Narratives of Focal Brain Injured Individuals: A Macro-Level Analysis

by

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ABSTRACT

Focal brain injury has detrimental effects on producing narratives. This study examined the narrative production of unilateral brain damaged patients and healthy controls by focusing on the narrative complexity and the evaluative aspect of their narratives. The results showed that narratives of the left hemisphere damaged (LHD) patients were less complex as indicated by fewer story components included in their narratives compared to the controls. In addition, they had problems in maintaining the overall theme of the story. The evaluative aspect of the LHD patients' narratives was also deficient compared to the controls. The right hemisphere damaged (RHD) patients seemed to be preserved in both of these linguistic abilities as a group. Yet, the single case analyses revealed that particular regions in the right hemisphere such as damage to the frontal lobe including the dorsolateral prefrontal cortex (DLPFC), both the anterior and superior temporal gyrus, the middle temporal gyrus, and the supramarginal gyrus can lead to problems in creating narratives. These findings suggest that an intact left hemisphere is needed for both the production of complex narratives that can be enriched through the use of evaluation. In addition, damage to the right frontotemporal regions and the left frontal regions together with the left insula seems to be related to the production of complex narratives.

Keywords: narrative, focal brain injury, narrative complexity, evaluation

ÖZET

Fokal beyin yaralanmasının anlatı becerilerine olumsuz etkisi vardır. Bu çalışmada beyninin tek yarımküresinde fokal hasar olan hastalar ile sağlıklı katılımcıların anlatı becerileri, karmaşık hikaye anlatabilme ve bu hikayelere yorum katabilme yetenekleri esas alınarak incelenmiştir. Sol yarımküresinde hasar olan hastaların hikayelerinin, daha az hikaye bileşenini anlatımlarına katmaları sonucunda, sağlıklı kontrol grubuna göre basitleştiği bulunmuştur. Ayrıca, bu hastaların hikaye anlatımlarında ana temayı sürdürmekte sorun yaşadıkları gözlenmiş, anlattıkları hikayeye yorum katabilme becerilerinin sağlıklı kontrollere göre zayıfladığı bulunmuştur. Sağ yarımküresinde hasar olan hastalar grup olarak incelendiklerinde bu iki dil becerisini de korudukları görünmüştür. Ancak, sağ yarımkürede dorsolateral prefrontal kortex dahil olmak üzere frontal lob, anterior ve superior temporal girus, medial temporal girus, ve supramarginal girus gibi çeşitli bölgelerde görülen hasarların hikaye anlatımındaki sorunlarla ilişkili olduğu bulunmuştur. Bu bulgular, sol yarımküre sağlığının karmaşık ve yorum katılarak zenginleştirilmiş hikayelerin anlatımında gerekli olduğunu; sağ frontotemporal bölge ve sol frontal bölge ile sol insula hasarının ise karmaşık hikaye anlatımı ile ilişkili olduğunu göstermiştir.

Anahtar Sözcükler: hikaye anlatımı, fokal beyin hasarı, hikaye karmaşıklığı, yorumlama

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CHAPTER 1

INTRODUCTION

1.1. General Overview

The nature of the relationship between linguistic functions and damage to specific neural structures has been widely investigated. One of the most studied linguistic functions is the ability to produce narratives. A narrative develops around characters and events, and has a superstructure that includes certain elements such as setting, complicating action, and resolution (Ulatowska, Allard & Chapman, 1990). Speakers express temporal progression, establish and maintain personal reference, and emphasize specific events above others while narrating a story. According to Ulatowska and colleagues (1981), studying narrative discourse is important since it provides rich amount of information that enables us to examine speakers' ability to use contextual language and their communicative competence. This investigation reveals important aspects of the relationship among cognition, the organization of human knowledge and language. Narrative studies also provide useful information for understanding formal and structural characteristics of discourse grammar.

Two major levels of analyses are used to study narrative production: (1) A within utterance or a micro-linguistic level that mainly focuses on lexical and grammatical processing responsible for intrasentential functions; (2) and a between-utterance or a macro-linguistic level that focuses on pragmatic and discourse-level processing, responsible for intersentential functions (Glosser & Deser, 1990; Jakobson, 1980; Kintsch, 1994). This study will mainly focus on macro-linguistic level narrative production of left hemisphere damaged (LHD) and right hemisphere damaged (RHD) patients. We aim to examine both complexity and evaluative aspects of their narration. In the following sections, we first review the previous research on micro-linguistic level language production of unilateral brain damaged patients to present a general idea of the overall linguistic problems the patients have, and then we will turn our focus to macro-linguistic level language production.

1.2. Micro-linguistic level language production of unilateral brain damaged patients

1.2.1. LHD Patients. Glosser and Deser (1990) have argued that micro-linguistic functions are dependent on the integrity of a specialized neural system within the left hemisphere. The literature on micro-linguistic level analyses of narratives suggests that verbal communication is impaired in almost all linguistic levels (phonetic, semantic, and syntactic) when patients have LHD (Herrmann, Koch, Johannsen-Horbach, & Wallesch, 1989). For example, LHD patients utter fewer motion sentences, talk with lower mean length of utterance, produce fewer types of verbs and prepositions than aged matched controls (Göksun, Lehet, Malykhina, & Chatterjee, 2015). Ulatowska and colleagues (1981) found that LHD-aphasics produced less complex language than healthy individuals indicated by fewer words per T-unit (defined as one independent clause plus any independent modifiers of that clause; Hunt, 1965) and less embedding (i.e. lower percentage of dependent and nonfinite clauses to total clauses). In addition, they produced more indefinite words such as “get”. Kaczmarek (1984) reported that in particular, damage in the left dorsolateral prefrontal cortex (LDLPFC) results in problems with the organization of linguistic information, production of less complex sentences, and difficulty in developing narratives. LDLPFC patients perseverate on single statements initiating the narrative and they have difficulty in continuing to tell their narratives. Studies also have documented word-finding difficulties for LHD-aphasic subjects (Dressler & Pleh, 1988, Larfeuil & Le Dorze, 1997).

Cohesion analysis is frequently used to evaluate narratives of individuals with communicative deficits. It focuses on the semantic relationship between an element in the passage and another element that is critical to its interpretation (Coelho, 1995). A cohesive device (e.g., personal pronouns, demonstrative pronouns, conjunctions) creates a connection with the information that is outside the sentence and establishes a meaning. Several studies reported that LHD-aphasic patients are unimpaired in their ability to use cohesive linguistic devices (Bloom, Borod, Santschi-Haywood, Pick & Obler, 1996; Ulatowska, North & Macaluso-Haynes, 1981). However, Glosser and Deser (1990) found impaired performance for LHD-aphasics for cohesion and argued that this impairment reflects problems in lexical retrieval rather than impaired intersentential organization. Marini and colleagues (2005) also suggested that LHD patients may have problems in the recruitment of micro-linguistic elements such as cohesive devices from textual information. They found that when LHD patients are required to retell stories that they read aloud previously, they perform much worse than controls. However, when they are asked to tell story from pictorial information, LHD patients are competent in using cohesive devices.

1.2.2. RHD Patients. While the role of left hemisphere in language processing on micro-linguistic level is well-established, right hemisphere's contribution is still controversial. Several studies found that RHD patients perform adequately with respect to lexical errors and syntactic complexity when subjects were required to describe family and work experiences or series of pictures (Glosser, 1993; Glosser, Deser, & Weisstein, 1992; Rivers & Love, 1980). The authors concluded that RHD patients are generally not deficient at the micro-linguistic level of discourse production. However, RHD participants' discourse is also reported to have reduced syntactic complexity (Joanette, Goulet, Ska, & Nespoulous, 1986; Sheratt & Bryan, 2012) and increased clarity disruptors as indicated by their elaborated, imprecise, non-specific and repetitive speech (Sheratt & Bryan, 2012). Their speech can be disfluent including increased false starts, incomplete mazes, repetition, non-word fillers and part-word productions compared to healthy controls (Sheratt & Bryan, 2012).

Mixed results were also reported in the literature regarding the relationship across sentences within the passage that is measured by the correct use of common cohesive markers (e.g., Davis, O'Neil-Pirozzi & Coon, 1997; Marini et al. 2005). A possible explanation of the inconsistent results can be due to nonhomogeneous research methods (experimental conditions or standard measures). For instance, Marini and colleagues (2005) found that RHD patients produced cohesive stories when they were asked to retell stories they read before. However, Davis, O'Neil-Pirozzi and Coon (1997) reported impaired performance for RHD patients compared to healthy controls when they retold the stories that had been read by the examiner. Similarly, Uryase, Duffy and Liles (1991) found deficit of cohesiveness when subjects recalled a video story. Inconsistent with these findings, Davis and colleagues (1997) reported preserved performance for cohesion when the subjects had to tell the depicted story while a series of pictures were placed in front of them or when the pictures were removed from their view.

