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The ear craves the familiar: Pragmatic repetition in left and right cerebral damage

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Background: Repetition occurs plentifully in normal conversation, but empirical studies of the pragmatic use of repetition are rare and *pragmatic repetition*, defined as verbal repetition in conversational use, in disordered language has not been systematically investigated. Applying a method of analysis that was piloted utilising normal discourse, discourse samples from persons with left and right brain damaged were examined for incidence and charcteristics of repetition.
Aims: The purpose of this exploratory study was to examine verbal repetition following cerebral hemispheric damage. From previous studies of hemispheric influences on communicative competence, it was hypothesised that unilateral damage would affect verbal repetition differently. Following earlier results for hemispheric effects on proportion of formulaic expressions, overall more verbal repetition was predicted in persons with left hemisphere damage than those with right hemisphere damage or healthy speakers. Furthermore, previous studies led to a prediction of more repetition of formulaic (than novel, propositional) expressions following left hemisphere damage than the other two study groups. We explored whether characteristics and functions of repetition, developed as part of a new method for quantifying repetition in spontaneous speech, differed systematically between groups.
Methods & Procedures: Transcripts of discourse by persons diagnosed with a single cerebral vascular accident and from age- and education-comparable healthy control (HC) participants were analysed. A method was developed for quantifying verbal repetition and identifying five factors, specifically localness (immediate, delayed, or distant), preservation of the original target (identical or altered), source (self or other), grammatical unit of speech (word, phrase, clause, or sentence), and phrase type (formulaic or novel), and three functions (maintaining form, enhancing content, and socialisation).

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The title is adapted from a quote by W. H. Auden: "The ear tends to be lazy, craves the familiar and is shocked by the unexpected; the eye, on the other hand, tends to be impatient, craves the novel and is bored by repetition." We appreciate the generosity of Dr. Guila Glosser in sharing data with us, and we mourn her untimely demise.

Outcomes & Results: Results revealed significantly higher use of repetition by left hemisphere (28%) than right hemisphere-damaged (RHD) participants (19%) or the HC group (18%). The proportion of formulaic expression repeated by the left hemisphere group was significantly higher (57%) than the right hemisphere group (30%). Fewer repetitions were used by the left hemisphere group (25%) for the function of enhancing the content of talk as compared to the HC group (40%), whereas the RHD group used the least repetition for socialisation (15%).
Conclusions: Pragmatic repetition is to be distinguished from rote repetition (on command) in aphasia diagnosis and from pathological repetition behaviours, including perseveration, following brain damage. The method described here allows for the measurement of pragmatic repetition and its characteristics in normal and disordered language. The findings support previous results for pragmatic and formulaic language behaviours in these populations. This study provides new information on the roles of repetition in normal conversation and on the impact of neurological damage on this function. Identification and measurement of repetition will inform perspectives on evaluation and rehabilitation of conversational speech.

Keywords: Repetition; Pragmatics; Left hemisphere cerebral damage; Right hemisphere cerebral damage; Formulaic language; Discourse.

BACKGROUND: REPETITION IN NORMAL CONVERSATION AND PATHOLOGICAL CONDITIONS

People repeat themselves and others in a conversational setting normally and frequently for a number of useful purposes. Functions include supporting the structure of the conversation (Schegloff, 2000; Tannen, 1989), enhancing its content (Quick, 2007; Stivers, 2004; Wong, 2000), and contributing social qualities such as bonding, affirmation, humour, and affective innuendo (Hopper & Glenn, 1994; Merritt, 1994; Norrick, 1993, 1994). *Pragmatic repetition*, as it is termed here, occurs as a natural component of communicative behaviours. It refers to the purposeful iteration of one's own speech or the speech of a co-participant during spontaneous discourse (Van Lancker Sidtis & Wolf, 2014). Pragmatic repetition is to be distinguished from rote repetition (the intentional re-stating of an utterance on command) and various forms of pathological repetition. Rote repetition is standard in learning (Bean & Patthey-Chavez, 1994; Cook, 1994) and language therapy (Ferrara, 1994). The rote repetition skill is routinely utilised in classifying the aphasias: Persons with aphasia are classified according to whether they can, or cannot, successfully repeat an utterance spoken by the examiner (Brookshire, 1997). In the classic model of language representation in the brain (Geschwind, 1965; Geschwind & Galaburda, 1985; Obler & Gjerlow, 1999), a diagnosis of conduction aphasia results when repetition on command is worse than spontaneous speech production and comprehension performance (Benson & Ardila, 1995), and one of three kinds of transcortical aphasia is diagnosed in persons who successfully repeat verbal utterances (Berthier, 1999). Although several descriptive studies on focused topics related to this theme have appeared, such as self-repair (Rieger, 2003) and frequent use of specific speech formulas (e.g., *like*; Romaine & Lange, 1991), little quantitative work has been applied to pragmatic repetition (i.e., repetition as normally present in everyday talk).

