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Linking inter- and intra-sentential processes for narrative production following traumatic brain injury: Implications for a model of discourse processing

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ABSTRACT

Some suggest that traumatic brain injury (TBI) produces dissociation between the macrolinguistic and microlinguistic levels of discourse production. This assumption is based primarily on studies that have found preserved intersentential cohesion and/or intra-sentential processing in narratives produced by these individuals. However, few studies exist, if any, that have investigated the relationship between these processes in TBI speakers who do demonstrate such microlinguistic impairments. This study investigated the relationship between impairments of intersentential cohesion and intra-sentential processing in the discourse of 15 speakers with severe TBI. The results demonstrated a significant relationship between the production of cohesive ties and instances of intra-sentential impairment that suggests that utilization of resources for adequate cohesion appears to negatively affect intra-sentential processing following TBI. We propose that macrolinguistic and microlinguistic processes are not independent of one another, as has been proposed, but share cognitive resources that support the planning and production of both local (microlinguistic) and long-distance (macrolinguistic) relationships expressed through discourse.

1. Introduction

The examination of narrative discourse has become an important clinical tool to describe the effects of traumatic brain injury (TBI) on spoken language (Cannizzaro and Coelho, 2012; Galetto et al., 2013; Marini et al., 2014; Peach, 2013). It has also provided data that have contributed in important ways to understanding how language is organized in both normal and brain-damaged speakers (e.g., Adornetti et al., 2014; Cosentino et al., 2013; Glosser and Deser, 1991; Glosser, 1993). Generally, these analyses have focused on macrolinguistic and microlinguistic processing for texts. Macrolinguistic processing is concerned with the overall meaning of the text and the way these meanings are organized, i.e., its coherence. Microlinguistic processing involves the lexical and syntactic aspects of the discourse. Linking the two levels is intersentential cohesion, a semantic relation realized by cohesive ties that are either lexical or grammatical in nature (Armstrong, 2000).

Whether establishing intersentential cohesion represents a macrolinguistic or microlinguistic operation has been the source of some confusion. For example, Glosser and Deser (1991); see also Glosser (1993) suggested that intersentential cohesion (i.e., local coherence) and global coherence may represent distinct points within macrolinguistic processing. Coelho et al. (2005) classified intersentential cohesion as a macrolinguistic measure because it deals with text relations that cross sentence boundaries (see also Coelho, 2007). Marini et al. (2011) include intersentential cohesion with macrolinguistic processing as it has to do with establishing conceptual links between utterances. Davis and Coelho (2004) classify local and global coherence at the between-sentence level but refer only to global coherence as macrolinguistic.

Alternatively, Hough and Barrow (2003) considered intersentential cohesion to be a microlinguistic function in that it focuses on the relations between structural elements at the local level of the word or sentence. Cosentino et al. (2013) contend that the macrostructure of a narrative, that is, its global coherence, is independent from the microstructure, i.e., the cohesion of the sentence.

A unifying construct among these approaches is the separation of local from long-distance or global dependencies. Adopting this approach, some authors have referred to intersentential cohesion

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as a microstructural sublevel of the narrative macrostructure (Coelho, 2007) or as constituting sentence level analysis apart from global analyses of discourse (Cannizzaro and Coelho, 2012). Using this framework, we include intersentential cohesion with intra-sentential sentence processing at the microlinguistic level of narrative production.

Substantial evidence has accumulated over the past 35 years suggesting deficient intersentential cohesion in the narrative discourse of many individuals with traumatic brain injury (TBI). Since Mentis and Prutting (1987) reported significantly fewer cohesive ties in the narratives of brain-injured versus normal speakers, a number of reports have replicated and expanded upon these findings (e.g., Coelho et al., 1995; Davis and Coelho, 2004; Hartley and Jensen, 1991; Liles et al., 1989). At the same time, several studies have not found evidence of deficient intersentential cohesion in these adults (Coelho, 2002; Glosser and Deser, 1991; Hough and Barrow, 2003; Marini et al., 2011). It can be said then that the narratives produced by at least some speakers with TBI tend to show less adequate intersentential cohesion than that observed in normal speakers (Cannizzaro and Coelho, 2012; Coelho, 2007).

Variable intra-sentential impairment has also been observed in narrative discourse following TBI. Sentences produced by speakers with TBI have been reported to include more lexical and syntactic errors, increased mazes, more frequent pausing, and greater reductions in content when compared to normal speakers (Biddle et al., 1996; Ellis and Peach, 2009; Glosser and Deser, 1991; Hartley and Jensen, 1991; Peach, 2013; Peach and Schaude, 1986; Stout et al., 2000). Such narratives also tend to be less efficient (i.e., lengthier and containing more words per maze) (Biddle et al., 1996; Ehrlich, 1988; Hartley and Jensen, 1991; Stout et al., 2000) and less complex (Coelho et al., 2005; Peach et al., 1990) than those produced by normal speakers. Nonetheless, other studies have found few, if any, such microlinguistic disturbances in speakers with TBI (Hough and Barrow, 2003; Marini et al., 2011).

