APHASIOLOGY, 2006, 20 (5), 411–426 Psychology Press Taylor & Francis Group

Formulaic expressions in spontaneous speech of left- and right-hemisphere-damaged subjects

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Background: The preservation of swearing, serial speech, and speech formulas is well documented in clinical descriptions of aphasia. Proper nouns and sentence stems have also been reported in the residual speech of severely aphasic subjects. The incidence of formulaic expressions in spontaneous speech of right-hemisphere-damaged subjects has not yet been well examined. Recent interest in formulaic expressions (FEs) in normal language use, combined with the converging evidence of a role for the right hemisphere in processing pragmatic elements of language, led to this study.
Methods & Procedures: We undertook an examination of hypotheses about the hemispheric processing of FEs in the spontaneous speech of persons with left hemisphere (LH) and right hemisphere (RH) damage. Based on preserved use of formulaic expressions in clinically described aphasic speech, the hypothesis under examination in this study was that the intact RH has a role in the production of formulaic expressions. Further inquiries involved possible differences in incidence in the speech samples between subsets of FEs, such as proper nouns and discourse particles.
Outcomes & Results: Our results indicate a greater proportion of FEs in the spontaneous speech of persons with LH damage, and proportionally fewer FEs in RH speech, when compared to normal control speakers. Examination of the incidence of separate categories indicates a paucity of proper noun production in the LH group, supporting the association of proper noun anomia with LH damage. Pragmatically determined vocal elements (pause fillers, discourse elements) were least present in RH dysfunction. These results suggest that clinical evaluation of formulaic as well as novel language functions may give important insights into the language disorder profile of various neurological populations. The identification of relatively preserved formulaic expressions in LH damage may provide a basis for a more effective treatment plan, while evaluation of RH damaged individuals using this perspective may identify communication disorders not previously recognised.
Conclusions: These results support the notion that an intact RH supports use of some types of formulaic language.

Studies of discourse production in neurologically disordered speech have become important clues to language organisation (Stemmer, 1999). Many studies at the

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http://www.psypress.com/aphasiology DOI: 10.1080/02687030500538148

discourse level of language function have examined such topics as syntax or semantics (Berndt, Haendiges, Mitchum, & Sandson, 1997; Glosser & Deser, 1990; Glosser, Wiener, & Kaplan, 1988), while others have revealed patterns of deficit and preservation of pragmatic competence, such as gesture or turn-taking in conversation (Boles, 1998; Glosser, 1993; Schegloff, 1988). This study focuses on another aspect of pragmatic competence, the use of formulaic expressions (FEs). Interest in FEs in normal speech has grown (Bell & Healey, 1992; Bolinger, 1976; Jackendoff, 1995; McCarthy, 2002; Moon, 1998; Nunberg, Sag, & Wasow, 1994; Sprenger, 2003; Tannen & Öztek, 1981; Van Lancker, 1973; Wray, 2002; Wray & Perkins, 2000) and has been extended to studies of FEs in neurologically impaired populations (Code, 1982a, 1982b, 1989a, 1994a; Dobbinson, Perkins, & Boucher, 2003; Ghacibeh & Heilman, 2003; Papagno & Vallar, 2001; Paul, Van Lancker, Schieffer, Dietrich, & Brown, 2003; Whitaker, 1976).

The preservation of certain categories of utterances (swearing, serial speech such as counting, pause fillers such as "well" and "oh", speech formulas such as "hello" and "good-bye") has been well documented in clinical descriptions of impaired propositional speech in aphasia (Alajouanine, 1956; Benson, 1979; Code, 1989b; Critchley, 1962, 1970; Espir & Rose, 1970; Gardner, 1985; Hughlings Jackson, 1874, 1915; Marshall, 2000; Van Lancker, 1973, 1993; Van Lancker Sidtis, in press-a; called "dynamic aphasia" in Luria & Tsvetkova, 1970). A few controlled clinical studies have also shown a superiority for "automatic" over propositional speech in aphasic production (Lum & Ellis, 1994; Van Lancker & Bella, 1996). Influential surveys targeted preserved utterances in severely aphasic individuals and identified expletives, interjections, greetings, and numerals as corresponding well to the categories typically mentioned in clinical descriptions. In those surveys, proper nouns and sentence stems were also documented in German (Blanken, Dittman, Hass, & Wallesch, 1988; Blanken & Marini, 1997; Blanken, Wallesch, & Papagno, 1990) and British English (Code, 1982a, 1982b, 1989a, 1994a). Later, similar observations were described for Cantonese speakers (Chung, Code, & Ball, 2004).

Although selectively preserved formulaic expressions produced by persons with severe propositional language deficits arising from stroke or traumatic brain injury are usually short (1–3 words), or involve utterance completion (e.g., "she has him eating out of her _____"), longer sequences, such as proverbs, idioms, and Shakespearean quotes, have also been described (Whitaker, 1976; Van Lancker, 1988, Van Lancker Sidtis, 2001; Critchley, 1970; Peña-Casanova, Bertran-Serra, Serra, & Bori, 2002). The question arises whether these kinds of stereotypic language are processed differently from novel language; by "differently" we mean by different brain structures according to different principles of organisation.

Another category, sentence initials or sentence stems, which refers to the frequently and conventionally utilised initial portions of sentences in a given language, was first described as conventionalised formulaic language in normal speakers by Pawley and Syder (1983). These were observed in ample supply in persons with severe aphasia: Code (2005) refers to these as "Pronoun + Modal/Aux Verb" and gives examples such as "I want …", "You can't …". Comparable sentence initials were described in an aphasic patient by Buckingham, Avakian-Whitaker, and Whitaker (1975). Even more strikingly, these types of sentence initials were also uttered by the adult left hemispherectomy patient E.C. (e.g., "I don't …", "I couldn't …"), who was severely aphasic for novel language (Code, 1996; Smith, 1966; Van Lancker Sidtis, 2004; Zangwill, 1967). These published observations motivated the selection of formulaic categories to examine in this study.

BRAIN REPRESENTATION OF RESIDUAL SPEECH AND FORMULAIC LANGUAGE

It has not been established whether preserved aphasic utterances are processed primarily in the undamaged right hemisphere (RH) or by intact areas of the left hemisphere (LH), although since Jackson's time the bulk of evidence favours a role of the RH (Blanken, 1991a, 1991b; Code, 1987, 1989b, 1996, 1997; Haas, Blanken, Mezger, & Wallesch, 1988; Van Lancker Sidtis, in press-a). Clinical review studies, such as those by Czopf (1981) and Kinsbourne (1971), using WADA testing in aphasic subjects, demonstrated a significant role of the RH in residual aphasic speech. RH residual speech was inferred in a case study of aphasia through occurrence of a second stroke (Cummings, Benson, Walsh, & Levine, 1979). Graves and Landis (1985) measured greater left-sided mouth openings in unilaterally damaged stroke patients for "automatic speech" production and singing than for "propositional" speech, directly implicating the contralateral RH in these behaviours. Benton (1968) reported that right frontal lobe disease contributed as much as left frontal lobe disease to deficient proverb interpretation. Several single-case studies have provided an opportunity to study production phenomena in depth. As mentioned earlier, the case (E.C.) presented in Smith 1966 (see also Code, 1996, 1997), and discussed in Van Lancker Sidtis (2004), of a right-handed adult male whose LH was removed for treatment of cancer, revealed preservation of swearing, pause fillers ("well", "oh"), speech particles ("uh", "um"), and sentence initials ("I don't …"), in striking contrast to his profound aphasia. The speech of AC, a right-handed male with transcortical sensory aphasia following a large LH stroke, consisted almost exclusively of formulaic expressions (Van Lancker Sidtis, 2001). Another patient, whose speech disorder consisted of phonologically governed intrusive syllables, showed increased deficit on counting and reciting in comparison to free speech (Van Lancker, Bogen, & Canter, 1983). Intrusive automatic inner speech following bilateral brain injury has been reported (Ellis, Young, & Critchley, 1989), and selective preservation of formulaic expressions has been seen in cases of isolation of the speech area (Geschwind, Quadfasel, & Segarra, 1968; Whitaker, 1976).