One study reflected the awareness of different roles for rote and spontaneous repetition in aphasia. Oelschlaeger and Damico (1998) presented a person with a diagnosis of conduction aphasia, characterised by poor rote repetition on testing, who was nonetheless able to use repetition effectively during discourse to compensate

for linguistic limitations and remain pragmatically appropriate. A study of persons with conduction aphasia found variable abilities to repeat self-generated utterances in three participants (Odell, Bonkoski, & Mello, 1995). In general, however, diagnostic measures have provided little or no information regarding how neurological damage impacts pragmatic repetition. Nor has a distinction between verbal perseveration, which is viewed as a disorder, and normal repetition behaviours been established in theory or practice. It is a major goal of this study to provide information regarding normal repetition and its disturbance following brain damge.

It is well documented that the location of brain damage impacts linguistic abilities in different ways. Following damage to the right hemisphere, persons generally present with language deficits which mainly impact pragmatic components of language—*pragnosia*, the impaired use of language in communicative settings (Brownell, Gardner, Prather, & Martino, 1995; Brownell, Pincus, Blum, Rehak, & Winner, 1997; Gardner, Brownell, Wapner, & Michelow, 1983; Gardner, Ling, Flamm, & Silverman, 1975; Joanette, 1993; Paradis, 1998). The term "pragnosia" was originally defined as "a defect in the pragmatics of communicative style" (Nelson et al., 1989, p. 266) and corresponds to current notions of deficiencies in language use, or pragmatic deficits, in social, discourse, and conversational settings. Pragnosia includes tendencies to be verbose (Mackisack, Myers, & Duffy, 1987), failure to recognise theme, nonliteral and connotational meanings and humour in discourse (Brownell, Potter, Michelow, & Gardner, 1984; Gardner & Denes, 1973; Van Lancker, 1997), and impoverishment in formulaic expressions (Sidtis, Canterucci, & Katsnelson, 2009; Van Lancker Sidtis & Postman, 2006) including reduced use of conversational advancers such as "uh-huh" and "yes" (Myers, 1999).

Given that verbal repetition falls into the category of language use, or pragmatic behaviours, it might be expected that persons with right hemisphere damage would differ significantly in incidence and kind of verbal repetition from normal speakers (Myers, 1999). Reduced proportions of incidence of repetition, as well as differing measures on the chosen repetition variables, were predicted. In contrast to persons with right hemisphere damage, who do not have language deficits as traditionally evaluated, individuals with left hemisphere damage manifest language disorders in many different forms, while pragmatic abilities remain largely intact. Verbal repetition in spontaneous speech of persons with aphasia has been found to occur for purposes of emphasis (Olness, Matteson, & Stewart, 2010), and recurrent utterances are often observed (Code, 1989, 1994; Moses, Sheard, & Nickels, 2007). In this group, repetition in naturalistic conversation may be expected to occur with frequencies outside the normal range. In fluent aphasia, it is important to determine whether persons with aphasia are using repetition within normal ranges or whether such practice exceeds normal incidence. Overuse of verbal repetition in spontaneous speech may mask important aspects of a language impairment (Helm-Estabrooks, 2004).

This study seeks to quantify verbal repetition in speech following cerebral insult to left or right hemisphere, in comparison with healthy control (HC) participants. A method for quantifying verbal repetition, including classifying types and functions of these repetitions, was successfully tested using three corpora of normal discourse samples (Van Lancker Sidtis & Wolf, 2014). In the present study, the method has been applied to repetition behaviours in the discourse of individuals with left hemisphere damage and the diagnosis of aphasia, and to persons with right hemisphere damage, in comparison with HC participants matched for pertinent variables. Two conditions regarding the spontaneous speech samples led to the conclusion that the

method for quantifying repetition, successfully pretested on normal discourse samples, could provide valid and revealing information about the effects of hemisphere damage on repetition behaviours. The first was the ability of the participants to interact in the interview setting by providing spontaneous speech samples, indicating sufficiently preserved communicative competence. Second, none of the participants had diagnoses directly implicating clinically identifiable repetition behaviours, such as conduction or transcortical aphasia, and none showed the kinds of perservative phenomena classified as abnormal (Stark, 2007).

First, all verbal repetitions were identified and quantified and expressed as a percentage of each of the total sample sizes in the respective corpora. Next, repetitions were classified according to five formal factors that have emerged from the sociological literature as useful to a description of conversation. Precise operational definitions were established for each of these categories. The five formal factors are (1) Localness: was the repetition immediate, delayed, or distant? The phenomenon of localness was investigated as it relates to the length of time linguistic information is stored from the initial production; the measure takes number of turns into account. (2) Preservation: was the repetition identical to the original form or altered? (3) What was the source of the repetition: self or other? This variable provides information about initial generation of content and subsequent use of content. (4) The grammatical unit comprising the repetition was identified: word, phrase, clause, or sentence.