Bartels-Tobin and Hickley (2005) analyzed the narratives' of RHD patients by using production of correct information units (CIU) as an intrasentential level of analyzing content relevance. CIU analysis discriminates words and utterances that are intelligible, relevant, informative, and accurate. Their results revealed poorer performance for RHD patients than those of healthy controls. This finding also implies a difference for RHD patients and healthy individuals in the ability to produce topically related content during discourse production, which will be reviewed in the next section in more detail. Marini et al. (2005) used a similar method to examine lexical–semantic appropriateness of RHD and LHD-nonaphasic subjects' narratives. They analyzed lexical information units constituted by all the words except semantic or verbal paraphasias (e.g., substituting the target word with another word), fillers (e.g., verbal interruptions such as "uh", "um" that do not relate to the proposition of the main message), paragrammatisms (e.g., disturbance of grammatical morphology) or tangential utterances (e.g., utterances that deviate from the main stream of information about the stories). RHD patients performed poorer than healthy controls in all these aspects that indicated low levels of informativeness for their narratives whereas no indication of impairment was found for LHD patients. RHD patients' deficiency in this within-sentence level informativeness may be an indicator of their problems in a more global level of discourse which is reviewed as macro-linguistic level problems in the next section.

Overall, the literature on micro-linguistic abilities of unilateral brain damaged patients provides stronger evidence for the impairment for LHD patients, whereas results for RHD subjects are still subject to debate.

1.3. Macro-linguistic level language production of unilateral brain damaged patients

1.3.1. LHD Patients. Although LHD is generally associated with micro-linguistic level problems, studies examining macro-linguistic level processes provide evidence for particular impairments as well. That is, reductions are reported in content (Berko-Gleason et al., 1980; Bloom, Borod, Obler & Gerstman, 1992), evaluative aspect of narrative (Ulatowska et al., 1981; Ulatowska et al, 1983) and coherence (e.g., Bloom et al., 1996), which reflects the speaker's ability to maintain thematic unity and characterize the conceptual organizational aspects of discourse at the suprasentential level (Agar & Hobbs, 1982).

The complexity of language at the discourse level was reduced as indicated by a fewer number of episodes produced in the LHD-aphasics' narratives (Ulatowska et al., 1981; Ulatowska et al, 1983). Similarly, Bloom and colleagues (1992) found that LHD-aphasics' discourse contained significantly less information content than those of controls. Coelho and colleagues (2012) also reported that individuals with LDLPFC lesions have deficits in inclusion of critical story components and in global coherence that refers to the relationship of the meaning or content of an utterance to the general topic of the story. Yet, the preservation of macro-linguistic level abilities was also reported. For example, Marini and colleagues

(2005) found that LHD-nonaphasic patients preserve informativeness as indicated by their use of adequate number of thematic units with respect to the healthy group.

According to Berman and Slobin (1994) a narrative should be structured around an overall plotline to be characterized as thematically coherent, which can be attained through the inclusion of three basic components in narrative: Plot onset referring to an initiating event, plot unfolding referring to continuing events in the story and plot resolution referring to reaching an outcome. Ulatowska and colleagues (1981) also stress that the inclusion of similar elements such as setting, complicating action and resolution is essential to construct a fully formed narrative. They showed that LHD-aphasics devote normal proportion of their narratives to these structure elements, and maintained their order, indicating no simplification of superstructure and overall preservation of the story's grammar. However, when relatively less important and optional elements of narrative superstructure such as codas and summary were analyzed, Ulatowska and colleagues (1983) found impaired performance for LHD-aphasics, indicating some level of reduction in superstructure for these patients' narratives. Similarly, Rivers and Love (1980) found that LHD-aphasics' narrative structures were simplified compared to controls as they had difficulty in producing complete stories which have a clear beginning and an end.

Ulatowska and colleagues (1983) also wanted to compare the results of the objective analysis of discourse production with subjective evaluation of the listeners in terms of content and clarity. This analysis revealed significantly lower ratings for LHD-aphasics narratives than those of controls for both content and clarity aspects of the narratives. Similarly, Bloom and colleagues (1996) evaluated LHD-aphasics and RHD patients' narrative coherence defined as the listeners' ability to interpret the overall meaning of discourse. Using a similar method adapted from Ulatowska and colleagues (1983), they found impaired coherence performance for LHD-aphasics compared to both healthy controls and RHD patients. Instead of using evaluations of the listeners for the coherence analysis, Marini and colleagues (2005) used an objective method and counted coherence errors of LHD- nonaphasic patients such as absence of a referent, semantic shifts or tangential utterances. This analysis revealed preservation of coherent organization for LHD-nonaphasic patients.

Labov and Waletzky (1967) distinguished the basic functions of a personal narrative as referential and evaluative. Referential function refers to the sequence of narrative clauses that concerns the actual events and lists them in their sequential order, while evaluative function suspends the sequentiality of events and complements the referential function (Bamberg & Damrad-Frye, 1991). According to Labov and Waletzky (1967), narratives should include evaluative information to be considered as good narratives. That is, to produce a “good” narrative, the narrator should comment on the meaning or the significance of the events through using particular evaluative devices (e.g., cognitive inferences, reference to affective states), which reflect the narrator’s perspective on the characters and their activities. Story actions and resolution become more vivid and real through the use of evaluation. Listeners may judge the narratives without evaluation as flat and pointless, or as reporting rather than story telling. Thus, evaluation is particularly an essential element in a well formed narrative episode (Freedman-Stern, Ulatowska, Baker, & DeLacoste, 1984). Studies show that LHD-aphasics produce less evaluation as measured by the number of clauses containing evaluation or the number of evaluative expressions per clause compared to healthy controls (Ulatowska et al., 1981; Ulatowska et al., 1983). Ulatowksa and colleagues (1981) argued that this reduction in evaluation did not affect the overall plot structure remarkably since evaluation is considered as having a secondary role among other narrative structure elements such as setting or resolution.

1.3.2. RHD Patients. Research demonstrates narrative production deficits in patients with right brain damage mainly at the pragmatic-communicative level of discourse such as problems in presenting the order of the themes, staying on a topic or using nonverbal cues (Bartels-Tobin & Hickley, 2005; Davis, O'Neil-Pirozzi, & Coon, 1997; Joanette, Goulet, Ska, & Nespoulous, 1986; Marini, Carlomagno, Caltagirone, & Nocentini, 2005; Sherratt & Bryan, 2012, for a review Mar, 2004). Several studies on RHD patients' narrative production have used sequential visual stimuli (Bartels-Tobin & Hickley, 2005; Bloom et al., 1992; Davis, O'Neil-Pirozzi, & Coon, 1997; Joanette, Goulet, Ska, & Nespoulous, 1986; Marini et al., 2005; Rivers & Love, 1980) or videos (Uryase, Duffy, & Liles, 1991) to elicit narratives. These studies suggest that RHD patients' narratives lack the critical story elements that are essential to tell the story, which results in production of less informative discourse than those of healthy controls. RHD patients also found to be impaired in accuracy of narration (Davis, O'Neil-Pirozzi, & Coon, 1997). In addition, the narrative structure analyses of RHD patients' narratives showed that they were impaired in producing complete stories (i.e. whether the stories have an obvious beginning and end, integrating information from each sequential picture) compared to controls (Rivers & Love, 1980). Similarly, Uryase and colleagues (1991) investigated completeness of episodes and story grammar elements such as setting and initiating event. RHD patients were impaired in number of episodes and complete episodes, and they provided less information than controls in each element. RHD patients also had difficulty in organizing cartoon frames into their narrative sequence (Huber & Gleber, 1982).

Statements in a narrative are interrelated by logical connections, in which an action is caused by another action or motivated by a mental state (Trabasso & Sperry, 1985). RHD patients found to produce less logical connections than controls indicating deficiency in logical coherence (Davis, Pirozzi & Coon, 1997). Based on the analyses of semantic shifts, absence of referent or tangential utterances, Marini and colleagues (2005) found that RHD patients also have problems in producing coherent narratives compared to healthy controls. The authors pointed out that the coherence of patients' descriptions were deficient because they filled their narratives with irrelevant details and comments. Likewise, Sheratt and Bryan (2012) suggest that RHD patients have problems with the relevance and quantity of information mostly because of using “additional and excessive detail”, “insufficient content” or including “broadly related, but not specifically appropriate, information” in their narratives. Although Bloom and colleagues (1996) used a different method to evaluate coherence of RHD patients’ narratives and asked some questions to the listeners about the coherence of each narrative produced by the subjects, RHD patients presented no deficits on this measure of discourse inconsistent with Marini and colleagues’ (2005) findings.

