live?''
	Comments	Utterances not containing an explicit demand for a response.	''It's a nice place to work.''
Appropriateness: Speaker Responses	Adequate	Utterances that appropriately met the initiator's verbalisation.	In response to the question, ''What time is it?'' the response might be ''It's three o'clock.''
	Adequate Plus	Utterances that are relevant and elaborate on the theme, providing more information than was requested.	In response to the question ''What time is it?'' the response might be ''It's three o'clock. I know that because I just passed the new clock at the Dime Savings Bank.''
	Inadequate	Utterances in which the information offered is invalid, irrelevant, or insufficient to meet the constraints established by the initiator's utterance.	In response to the question ''What time is it?'' the response might be ''I'm 37 years old.''
Topic Initiation	Novel Introduction	Occurs at the beginning of the conversation, or by ending discussion of one topic and initiating another.	''Terry told me you were from New Jersey. How long have you lived there?''
	Smooth Shift	Occurs when the discussion of one topic is subtly switched to another.	If the topic of discussion pertained to buying cars and one of the participants stated ''I really need a new car. I want to drive to Florida for my vacation.'' From that point on the topic shifted to a discussion of Florida
	Disruptive Shift	Occurs when the discussion of one topic is abruptly or illogically switched to another topic.	If, during a discussion of the Vietnam war, one participant stated ''I cut my hand on a fish hook yesterday.''

What was noteworthy about these findings was the degree of overlap among the individuals who were misclassified and the group with which they were identified. Figure 1 depicts the performance of the individuals with CHI who were misclassified as NBI for the measure Number of Comments. It is apparent that for this measure the performance of those participants who were misidentified exceeded that of their CHI peers and was more comparable to the NBI group.

Discussion. All four of the participants with CHI who were misclassified as NBI appeared more interactive based on their use of comments. They seemed more engaged in the conversations and less dependent on the examiner to sustain the conversational flow. These individuals also produced fewer Adequate Plus Responses and a greater number of Obliges, which was comparable to the performance of the NBI group versus the CHI

TABLE 5
Z-scores for CHI individuals misclassified as NBI compared to all correctly classified CHI individuals on conversational discourse tasks

	Obliges	*Comments*	*Adq. Plus*
CHI Range	0.00–14.00	0.00–33.00	11.00-80.00
CHI Mean	2.89	18.36	47.86
CHI 33	13.00	43.00	5.00
***Z*-score**	**2.46929**	**2.70974**	**−2.24472**
CHI 37	10.00	43.00	38.00
***Z*-score**	**1.84471**	**2.70974**	−0.56894
CHI 47	0.00	31.00	35.00
***Z*-score**	−0.79369	**1.55442**	−0.73900
CHI 49	11.00	39.00	50.00
***Z*-score**	**2.06547**	**2.36784**	0.12439

Z-scores > 1.0 above or below the mean are in bold.

group. The greater use of Obliges in comparison to the lack of Adequate Plus Responses may have facilitated *disclosure* on the part of their partner. As described by Bond and Godfrey (1997), the function of disclosure in an interaction is to allow the opportunity to talk about oneself or subjects of interest to oneself. Facilitation of disclosure demonstrates some interest in the communication partner and assists in establishing and sustaining an enjoyable social interaction.