The fifth formal category was (5) phrase type: novel (a newly created sentence) or formulaic (formulaic expressions such as an idiom, proverb, conversational speech formula, expletive, and so on; Fillmore, 1979; Van Lancker Sidtis, in press). For example, "he has his head in the clouds" is a formulaic expression (meaning "he's day dreaming"), whereas "he takes his pets in the car" is a novel expression. This category was included because several studies of repetition have noted similarities between the use of formulaic language and repetition practices (Johnstone, 1994; Tannen, 1987a, 1987b, 1989). Formulaic expressions are unitary and known to a community of language users; novel expressions are newly created. A method for identifying formulaic expressions using formal and functional criteria was developed previously (Van Lancker Sidtis & Rallon, 2004) and has been utilised in several subsequent studies (Bridges & Van Lancker Sidtis, 2013; Bridges, Van Lancker Sidtis, & Sidtis, 2013; Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006). Native speakers' intuitions are employed as an aid, as is standard in linguistic analysis (Devitt, 2006), for identifying the several categories of formulaic language, with the primary criterion being a formal one, the cohesive nature of a phrase: word selection and word order are fixed, usually with a stereotyped prosodic contour. Meaning relations may be nonliteral, as in idioms ("She has him eating out of her hand") and proverbs ("You can't keep a good man down"), or less so, as in some conventional expressions ("All things being equal"). Conversational speech formulas are highly dependent on the context and often serve to move the dialogue along ("Right," "Okay," "I couldn't agree more"), whereas idioms are relatively context free.

In this study of repetition in spontanous speech, in addition to five formal dependent variables (localness, preservation, source, grammatical unit, phrase type as newly created or formulaic expression), repetitions were classified by primary function: (1) maintaining the form of the conversation, (2) enhancing the content, and (3) serving socialisation, such as bonding or humour.

It was hypothesised that (1) individuals with left hemisphere brain damage and aphasia, having relatively preserved pragmatic communication abilities, will show

increased use of repetition with predominance of the social-communicative function, including repetition of a higher proportion of formulaic expressions, when compared to matched right hemisphere-damaged (RHD) and HC groups. This was predicted on theoretical as well as empirical bases. Preservation of formulaic expressions (previously termed "automatic speech)" in severe left brain damage has been amply demonstrated (Code, 1989, 1994), indirectly implicating a right hemisphere contribution. The intact right hemisphere has been associated with preserved pragmatic competence in communciation (for review see Van Lancker, 1997), and formulaic expressions are prime elements in conversational interaction, a major component of pragmatic function. Empirically, published studies indicate a significant influence of right hemisphere damage in reducing the proportion of formulaic expressions in spontaneous speech compared to matched speech samples from left hemisphere-damaged (LHD) or HC participants (Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006). The second hypothesis (2) is based on theoretical considerations and observations derived from the literature cited above and states that individuals with right hemisphere brain damage, who reportedly have reduced pragmatic skills, will use fewer repetitions during discourse, and lower proportions of formulaic expressions in their repeated material, than LHD or HC participants. Finally, it was hypothesised (3) that types and functions of repetitions used by RHD and LHD participants will differ. This prediction was examined using secondary measures associated with differential effects of lateralised disease, when compared to HCs. Secondary analyses address the impact of side of brain injury on the five factors: localness, preservation of original target, source (self or other), grammatical unit, and phrase type: novel or formulaic (see precise descriptions below), and functional categories.

METHODS

Study participants

Five individuals with right hemisphere damage, five individuals with left hemisphere brain damage, and five HC participants were studied. In both the left and the right hemisphere groups, neurological damage resulted from a single cerebral vascular accident verified by neuroradiological and neurological examination. All the 15 participants were right handed, and all were male except for two HC participants. The groups were matched in age and education. These persons participated in a series of neurolinguistic studies at an earlier time (Glosser & Deser, 1991; Glosser, Wiener, & Kaplan, 1988; Van Lancker Sidtis & Postman, 2006). Persons not falling under the criterion of a single, focal stroke to left or right hemisphere were eliminated from the study group. In these studies, all the participants underwent extensive neurological, neuropsychological, psychiatric, and neuroradiological evaluation, and were diagnosed and characterised by the study team (Glosser, Butters, & Kaplan, 1977; Glosser, Deser, & Weisstein, 1992; Glosser & Goodglass, 1991).