Related to brain representation of preserved speech is the question of where language rehabilitation takes place in the damaged brain. The contribution of the RH to effective language rehabilitation following speech-language therapy is uncertain (Code, 1994b). fMRI and PET imaging studies of brain function in the course of language rehabilitation have provided contradictory findings. Some have reported RH activity in aphasic language performance (Ohyama, Senda, Kitamura, Ishii, Mishina, & Terashi, 1996; Rosen et al., 2000; Weiller, 1998), while other recent neuroimaging studies of post-stroke aphasia recovery have shown that the best linguistic recovery is associated with restoration of activation in the LH, particularly perilesional areas (Belin et al., 1996; Cao, Vikingstad, George, Johnson, & Welch, 1999; Heiss, Thiel, Kessler, & Herholz, 2003; Zahn et al., 2004). Clear evidence of neurological substrates for processing of formulaic language in unilaterally brain-damaged subjects may shed some light on this question.

Functional imaging studies evaluating brain activity for formulaic expressions began with early SPECT studies using injected radioactive xenon-133. These reported bilateral activity for listening, reading aloud, and production of automatic speech (Lassen & Larsen, 1980). In a study by Bookheimer, Zeffiro, Blaxton,

Gaillard, and Theodore (2000), recitation of memorised speech (the American Pledge of Allegiance) was associated with activation in traditional language areas, while serial speech (reciting the months of the year) engaged only limited language areas. Another study compared a traditional "automatic speech" task (counting) with a word fluency task (animal names) and with nonlexical vocalisations in aphasic and healthy subjects (Van Lancker, McIntosh, & Grafton, 2003), using a partial least squares analysis. The analysis identified greater left frontal activation for naming and vocalisations, while more RH and basal ganglia areas were identified for counting. For aphasic subjects, naming, counting, and vocalisations were more diffusely represented. Bilateral activation for number repetition was reported in a PET functional activation study (Cowell, Egan, Code, Harasty, & Watson, 2000). Another PET study compared spontaneous narration with counting and nursery rhymes (Blank, Scott, Murphy, Warburton, & Wise, 2002). As is often the case for language processing (Van Lancker Sidtis, in press-b), bilateral activation was observed for both speech tasks, with additional left cerebral systems associated with the propositional task. Thus although brain-imaging studies of recovery of speech function following neurological damage have yielded contradictory results as to hemispheric site of recovered speech, some have suggested that processing of formulaic speech is represented in sites other than traditional LH language areas.

Other evidence points to a role of subcortical structures in production of formulaic language. Two case studies of patients with right-sided subcortical damage revealed a deficient or reduced ability to produce recited or formulaic speech (Speedie, Wertman, T'air, & Heilman, 1993; Van Lancker Sidtis, Pachana, Cummings, & Sidtis, in press). Similarly, in an extensive CT scan study by Brunner, Kornhuber, Seemuller, Suger, and Wallesch (1982), no patients with exclusive basal ganglia damage were found to have recurrent speech utterances. Conversely, the hyperactive swearing (a type of formulaic speech) sometimes seen in Tourette's syndrome is indirectly associated with dysfunction of the basal ganglia (Eidelberg et al., 1997; Gates et al., 2004) and basal ganglia-limbic structures (Van Lancker & Cummings, 1999). Likewise, speech formulas have been evoked in deep brain stimulation studies, in which electrical stimulation is applied to subcortical structures (Schaltenbrand, 1965; Schaltenbrand & Woolsey, 1964) and FE production has occurred in the vegetative state (Schiff, Ribary, Plum, & Llinas, 1999). A review of aphasiological evidence led Code (1989a) to suggest that "real-word speech automatisms may originate as holistically created products of a right-hemisphere-limbic system mechanism" (p. 174).

EVIDENCE FROM COMPREHENSION STUDIES

Persons with aphasia following LH damage comprehend idiomatic expressions relatively well, while those with RH damage have deficient comprehension of idioms, proverbs, and other formulaic expressions (Myers & Linebaugh, 1981; Van Lancker & Kempler, 1987; Wapner & Gardner, 1979). A similar double dissociation has also been reported for comprehension of proper nouns versus common nouns in unilateral brain damage (Van Lancker & Klein, 1990; Van Lancker, Lanto, Klein, Riege, Hanson, & Metter, 1991; Yasuda & Ono, 1998) and in normal subjects (Ohnesorge & Van Lancker, 2001).

PROPER NOUNS IN PRODUCTION

With respect to proper noun production, survey studies of persons with severe aphasia identified proper nouns as a prominent feature of residual aphasic speech (Blanken & Marini, 1997; Blanken et al., 1990; Code, 1982a, 1982b, 1989a). However, neurolinguistic studies also associate proper noun anomia with LH damage (Damasio, Grabowski, Tranel, Hichwa, & Damasio, 1996; Hittmair-Delazer, Denes, Semenza, & Mantovan, 1994; Lucchelli & DeRenzi, 1992; McNeil, Cipolotti, & Warrington, 1994; Semenza, Mondini, & Zettin, 1995, Semenza & Zettin, 1988, Shallice & Kartsounis, 1993). Although several studies suggest that the RH is competent in recognising personally familiar proper nouns (Ohnesorge & Van Lancker, 2001; Van Lancker & Klein, 1990), the evidence for a RH involvement in production is not strong (Bredart, Brennan, & Valentine, 1997).

GOAL OF THE STUDY

The recent interest in FEs in everyday language use, combined with observations from aphasia and converging evidence of a role of the RH in processing conversation (Brownell & Joanette, 1993; Kaplan, Brownell, Jacobs, & Gardner, 1990; Rehak, Kaplan, & Gardner, 1992), motivated this study. Corpus studies of discourse in normal subjects indicate a considerable proportion of FEs in spontaneous speech. Counts derived from studies of normal conversation suggest that between 15% and 40% of all utterances are fixed expressions (Moon, 1998; Sorhus, 1977; Strässler, 1982; Van Lancker Sidtis & Rallon, 2004), depending on the method of counting, speakers, topic, and context. However, little is known about the incidence of FEs in the speech of brain-damaged persons. Our general goal was to evaluate hypotheses about cerebral processing of FEs. To begin this task, we examined FEs in the spontaneous speech of persons with unilateral brain damage, and compared these measures with speech from age- and education-matched normal control subjects. While preservation of a few ''automatic'' utterances is dramatically obvious in nonfluent aphasia, and has been described, in this study we examine the incidence of formulaic expressions in fluent aphasia, drawing on guidelines given by Code (1989a, p. 158) and Wray (2002, pp. 219, 223–224). An additional objective was to examine whether the groups differ in incidence of FE subtypes.