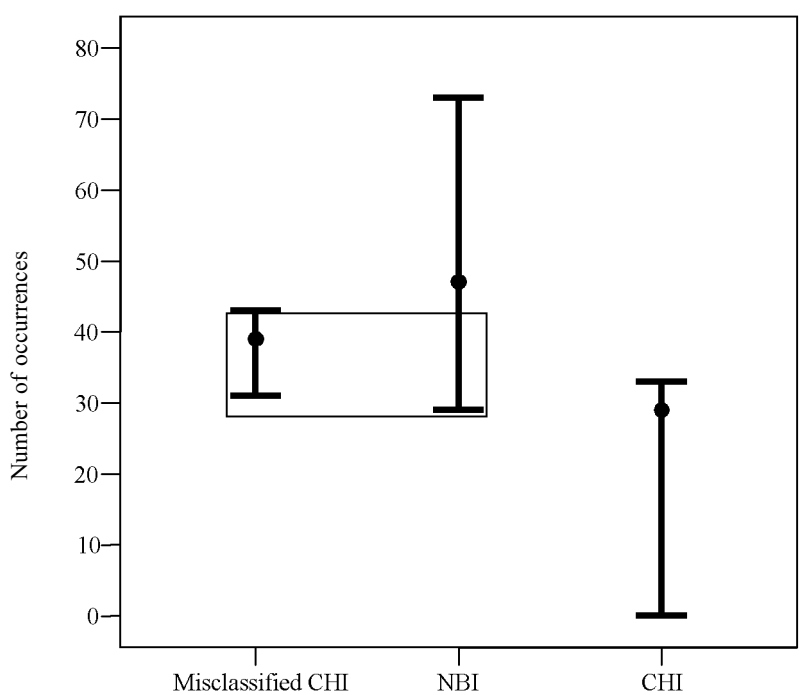

Figure 1. Individuals with CHI misclassified as NBI on the measure Number of Comments during the conversation task. Vertical bars represent range; filled circles represent mean; boxes demonstrate overlap.

NBI individuals misclassified as CHI on conversational measures

Results. A total of 13 NBI participants were misclassified as CHI using the conversational measures. The *z*-scores for the NBI participants who were misclassified as CHI are shown in Table 6. Scores for the measure Number of Comments were at least one standard deviation below the NBI group mean for all 13 participants who were misclassified as CHI. An additional conversational measure, Number of Adequate Plus Responses, yielded *z*-scores of at least one standard deviation above the NBI group mean for 6 of the 13 participants.

Figure 2 illustrates the performance of these misclassified NBI individuals for the measure Comments during conversations. Once again, the degree of overlap between the NBI participants' performance and that of the CHI group readily accounts for the misclassification. The performance of these NBI individuals, for the Comments measure, was more consistent with the CHI group than that of their NBI peers.

TABLE 6
Z-scores for NBI individuals misclassified as CHI compared to all correctly classified NBI individuals on conversational discourse tasks

	Obliges	*Comments*	*Adq. Plus*
NBI Range	0.00–51.00	29.00–73.00	4.00–50.00
NBI Mean	9.17	47.10	27.40
NBI 4	8.00	25.00	42.00
***Z*-score**	−0.09315	**−1.84771**	**1.03959**
NBI 9	3.00	26.00	42.00
***Z*-score**	−0.49038	**−1.77335**	**1.03959**
NBI 11	0.00	6.00	61.00
***Z*-score**	−0.72532	**−3.02648**	**2.22142**
NBI 17	0.00	10.00	32.00
***Z*-score**	−0.72532	**−2.81541**	0.33317
NBI 20	0.00	19.00	41.00
***Z*-score**	−0.72532	**−2.26854**	0.97077
NBI 23	0.00	20.00	38.00
***Z*-score**	−0.72532	**−2.20149**	0.76150
NBI 24	0.00	18.00	32.00
***Z*-score**	−0.72532	**−2.33433**	0.33317
NBI 39	0.00	10.00	60.00
***Z*-score**	−0.72532	**−2.81541**	**2.16613**
NBI 40	0.00	17.00	58.00
***Z*-score**	−0.72532	**−2.39886**	**2.05306**
NBI 42	0.00	28.00	50.00
***Z*-score**	−0.72532	**−1.62120**	**1.56897**
NBI 44	2.00	7.00	20.00
***Z*-score**	−0.56908	**−2.97549**	−0.53436
NBI 46	0.00	19.00	35.00
***Z*-score**	−0.72532	**−2.26854**	0.54865
NBI 49	5.00	26.00	36.00
***Z*-score**	−0.33209	**−1.77335**	0.61994

Z-scores > 1.0 above or below the mean are in bold.