It has been suggested that brain injury produces a dissociation between the macrolinguistic and microlinguistic components of narrative production (Glosser and Deser, 1991; Hough and Barrow, 2003) and thus, that the processing for discourse coherence and that for inter- and intra-sentential relations are based on different cognitive mechanisms. Recently, a top-down model of coherence processing has been proposed which attributes the difficulties of TBI speakers to executive function deficits for planning and monitoring discourse (Adornetti, 2014; Cosentino et al., 2013). The model is based on the assumption that TBI patients have no difficulties in constructing sentences or in connecting them using cohesive ties but have difficulty maintaining global coherence because of an inability to relate individual sentences to a general plan. According to Cosentino et al., "coherence appears to be controlled by a higher-order conceptual process, whereas local coherence may be driven by more automated linguistic processes that are not disrupted after TBI" (p. 71). The latter statement, however, is at odds with the considerable literature demonstrating such microlinguistic deficits (see above).

The alternative question then is whether such microlinguistic impairments do share cognitive processes that influence the coherence of the narratives of brain-injured speakers (see, e.g., Boyle, 2011; Christiansen, 1995). Such an approach might be said to include the more traditional bottom-up model of discourse processing that posits that the macrostructure of a discourse is derived from the properties of sentences and the relations between them (Halliday and Hasan, 1976; Kintsch and Van Dijk, 1978). In this model, text coherence is dependent on sentence cohesion (Bublitz, 2011). Yet, as Cosentino et al. (2013) argue, the bottom-up approach must reconcile how the largely encapsulated processes responsible for sentence construction and intersentential cohesion are prerequisite to establishing global coherence.

We hypothesize that microlinguistic impairments to intersentential cohesion and sentence planning following TBI are not solely the result of deficits in fast, encapsulated, automatic linguistic processes but include executive deficits that influence not only coherence, but sentence planning and cohesion on a moment-to-moment basis. That is, the executive deficits that impact coherence processing influence the ways in which TBI speakers plan and organize sentences (Peach, 2013) and also affect their ability to establish cohesion among these sentences consistently. The variability in the microlinguistic patterns of TBI speakers seems to provide support for this hypothesis and suggests that these microlinguistic impairments might be the result of an effortful interaction between the processing of intersentential cohesion and sentence planning rather than the product of automatic linguistic processes. However, few studies exist that attempt to establish the relationship between intersentential cohesion and sentence planning. As a result, there is little information available to describe how specific changes at either level may influence microlinguistic processing generally and perhaps, macrolinguistic processing as well.

This study investigated the relationship between intersentential cohesion and intra-sentential planning in the discourse produced by speakers with severe traumatic brain injury (TBI). We tested the hypothesis that impairments in intersentential cohesion and intra-sentential planning are the result of executive deficits that support microlinguistic processing. Variable but coincident breakdowns in intersentential cohesion and sentence planning during the production of narratives would be expected if such impairments are the result of executive dysfunction. On the other hand, if intersentential cohesion and sentence planning are the result of automatic, linguistic processes that are not influenced by executive dysfunction, we would expect either an absence of microlinguistic impairment in TBI speakers due to preserved automatic processing (as suggested above) or a consistent pattern of impairment when either intersentential cohesion or sentence planning are disrupted.

2. Methods

2.1. Participants

Fifteen individuals approximately six months post severe traumatic brain injury (TBI) and ten non-brain-damaged (NBD) individuals participated in this study. The TBI group consisted of seven men and eight women while six men and 4 women comprised the NBD group. All participants were native English speakers. The mean age of the TBI group was significantly higher than that of the NBD group ($t[20.98]=2.86$, $p=0.009$). There were no significant differences between the two groups in their mean education ($t[23]=0.606$, $p=0.550$). All participants had attained at least 11 years of formal education. All participants denied that they had or suspected hearing loss. They were screened prior to admission to the study to rule out a history of significant alcohol, drug, or psychiatric involvement (e.g., depression).

Medical records were obtained and reviewed for each TBI participant. All of these individuals had a history of hospital admission with a diagnosis of traumatic brain injury and a documented period of coma greater than 24 h, that is, no eye opening, no obeying commands, and no uttering words (Jennett and Teasdale, 1981). None of these individuals had a history of previous head injury or other neurological involvement. Based on the review of medical records, all TBI participants demonstrated the typical pattern of diffuse axonal injury associated with traumatic brain injury and presented no other complicating medical conditions resulting in diffuse brain damage (e.g., anoxia) other than