Several explanations of narrative production problems of RHD have been proposed in the literature. Some explanations focus on factors such as stimulus processing and task demands. Since it is well-known that RHD patients tend to display some visuospatial and/or visuoperceptive deficits (Hecaen & Albert, 1978), it is not clear whether the RHD patients’ problems in narrative formulation is a specific language problem or a reflection of the disturbed processing of information presented visually, such as by using pictures or videos (e.g., Rivers & Love, 1980). Another possibility that is considered to contribute to the RHD patients’ discourse deficits is the inability to capture emotional nuances and interpret the emotional importance of pictured scenes (e.g., Cicone, Wapner, & Gardner, 1980; Dekoskey, Heilman, Bowers, & Valenstein, 1980; Moscovitch, 1983). Consistent with this interpretation, Bloom and colleagues (1992) reported specific reduction in the production of emotional content relative to neutral/procedural and visual-spatial content, suggesting a special role for the right hemisphere in the verbal expression of emotional content in discourse. Bloom and colleagues (1993) also showed that emotional content suppresses the pragmatic performance (e.g., topic maintenance, relevancy) of the RHD patients compared to controls.

Despite of these results indicating poor performance for RHD macro-linguistic abilities for pictured stimuli, Marini and colleagues (2005) found that RHD patients produced coherent stories when they were asked to retell stories they read before, suggesting preserved ability to draw a coherent mental representation from a written text. This result is consistent with previous findings by Huber and Gleber (1982), indicating that RHD patients can integrate verbal information in a coherent text. Marini and colleagues (2005) concluded that RHD patients have problems in organizing informational content and in retrieving a general story schema from pictorial information, but not from the linguistic one. Inconsistent with this interpretation, Delis, Wapner, Gardner, and Moses (1983) found poorer performance for RHD patients compared to healthy controls in a task requiring the subjects to rearrange written sentences comprising a story. Delis et al. (1983) concluded that RHD patients had difficulty integrating complex elements such as sentences into a coherent whole, such as a story.

1.4. The present study

Even though the literature on macro-linguistic level language production of unilateral brain damaged patients provides stronger evidence for the impairment in RHD patients, results are not conclusive for either of the patient groups because of nonhomogeneous discourse elicitation methods and different coding systems used, thus further investigation is needed. In addition, research on aphasia has mainly focused on the production of relatively concrete and factual information while the way the narrator conveys her particular stance or viewpoint on this information and how she engages the audience in this experience is understudied (Armstrong & Ulatowska, 2007). To our knowledge there are only a few studies examining the evaluative aspect of narration in LHD-aphasic patients (e.g., Ulatowska 1981; 1983). We also could not find any study investigating diverse type of evaluation use of RHD patients in narratives; only a few studies focused solely on verbal expression of emotion (e.g., Bloom et al., 1992; Cimino, Verfaellie, & Bowers, 1991). In an attempt to address these issues, in the current study, first we will examine the narrative complexity of LHD and RHD patients' and healthy controls' as measured by the number of basic story components included in their narratives. Based on the previous studies (e.g. Joanette et al., 1986; Marini et al., 2005), we hypothesize that only RHD patients' performance in including these basic story components into narratives will be impaired compared to controls. Even though LHD patients may have impaired or simplified speech, their narratives will not be simplified by a reduction of informative components contained, and therefore will perform comparable to controls.

Second, we will examine the evaluative aspects of LHD and RHD patients' and healthy controls' narration as measured by the production of evaluative devices (i.e., cognitive inferences about the motivation for protagonists' actions, references to affective states and behaviors, social engagement devices, enrichment expressions, hedges and evaluative remarks). There is not much information in the literature regarding this population's ability of narrative enrichment through the use of evaluative devices, but based on Ulatowska and colleagues' (1981; 1983) findings we might expect that LHD patients' (particularly those who have impaired speech) use of evaluative devices will be less than healthy controls. We do not have a specific prediction regarding RHD patients' performance in terms of their overall use of evaluative devices. Yet, we predict that the use of affective states and behaviors as a specific subgroup of evaluative devices might differentiate the RHD group from controls due to the impairments in extracting emotional information from visual stimuli (e.g., Bloom et al., 1992). Additionally, overall narrative length measures will be analyzed and their relations with the macro-linguistic level measures will be examined.

To investigate the individual cases that could have impairments in measures of narrative complexity and evaluation, we will use "Bayesian analysis for a simple difference" (Crawford & Garthwaite, 2007). This case statistics method applies Bayesian Monte Carlo methods to determine whether a subjects' performance is an observation from the control population, as stated by the null hypothesis. So, if the test indicates that the patients' score is significantly below the average scores of control participants, the null hypothesis can be rejected (Ianni, Cardillo, McQuire, & Chatterjee, 2014). For the patients who perform worse than the controls on a given dependent variable, we will make lesion overlays to see the involvement of specific lesions on poor performance.

CHAPTER 2

METHOD

2.1. Participants

The data come from the Focal Lesion Subject Database at the University of Pennsylvania (Fellows, Stark, Berg, & Chatterjee, 2008). 18 LHD and 18 RHD patients were included in the study and they were not chosen based on specific lesion locations or behavioral criteria. Figure 1 displays lesion overlap maps of patients. The patients did not have a history of other neurological disorders, psychiatric disorders, or substance abuse. LHD patients ranged in age from 37 to 79 (M = 64.28, SD = 11.75, 10 females) and RHD patients ranged in age from 45 to 87 (M = 63.33, SD = 12.4, 12 females). The LHD and RHD patients had an average of 13.56 (SD = 2.01) and 15 (SD = 3.33) years of education, respectively. LHD and RHD patients did not differ in lesion size, $p > .05$. Thirteen age-matched (range: 38-77, M = 60.85, SD = 11.05, 9 females) older adults served as a healthy control group. They had an average of 16 (SD = 2.04) years of education. All RHD and control participants were right-handed and one LHD participant was left-handed. All participants were native English-speakers and our criterion was to test individuals with a minimum of 10 years of education. All participants provided written informed consent in accordance with the policies of the University of Pennsylvania's Institutional Review Board. Participants received $15/h for volunteering their time.

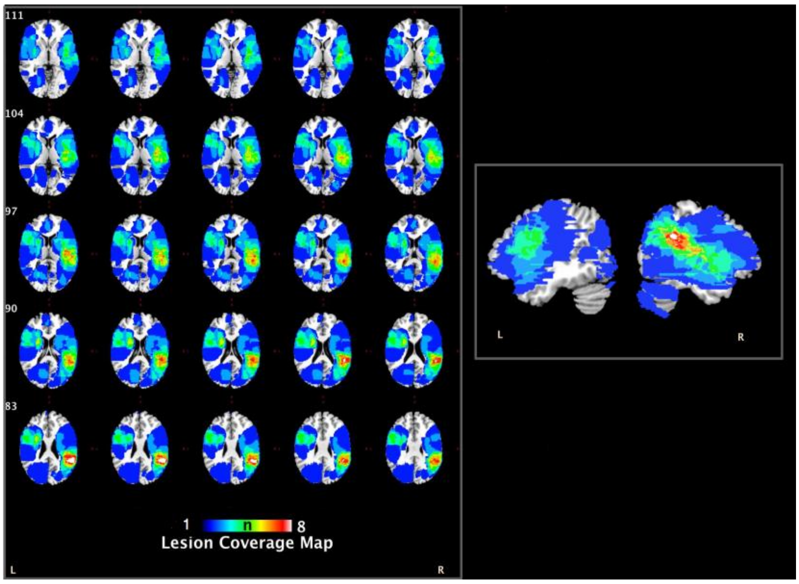

Figure 1. Coverage map indicating the lesion locations for all participants. The colored scale represents the number of lesions for each pixel.

2.2. Materials and Procedure

2.2.1. Neuropsychological tasks. Patients were administered the language comprehension and language production subtests of the Western Aphasia Battery (WAB; Kertesz, 1982). They were also administered the Object and Action Naming Battery (OANB; Druks, 2000). In this task, each patient named 50 pictures of actions and 81 pictures of objects.

2.2.2. Narrative task. The participants were presented with the 24-page wordless children's picture book, Frog, Where Are You? (Mayer, 1969) and asked to tell a story to the experimenter. The story is about a boy and his dog, searching for their frog. While they are searching for the frog, the boy and the dog involve in a series of adventures such as encountering a groundhog, a hive of bees, an owl, and a deer. At the end of the story, they find the lost frog with another lady frog and several baby frogs. The boy and the dog take one of the babies as their new pet frog while waving a goodbye to the frog family. The book contains no words and has been used to elicit narrative formation in more than 70 languages and in diverse populations including patients (e.g., Ash et al., 2006; Berman & Slobin, 1994;

Reilly et al., 1998, 2004). In addition to the series of temporally sequenced complex events, with its sketchy and ambiguous drawings, the book requires narrators to make inferences and judgements about the characters' relationships, thoughts, feelings, and motivations throughout the story, providing appropriate data for the investigation of evaluative language (Küntay & Nakamura, 2004; Reilly et al., 2004)

Before beginning to tell a story, each participant was asked to look through the book to become familiar with the story. When ready, they were asked to start from the beginning and describe the story page by page. The experimenter held the book for them to enable the spontaneous gesture use because the data was originally collected for another project that investigated the gesture use of the narrators. The session was videotaped for further transcriptions of speech. The neuropsychological tasks were administered on a different testing session either before or after the experimental task.