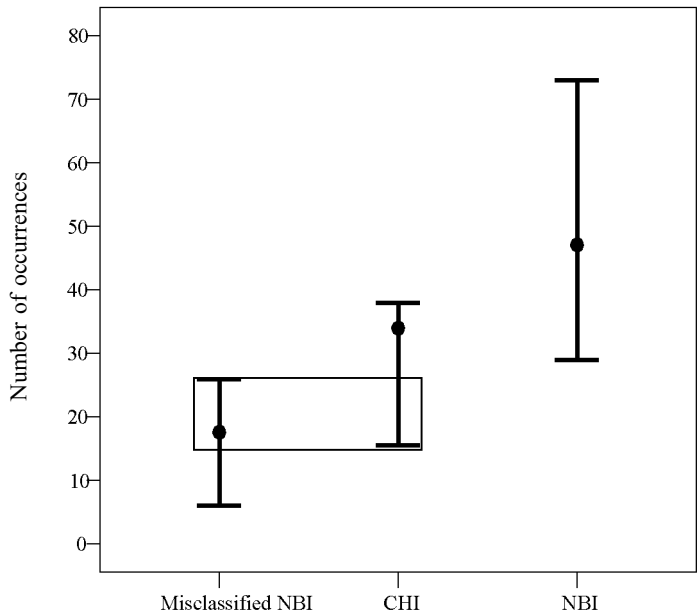

Figure 2. NBI individuals misclassified as CHI on the measure Number of Comments during the conversation task. Vertical bars represent range; filled circles represent mean; boxes demonstrate overlap.

Discussion. The NBI participants who were misclassified as CHI were less interactive than the other NBI participants. All of them produced fewer Comments than their NBI peers, and nearly 50% of the group produced a higher proportion of Adequate Plus Responses, which was also not typical of the other NBI participants. Closer examination of these misclassified NBI participants revealed two subsets: one that produced fewer Comments, and a second that produced fewer Comments as well as a higher number of Adequate Plus Responses.

Individuals with CHI misclassified as NBI on story narrative measures

Results. Nine participants with CHI were misclassified as NBI on the story narrative measures. Table 7 illustrates their *z*-scores for the story generation and story retelling tasks. One measure, Proportion of T-units Contained Within Episode Structure for the story generation task, yielded scores of at least one standard deviation above the CHI group mean for eight of the nine participants who were misclassified as NBI. Four of them also had *z*-scores greater than one standard deviation above the CHI group mean on the measure of Words per T-unit for both the story generation and the story retelling tasks. All other story narrative measures had *z*-scores greater than one standard deviation above the group mean for one, two, or three of the misclassified CHI participants.

The performance of the individuals with CHI who were misclassified as NBI on the story generation measure Proportion of T-units Within Episode Structure is shown in Figure 3.

Discussion. The greater degree of overlap with the NBI group for these CHI participants on this story grammar measure suggested that these individuals' performances

TABLE 7
Z-scores for CHI individuals misclassified as NBI compared to all correctly classified CHI individuals on story narrative discourse tasks

	GWDSTU	*GSUBT*	*GCOMTPC*	*GTUEPTR*	*RWDSTU*	*RSUBT*	*RCOMTPC*	*RTUEPTR*
CHI Range	5.67–25.00	0.00–1.67	16.67–94.12	0.00–0.67	6.56–12.94	0.00–0.24	57.14–100.00	0.13–1.00
CHI Mean	11.45	0.50	64.22	0.26	9.37	0.08	86.59	0.59
CHI 17	13.00	0.33	100.00	0.67	11.29	0.14	100.00	0.57
***Z*-score**	0.34906	−0.41851	**1.81709**	**1.79485**	**1.22966**	0.69636	**1.05804**	−0.11264
CHI 26	22.75	1.00	50.00	0.75	9.55	0.00	91.30	0.60
***Z*-score**	**2.24068**	**1.18297**	−0.77509	**2.09270**	0.11721	−0.98460	0.38061	0.03499
CHI 29	21.50	0.00	50.00	1.00	8.29	0.21	78.75	0.68
***Z*-score**	**2.04204**	**−1.20022**	−0.77509	**2.81834**	−0.71692	**1.48018**	−0.62897	0.43912
CHI 40	11.25	0.50	80.00	0.50	12.88	0.88	93.10	1.00
***Z*-score**	−0.04480	−0.00953	0.85744	**1.11849**	**2.08958**	**4.20664**	0.52425	**1.91864**
CHI 46	10.50	0.25	87.50	0.50	10.12	0.06	95.56	0.65
***Z*-score**	−0.21379	−0.62002	**1.23971**	**1.11849**	0.49286	−0.30178	0.71757	0.27770
CHI 47	14.67	0.33	60.00	0.67	7.13	0.00	95.45	0.75
***Z*-score**	0.71753	−0.41851	−.23302	**1.79485**	**−1.42804**	−0.98460	0.70967	0.79839
CHI 48	10.43	0.14	77.78	0.71	13.38	0.13	100.00	0.63
***Z*-score**	−0.22985	−0.87394	0.74009	**1.96853**	**2.31876**	0.48761	**1.05804**	0.16409
CHI 49	18.13	1.00	67.86	0.38	14.67	0.25	100.00	0.33
***Z*-score**	**1.43431**	**1.18297**	.20104	0.55466	**2.82023**	**1.83026**	**1.05804**	**−1.29134**
CHI 50	23.00	0.75	60.00	0.75	9.62	0.08	97.18	0.62
***Z*-score**	**−2.27866**	0.60144	−.23302	**2.09270**	0.16074	−0.08559	0.84391	0.11446