The participants with left hemisphere damage were an average of 46.8 (SD 31.9) months post-onset of injury. Mean months post-onset for the larger group of 16 persons with right hemisphere damage, from which the individuals in this study were drawn, was 37.7 months. The RHD participants in this study were at least 2 months post-onset of injury. Mean age for the left hemisphere group was 58.4 (SD 14.8) and 59.4 (SD 9.97) for the RHD group; education averaged 12.6 (SD 2.3) and 12.2 (SD

0.4), respectively. Participants were alert and cooperative, and were judged to be stable for language testing and participation in conversational exchanges with an examiner (Glosser et al., 1992). Three persons with left hemisphere damage and moderate aphasia, evaluated using the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1972), had severity ratings of 2 ("Conversation about familiar subjects is possible with help from the listener"); ratings for the other two were 3 and 3.5 ("The patient can discuss almost all everyday problems"). The mean Naming score from the BDAE for the participants diagnosed with aphasia was 106.8 (SD 17.9; maximum is 165) and mean Auditory Comprehension score 94.4 (SD 15.6; maximum is 119). The individuals with right hemisphere damage underwent a battery of neuropsychological testing, indicating significant impairment in executive function (Glosser & Goodglass, 1990). Results from the Digit Symbol Substitution Test (DSST), held to be a consistent and reliable indicator of brain damage, indicated significantly increased processing times and reduced accuracies in the larger RHD group compared to healthy participants' performance (Glosser, Butters, & Kaplan, 1977). For the LHD group, diagnoses by a speech-language pathologist yielded Wernicke's aphasia for four of the participants, and one was diagnosed with anomia. None presented with jargon or neologisms. Their comprehension ability was sufficient to engage in conversation with the examiner.

Discourse samples

Discourse samples were obtained from each of the 15 participants in a dialogue whereby only occasional, minimal encouragement to continue was provided by the clinician. Participants were interviewed individually for 10–20 minutes, and audio recordings were made of the interviews. Each individual was first asked to describe his/her family and then a work experience from the past. Participants were given free rein to speak about any aspect of the suggested topic and to talk as long as they wished. All spoken material by the participants was transcribed in full detail.

Repetition analyses: Development and procedures

Repetitions (all occurrences of verbal repetition) were identified independently by two trained raters using criteria operationally defined in this study, and a high degree of concordance was found. Minor discrepancies between raters were reviewed until consensus was met.

In order to quantify the incidence of repetition in each speech sample, the morpheme, defined in linguistics as the minimal unit of meaning, was taken as a primary unit of measure. The analysis was performed on morphemes. An utterance was counted as a later variant of a previous utterance (either original or itself a variant) when up to 50% of morphological elements reoccurred. Percentages were determined by matching the morphological elements of an utterance to any previous production. In order to determine percentage of correspondence between prototype and variant, the total morphemes in the two productions were divided by the number of repeated morphemes in the two productions.

Five characteristics of repetitions were subjected to measurement and constituted dependent variables in this study. (1) *Localness* is of interest because repetition has been found to have a meaningful presence at considerable distance from the prototype (original utterance), and these differ in function from immediate repetitions

(Johnstone, 1994). Immediate was defined as next turn by self or other; delayed was defined as occurring after two to five turns; a distant repetition occurred a more than five turns from the prototype. (2) The factor *Preservation* provides a metric for how exactly the repetition compares to the prototype, and is defined as identical or altered. (3) *Source* as a factor allows for specific identification of whom the repetition is referencing: self or other; neurological damage can be expected to impact this variable. (4) *Linguistic units* were identified, recording whether the repetition was of a word, phrase, clause, or sentence. (5) *Phrase type* identified whether repeated elements were formulaic or novel expressions. Formulaic expressions were identified using previously published formal and functional criteria (Van Lancker Sidtis & Rallon, 2004).

Finally, repetition performs a number of functions. Repetitions were classified into one of three functional groupings (Lahey, 1988): maintaining the form of the conversation (e.g., structuring turns, openings and closings); enhancing the content (e.g., providing or asking for topic information, underscoring thematic elements); and socialisation (e.g., expressing solidarity, affirmation, bonding, and humour).

RESULTS

Incidence

Given the number of participants in each group in this study and corresponding uncertainty regarding the form of the underlying distributions in each group, the Mann–Whitney *U* test was used to compare groups rather than the *t* test. For the same reasons, the Wilcoxon signed-rank test was used for within-groups comparisons. Both the Mann–Whitney *U* and the Wilcoxon signed-rank tests are non-parametric or distribution-free tests that are appropriate to use in this situation. The alpha level was set at a probability less than 0.05 for all comparisons.

The transcribed discourse samples for the left hemisphere brain-damaged (LBD) participants ranged in length from 362 to 735 words (M = 516; SD = 142), for the RHD participants from 392 to1045 words (M = 647; SD = 271.9), and for the HC group from 279 to 1035 words (M = 553; SD = 288.5). Translated into morphemes, the unit of measurement in this study, the means and standard deviations are as follows: RHD, M = 714.4, SD = 302.0; LHD, M = 573.8, SD = 152.8; HC, M = 663.2, SD = 325.6. Because discourse corpus sizes, and therefore the total number of morphemes, differed across speakers, repetition measures of all the parameters are expressed as a proportion relative to corpus morpheme counts. Results are displayed in Figure 1 for the proportion of morphemes repeated out of the total morphemes for the five LHD (M = 27.7%, SD = 6.2, the five RHD (M = 19.18%, SD = 5.1), and the five HC participants (M = 17.8%, SD = 6.0).