METHOD

Subjects

Speech samples from 15 right-handed, age- and education-matched subjects in three different groups were used in this investigation (see Glosser et al., 1988). Natural speech samples were collected from five patients with aphasia following left hemisphere (LH) damage due to a cerebral vascular accident, five patients with right hemisphere (RH) damage due to a cerebral vascular accident, and five neurologically intact normal control subjects (NC). The LH-damaged subjects, including one with anomia and four with Wernicke's aphasia, ranged in age from 49 to 76 (mean=62.8, SD=10.7) They had an average education of 12.6 years (SD=2.6). These were drawn from a group of nine patients at least 1 month post-onset of injury, with a mean post-onset time of 24.7 months. All subjects were evaluated with the Boston Diagnostic Aphasia Examination, and their severity scores ranged from 2–3.5

(Goodglass & Kaplan, 1972). The age of RH subjects ranged from 41 to 70 (mean=59.4, *SD*=11.1), with 12.2 (*SD*=0.5) mean years of education. These were drawn from a study group of 16 patients at least 2 months post-onset of injury, whose mean post-onset time was 37.7 months.

All patients were sufficiently medically stable to undergo language testing and participate in conversation (Glosser & Deser, 1990; Glosser, Deser, & Weisstein, 1992; Glosser & Goodglass, 1991). NC subjects ranged in age from 46 to 78 (mean=63.6, *SD*=13.8), and were educated at a mean of 15.2 (*SD*=3.0) years. When LH, RH, and NC groups were compared on age and education data, no significant differences were observed between the groups. All participants were male except for two NC females. The gender discrepancy and the non-correspondence in mean years of education were not considered likely to affect parameters measured in spontaneous speech. Detailed subject information is given in Table 1.

Materials and procedure

Written transcripts of spontaneous speech were utilised, in which subjects described their family and work. The texts of RH patients contained a mean of 614.6 words (range=325–1030; *SD*=284.4) with a mean length of utterance (MLU) of 11 words. The texts of LH subjects averaged 433.6 words (range=257–587; *SD*=156.1). MLU was 8.8. The NC texts contained 518 words (range 367–1022; *SD*=298.8) with a MLU of 10.2. The transcripts were examined by two independent raters who identified and classified FEs.

The difficulties of classifying fixed expressions are well known (Wray, 2002). Identification and classification of FEs were conducted according to the methodology described in Van Lancker Sidtis and Rallon (2004). After a preliminary analysis of the speech samples, eight categories of FEs were selected for inclusion in the analysis; an

TABLE 1
Subject information

Subject number	*Age*	*Education*	*Gender*	*BDAE severity score*
LHD 1	71	16	M	3
LHD 2	59	9	M	2
LHD 3	76	12	M	3.5
LHD 4	59	12	M	2
LHD 5	49	14	M	2
RHD 1	63	12	M	NA
RHD 2	41	12	M	NA
RHD 3	58	13	M	NA
RHD 4	70	12	M	NA
RHD 5	65	12	M	NA
NC 1	46	18	F	NA
NC 2	56	12	M	NA
NC 3	61	12	M	NA
NC 4	77	16	M	NA
NC 5	78	18	F	NA

LHD=left hemisphere damage; RHD=right hemisphere damage; NC=normal control; BDAE=Boston Diagnostic Aphasia Examination

additional category, proper nouns, was included. We used a guideline similar to the criterion of "well-formedness" for sentences in grammatical competence: Would a native speaker of English recognise this expression as "familiar" in the special sense of expressions learned as a whole? Intuition by native speakers about well-formedness has long served essentially exclusively to underpin claims about grammaticality in generative syntax studies. Operationally, in the case of formulaic expressions, these criteria predict that a preponderance of native speakers will correctly fill in a missing word for the expression under scrutiny. The additional step of verifying this procedure was taken in a previous study; this prediction was supported and this methodology was thus validated (Van Lancker Sidtis & Rallon, 2004).

Arguments have been made for and against intuition, and for and against functional and formal standards for identifying formulaic utterances (Wray, 2002). In this study, all three were utilised: the intuition of native speakers' recognition of formulaic expressions, functional criteria in categorising sentence stems and conversational formulaic expressions, and formal criteria in classifying idioms, expletives, discourse particles, pause fillers, numerals, and proper nouns. We view these assays as preliminary, as the study of formulaic speech itself is in a developmental stage. In the current analysis, the total number of formulaic expressions in any particular group was not the goal; instead, we undertook to compare incidence between groups. Therefore, consistent application of the criteria across examination of all the transcriptions was rigorously maintained.

The nine categories chosen for analysis, following descriptions in the linguistic and neurolinguistic literature reviewed above, are the following: (1) idioms (e.g., "lost my train of thought"); (2) conventional expressions (e.g., "as a matter of fact"); (3) conversational formulaic expressions (e.g., "first of all", "right"); (4) expletives (e.g., "damn"); (5) sentence stems (e.g., "I guess"); (6) discourse particles (e.g., "well"), and (7) pause fillers (e.g., "uh"). As preserved counting ability is ubiquitous in aphasic speakers, the incidence of (8) numerals in any form was also noted. Following findings by Code (1989a, p. 160) for production and Van Lancker and Klein (1990) for comprehension, the occurrence in the speech samples of (9) familiar proper nouns (those personally known to the speaker) was identified. These categories were searched for and counted. Two raters were utilised. One rater had experience in identifying speech formulas from a previous series of studies (Van Lancker Sidtis & Rallon, 2004); the second rater was trained in these methods. Ratings derived throughout transcript analysis were intermittently verified by consultation with other native speakers of American English. Results of the independent analyses were checked against each other and scoring disagreements were jointly resolved.

RESULTS

Results for the five LH-damaged, the five RH-damaged, and the five normal control subjects are shown in Figure 1 (total words in FEs and novel expressions) and Figure 2 (proportions of words in FEs). The proportions of words comprising FEs in the texts were compared across groups. The RH group had the smallest proportion of FEs in their speech (16.5%), while the LH group had the highest proportion (29.5%). The value for the NC group (24.6%) fell between the values of the two brain-damaged groups. A one-way ANOVA comparing proportions of FEs in the three groups revealed a significant main effect of group, $F(2, 12) = 7.343$, $p < .01$. A