Z-scores > 1.0 above or below the mean are in bold. GWDSTU = Generation Words per T-unit; GSUBT = Generation Subordinate Clauses per T-unit; GCOMTPC = Generation Complete Ties out of Total Ties; GTUEPTR = Generation T-units Contained within Episode Structure; RWDSTU = Retelling Words per T-unit; RSUBT = Retelling Subordinate Clauses per T-unit; RCOMTPC = Retelling Complete Ties out of Total Ties; RTUEPTR = Retelling T-units Contained within Episode Structure.

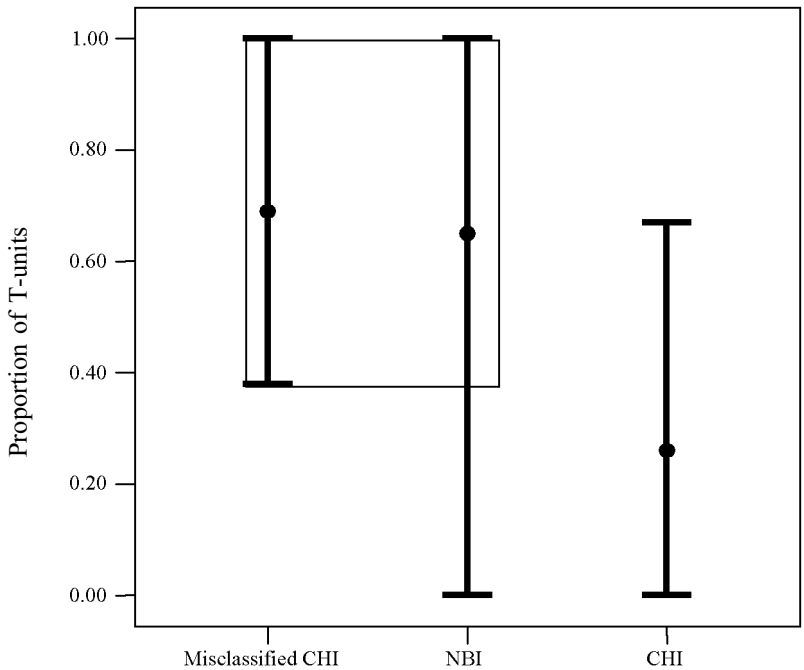

Figure 3. Individuals with CHI misclassified as NBI on the story generation measure of T-units Within Episode Structure. Vertical bars represent range; filled circles represents mean; boxes demonstrate overlap.

were more comparable to the NBI group than that of their CHI peers, thus leading to the inaccurate classification. With regard to the story narrative tasks, nearly 90% of these participants demonstrated a superior ability to organise semantic content within the story generation task. It has been suggested that the story generation task is a more challenging task than story retelling (Coelho, 2002). In addition, approximately 44% of these individuals produced story narratives that were longer than those of the correctly classified CHI group in both the retelling and generation tasks. Finally, roughly 33% of this group also produced stories that were characterised by more complex sentences (i.e., more subordinate clauses per T-unit). Clearly, these individuals were functioning at a level of language proficiency that exceeded the level of the other CHI participants and overlapped the NBI range.