2.3. Coding

Narratives were transcribed word by word by native English speakers. First, these event chunks were coded for general features of language production: the number of utterances, the number of words, mean length of utterance (MLU), and the number of nouns and verbs. An utterance was defined as a T-unit that consisted of an independent clause and all clauses or phrases on it (Hunt, 1965). When two independent clauses conjoined by the connective "*and*", they were counted as two utterances. MLU was defined as total number of words per utterance (Marini, Tavano & Fabbro, 2008). Number of words included all complete words (repetitions were included). All nouns and verbs (inflected verbs, infinitives, and participles) were also counted (see Ash et al., 2006 for details of speech coding).

Second, the transcriptions were coded for narrative complexity based on the criteria discussed in Berman and Slobin (1994) and Köksal (2011). Definition and examples of coding for narrative complexity is provided in Appendix A. The narratives were coded in terms of three main plot components including plot onset, plot unfolding and plot resolution:

1) *The plot onset* component was scored based on the presence of the following sub-components: The precedent event (e.g., the boy wakes up), temporal location (in the morning/evening), characters (the boy, the dog, the frog), main characters' finding out that something has happened to the frog (e.g., the boy noticed that the frog had gone missing), inference about the frog's disappearance (e.g., the frog escaped the fishbowl) and the response of the protagonist (e.g., the boy was shocked). Thus, the score one can obtain from the plot onset ranged from 0 to 8.

2) *The plot unfolding* component included the following sub-components: looking for the lost frog in the home, interaction with bees, with gopher, with owl, with deer and falling down into the lake. The presence of these subcomponents determined the score one can obtain for the plot unfolding which ranged from 0 to 6.

3) *The plot resolution* component was scored based on the reference to the finding of the lost frog by the protagonists and the presence of this component received 1 point.

In addition to these three plot components, the narratives were also coded for the search theme to examine the degree to which the subjects understood the motivation for the boy's actions and the overall theme of the story. We coded 1) whether the subject explicitly mentioned that the frog was missing and that the boy was searching for him (the scores ranged from 0 to 2: 1 point for mentioning each of these two aspects) and 2) whether the search theme was reiterated later in the story: The subjects received 0 points for no additional mention, 1 point for one or two additional mentions and 2 points for multiple additional mentions. This analysis of reiteration of the search theme indicated the extent to which the subjects can understand the boy's continuing behavior (Reilly et al., 1998).

Third, to examine the extent to which subjects were able to evaluate the content of their narratives, we code the use of specific evaluative devices (cognitive inferences, social engagement devices, references to affective states or behaviors, enrichment expressions, hedges and evaluative remarks) by adapting and combining the schemes used by Reilly and colleagues (2004), Küntay and Nakamura (2004), and Bamberg and Damrad-Fyre (1991). Appendix B presents explanations of these categories and examples from our data. A total evaluation score was obtained by summing across all of the scores from subcategories for each subject.

In addition, an evaluative diversity score was obtained, indicating the range of evaluation subcategories produced in the narrative by assigning 1 to used subcategories and 0 to the unused categories. Thus, the possible score for evaluative diversity ranged from 0 to 5.

A sample coding for a subject is presented in Appendix C.

2.4. Reliability

Two independent transcribers checked all the transcriptions. To establish reliability, a second coder coded randomly selected narratives of 9 out of 36 patients (25%) and 5 healthy controls out of 13 (38.5%) for both the narrative complexity and the evaluation measures. For the narrative complexity, agreement between coders was 98% and for the evaluative devices it was 95%. Agreement for the subcategories of evaluative devices was as follows: Cognitive inferences: 100%, social engagement: 90%, references to affective states and behaviors: 99%, enrichment expressions: 98%, hedges 99%, evaluative remarks 94%.

CHAPTER 3

RESULTS

3.1. Neuropsychological Analyses

Even though most of the patients were not severely impaired (6 patients were categorized as having anomic aphasia and 1 patient was categorized as having Wernike's aphasia based on their WAB scores), WAB scores were lower for the LHD patients compared to the RHD patients, $F(1, 29) = 6.802$, $p = .014$, $\eta^2 = .19$ ($M_{LHD} = 91.75$ and $M_{RHD} = 97.94$). For naming objects and actions, the groups did not differ significantly, ps $> .05$ (see Table 1).

Table 1. Patient demographic and neuropsychological data

Patient	Gender	Age	Education (years)	Lesion Side	Location	Lesion Size (# of voxels)	Cause	Chronicity	WAB (AQ)	OANB (Action)	OANB (Object)
LT_85	F	63	15	L	I	13079	Stroke	177	98.8	100	98.8
CD_141	F	52	16	L	Pe	21605	Stroke	143	98.8	100	96
KG_215	M	61	14	L	F	17422	Stroke	145	94.4	96	93.8
TO_221	F	77	13	L	O	5886	Stroke	160	100	100	100
BC_236	M	65	18	L	FP	155982	Stroke	210	80.8	88	94
XK_342	F	57	12	L	OT	42144	Stroke	125	91.4	94	93
TD_360	M	58	12	L	T BG	38063	Stroke	118	65.3	52	28
IG_363	M	74	16	L	F	16845	Stroke	117	91.4	96	95
KD_493	M	68	14	L	ACA	22404	Aneurysm	101	92.1	98	95
DR_529	F	66	12	L	PA F	8969	Stroke	100	94.9	94	90.1
DR_565	F	53	12	L	PA F	14517	Aneurysm	103	99.8	98	97.5
MC_577	F	79	11	L	C	4191	Stroke	50	85.3	82	79
NS_604	F	37	12	L	PO	79231	AVM	113	100	100	98
UD_618	M	77	15	L	F	48743	Stroke	47	89.4	76	85
KM_642	M	77	12	L	P	7996	Stroke	109	96.8	94	98
MR_644	F	74	12	L	C	-	Stroke	-	-	-	-
CC_749	F	71	12	L	P	34266	Stroke	50	88.8	-	-
FC_83	M	70	12	R	FTP	8040	Stroke	169	99.8	96	98
MB_101	F	58	18	R	T BG	10543	Stroke	426	98.4	98	98
NC_112	F	48	16	R	O	4733	Stroke	178	100	98	-
HX_252	M	77	12	R	MCA	-	Stroke	-	94.6	78	85
RT_309	F	66	21	R	T	79691	Hematoma	128	-	-	-
DF_316	F	87	12	R	P	2981	Stroke	126	97.1	88	93
DC_392	M	56	10	R	PT	39068	Stroke	108	97.6	98	95
DX_444	F	80	12	R	PT	41172	Stroke	106	95.5	94	93
TS_474	F	51	11	R	P	22208	Stroke	100	95.1	98	95
UD_550	F	47	12	R	C	-	Stroke	-	-	-	-
NS_569	F	72	18	R	FT BG	37366	Stroke	77	100	100	99
DG_592	F	45	12	R	PT	130552	Stroke	127	97.8	98	98
KG_593	F	49	12	R	FTP BG	170128	Stroke	58	100	90	95
KS_605	M	63	18	R	C	23217	Stroke	76	98.8	100	100
ND_640	F	70	18	R	PT	64603	Stroke	54	96.8	100	100
CS_657	M	75	18	R	PO	33568	Stroke	43	99.2	98	100
KN_675	M	64	18	R	FT	23779	Stroke	32	-	-	-
MN_738	F	62	16	R	C	32154	Stroke	25	98.4	100	100
DD_755	F	48	16	R	C	-	Stroke	-	-	-	-

Key: F: frontal; T: Temporal; P: Parietal; O: Occipital; BG: Basal Ganglia; C: Cerebellum; I: Insula; Pe: Perisylvian; PA: Pericallosal artery; ACA: Anterior Cerebral Artery; MCA: Middle Cerebral Artery; AVM: arteriovenous malformations. WAB- AQ indicates a composite language score with a maximum possible score of 100. OANB (action) and OANB (object) demonstrate knowledge of verbs and nouns with a maximum possible score of 100.