Although the groups did not differ in the number of total morphemes produced or in the total number of morphemes repeated, the groups did differ in proportions of morphemes represented in repetitions. The LHD group had a significantly larger percentage of repeated morphemes than the the RHD group,Mann–Whitney U = 2.5; p = 0.036, and the HC group, Mann–Whitney U = 2.5; p = 0.036. Differences in percentages for each subject are noted in Table 1.

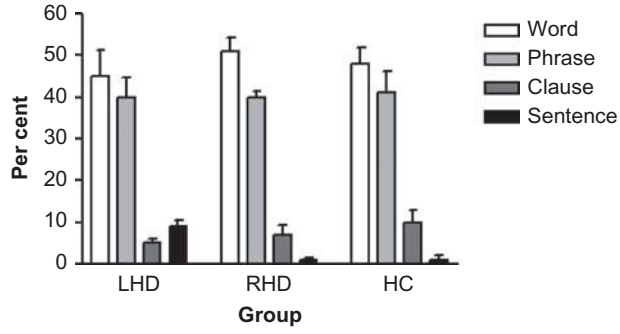

Figure 1. Grammatical units by group.

TABLE 1
Percentage of repeated morphemes per subject

Subject	*Repeated (%)*	*Subject*	*Repeated (%)*	*Subject*	*Repeated (%)*
1. LHD	27	6. RHD	24	11. HC	17
2. LHD	17	7. RHD	14	12. HC	25
3. LHD	31	8. RHD	15	13. HC	22
4. LHD	33	9. RHD	25	14. HC	10
5. LHD	27	10. RHD	17	15. HC	14
Mean 27.7% (SD = 6.2)		Mean 19.2% (SD = 5.1)		Mean 17.8% (SD = 6.0)	

Localness

The localness measure takes into account number of turns. For the LHD group, between 2 and 19 turns occurred, with a mean of 12; in the RHD group, the range of turns was from two to nine with a overall mean of four turns; there were between two and seven turns taken by the examiner in the HC group, with a mean of five turns. The number of turns taken by the examiner was not significantly different when groups were compared. Immediate repetitions occurred more frequently than delayed or distant repetitions for all groups: LHD (51%, SD = 11.2), RHD (51%, SD = 18.0), and HC (45%, SD = 8.7). Delayed and distant repetitions also occurred in similar proportions across groups: LHD: delayed, 24% (SD = 6.2); distant, 25% (SD = 7.6); RHD: delayed, 24% (SD = 4.8); distant, 26% (SD = 17.0); HC: delayed, 29% (SD = 7.7); distant, 27% (SD = 4.3). Group differences were not significant for any of the localness measures.

Preservation: Identical versus altered

Overall, study participants were more likely to maintain the form of a prototype rather than altering it in subsequent productions. Of all the verbal repetitions, for the RHD group 76%, SD = 4.0 were identical repetitions followed by the LHD group (66%, SD = 12.5) and the HC group (60%, SD = 18.7). These group differences were not significant in these analyses.

Source: Self versus other

As mentioned earlier, the number of turns taken by the examiner can affect the measure. This is true also of source: whether the repetition is of self or other. This is because turns by the examiner provide an opportunity to repeat the other (see tabulation above; the number of turns the examiner had taken was not significantly different between groups). The LHD group presented with the lowest proportion of self repetition (87%, SD = 9.8), having the highest number of opportunities to repeat the examiner.The RHD group presented with the highest proportion of self repetition (97%, SD = 5.0), and the lowest number of turns by examiner. The HC group at 91% (SD = 7.0) had few opportunities to repeat the examiner. Significant differences between groups were not noted for repetition of self.

Grammatical unit

Forty-five per cent (SD = 14.1) of total repetitions were words in the LHD group, 51% (SD = 7.6) of total repetitions were of words in the RHD group, and 48% (SD = 9.1) of total repetitions were of words in the HC group. Proportion of repetition at the phrase level of language was also similar for groups: LHD group (40%, SD = 10.3), RHD group (40%, SD = 3.1), and HC group (41%, SD = 12.0). Repetition of clauses and sentences occurred in smaller proportions than repetition of words and phrases. Clause repetitions occurred at 10% (SD = 6.4) in the HC group followed by the RHD group (7%, SD = 5.4), and then by the LHD group (5%, SD = 2.1). None of the comparisons between incidence of grammatical unit or between group measures on these variables was statistically significant. Repetition of sentences, low for the HC (1%, SD = 2.7) and RHD groups (1%, SD = 1.4), occurred more frequently in the LHD group (9%, SD = 3.8). The LHD group had a significantly larger percentage of repeated sentences than the HC group, Mann–Whitney $U = 2.0$; $p = 0.023$ and the RH group, Mann–Whitney $U = 0$; $p = 0.008$ (see Figure 1).