NBI individuals misclassified as CHI on story narrative measures

Results. A total of 11 NBI participants were misclassified as CHI using the story narrative measures. *Z*-scores for the story generation and retelling tasks for the NBI participants who were misclassified as CHI are shown in Table 8. Again, it was the measure Proportion of T-units Contained Within Episode Structure that distinguished the group. For the story generation task, 6 of the 11 misclassified NBI participants had *z*-scores greater than one standard deviation below the NBI group mean for this measure. Likewise, 7 of the 11 NBI participants had *z*-scores greater than one standard deviation below the NBI group mean for the same measure in the story retelling condition. No other

TABLE 8
Z-scores for NBI individuals misclassified as CHI compared to all correctly classified NBI individuals on story narrative discourse tasks

	GWDSTU	*GSUBT*	*GCOMTPC*	*GTUEPTR*	*RWDSTU*	*RSUBT*	*RCOMTPC*	*RTUEPTR*
NBI Range	9.67–36.00	0.00–2.50	25.00–100.00	0.00–1.00	6.57–38.00	0.00–1.00	50.00–100.00	0.42–1.00
NBI Mean	15.82	0.62	70.36	0.65	11.07	0.21	92.97	0.76
NBI 8	15.71	0.86	71.43	0.14	11.27	0.15	96.97	0.46
***Z*-score**	−0.01634	0.43005	0.05960	**−1.48014**	0.03428	−0.28389	0.34428	**−1.72565**
NBI 11	14.33	0.50	76.47	1.00	9.07	0.15	96.72	0.56
***Z*-score**	−0.23406	−0.21095	0.33938	**1.02923**	−0.34783	−0.31041	0.32297	**−1.21167**
NBI 19	12.00	0.67	50.00	0.33	10.67	0.05	98.21	0.90
***Z*-score**	−0.59868	0.08874	**−1.10660**	−0.95018	−0.07081	−0.77276	0.45078	0.89863
NBI 26	8.40	0.20	72.73	0.40	9.57	0.14	50.00	0.43
***Z*-score**	**−1.14311**	−0.74346	0.13181	−0.75651	−0.26152	−0.33502	**−3.03760**	**−1.89457**
NBI 28	12.17	0.33	73.68	0.33	10.00	0.00	88.00	0.50
***Z*-score**	−0.57286	−0.50863	0.18498	−0.95018	−0.18697	−0.98627	−0.42771	**−1.52088**
NBI 31	16.20	0.90	81.25	0.20	11.67	0.43	96.47	0.50
***Z*-score**	0.06031	0.50626	0.60193	**−1.32531**	0.10357	**1.00430**	0.30144	**−1.52088**
NBI 34	12.94	0.33	85.71	0.11	11.68	0.04	98.51	0.52
***Z*-score**	−0.45184	−0.50863	0.84307	**−1.56445**	0.10590	−0.80721	0.47579	**−1.41130**
NBI 37	8.75	0.00	60.00	0.50	7.57	0.05	100.00	0.62
***Z*-score**	**−1.09152**	**−1.08709**	−0.57271	−0.46034	−0.60663	−0.77276	0.60259	−0.84176
NBI 44	12.86	0.29	76.47	0.29	8.69	0.00	100.00	0.69
***Z*-score**	−0.46546	−0.59292	0.33938	**−1.08619**	−0.41472	−0.98627	0.60259	−0.42846
NBI 46	11.17	0.33	58.82	0.00	7.63	0.05	97.56	0.79
***Z*-score**	−0.72711	−0.50863	−0.63683	**−1.84915**	−0.59634	−0.75004	0.39493	0.19974
NBI 49	11.00	0.38	92.59	0.25	10.09	0.09	96.30	0.27
***Z*-score**	−0.75265	−0.43456	**1.20345**	**−1.18677**	−0.17114	−0.57523	0.28647	**−2.60442**

Z-scores > 1.0 above or below the mean are in bold. GWDSTU = Generation Words per T-unit; GSUBT = Generation Subordinate Clauses per T-unit; GCOMTPC = Generation Complete Ties out of Total Ties; GTUEPTR = Generation T-units Contained within Episode Structure; RWDSTU = Retelling Words per T-unit; RSUBT = Retelling Subordinate Clauses per T-unit; RCOMTPC = Retelling Complete Ties out of Total Ties; RTUEPTR = Retelling T-units Contained within Episode Structure.

story narrative measure yielded *z*-scores greater than one standard deviation below the group mean for more than two participants.

Figures 4 and 5 illustrate the performance of the NBI individuals who were misclassified as CHI on the measure T-units Within Episode Structure for the story generation and retelling tasks.