3.2. Narrative Length Measures

No main effect of group was found for the total number of utterances they produced or the number of words, verbs and nouns they used, *ps* > .05. However, the results revealed a significant difference in the mean length of utterance (MLU) score among groups, $F(2, 46) = 7.175$, $p = .002$, $\eta^2 = .24$. Bonferroni t-tests showed that the LHD patients' MLU scores ($M = 8.66$, $SD = .88$) were significantly lower than the controls' ($M = 10.42$, $SD = 1.55$) ($p = .001$). The production of nouns was also positively correlated to Object and Action Naming Battery's object scores ($r = .438$, $p = .017$) (see Table 2).

Table 2. Correlations between measures

		2	3	4	5	6	7	8	9	10	11	12	13
1. WAB	*r*	.839**	.874**	-.125	.065	.131	.322	.152	.191	.582**	.523**	.386*	.159
	N	30	29	30	31	31	31	31	31	31	31	31	31
2. OANB_action	*r*		.920**	-.101	.053	.095	.360	.008	.096	.772**	.684**	.260	.042
	N		29	29	30	30	30	30	30	30	30	30	30
3. OANB_object	*r*			.027	.060	.142	.438*	-.008	.169	.643**	.548**	.277	.017
	N			28	29	29	29	29	29	29	29	29	29
4. Lesion Size	*r*				-.026	.031	.113	-.193	.146	-.182	-.197	-.293	-.310
	N				32	32	32	32	32	32	32	32	32
5. Total Utterance	*r*					.912**	.695**	.875**	.352*	.153	-.002	.640**	.233
	N					49	49	49	49	49	49	49	49
6. Words	*r*						.825**	.914**	.601**	.230	.101	.721**	.262
	N						49	49	49	49	49	49	49
7. Nouns	*r*							.651**	.547**	.340*	.183	.437**	.011
	N							49	49	49	49	49	49
8. Verbs	*r*								.551**	.172	.046	.786**	.353*
	N								49	49	49	49	49
9. MLU	*r*									.283*	.252	.459**	.253
	N									49	49	49	49
10. Narrative Complexity	*r*										.927**	.435**	.211
	N										49	49	49
11. Search Theme	*r*											.369**	.221
	N											49	49
12. Evaluation	*r*												.530**
	N												49
13. Evaluative Diversity	*r*												1
	N												49

*.Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

3.3. The Narrative Complexity

A univariate ANOVA indicated a main effect of group for the narrative complexity, $F(2, 46) = 3.555$, $p = .037$, $\eta^2 = .13$. As shown in Figure 2, the LHD patients' narratives included significantly fewer story components ($M = 12.56$, $SD = 4.66$) than the controls' ($M =$

16.31, *SD* = 1.25), (Bonferroni, $p = .032$). When the scores obtained from each plot component (plot onset, plot unfolding and resolution) were analyzed separately, the results showed no differences among groups, *p*s < .05. However, a significant difference among groups was found in establishing and maintaining the story's search theme, $F(2,46) = 4.082$, $p = .023$, $\eta^2 = .15$. The LHD patients established and maintained the story's search theme ($M = 2.39$, $SD = .31$) significantly less often than the controls ($M = 3.77$, $SD = .37$) (Bonferroni, $p = .02$). Yet, when we looked at each score alone (establishing the initial mention of the search theme and maintaining the theme), no significant difference was revealed for the initial mention of the search theme among groups, $p > .05$. But a main effect of group was found for maintaining the search theme $F(2, 46) = 4.836$, $p = .012$, $\eta^2 = .17$. In particular, the LHD patients reiterated the search theme significantly less often ($M = 1$, $SD = .18$) than the controls ($M = 1.85$, $SD = .21$), (Bonferroni, $p = .01$).

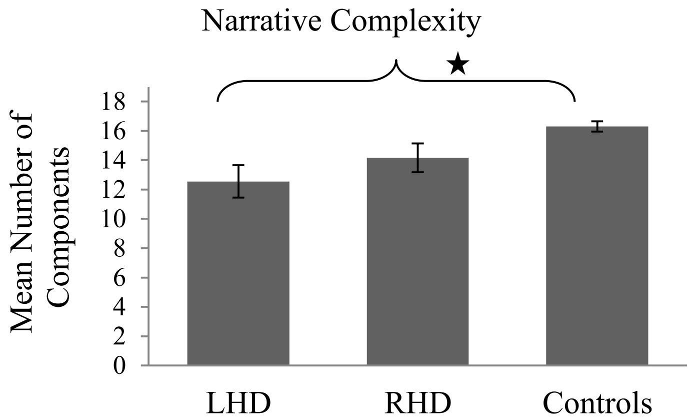

Figure 2. Mean number of story components included in the narratives of LHD and RHD patients, and controls. *p < .05.

The narrative complexity was also tested at the level of individual patient using Bayesian single-case statistics. Results revealed that 7 LHD patients and 4 RHD patients were significantly impaired in including story components in their narratives compared to the controls, $p < .01$ (see Table 3). We then constructed a lesion overlap for these patients group who were significantly impaired. As shown in Figure 3, these patients had lesions that maximally overlapped in the right frontal lobe including the dorsolateral prefrontal cortex (DLPFC), both the anterior and superior temporal gyrus, the middle temporal gyrus, and the supramarginal gyrus; in the left hemisphere the middle, inferior and superior frontal gyrus, DLPFC and left insula.

Table 3. Single case statistics profile of patients for narrative complexity

Control Sample			Patients						
							Significance Test	Estimated % of control population obtaining lower score than case	
n	Mean	SD	Lesion Side	ID	Scores	t	*p*	Point (%)	95% CI lower limit (%)
13	16.31	1.25	Left	TD_360	3	-10.261	0.000	0.00	0.00
				MC_577	5	-8.719	0.000	0.00	0.00
				UD_618	6	-7.948	0.000	0.00	0.00
				CC_749	6	-7.948	0.000	0.00	0.00
				IG_363	9	-5.635	0.000	0.01	0.00
				KM_642	12	-3.323	0.006	0.30	0.00
				KD_493	12	-3.323	0.006	0.30	0.00
			Right	HX_252	2	-11.032	0.000	0.00	0.00
				KG_593	7	-7.177	0.000	0.00	0.00
				RT_309	10	-4.864	0.000	0.02	0.00
				DX_444	11	-4.093	0.001	0.07	0.00

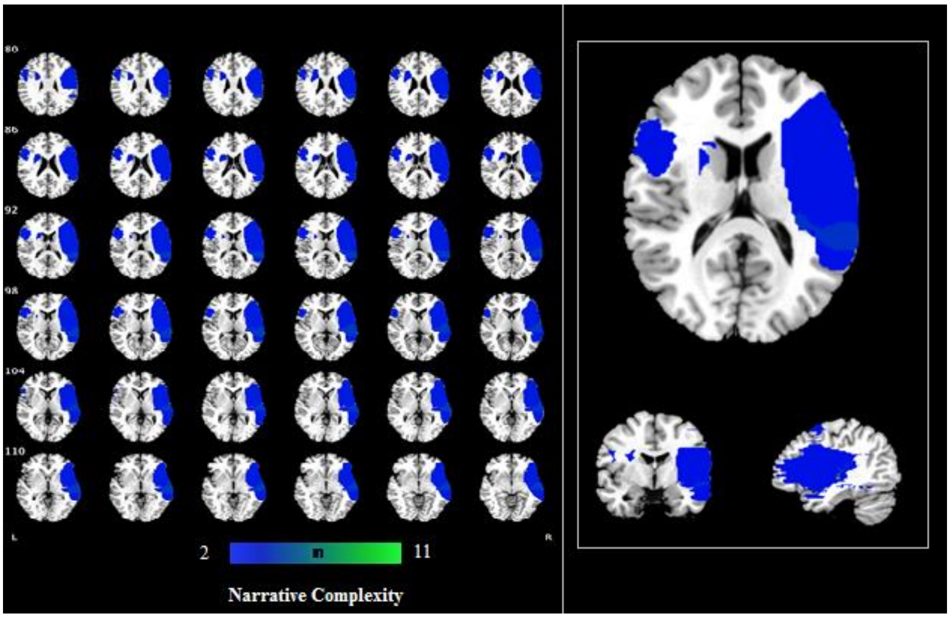

Figure 3. Representative slices from single case analyses for the narrative complexity. The maps show the overlapped lesions among 11 patients (minimally 2 patients have lesions on a specific area).

The narrative complexity score was positively correlated with all the neuropsychological test scores; WAB (r = .582, p = .001), Object and Action Naming Battery's action (r = .772, p < .001) and object scores (r = .643, p < .001). The significant positive correlations were also found between the narrative complexity scores and the production of nouns (r = .34, p = .017), and the MLU scores (r = .283, p = .049) (see Table 2).