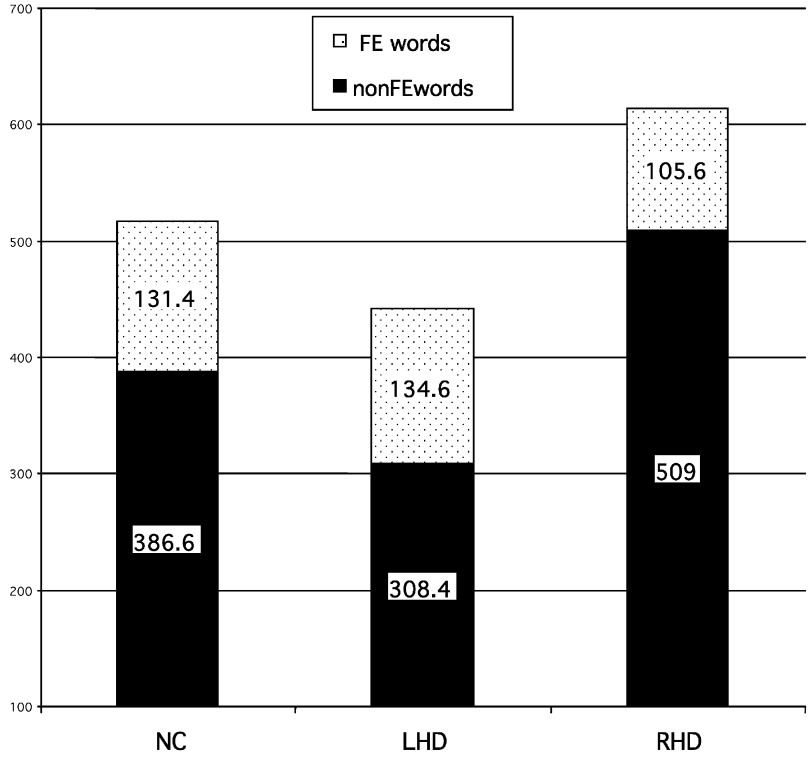

Figure 1. Number of total words and number of words in formulaic expressions (FEs) in the three subject groups (NC=normal control, LHD=left hemisphere damaged, RHD=right hemisphere damaged).

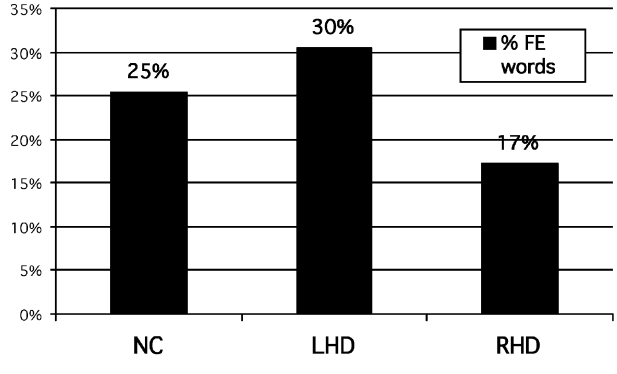

Figure 2. Percentage of words making up formulaic expressions in the three subject groups (NC=normal control, LHD=left hemisphere damaged, RHD=right hemisphere damaged).

post-hoc, two-tailed, independent samples *t*-test again showed that the RH group had significantly fewer FEs than the LH group, $t(8) = 3.450$, $p < .01$, and than the NC group, $t(8) = 3.371$, $p = .01$. Independent-sample, two-tailed *t*-tests comparing results obtained from LH and RH damaged subjects on FEs demonstrated that FE measures in the RH group were significantly lower than the LH group when proportions were compared, $t(8) = 3.9176$, $p < .01$, and when total FEs were compared, $t(8) = 3.5143$, $p < .01$.

An ANOVA performed on the proportion of FEs after proper nouns were removed also revealed a significant group difference, $F(2, 12) = 10.812$, $p < .01$, with significant group differences between LH–RH $t(8) = 4.140$, $p < .01$, RH–NC $t(8) = 2.547$, $p = .05$, and NC–LH $t(8) = -2.500$, $p = .05$. Mean numbers of FE utterances were counted for each group: RH = 54.6, LH = 80.0, and NC = 70.4. Within these, the proportion of proper nouns was calculated, revealing the least for the LH group: RH = 26.0%, LH = 7.0%, NC = 23.3%. A one-way ANOVA revealed a main effect of group, $F(2, 12) = 4.918$, $p < .03$, and on post-hoc analyses, significant differences were seen for the LH/RH comparison, $t(8) = -3.594$, $p < .01$, and the NC/LH comparison, $t(8) = 2.520$, $p < .05$.

Words comprising FEs within each utterance in each text were counted and averaged for each group (RH = .98, LH 1.61, and NC = 1.49 words in FEs per utterance). These differences, while suggestive, were not significant. ANOVAs comparing the three groups on measures of total numbers of proper nouns, total words in text, or total FEs were not significant.

To informally examine differences between types of formulaic language, idioms, conventional expressions, and conversational speech formulas were merged into a grouping called "speech formulas". No expletives were identified in this sample. The incidence of the resulting six FE categories is shown in Figure 3. LH subjects utilised proportionately more speech formulas and discourse elements and strikingly fewer proper nouns than speakers in the other two groups, as was also revealed in the statistical analysis above. RH subjects used somewhat fewer speech formulas and discourse elements. A paucity of pause fillers was in evidence in this sample when compared to the two other groups.

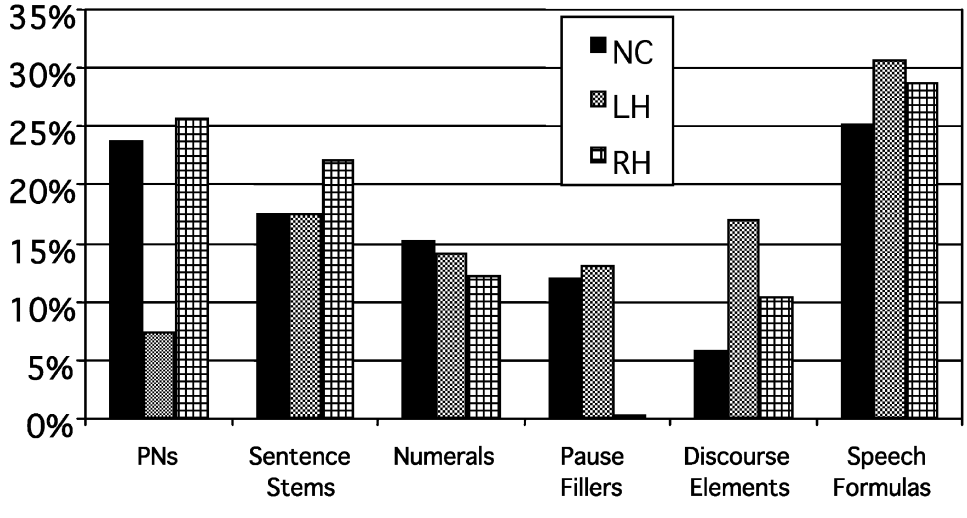

Figure 3. Percentages of six categories of formulaic expressions by subject group; idioms, conventional expressions, and conversational speech formulas are combined in the category "speech formulas". PN=proper nouns. No expletives appeared in this sample ((NC=normal control, LHD=left hemisphere damaged, RHD=right hemisphere damaged).

DISCUSSION

The major finding that right-hemisphere-damaged subjects used fewer formulaic expressions than left-hemisphere-damaged subjects with fluent aphasia in spontaneous speech supports the notion that an intact right hemisphere contributes to the processing of formulaic expressions. The observation of a larger proportion of formulaic expressions in the left-hemisphere-damaged group is in agreement with a single-case study of the linguistic characteristics of aphasic speech; "minor units" in spontaneous speech were identified in one subject, defined as "nonproductive units such as greetings, vocatives, etc." (Edwards & Knott, 1994, p. 95), and with another study in which measures of "automatic speech" were taken from four aphasic subjects (McElduff & Drummond, 1991). Other evidence documents the use of formulas by aphasic persons to facilitate conversation (Oelschlaeger & Damico, 1998). The decreased incidence of proper nouns produced by the left-hemisphere-damaged group is consistent with the position that anomia for proper nouns is associated with left hemisphere damage (Semenza et al., 1995; Damasio et al., 1996). The paucity of pause fillers and, to a lesser extent, discourse elements in the right-hemisphere-damaged group is in agreement with the observations of E.C., the adult left-hemispherectomised subject, who produced these elements liberally (Code, 1996; Smith, 1966; Van Lancker Sidtis, 2004). However, no expletives were observed in this sample, despite their presence in other descriptions of aphasic residual speech and their prominence in the preserved speech of E.C. The small difference between groups in incidence of numerals may be due to the procedure of counting all numerals that appeared in the transcripts, including those that might be considered propositional, in that they referred to dates or addresses. It is possible that the salience of numerals comprising preserved speech in aphasia is limited to processes related to sequential counting.