Discussion. On the basis of these findings, it appeared that the discourse performance of those NBI individuals was more consistent with the CHI group than their NBI peers for this measure, contributing to the misclassification. For the misclassified NBI individuals, approximately 64% demonstrated poorer performance on the story grammar measure Proportion of T-units within Episode Structure. This indicates reduced organisation of semantic content as compared to their NBI peers, and was noted for both the story retelling and generation tasks. Although this story grammar measure was an important factor for discriminating the CHI and NBI groups, performance ranges overlapped for the two elicitation tasks studied, thus leading to the misclassification of certain individuals.

CONCLUSIONS

The purpose of the present study was to re-examine the discourse performance of CHI and NBI participants misclassified in a previous DFA procedure (Coelho et al., 2003). It was hypothesised that the classification errors were attributable to the relatively large range in performance that has been observed in the discourse production of NBI indi-

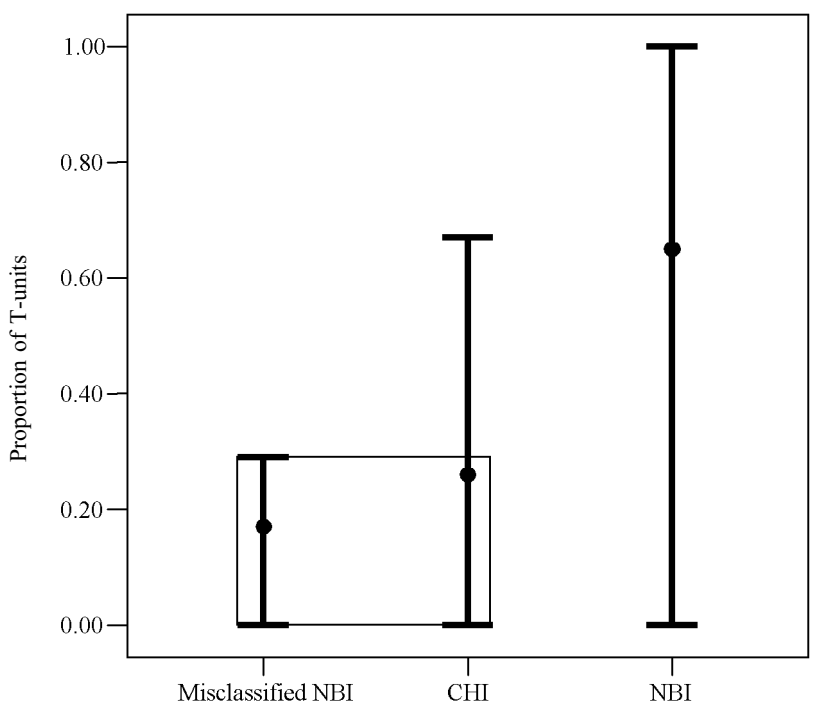

Figure 4. NBI individuals misclassified as CHI on the measure T-units Within Episode Structure for the story generation task. Vertical bars represent range; filled circles represents mean; boxes demonstrate overlap.

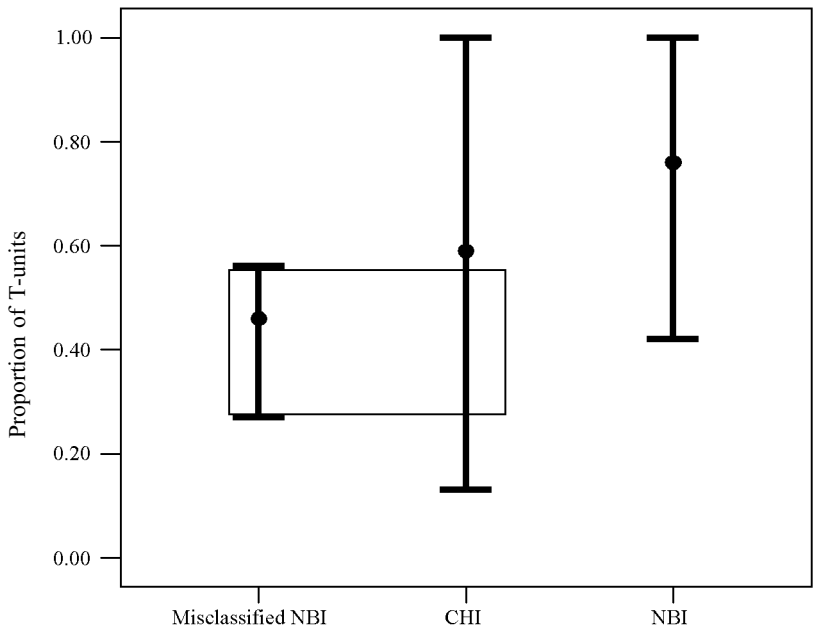

Figure 5. NBI individuals misclassified as CHI on the measure T-units Within Episode Structure for the story retelling task. Vertical bars represent range; filled circles represent mean; boxes demonstrate overlap.