In sum, the results indicated poorer performance only for the LHD patients as a group in narrative complexity compared to the controls. They were also found deficient in maintaining the stories' overall theme. We found certain areas damaged in frontotemporal regions of the right hemisphere and mostly frontal regions in the left hemisphere that were linked to poorer performance in narrative complexity.

3.4. The Evaluation of the Story

A univariate ANOVA indicated no difference among groups for evaluative diversity, p > .05. Since the groups' stories did not differ significantly in length as measured by the total number of utterance, the evaluation scores were analyzed as total raw scores rather than dividing the total number of evaluative devices by the total number of utterances for each subject. Yet, a significant main effect of group on the production of evaluative devices was revealed, $F(2,46) = 4.412$, $p = .018$, $\eta^2 = .16$ (see Figure 4). The LHD patients produced significantly fewer evaluative devices ($M = 21.78$, $SD = 13.84$) than the controls ($M = 37.85$, $SD = 13.78$), (Bonferroni, $p = .021$). Further analyses on subcategories of evaluative devices revealed no significant difference among groups for the cognitive inference, the references to affective states and behaviors, and the evaluative remarks subcategories, *p*s > .05. However, the use of enrichment devices was significantly different among groups, $F(2, 46) = 3.499$, $p = .039$, $\eta^2 = .13$. The LHD patients produced significantly fewer enrichment devices ($M = 4$, $SD = 2.50$) than the RHD patients ($M = 7.39$, $SD = 5.50$), (Bonferroni, $p = .039$). The use of hedges was also significantly different among groups, $p = .033$, $\eta^2 = .14$. The LHD patients produced significantly fewer hedges ($M = 4.94$, $SD = 3.92$) than the controls ($M = 10.92$, $SD = 7.98$), (Bonferroni, $p = .028$) (see Table 4).

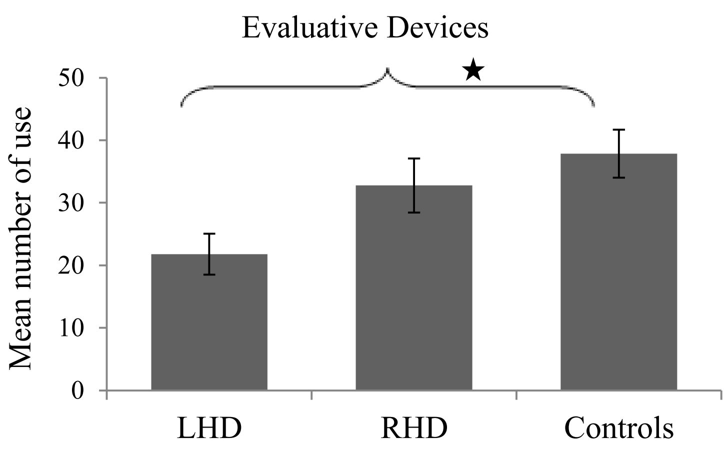

Figure 4. Mean number of evaluative devices used in the narratives of LHD and RHD patients, and controls. *$p < .05$.

Table 4. Production of evaluative devices (1, Control, *n* = 13; 2, LHD, *n* = 18; 3, RHD, *n* = 18).

	Group	Mean	SD	Range
Cognitive inferences	1	11.62	5.58	3-24
	2	8.33	6.43	0-27
	3	11.28	5.83	1-20
Social engagement	1	3.54	4.61	0-13
	2	1.33	1.78	0-7
	3	2.39	3.07	0-9
Affective states and behaviors	1	4.7	3.17	2-14
	2	2.89	2.54	0-10
	3	3.67	2.87	0-12
Enrichment expressions	1	6.38	2.72	3-13
	2	4	2.5	0-10
	3	7.39	5.5	1-18
Hedges	1	10.92	7.98	3-27
	2	4.94	3.92	0-12
	3	7.11	6.25	0-23
Evaluative remarks	1	.69	1.03	0-3
	2	.28	.46	0-1
	3	.94	1.98	0-8

Application of the Bayesian test revealed 2 LHD patients who were impaired in including story components in their narratives, $p < .05$ (see Table 5).

Table 5. Single case statistics profile of patients for evaluative devices.

Control Sample			Patients						
							Significance Test	Estimated % of control population obtaining lower score than case	
n	Mean	SD	Lesion Side	ID	Scores	t	*p*	Point (%)	95% CI lower limit (%)
13	37.85	13.78	Left	TD_360	6	-2.227	0.046	2.29	0.04
				IG_363	0	-2.647	0.021	1.07	0.00

The use of evaluative devices was positively correlated with WAB scores ($r = .386$, $p = .032$), the production of total utterance ($r = .64$, $p < .001$), word ($r = .721$, $p < .001$), noun ($r = .437$, $p = .002$), verb ($r = .786$, $p < .001$), and the MLU scores ($r = .459$, $p = .001$). A significant correlation was also found between the use of evaluative devices and the narrative complexity (r = .435, p = .002). The evaluative diversity scores were positively correlated with verb production (r = .353, p = .013) (see Table 2).

CHAPTER 4

DISCUSSION

The purpose of the study was to investigate the macro-linguistic level language production of unilateral brain damaged patients by focusing on the narrative complexity and the use of evaluative devices in narratives. We examined the narratives produced by LHD and RHD patients and healthy controls. First, we found that LHD patients' narratives were less complex as indicated by significantly fewer story components included in their narratives compared to the controls. As establishing and maintaining the story's search theme is considered to be a good index of story coherence (Ash et al., 2006; Reilly et al., 1998), we also compared the groups' initial and subsequent mention of the search theme. We found that even though LHD patients were able to establish the story's search theme, they were not able to maintain this overall theme of the story. Although as a group RHD patients performed similarly to controls, results from the case statistics indicated that patients with lesions in the frontotemporal areas produced poor narratives compared to controls. Second, the evaluative aspect of LHD patients' narratives was also found to be impaired compared to controls. When we examined the specific types of evaluative devices, LHD patients' narratives included less hedges compared to controls and less enrichment expressions compared to RHD patients. Our results revealed preserved performance for RHD patients in the evaluative aspect of narratives.

4.1. The Narrative Complexity

The use of a complex narrative is an indicator of a speaker's use of proper and rich language and important for her communicative competence. Although telling a story from sequenced pictures may seem simple, it is a highly complex task as it involves many steps such as recognizing the setting, characters, actions and the outcome while maintaining the overall theme of the story and realizing when a resolution is reached (Ash et al., 2006). Our data shows that when the narrative complexity is impaired as a result of the left hemisphere damage, patients talk about fewer components of a story and have problems in maintaining the storyline (even though they do not have a problem in initiating the story theme), and understanding the motivation for the protagonists' continuing actions and the overall theme of the story. These results indicate that as a group, LHD patients had difficulty in producing coherent and complex narratives involving basic informative components of the story while keeping in mind the overall theme of the story. It is important to emphasize that even though our results did not indicate poorer performance for RHD patients than controls in these aspects of narrative, the results could not differentiate RHD patients' performance from those of LHD patients either.

Our finding regarding the reduction in narrative complexity in LHD patients are consistent with previous findings suggesting macro-linguistic level impairments in narrative production for these patients (e.g., Bloom et al., 1992; Coelho et al., 2002; Ulatowska et al., 1981). Importantly, LHD patients' impairment in narrative complexity is not directly related to the reduction in the amount of speech since there were no group differences in the total number of words or utterances produced. Bloom and colleagues (1992) also found reduced information content included in LHD-aphasic patients' narratives compared to controls, even though they produced comparable amount of speech. They concluded that their findings for these patients might be consistent with their overall problems in language. We also found that patients' narrative complexity scores were related to their aphasia, object, and action naming scores.

Similarly, Ulatowksa and colleagues (1983) emphasized the relation between content ratings of LHD-aphasic patients' narratives to their aphasia scores. Ulatowksa and colleagues (1981, 1983) investigated LHD-aphasic patients' and controls' narratives and found that even though the LHD-aphasic subjects produced well-structured narratives as measured by the length of narrative structure elements (e.g. setting), there was reduced informativeness manifested by fewer story episodes (i.e. an entire action sequence) included in their stories. The LHD-aphasics narratives were also rated lower for content compared to controls, measured by the raters' response to number of questions regarding the information contained in the stories, such as "Do you know what is happening in the story?" (Bloom et al., 1996; Ulatowska et al., 1983). Ulatowska and colleagues (1983) emphasized that the patients' scores on Boston Diagnostic Aphasia Examination were correlated with this content ratings. These previous findings and our results suggest that left hemisphere plays a crucial role in the ability to tell informative and coherent narratives. The ability to produce and meaningfully organize connected language can be partly predicted by overall linguistic functioning assessed by the standardized tests. Thus, it is not the quantity of words used in the narrative, but the quality of the narrative is mainly impaired in our LHD group.