The major findings of this study support the hypothesis that the right and left hemispheres may each serve as neural substrates for separate components of language performance. This result is in good accord with the distributed lexical model proposed by Wray (2002, p. 249), which associates customary collocations, routine and interactional expressions, and holistic and memorised texts with right hemisphere representation. Our findings are also consistent with the dual-process model of language processing (Sinclair, 1991;Van Lancker, 1973, 1988; Van Lancker Sidtis, 2004; Wray, 2002), which proposes two modes within language competence: storage and processing of fixed expressions, and generation of novel utterances. We suggest that this perspective be considered in studies that are designed to assess neurological substrates for language recovery in aphasia.

Some cautionary notes regarding these results are appropriate. Our measures were made from written transcripts and so a possibility of transcription error cannot be completely eliminated. Individual differences in the use of formulaic expressions are to be expected in any population, so that a larger sample would be desirable. Thorough neurological details were not sufficient for determining a possible role of subcortical involvement in these patients. How contributory or crucial subcortical structures are in the production of various types of formulaic expressions is an important question to pursue, but this study did not allow us to do so. We have acknowledged the difficulty of categorising and identifying formulaic expressions with regard to our level of theoretical understanding as well as in applied science, and questions remain with respect to which subsets of formulaic expressions

should be considered in the analysis. For example, the relative preservation of sentence stems in the right-hemisphere-damaged group and the lack of proper nouns in the left-hemisphere-damaged group suggest that these subsets might best be examined separately. The paucity of pause fillers in the right-hemisphere-damaged group and higher incidence of discourse elements in the left-hemisphere-damaged group merits comment. One plausible explanation is that these constitute a basic unit in pragmatic discourse. The evidence that many pragmatic operations are managed by the right hemisphere is consistent with our result, yielding the conclusion that the left-hemisphere-damaged group relied more on these expressions, and the right-hemisphere-damaged persons failed to utilise them, in the discourse.

There is considerable evidence from previous comprehension studies cited above that some kinds of formulaic expressions, especially idioms, proverbs, and proper nouns, are recognised bilaterally in the brain (e.g., Brownell & Joanette, 1993; Myers, 1999; Van Lancker, 1990). How the several types of formulaic expressions are organised and mediated by the hemispheres in the production modality remains to be investigated. It is possible that swearing, discourse particles, pause fillers, and some kinds of conversational speech formulas may have less bilateral representation, and can be produced by a circuit outside of the left hemisphere speech areas. Although proper noun comprehension appears to be bilaterally represented, proper noun production may require left hemisphere language mechanisms. Larger corpora will be needed to more fully assay the broader range of formulaic expressions in spontaneous speech.

Further studies are needed to explore the role of subcortical nuclei suggested by neurological reports (Van Lancker & Cummings, 1999). There are numerous indications that the basal ganglia can represent holistic action sequences that are subsequently implemented as performance units (Graybiel, 1998). Studies of memory refer to habit learning as taking place in subcortical nuclei (Knowlton, Mangels, & Squire, 1996; Squire, 2004; Squire & Zola, 1996). We consider the results of this study to contribute to the notion that an RH/subcortical circuit subserves the production of some kinds of formulaic expressions and that further study of this issue would be rewarding.

These results suggest that clinical evaluation of formulaic and novel language functions may give important insights into a patient's language disorder profile. Accurately identifying the presence of formulaic language in the speech of fluent aphasic speakers will significantly influence the evaluation of the language disorder, as well as the treatment approach. As Wray (2002, p. 219) states, "If it is possible for a speaker to access [linguistic material] in prefabricated form … then recognising when an aphasic person has done so will make an enormous difference" in how language ability is evaluated. We can conclude, as Wray (2002) predicted, that "some of the fluency achieved by people with Wernicke's aphasia is the result of using formulaic sequences" (Wray, 2002, p. 222). In this study, examination of speech from persons with right hemisphere damage leads to the inference that the normal right hemisphere plays an important role in producing formulaic language. These findings may have implications for recent observations of the important role of the right hemisphere in language recovery following stroke (Weiller et al., 1995). Further, the identification of relatively preserved formulaic expressions may provide a basis for a more effective treatment plan. For persons with right hemisphere damage, who sometimes appear to have communication deficits that are difficult to specify,

identification of a deficient use of FEs may lead to proper counselling and to more effective communicative rehabilitation.

In so far as formulaic expressions are overlearned and holistically processed (Simon, 1974; Wray, 2002) and may constitute "automatically executed" (Code, 1982a, p. 156) or procedural knowledge, motor control structures of the basal ganglia are a good candidate for an important role in formulaic language production. In his recent review article, Code (2005) proposed that the "right hemisphere, basal ganglia, thalamus and limbic structures" must be considered in the processing of "formulaic, nonpropositional, metaphorical, idiomatic and pragmatic aspects of language" (p. 325). Our study seeks to further explore this notion by evaluating the speech of right- and left-hemisphere-damaged subjects. Although we agree that there is strong evidence for an important role of the basal ganglia, in cooperation with RH structures, this part of the question must await a later project. This study, using consistent classification criteria to compare spontaneous speech in unilaterally brain-damaged subjects, has shown significant differences in usage of formulaic expressions. As this finding is further supported, it has important implications for language evaluation in aphasia, speech treatment approaches, and neurolinguistic models of language.

Manuscript received 7 August 2005
Manuscript accepted 22 December 2005

REFERENCES

Alajouanine, T. (1956). Verbal realization in aphasia. *Brain*, *79*, 1–28.

Belin, P., Van Eeckhout, P., Zilbovicious, M., Remy, P., Francois, C., & Guillaume, S., et al. (1996). Recovery from nonfluent aphasia after melodic intonation therapy: A PET study. *Neurology*, 47, 1504–1511.

Bell, R. A., & Healey, J. G. (1992). Idiomatic communication and interpersonal solidarity in friends' relational cultures. *Human Communication Research*, *18*(3), 307–335.

Benson, D. R. (1979). *Aphasia, alexia and agraphia*. New York: Churchill Livingston.

Benton, A. (1968). Differential behavioral effects in frontal lobe disease. *Neuropsychologia*, *6*, 53–60.

Berndt, R. S., Haendiges, A. N., Mitchum, C. C., & Sandson, J. (1997). Verb retrieval in aphasia. 2. Relationship to sentence processing. *Brain and Language*, *56*(1), 107–137.

Blank, S. C., Scott, S. K., Murphy, K., Warburton, E., & Wise, R. J. S. (2002). Speech production: Wernicke, Broca and beyond. *Brain*, *125*, 1829–1838.