Phrase type: Formulaic versus novel

Formulaic repetitions occurred proportionately more frequently in the LHD group (57%, SD = 10.1) and HC group (53%, SD = 18.1) than in the RHD group (30%, SD = 14.6) (see Figure 2). Comparisons between the LHD and the HC or RHD

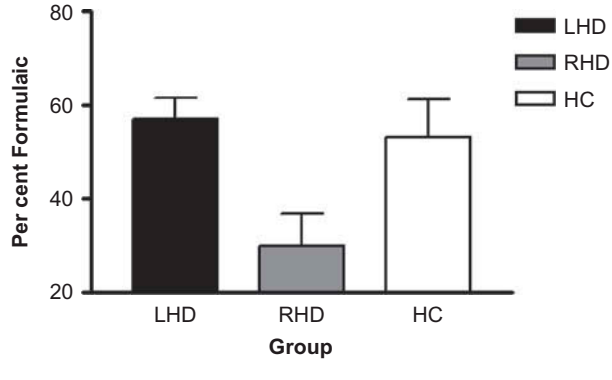

Figure 2. Proportions of repetitions that are formulaic expressions by group.

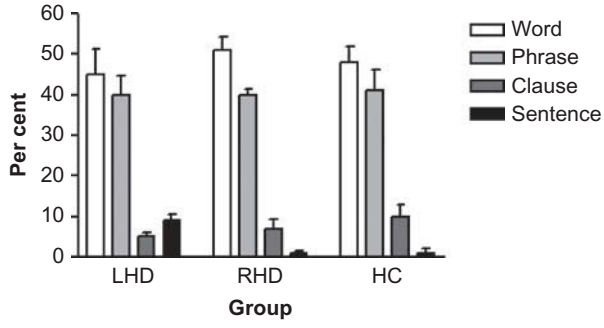

Figure 3. Functions of repetition by group.

groups did not yield statistical significance. The proportion of formulaic expressions between the RHD and LHD group differed significantly, Mann–Whitney $U = 2.0$; $p = 0.028$ (Figure 2).

Functions of repetition

Repetition to enhance form of talk occurred at 54% (SD = 13.9) in the LHD group, less frequently in the RHD (44%, SD = 17.5) and HC groups (35%, SD = 14.3). Content repetitions were used least by the LHD group (25%, SD = 10.5) and more frequently by the RHD group (41%, SD = 9.6) and HC group (40%, SD = 12.5). Although the group measures were not statistically significantly different, trends suggested that the LHD group had reduced content repetitions compared to the HC, Mann–Whitney $U = 3.5$; $p = 0.059$ and RH groups, Mann–Whitney $U = 4.0$; $p = 0.075$.

Use of repetition mainly for the purpose of socialisation occurred in the smallest proportions across groups. Measures for the the LHD group (21%, SD = 5.8), RHD group (15%, SD = 12.4), and the HC group were 25% (SD = 13.5). For our hypothesis, these results are suggestive, but the differences were not statistically significant.

Although there were no significant group differences in the percentage of repetitions for different functions, comparisons of functions within groups yielded significant results, suggesting that the groups used these functions differently. The LHD group had significantly fewer repetitions establishing socialisation than maintaining form, Wilcoxon signed-rank test $Z = -2.023$; $p = 0.04$. The RHD group had fewer repetitions establishing socialisation than conveying content, Wilcoxon signed-rank test $Z = -2.023$; $p = 0.04$. The HC group demonstrated no differences in the use of different functions in their repetitions (Figure 3).

DISCUSSION

The purpose of the present retrospective, exploratory, descriptive study was to explore verbal repetition in the discourse of LHD and RHD persons with regard to incidence, characteristics, and functions of repetition. It was hypothesised that specific parameters of repetition in discourse would vary with neurological damage.

As predicted, persons with left hemisphere damage used significantly more repetition (23%) in spontaneous discourse than the HC group (18%).The RHD subjects used proportions of repetition (19%) comparable to the HC group (18%). It is not known how verbal repetition relates to pragmatic functions usually associated with the right hemisphere. However, deficient pragmatic ability in the RHD group was evidenced by the significant differences with respect to the use of formulaic repetitions. The RHD group used a significantly smaller proportion of repetitions categorised as formulaic in their total body of repeated utterances. These findings concur with Van Lancker Sidtis and Postman (2006) and Sidtis et al. (2009), who found fewer formulaic expressions in the spontaneous speech of RHD than LBD participants.

It was also predicted that left hemisphere damage would be associated with increased use of formulaic repetitions, because research suggests that formulaic language is modulated by a right hemisphere/subcortical system (Sidtis et al., 2009; Van Lancker, 1988; Van Lancker Sidtis, 2012a, 2012b; Van Lancker Sidtis & Postman, 2006). In fact, the left hemisphere group did use the highest proportion of formulaic repetitions among their total repeated utterances (57%) and significantly more than the RHD participants (30%). These results suggest that some persons with left hemisphere damage may use repetition of formulaic expressions as a compensatory strategy for reduced ability to create novel utterances.