viduals. In general, the findings of this study supported this contention. For most of the conversational and story narrative discourse measures, misclassifications occurred because an individual's performance was more comparable to that of the NBI group (for the CHI participants) or the CHI group (for the NBI participants). What was not anticipated in these findings was that the performance overlaps occurred on most of the same discourse measures that were previously touted as being fairly good discriminators of CHI versus NBI discourse performance by Coelho and colleagues (2003). Consequently, we are unable to recommend which of the discourse measures should be eliminated from the discourse analysis procedure. These measures were able to accurately classify between 70% and 81% of the participants (i.e., depending on the combination of measures entered into the DFA) and yet these same combinations of measures misclassified between 19% and 30% of the participants. Other factors must have influenced these findings as well.

The first potential factor, and perhaps most important, involves the assessment of communication somewhat acontextually. Although the measures of monologic story narrative discourse performance were able to distinguish approximately 70% of the CHI and NBI participants (Coelho et al., 2003), perhaps the lack of communicative context limited the sensitivity of the measures for those who were minimally animated or expressive. The finding that the conversational discourse measures were able to classify the participant groups with a higher degree of accuracy (i.e., 77% [Coelho et al.]) lends support to this argument. The interactive nature of conversation appeared to be more challenging than the story narratives for all participants. This is consistent with the observation of Snow and Douglas (1999) that discourse needs to be viewed ''. . . as a tool by which the individual negotiates a wide range of interactions—at home, at work, and/or in educational settings . . .'' (p.303); therefore clinicians need to view these settings as

appropriate for intervention, including assessment. Whenever possible, discourse performance should be sampled in a variety of natural everyday contexts.

A second issue pertains to the specific characteristics of the NBI and CHI participants who were misclassified. Three features of these individuals could have contributed to their misclassification. These included level of education, severity of injury, and time post-injury for the CHI group, and level of education for the NBI group. Re-examination of Table 1 indicates that of the 11 CHI participants who were misclassified on the conversation or story narrative discourse measures, years of education ranged from 11 to 18, but only 2 of the 11 had more than 13 years. This group was comparable in education to the group of CHI participants from the original DFA study (Coelho et al., 2003) that was accurately classified. With regard to severity of injury, seven individuals were initially rated as having severe injuries, and four had moderate injuries. Therefore, level of education and severity of injury did not seem to contribute to the misclassification of this subgroup of CHI participants. Time post-onset also did not appear to be an explanatory factor. Misclassified CHI participants included the entire range, from 1 month to 99 months post-onset. However, because of the heterogeneity of the CHI population, it is important that future studies examine the influence of such factors on discourse performance in individual participants as opposed to participant groups. For the 20 NBI participants who were misclassified on the conversation or story narrative discourse measures, level of education ranged from 11 to 22 years (see Table 2), which was identical to that of the NBI group from the Coelho et al. study. Of this group, 10 participants had 11–12 years of education, and 10 participants had more than 12 years. Therefore, it did not appear that level of education influenced the misclassification of the NBI subgroup in a straightforward manner. This was particularly the case for those seven NBI participants with 16 or more years of education who were classified as CHI.

The final factor is the underlying assumption of the DFA procedure employed. In general, such parametric procedures treat the phenomenon of interest, in the present study discourse performance, as though it were homogeneous; that is, as if the same relationship between variables was constant over all of the measurements of discourse performance for both the CHI and NBI groups. In reality, what makes a data set interesting is not only its size but also its complexity, where complexity can include such considerations as: a mixture of data types, nonstandard data structure, and perhaps most challenging, heterogeneity. Nonparametric classification procedures, referred to as classification and regression trees (CART) (Breiman et al., 1984; Johnson & Wichern, 2002) have been developed for complex, heterogeneous data sets. It is likely that the heterogeneity of the CHI and NBI groups was a factor that may have biased the classification of the CHI and NBI participants. Follow-up studies interested in DFA of discourse data should employ the CART methodology.

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