Blanken, G. (1991a). Die neurolinguistische Basis von Sprachautomatismen. In G. Blanken (Ed.), *Einführung in die linguistische Aphasiologie: Theorie und Praxis*. Freiburg i. Br., Germany: HochschulVerlag.

Blanken, G. (1991b). The functional basis of speech automatisms (recurring utterances). *Aphasiology*, *5*, 103–127.

Blanken, G., Dittmann, J., Haas, J-C., & Wallesch, C-W. (1988). Producing speech automatisms (recurring utterances): Looking for what is left. *Aphasiology*, *2*, 545–556.

Blanken, G., & Marini, V. (1997). Where do lexical speech automatisms come from? *Journal of Neurolinguistics*, *10*, 19–31.

Blanken, G., Wallesch, E-W., & Papagno, C. (1990). Dissociations of language functions in aphasics with speech automatisms (recurring utterances). *Cortex*, *26*, 41–63.

Boles, L. (1998). Conversational discourse analysis as a method for evaluating progress in aphasia: A case report. *Journal of Communication Disorders*, *31*(3), 261–273.

Bolinger, D. (1976). Meaning and memory. *Forum Linguisticum*, *1*, 1–14.

Bookheimer, S. Y., Zeffiro, T. A., Blaxton, T. A., Gaillard, P. W., & Theodore, W. H. (2000). Activation of language cortex with automatic speech tasks. *Neurology*, *55*, 1151–1157.

Bredart, S., Brennen, T., & Valentine, T. (1997). Dissociations between the processing of proper and common nouns. *Cognitive Psychology*, *14*, 209–217.

Brownell, H. H., & Joanette, Y. (Eds.). (1993). *Narrative discourse in neurological impaired and normal aging adults*. San Diego, CA: Singular Publishing Company.

Brunner, R. J., Kornhuber, H. H., Seemuller, E., Suger, G., & Wallesch, C-W. (1982). Basal ganglia participation in language pathology. *Brain and Language*, *16*, 281–299.

Buckingham, H. W., Avakian-Whitaker, H., & Whitaker, H. A. (1975). Linguistic structures in stereotyped aphasic speech. *Linguistics*, *154/155*, 5–13.

Cao, Y., Vikingstad, E. M., George, K. P., Johnson, A. F., & Welch, K. M. (1999). Cortical language activation in stroke patients recovering from aphasia with functional MRI. *Stroke*, *30*(11), 2331–2340.

Chung, K. K. H., Code, C., & Ball, M. J. (2004). Lexical and non-lexical speech automatisms in aphasic Cantonese speakers. *Journal of Multilingual Communication Disorders*, *2*, 32–42.

Code, C. (1982a). Neurolinguistic analysis of recurrent utterance in aphasia. *Cortex*, *18*, 141–152.

Code, C. (1982b). On the origins of recurrent utterances in aphasia. *Cortex*, *18*, 161–164.

Code, C. (1987). *Language, aphasia, and the right hemisphere*. London: Wiley.

Code, C. (1989a). Speech automatisms and recurring utterances. In C. Code (Ed.), *The characteristics of aphasia* (pp. 155–177). London: Taylor & Francis.

Code, C. (1989b). Symptoms, syndromes, models: The nature of aphasia. In C. Code (Ed.), *The characteristics of aphasia* (pp. 1–22, evolution, hierarchy). London: Taylor & Francis.

Code, C. (1994a). Speech automatism production in aphasia. *Journal of Neurolinguistics*, *8*(2), 135–148.

Code, C. (1994b). Role of the right hemisphere in the treatment of aphasia. In R. Chapey (Ed.), *Language intervention strategies in adult aphasia*. Baltimore: Williams & Wilkins.

Code, C. (1996). Speech from the isolated right hemisphere? Left hemispherectomy cases E. C. and N. F. In C. Code, C-W. Wallesch, Y. Joanette, & A-R. Lecours (Eds.), *Classic cases in neuropsychology, Vol. 1*. Hove, UK: Lawrence Erlbaum Associates Ltd.

Code, C. (1997). Can the right hemisphere speak? *Brain and Language*, *57*, 38–59.

Code, C. (2005). First in, last out? The evolution of aphasic lexical speech automatisms to agrammatism and the evolution of human communication. *Interaction Studies*, *6*, 311–334.

Cowell, S. F., Egan, G. R., Code, C., Harasty, J., & Watson, J. D. (2000). The functional neuroanatomy of simple calculation and number repetition: A parametric PET activation study. *Neuroimage*, *12*, 565–573.

Critchley, M. (1962). Speech and speech-loss in relation to the duality of the brain. In V. Mountcastle (Ed.), *Interhemispheric relations and cerebral dominance* (pp. 208–213). Baltimore: Johns Hopkins University Press.

Critchley, M. (1970). *Aphasiology and other aspects of language*. London: Edward Arnold Ltd.

Cummings, J. L., Benson, D. F., Walsh, M. J., & Levine, H. L. (1979). Left-to-right transfer of language dominance: A case study. *Neurology*, *29*, 1547–1550.

Czopf, J. (1981). Über die Rolle der nicht dominanten Hemisphäre in der Restitution der Sprache der Aphasischen. *Archiven Psychiatrischen Nervenkrankheiten*, *216*, 162–171.

Damasio, H., Grabowski, T., Tranel, D., Hichwa, R., & Damasio, A. (1996). A neural basis for lexical retrieval. *Nature*, *380*, 449–505.

Dobbinson, S., Perkins, M., & Boucher, J. (2003). The interactional significance of formulas in autistic language. *Clinical Linguistics & Phonetics*, *17*, 299–307.

Edwards, S., & Knott, R. (1994). Assessing spontaneous language abilities of aphasic speakers. In D. Graddol & J. Swann (Eds.), *Evaluating language*. Clevedon, OH: Multilingual Matters, 91–101.

Eidelberg, D., Moeller, J. R., Antonini, A., Kazumata, K., Dhawan, V., & Budman, C., et al. (1997). The metabolic anatomy of Tourette's syndrome. Neurology, 48, 927–934.

Ellis, A. W., Young A, W., & Critchley, E. M. R. (1989). Intrusive automatic or nonpropositional inner speech following bilateral cerebral injury: A case report. *Aphasiology*, *3*, 581–585.

Espir, L., & Rose, F. (1970). *The basic neurology of speech*. Oxford, UK: Blackwell Scientific Publications.

Gardner, H. (1985). The loss of language. In V. Clark, P. Eschholz, & A. F. Rosa (Eds.), *Language: Introductory readings*. New York: St. Martin's Press.

Gates, L., Clarke, J. R., Stokes, A., Somorjai, R., Jarmasz, M., & Vandorpe, R., et al. (2004). Neuroanatomy of coprolalia in Tourette syndrome using functional magnetic resonance imaging. Progress in Neuro-psychopharmacology & Biological Psychiatry, 28, 397–400.

Geschwind, N., Quadfasel, F., & Segarra, J. (1968). Isolation of the speech area. *Neuropsychologia*, *6*, 327–340.

Ghacibeh, G. A., & Heilman, K. M. (2003). Progressive affective aprosodia and prosoplegia. *Neurology*, *60*(7), 1192–1194.

Glosser, G. (1993). Discourse production patterns in neurologically impaired and aged populations. In H. H. Brownell & Y. Joanette (Eds.), *Narrative discourse in neurologically impaired and normal aging adults* (pp. 191–212). San Diego, CA: Singular Press.