A suggestive observation arises from the LHD participants, who had the most repetition of "other" (13%). Even when differences in turn taking opportunity were accounted for, persons with left hemisphere damage used more repetition of other than the RHD group (3%), although differences were not significant. Differences likely resulted from limited ability of the LHD participants to generate linguistic content, while trying to maintain social interaction and flow of conversation. Repeating words of the participant is a useful strategy for maintaining conversational flow.

Functions of repetition differed with side of cerebral hemispheric damage. The LHD individuals used repetition mainly to maintain the form or flow of talk (54%), and there was a trend towards less use of repetition to enhance content. The RHD group used repetition significantly less often for socialisation (15%) than form or content. Measures in the HC speakers did not reveal differences in their use of the three functions.

Determining the characteristics that differentiate normal pragmatic repetition from pathological repetition remains a compelling question. Detailed analyses of perseveration in aphasia, viewed as abnormal repetition, have been conducted (Christman, Bousten, & Buckingham, 2004; Helm-Estabrooks, 2004; Stark, 2007). In some descriptions, perseveration gives way in stages to fluent expression (Alajouanine, 1956; Code, 2005). In studying perseveration, most studies utilise formal or semiformal speech tasks such as confrontation or generative naming or picture description, and therefore extrapolation to spontaneous speech is not straightforward (Ackermann & Ellis, 2007; Helm-Estabrooks, Ramage, Bayles, & Cruz, 1998; Moses, Sheard, & Nickels, 2007).

Persons with left hemisphere damage have been reported to use repetition effectively (Olness et al., 2010). Ghika, Bogousslavsky, Ghika-Schmid, and Regli (2004) report on two neurologically impaired persons, diagnosed with transcortical motor aphasia, whose repetitious verbalisations consisted of "echoing approval." When presented with questions, these persons replied using the same affirmative or negative responses up to 80% of the time. Another study described two persons with aphasia

who used lexical repetition as a communicative strategy (Leiwo & Klippi, 2000). One individual mainly used repetition of context-specific words, which were produced by other speakers. The second used repetition mainly of self and the lexical items repeated were less context bound and more often fillers or formulaic expressions. The researchers conclude that the variability in results between persons with similar location of injury suggests that "communicative repetitions form a continuum" leading to implications for therapy (Leiwo & Klippi, 2000, p. 223).

A few studies have examined "perseveration" in normal speech using formal tasks. Rates were about 1% of "perseverated" responses in naming and definition tasks in normal speakers (Ramage, Bayles, Helm-Estabrooks, & Cruz, 1999), rates comparable to those reported by Albert and Sandson (1986). Overall perseveration rates were higher in the "design generation" task, which more closely approximates spontaneous speech (Foldi, Helm-Estabrooks, Redfield, & Nickel, 2003). Texts obtained in the present study from persons who had suffered stroke did not contain perservations, defined as "inappropriate recurrence or uncontrolled repetition of a previously produced response—phoneme, word, syntactic structure, semantic feature, idea, and the like" (Stark, 2011, p. 135). All repetitions in these samples appeared to reflect naturalistic practices of repetition, here termed pragmatic repetition. This issue can be further explored by applying this methodology to speech samples from a larger group of persons with aphasia, including those with various kinds of verbal perseverative features, and to other varieties of language disorder, such as autism and Parkinson's disease.

In the present study, the higher proportion of repetition in the LHD group, as well as increased repetition of formulaic expressions, may be attributed to limited ability to create novel, propositional language. These findings support evidence from previous research which found repetition to be used effectively for social purposes and as a compensatory strategy (Leiwo & Klippi, 2000; Oelschlaeger & Damico, 1998; Ulatowska, Olness, Hill, Roberts, & Keebler, 2000).

SUMMARY

Differences and similarities in measures of pragmatic repetition were found in association with brain damage to left or right hemisphere. Significantly more repetitions occurred in the left hemisphere group than right hemisphere group or the HC group. All participants repeated more prototypes immediately than at a delayed or distant time; this value may differ for other normal discourse styles or neurological groups. Overall, words and phrases were repeated more than clauses and sentences; the left hemisphere group repeated significantly more sentences than the other groups. The repeated items from the left hemisphere group contained proportionally more formulaic expressions than those from the right hemisphere group. This finding is in agreement with previous studies that reported a significantly lower proportion of formulaic expressions in persons with right hemisphere damage than in left brain damage or in healthy speakers, and a higher proportion associated with left brain damage and intact right hemisphere function than either comparison group (Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006). These findings are also concordant with the dual process model of language, which associates competently produced formulaic language with intact, healthy right hemisphere functions (Van Lancker Sidtis, 2008, 2012b, in press).