Even though there is limited research suggesting preserved performance for RHD patients in content and coherence (e.g., Bloom et al., 1996), our results are surprising, given the impaired ability for RHD patients in macro-linguistic level narrative production reported in the literature (e.g., Joanette et al., 1986; Rivers & Love, 1980). It may partly because of the stimuli that were used to elicit narrative production in the earlier studies. For instance, Uryase, Duffy and Liles (1991) examined narratives of LHD-aphasic and RHD patients and healthy controls elicited by a video rather than pictures. Both LHD-aphasic and RHD patients produced less informative narratives compared to controls. The differences in the visual complexity of stimuli may play a specific role in RHD patients' narrative performance since the right hemisphere is associated with visual information processing (Meadows, 1974). In addition, even though we could not find any group differences between RHD patients and controls, we found individual cases that were impaired at producing a complex narrative (i.e. patients scoring significantly below the scores of controls). Lesions to the right frontal lobe including the dorsolateral prefrontal cortex, both the anterior and superior temporal gyrus, the middle temporal gyrus, and the supramarginal gyrus were linked to poor performance in narrative complexity. For the left hemisphere, we found lesions to the middle, inferior and superior frontal gyrus, DLPFC and left insula were linked to poorer performance in narrative complexity.

In an fMRI study, Troiani and colleagues (2008) found that narrative production activated bilateral inferior frontal cortex, dorsal inferior frontal regions of the left hemisphere, and the lateral temporal-parietal area. The lesions we found in the left hemisphere that were related with decreased narrative complexity are consistent with these results except the lateral temporal-parietal area. The left inferior frontal gyrus, left ventral and dorsal medial prefrontal cortex were also associated with amodal semantic processing (Binder, Desai, Graves, & Conant, 2009). Consistent with our findings, a number of fMRI studies investigating processing of narrative coherence showed greater activation in bilateral medial and lateral frontal and anterior temporal and left medial prefrontal regions (Ferstl et al., 2002; Fletcher et al., 1995; Gallagher, 2000; Mazoyer et al., 1993; Xu, Kemeny, Park, Frattali, & Braun, 2005). Coelho and colleagues (2012) also reported that individuals with LDLPFC lesions have deficits in inclusion of critical story components and in global coherence.

In her review of fMRI studies on the anatomy of language, Price (2010) identifies several regions in the left hemisphere involved in word retrieval processes that are damaged in our LHD patients, who performed worse than controls in narrative complexity: the inferior and middle frontal area, and both dorsal and ventral pars opercularis. Since in our data the narrative complexity scores were related to both object and action naming scores and total number of nouns used, we might argue that LHD patients with lesions to these regions in the frontal area have problems in producing a complex narrative related to their word finding difficulties. A relationship between lexical access difficulty and the production of reduced narrative content was also reached in another study investigating discourse impairments of patients with frontotemporal dementia (Ash et al., 2006). The findings indicated that semantic dementia patients' narratives had reduced content with a high rate of incomplete and missing elements compared to controls. They argued that lexical access and retrieval difficulty that semantic dementia patients experience while narrating a story may contribute to this deficiency. These findings together with our results suggest that the production of an informative narrative through inclusion of important content elements of the story may partly depend on the ability to access necessary lexical items to express these contents.

The lesions of RHD patients that we found to be related with reduced narrative complexity are similar to cortical atrophy profile of frontotemporal dementia patients with social and executive deficits who have damage in their prefrontal, ventral frontal and anterior temporal brain regions, often more prominently on the right than the left (Grossman et al., 2004; Rosen et al., 2005; Williams, Nestor, & Hodges, 2005). Limited connectedness in those patients' narratives reflected their problems in organizing and relating the events in narrative and maintaining the overall theme that is required to organize the elements of the story as a coherent whole (Ash et al., 2006). A correlation between impaired connectedness and cortical atrophy was obtained in several regions in the right hemisphere such as dorsolateral prefrontal, inferior frontal, and anterior temporal regions, which we also found to be damaged in our RHD patients. These impaired abilities may partly depend on executive resources such as organization, planning and working memory, which are required to relate the events in the narrative, to infer cause and effect relationship, and to understand the main point or goal of a story (Mar, 2004). Gernsbacher and Kaschak (2003) also identified the right temporal and frontal regions as important areas for the integrative aspects of narrative processing, emphasizing the hypothesis that the activation observed in these areas specific to discourse processing might be a function of memory processes that maintain the coherence of the narrative across sentences. Similarly, Troiani and colleagues (2008) argued that the inferior frontal cortex has a specific role in top-down organization that is needed to produce an extended narrative from a sequence of pictures. They also suggest that the left inferior frontal cortex activation may be related to working memory component that is necessary for keeping the narrative elements in an active state while producing the narrative.

In sum, we found that while as a group LHD patients had problems in telling a complex and coherent story by including informative components of the narrative while keeping the overall theme in mind, RHD patients seemed to be preserved in these abilities as a group. Nevertheless, we found that lesions to the frontotemporal regions including almost the entire frontal cortex, both the anterior and superior temporal gyrus and the middle temporal gyrus, and supramarginal gyrus were linked to poor performance in narrative complexity. For the left hemisphere, lesions to the frontal cortex including the middle, inferior and superior frontal gyrus, DLPFC, and left insula were related to narrative complexity.

4.2. The Evaluative Aspect of Narratives

The use of evaluation is an important element of a good narrative as it makes events and actions in the story more meaningful and serves to maintain listeners' attention and involvement (Bamberg & Damrad-Frye, 1991; Labov & Waletzky, 1967; Reilly et al., 2004). Our results suggest that the use of evaluation is impaired as a result of the left hemisphere damage. Even though LHD patients were able to include diverse types of evaluative devices in their stories, they used fewer evaluative devices compared to controls. While an intact left hemisphere seems to be necessary for producing rich stories in terms of evaluation, our data does not suggest the same for the right hemisphere, as we found preserved performance for RHD patients in both diversity and frequency of evaluation.

Our results are consistent with the previous findings suggesting impaired performance in using evaluations for LHD patients (Ulatowska et al., 1981; 1983). These studies found that LHD-aphasic patients produced fewer evaluations compared to controls both in terms of the number of clauses containing evaluation and the number of evaluative expressions per clause. The propositional analyses also revealed that LHD-aphasics often omit propositions that contain inner feelings and motivations of the protagonists in the stories rather than their actions. In addition to narratives elicited by sequenced picture stimuli, memorable experience narratives produced by LHD-aphasics also exhibit same impairments with picture descriptions (Ulatowska et al., 1983).

Ulatowska and colleagues (1981) suggested that reduction in evaluation may be a reflection of simplification of language since evaluative devices involve production of some complex syntactic devices such as comparatives. They also argue that evaluation has a secondary role in narrative structure compared to other essential elements of the story such as setting and resolution. Thus, the reason that the LHD patients' production of fewer evaluative devices might be related to either function related to communicating relatively less important information or form (complex syntax) or a combination of both (Ulatowksa et al., 1981). In our study, the use of evaluation is related to patients' aphasia scores, suggesting that producing a rich narrative may depend on overall linguistic skills. Indeed, we identified two LHD patients who scored significantly lower for the use of evaluation relative to controls. These patients were quite effortful in their speech, keeping them away from enriching their narratives with the use of evaluative devices.

We expected a specific impairment for RHD patients in mentioning affective states and behaviors of the protagonists in the story based on the previous findings on the role of right hemisphere in detecting emotional nuances and understanding the emotional importance of pictured scenes (e.g., Cicone, Wapner, & Gardner, 1980; Dekoskey, Heilman, Bowers, &

Valenstein, 1980; Moscovitch, 1983). In addition, Borod and colleagues (2002) point out that the right hemisphere plays an important role in lexical emotional expression. Yet, we could not provide any support for this prediction. Bloom and colleagues (1992) also suggested that RHD patients are deficient in extracting emotional information from visual stimuli. These inconsistencies may result from the differences in measures of emotional expression. Bloom and colleagues (1992) investigated the informativeness of narratives by looking at whether the subjects included basic informative components extracted from series of sequenced picture stimuli containing emotional, visuospatial or procedural content. Results demonstrated reduced information content for each condition, but when the pictures included emotional elements, poorer performance was revealed. Thus, the RHD patients were impaired at telling fully informative stories containing emotional content. The verbal expression of emotion in RHD patients was also examined by other studies using quite different procedures than ours (Cimino, Verfaellie, & Bowers, 1991; Heberlein, Adolphs, Pennebaker, & Traner, 2003). For instance, Cimino and colleagues (1991) investigated the emotional verbal expression using recalled autobiographical memories that patients produced in response to a cue word such as “angry” or “surprised”. The RHD patients’ reports were rated less on emotionality compared to controls. Sherratt (2007) also investigated RHD patients’ emotional expressions in their personal narratives. Because this was an exploratory study, she did not perform any statistical procedure but reported a tendency for RHD patients to use fewer appraisals (e.g., affect, judgement) compared to controls. Sherratt (2007) pointed out that RHD patients might have been impaired in expressing authorial (first person) affect while being able to express non-authorial (second or third person) affect, such as providing information about feelings of others in a retelling or a sequenced picture task. In our study, participants were required to report on the actions and the feelings/motivations of the protagonists in a pictured story, and we indicated comparable evaluative performance for RHD patients and controls when they provide non-authorial affect.