Glosser, G., & Deser, T. (1990). Patterns of discourse production among neurological patients with fluent language disorders. *Brain and Language*, *40*, 67–88.

Glosser, G., Deser, T., & Weisstein, C. (1992). Structural organisation of discourse production following right hemisphere damage. *Journal of Clinical and Experimental Neuropsychology*, *14*, 40.

Glosser, G., & Goodglass, H. (1991). Idiosyncratic word associations following right hemisphere damage. *Clinical and Experimental Neuropsychology*, *13*, 703–710.

Glosser, G., Wiener, M., & Kaplan, E. (1988). Variations in aphasic language behaviors. *Journal of Speech and Hearing Disorders*, *53*, 115–124.

Goodglass, H., & Kaplan, E. (1972). *The assessment of aphasia and related disorders*. Philadelphia: Lea & Febiger.

Graves, R., & Landis, T. (1985). Hemispheric control of speech expression in aphasia. *Archives of Neurology*, *42*, 249–251.

Graybiel, A. M. (1998). The basal ganglia land chunking of action repertoires. *Neurobiology of Learning and Memory*, *70*, 119–136.

Haas, J. C., Blanken, G., Mezger, G., & Wallesch, C-W. (1988). Is there an anatomical basis for the production of speech automatisms? *Aphasiology*, *2*, 552–565.

Heiss, W. D., Thiel, A., Kessler, J., & Herholz, K. (2003). Disturbance and recovery of language function: Correlates in PET activation studies. *Neuroimage*, *20*(Suppl.1), S42–49.

Hittmair-Delazer, H., Denes, G., Semenza, C., & Mantovan, M. C. (1994). Anomia for people's names. *Neuropsychologia*, *32*, 465–476.

Hughlings Jackson, J. (1874). On the nature of the duality of the brain. In J. Taylor (Ed.), *Selected writings of John Hughlings Jackson, Vol2* (pp. 129–145). London: Hodder & Stoughton. [Reprinted 1932.]

Hughlings Jackson, J. (1915). On affections of speech from diseases of the brain. *Brain*, *38*, 101–186.

Jackendoff, R. (1995). The boundaries of the lexicon. In M. Everaert, E. J. van der Linden, A. Schenk, & R. Schreuder (Eds.), *Idioms, structural and psychological perspectives* (pp. 133–169). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Kaplan, J. A., Brownell, H. H., Jacobs, J. R., & Gardner, H. (1990). The effects of right hemisphere damage on the pragmatic interpretation of conversational remarks. *Brain and Language*, *38*, 122–134.

Kinsbourne, M. (1971). The minor cerebral hemisphere as a source of aphasic speech. *Transactions of the American Neurological Association*, *96*, 141–145.

Knowlton, B. J., Mangels, J. A., & Squire, L. R. (1996). A neostriatal habit learning system in humans. *Science*, *273*, 1399–1402.

Lassen, H. A., & Larsen, B. (1980). Cortical activity in the left and right hemispheres during language-related brain functions. *Phonetica*, *37*, 27–37.

Lucchelli, F., & DeRenzi, E. (1992). Proper name anomia. *Cortex*, *28*, 221–230.

Lum, C., & Ellis, A. W. (1994). Why do some aphasics show an advantage on some tests of nonpropositional (automatic) speech? *Brain and Language*, *70*(1), 95–118.

Luria, A. R., & Tsvetkova, L. S. (1970). The mechanism of 'dynamic aphasia'. In M. Bierwisch & K. E. Heidolph (Eds.), *Progress in linguistics: A collection of papers* (pp. 187–197). The Hague: Mouton.

Marshall, R. C. (2000). Speech fluency and aphasia. In H. Riggenbuch (Ed.), *Perspectives on fluency* (pp. 74–88). Ann Arbor: University of Michigan Press.

McCarthy, M. (2002). *Listenership in spoken corpora: Exploring listener behavior across genres and varieties*. Symposium presented at the American Association for Applied Linguistics, April 6–9, Salt Lake City, Utah.

McElduff, K., & Drummond, S. S. (1991). Communication functions of automatic speech in non-fluent aphasia. *Aphasiology*, *5*, 265–278.

McNeil, J. E., Cipolotti, L., & Warrington, E. (1994). The accessibility of proper names. *Neuropsychologia*, *32*(2), 193–208.

Moon, R. E. (1998). *Fixed expressions and text: A study of the distribution and textual behaviour of fixed expressions in English. Oxford Studies in Lexicology and Lexicography*. Oxford, UK: Clarendon Press.

Myers, P. S. (1999). *Right hemisphere damage: Disorders of communication and cognition*. San Diego, CA: Singular.

Myers, P. S., & Linebaugh, C. (1981). Comprehension of idiomatic expressions by right-hemisphere-damaged adults. In R. H. Brookshire (Ed.), *Clinical aphasiology: Conference proceedings*. Minneapolis, MN: BRK.

Nunberg, G., Sag, I., & Wasow, T. (1994). Idioms. *Language*, *70*, 491–537.

Oelschlaeger, M. L., & Damico, J. S. (1998). Spontaneous verbal repetition: A social strategy in aphasic conversation. *Aphasiology*, *12*, 971–988.

Ohnesorge, C., & Van Lancker, D. (2001). Cerebral laterality for famous proper nouns: Visual recognition by normal subjects. *Brain and Language*, *77*, 135–165.

Ohyama, M., Senda, M., Kitamura, S., Ishii, K., Mishina, M., & Terashi, A. (1996). Role of the nondominant hemisphere and undamaged area during word repetition in poststroke aphasics. A PET activation study. *Stroke*, *27*, 897–903.

Papagno, C., & Vallar, G. (2001). Understanding metaphors and idioms: A single-case neuropsychological study in a person with Down syndrome. *Journal of the International Neuropsychological Society*, *7*(4), 516–527.

Paul, L. K., Van Lancker, D., Schieffer, B., Dietrich, R., & Brown, W. S. (2003). Communicative deficits in agenesis of the corpus callosum: Nonliteral language and affective prosody. *Brain and Language*, *85*, 313–324.

Pawley, A., & Syder, F. H. (1983). Two puzzles for linguistic theory: Nativelike selection and nativelike fluency. In J. C. Richards & R. Schmidt (Eds.), *Language and communication* (pp. 191–225), Longman, London.

Peña-Casanova, J., Bertran-Serra, I., Serra, A., & Bori, T. (2002). Uncommonly long sequence of speech automatisms in a young woman with traumatic brain injury. *Journal of Neurolinguistics*, *15*, 109–128.

Rehak, A., Kaplan, J. A., & Gardner, H. (1992). Sensitivity to conversational deviance in right hemisphere patients. *Brain and Language*, *42*, 203–217.

Rosen, H. J., Petersen, S. E., Linenweber, M. R., Snyder, A. Z., White, D. A., & Chapman, L., et al. (2000). Neural correlates of recovery from aphasia after damage to left inferior frontal cortex. Neurology, 55, 1883–1894.

Schaltenbrand, G. (1965). The effects of stereotactic electrical stimulation in the depth of the brain. *Brain*, *88*, 835–840.

G. Schaltenbrand, & C. N. Woolsey, (Eds.), (1964). *Cerebral localization and organisation*. Madison, WI: University of Wisconsin Press.

Schegloff, E. (1988). Discourse as an interactional achievement II: An exercise in conversation analysis. In D. Tannen (Ed.), *Linguistics in context: connecting observation and understanding* (pp. 135–158). Norwood, NJ: Ablex.

Schiff, N., Ribary, U., Plum, F., & Llinas, R. (1999). Words without mind. *Journal of Cognitive Neuroscience*, *11*, 650–656.

Semenza, C., Mondini, S., & Zettin, M. (1995). The anatomical basis of proper names processing: A critical review. *Neurocase: Case Studies in Neuropsychology, Neuropsychiatry, and Behavioural Neurology*, *1*(2), 183–188.

Semenza, C., & Zettin, M. (1988). Generating proper names: A case of selective inability. *Cognitive Neuropsychology*, *5*, 711–721.

Shallice, T., & Kartsounis, L. (1993). Selective impairment of retrieving people's names: A category specific disorder? *Cortex*, *29*, 281–291.

Simon, H. A. (1974). How big is a chunk? *Science*, *183*, 482–488.

Sinclair, J. M. (1991). *Corpus, concordance, collocation*. Oxford, UK: Oxford University Press.

Smith, A. (1966). Speech and other functions after left (dominant) hemispherectomy. *Journal of Neurology, Neurosurgery and Psychiatry*, *29*, 467–471.

Sorhus, H. B. (1977). To hear ourselves – Implications for teaching English as a second language. *English Language Teaching Journal*, *31*(3), 211–221.

Speedie, L. J., Wertman, E., T'air, J., & Heilman, K. M. (1993). Disruption of automatic speech following a right basal ganglia lesion. *Neurology*, *43*, 1768–1774.

Sprenger, S. A. (2003). Fixed expressions and the production of idioms. *MPI Series in Psycholinguistics*, *21* [The Netherlands].

Squire, L. R. (2004). Memory systems of the brain: A brief history and current perspective. *Neurobiology of Learning and Memory*, *82*, 171–177.

Squire, L. R., & Zola, S. M. (1996). Structure and function of declarative and nondeclarative memory systems. *Proceedings of the National Academy of Science*, *93*, 13515–13522.

Stemmer, B. (1999). Discourse studies in neurologically impaired populations: A quest for action. *Brain and Language*, *68*, 402–418.

Strässler, J. (1982). *Idioms in English: A pragmatic analysis*. Tübingen, Germany: Gunter Narr.

Tannen, D., & Öztek, P. C. (1981). Health to our mouths: Formulaic expressions in Turkish and Greek. In F. Coulmas (Ed.), *Conversational routine* (pp. 37–54). The Hague: Mouton.

Van Lancker, D. (1973). Language lateralization and grammars. In J. Kimball (Ed.), *Studies in syntax and semantics Vol. II* (pp. 197–204). New York: Academic Press.

Van Lancker, D. (1988). Nonpropositional speech: Neurolinguistic studies. In A. E. Ellis (Ed.), *Progress in the psychology of language*. (Vol. III, pp. 49–118). Hove, UK: Lawrence Erlbaum Associates Ltd.

Van Lancker, D. (1990). The neurology of proverbs. *Behavioral Neurology*, *3*, 169–187.

Van Lancker, D. (1993). Nonpropositional speech in aphasia. In G. Blanken, J. Dittmann, J. Grimm, J. C. Marshall, & C-W. Wallesch (Eds.), *Linguistic disorders and pathologies, An international handbook*. Berlin: Walter de Gruyter.

Van Lancker, D., & Bella, R. (1996). The relative roles of repetition and sentence completion tasks in revealing superior speech abilities in patients with nonfluent aphasia. *Journal of the International Neuropsychological Society*, *2*, 6.

Van Lancker, D., Bogen, J. E., & Canter, G. J. (1983). A case report of pathological rule-governed syllable intrusion. *Brain and Language*, *20*, 12–20.

Van Lancker, D., & Cummings, J. (1999). Expletives: Neurolinguistic and neurobehavioral perspectives on swearing. *Brain Research Reviews*, *31*, 83–104.

Van Lancker, D., & Kempler, D. (1987). Comprehension of familiar phrases by left- but not by right-hemisphere-damaged patients. *Brain and Language*, *32*, 265–277.

Van Lancker, D., & Klein, K. K. (1990). Preserved recognition of familiar personal nouns in global aphasia. *Brain and Language*, *39*, 511–529.

Van Lancker, D., Lanto, A., Klein, K. K., Riege K, W., Hanson, W., & Metter, E. J. (1991). Preferential representation of personal names in the right hemisphere. *Clinical Aphasiology*, *20*, 181–189.

Van Lancker, D., McIntosh, R., & Grafton, R. (2003). PET activation studies comparing two speech tasks widely used in surgical mapping. *Brain and Language*, *85*, 245–261.

Van Lancker Sidtis, D. (2001). Preserved formulaic expressions in a case of transcortical sensory aphasia compared to incidence in normal everyday speech. *Brain and Language*, *79*(1), 38–41.

Van Lancker Sidtis, D. (2004). When novel sentences spoken or heard for the first time in the history of the universe are not enough: Toward a dual-process model of language. *International Journal of Language and Communication Disorders*, *39*(1), 1–44.

Van Lancker Sidtis, D. (in press a). Where in the brain is nonliteral language? *Metaphor and Symbol*.

Van Lancker Sidtis, D. (in press b). Has neuroimaging solved the problems of neurolinguistics? *Brain and Language*.

Van Lancker Sidtis, D., Pachana, N., Cummings, J., & Sidtis, J. (in press). Dysprosodic speech following basal ganglia insult: Toward a conceptual framework for the study of cerebral representation of prosody. *Brain and Language*.

Van Lancker Sidtis, D., & Rallon, G. (2004). Tracking the incidence of formulaic expressions in everyday speech: Methods for classification and verification. *Language and Communication*, *24*, 207–240.

Wapner, W., & Gardner, H. (1979). A note on patterns of comprehension and recovery in global aphasia. *Journal of Speech and Hearing Research*, *29*, 765–772.

Weiller, C. (1998). Imaging recovery from stroke. *Experimental Brain Research*, *123*, 13–17.

Weiller, C., Isensee, C., Rijntjes, R., Huber, W., Müller, S., & Bier, D., et al. (1995). Recovery from Wernicke's aphasia: A positron emission tomographic study. Annals of Neurology, 37(6), 723–732.

Whitaker, H. A. (1976). A case of isolation of the speech functions. In H. Whitaker & H. A. Whitaker (Eds.), *Studies in neurolinguistics*. (Vol. 2, pp. 1–58). London: Academic Press.

Wray, A. (2002). *Formulaic language and the lexicon*. Cambridge, UK: Cambridge University Press.

Wray, A., & Perkins, M. (2000). The functions of formulaic language: An integrated model. *Language and Communication*, *20*, 1–28.

Yasuda, K., & Ono, Y. (1998). Comprehension of famous personal and geographical names in global aphasic subjects. *Brain and Language*, *61*(2), 274–287.

Zahn, R., Drews, E., Specht, K., Kemeny, S., Reith, W., & Willmes, K., et al. (2004). Recovery of semantic word processing in global aphasia: A functional MRI study. Cognitive Brain Research, 18(3), 322–336.

Zangwill, O. (1967). Speech and the minor hemisphere. *Acta Neurologica Psychiatrica Belgica*, *67*, 1013–1020.