Future research can focus on a specific point in the narrative structure (e.g., setting), where the evaluative devices are used rather than examining only frequency or diversity of evaluation. Evaluative devices mark and put emphasis on a particular part of a discourse (Cortazzi & Jin, 2000) by usually being used before the point or peak of the narrative (Labov, 1997). Besides using relatively fewer evaluative devices in their narratives, LHD patients may also use evaluation at unusual points. Likewise, even though RHD patients did not have difficulty in the frequency of evaluation use, they might be impaired at using evaluative devices in the proper points in the narrative. Thus, an investigation of the detail points of evaluative devices can be helpful in understanding the nature of macro-level language problems of focal brain-injured patients.

CONCLUSION

Taken together, our results showed that as a group LHD patients were deficient in both of our macro-linguistic measures; the narrative complexity and evaluative aspect of narrative. We showed that lesions to certain areas of frontotemporal regions of the right hemisphere and frontal regions and insula of the left hemisphere are related to narrating a complex story. This study contributes to the limited amount of literature on the use of evaluation in unilateral brain damaged patients and also adds to the literature showing contradicted findings on narrative measures such as informativeness and coherence. In addition, most of the studies examining these measures focused on group differences, not providing evidence for the relations of specific brain regions to impairments in these macro-linguistic measures at hand (e.g., Bloom et al., 1992; Joanette et al., 1986). Thus, this study is important for its contribution to our understanding of cortical regions that are essential for the production of complex narratives.

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APPENDICES

APPENDIX A

Definition and examples of coding for narrative complexity (adapted from Berman & Slobin, 1994 and Köksal, 2011).

Plot components	Plot Sub-Components	Examples and Explanations
Plot onset	Precedent event	-The boy and the dog wakes up
	Temporal location	-In the morning/evening
	Characters	The boy/child/kid, the dog, the frog Scoring ranges between 0-3: Only one character = 1 Two of the characters = 2 Three characters = 3
	The main characters learn something	-The boy and the dog noticed that the frog had gone missing -The boy and the dog wake up and see that the frog is gone
	Inference about the frog's disappearance	-The frog escaped from the jar -The frog is gone -The jar is empty
	The response of protagonist	-They are fascinated by the frog's disappearance -The boy was shocked
Plot unfolding	Searching for the lost frog in the home	-The boy is looking in his boots -The dog is looking in the jar
	Encountering the bees	-The dog is looking into the beehive -The bees are chasing the dog
	Encountering the gopher	-The boy is looking down a hole and a gopher comes out -The boy gets bitten by a gopher
	Encountering the owl	-The boy falls down because an

		owl comes out of the tree -The boy disturbed an owl in the tree
	Encountering the deer	-The child climbs on the deer -The deer tosses the boy over the cliff
	Falling down	-The boy and the dog falls in the water/pond/lake
Resolution	Protagonist finds the lost frog	-The kid finds his frog
Search theme	Explicit mention of the lost frog	-Whether the subject explicitly mentions that the frog is missing and the boy is searching for him (range: 0-2). 1 point for mentioning each aspect of initiating the search theme: -The frog is missing/ gone. -The boy is looking for the frog. * Only mentioning that the frog leaves its jar will not get point
	Reiteration of search theme	-Whether the search theme was reiterated later. (range: 0-2). No additional mention = 0 1 or 2 additional mentions = 1 Multiple additional mentions = 2.

APPENDIX B

Definition and examples of evaluation coding

1. *Cognitive inferences:* inferences of character motivation, causality, and mental states, as in ‘‘Little boy climbs up a tree *to see* if the frog jumped in there” or ‘‘He's *wondering* what happened to the frog.’’ Common examples included ‘think’, ‘look for’, ‘because’, ‘investigate’ etc.

2. *Social engagement devices*: using phrases or exclamations to capture addressee attention, e.g. sound effects, character speech accompanied by animated speech or intonation, and audience hookers, as in ‘‘*Voila!* He finds the frog!” or “The boy is over by the log saying "*shh*" to the dog”. Statements of indirect speech were not included in the category.

3. *References to affective states or behaviors*, as in “Everyone seems to be *happy*” or ‘‘The boy was *crying*”.

4. *Enrichment expressions*: adverbial phrases such as ‘again’ or ‘quickly’ that reveal the unexpected or inferred nature of an action; intensifiers such as ‘very’ or ‘so’; and repetitions which draw the audience’s attention to a certain event as in “He's *running running running*”; connectives such as ‘but’, ‘however’ or ‘instead’ that informs about the unexpected or contrastive occurrences of events.

5. *Hedges:* distancing devices that indicate a level of certainty/uncertainty, suggesting the narrator’s non-commitment to the truth value of the proposition. Common examples included ‘seems like’, ‘looks like’, ‘kind of’, ‘probably’, ‘I guess/think’, etc.

6. *Evaluative remarks:* the narrators’ reflections about the events of the narrative which communicate a subjective point of view as in “This was something stupid to do” or “The dog isn’t hurt, that’s a good thing”.

APPENDIX C

Sample coding

			Plot Onset	**Score**
			Precedent event	1
Time	**Utterances**	**Speech Transcription**	Temporal location	0
00:04	1	The boy loooking in the jar with the frog in it.	Characters(only one ch=1; two of ch=2; three ch=3)	3
00:10	2	The boy is sleeping and the frog is creeping out the jar	The main characters learn stg	0
00:15	3	The boy, the dog woke the boy up	Inference about the frog's disappearance	1
	4	and the frog is gone out of the jar,	Response of protagonist	0
	5	he is missing. Or she. It.	**Plot Unfolding**	
00:25	6	The boy gets up to* put his clothes on,	Seeking for the lost frog in the home	1
	7	he getting ready to put the boot,	Encountering with bees	1
	8	he looking in the boot,	Interacting with gopher	1
	9	to see if the frog is inside the boot.	Interacting with owl	1
00:33	10	The dog head is stuck in the jar.	Interacting with deer	1
00:37	11	The dog falls out the window,	Falling down	1
00:42	12	and kaboom, he breaks the jar	**Resolution**	
	13	and the boy looks kinda angry.	Protagonist finds lost frog	1
00:47	14	The boy is calling for the frog,	**Search Theme**	
	15	and the dog is howling	Frog missing	1
	16	there's just a tree in the forest	Boy looking	1
00:58	17	The dog is messing with the beehive, or wasps,or whatever it is	Reiteration of search theme	

	18	The boy is howling down a hole for the frog	1 or 2 additional mentions=1	
01:10	19	I guess that's a beaver came out of the hole. I think.	Multiple additional mentions=2	2
01:18	20	Okay, the beehive fell	**SUM:**	16
	21	Dog about to get jacked up with the bee stings		
01:28	22	The boy climbed the tree to howl in the tree for the frog		
01:34	23	The bee is chasing the dog		
01:40	24	The owl came out the tree, scared the boy		
	25	he falls		
01:49	26	The owl is chasing the boy		
	27	and now he's hiding,		
01:55	28	Now they climbs up on a rock		
	29	and holla for the frog.		
02:02	30	Then all the sudden,something just picked him up out of the blue.		
02:12	31	It was a deer.		
	32	It'scarrying him off near the edge of the ridge		
02:23	33	Tossed him into the little pondy pool and the dog		
02:29	34	They go "Ksplshh!"		
02:33	35	And the boy is sitting in the pond with the dog on top of him on his shoulder		
02:43	36	The boy is over by the log saying "shh" to the dog		
02:50	37	Then he leans over to see if the frog is over there		
02:56	38	And "Voila!" he finds the frog with another frog and little frogettes		
	39	and now he's happy		
03:11	40	And he waves goodbye		
	41	and took his frog		
	42	and told everybody else "see ya later"		

Evaluation	**Score**	**Evaluative Diversity**
Cognitive inferences	9	1
Social engagement	5	1
References to affective states or behaviors	4	1
Enrichment expressions	3	1
Hedges	6	1
Evaluative remarks	0	0
SUM:	27	5

*.The colors represent: blue, cognitive inferences; orange, social engagement; pink, references to affective states and behaviors; brown, enrichment expressions; green, hedges; purple, evaluative remarks.