Functions of repetition were allocated differently in the three groups, with the most repetition to maintain conversational form in the left hemisphere group, and significantly more repetitions to enhance content in the right hemisphere group. These results are in good accord with previous studies reporting impoverished propositional speech in left hemisphere damage compared to healthy persons or persons with right hemisphere damage (Van Lancker Sidtis, in press). Supporting the association with pragmatic abilities in the right hemisphere, the fewest repetitions for socialisation were counted for this group.

It can be further proposed that pathological repetition may be said to occur when the incidence of repetition is abnormally high and/or when one or more of the three functions of pragmatic repetition are minimally or not at all served by the repetition. Further studies are required to establish ranges and thresholds for identifying pathological repetition in various language disorders.

The purpose of this project was to demonstrate a viable method for quantifying and characterising pragmatic repetition in discourse obtained from persons with neurological impairment. This is the first such attempt, and we submit that the method can be of value in providing better understanding of a large number of language disorders, including persons diagnosed with high- and low-functioning autistic-spectrum disorder, Parkinson's and Alzheimer's disease, and psychiatric disease such as depression and schizophrenia. Close, detailed analysis of naturalistic, connected speech is notoriously labour intensive; these techniques can be adapted for computer-guided methodology. Using the quantification method, correspondence to quantification of other types of normal repetition, such as reduplication, can be made (Wang, 2005). The results on individual variables are provisional, due to the relatively small group of study participants. Further studies may reveal how distortions in proportion, formal category, and/or function of repetition reflect characteristic forms of repetition pathology in different kinds of discourse and communicative disorders.

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APPENDIX A

Discourse Sample from Healthy Control Participant

Repetitions are underscored.

Experimenter (Exp): Tell me a little about your family.

Healthy Control Participant (HCP): Well, there's the wife and I. I was married before. And I got three children. They're all married. I'm a grandfather five times. So uh I get to see them now and then.

Exp: Do they live around here?

HCP: No they live uh…they live in Ashburnham, upstate. In fact just two weeks ago I saw my daughter and my…my two grandchildren at uh Palm Sunday. Well, they're all getting along y'know. I mean they uh like I say a divorce…a divorce happened but they the kids grow up. And they're all doing fine. You know they're all…either the husband or the wife's working you know.

Exp: What kind of work do they do?

HCP: Well my son worked for the railroad. He worked for the railroad, and about six months ago had an automobile accident. And he's been, he was laid up. I don't even know if he's gone back to work yet. But uh my uh my other son-in-law he's the uh…He's building inspector for Westminster, Westminster and the surroundings towns, you know like Gardner and Athol S-Fitchburg.

Exp: Up in that area?

HCP: Yeah all up in that area. My other son-in-law…well last I know he was laid off from uh a place that shut down in Worcester. I don't even know if he's gone back to work. I don't see that one that often you know. But they'll make it. My wife uh my wife worked well my wife worked here with the home, making for better than a couple of years. And then her back started bothering her, so I told her this is about time for you to retire so she did. I've retired from General Motors. I worked for them…I worked for them thir-thirty years. I done all different kinds of work for 'em. I was foreman for nine years. In fact I went out to Ohio for 'em worked out there for six years. Then my wife didn't care for it out there so I, I gave up my foreman job there. And came back to Framingham and uh…where I put in my last seven years. And then I retired in January 1980. But it was a good relationship with General Motors. I learned a lot. It was a good college.

Exp: What kinds of things does a foreman do?

HCP: Well first of all when you uh when you run a line you have to make sure that you have all your people in. And if your people aren't in, you have uh what they call uh backup people that have to cover the jobs. Utility people we call 'em and uh that's the first thing you have to do in the morning. You have to make sure that every job is covered. And naturally you uh discipline when it's needed. You know they uh…There's times when uh they don't feel like working. And there's work that has to be done especially on assembly line. There's something has to be doneall the time otherwise we're in trouble. But uh you uh you stand to get a good relationship with your people. And they uh…they'll do a good job for you. LikeI say you treat them right they're gonna treat you right.

APPENDIX B

Discourse Sample from Participant with Right Hemisphere Damage

Repetitions are underscored.

Experimenter (Exp): Tell me a little about your family.

Right Hemisphere Participant (RHP): Well, I was born in i…in Peabody. And…and it was kind of a not too not too nice neighborhood and I guess it was a run-down area because I got pneumonia and I had to be taken out of the place and brought to my my grandfather's house where it was warmer and (logical continuation) I recuperated. And when I recuperated…then we had stayed in

Revere. We had stayed in Revere and at my grandfather's place. (Harry, go! I have a session with my therapist…) And when I recovered from the from pneumonia then we were out of Peabody. And we were we were now residents of Revere and I I I grew up.. at 330 on Revere Street which is a Italian neighborhood but being Irish, Keenan, wouldn't send me to St. Andrew's because that was an Italian church. I had to go to the other side of the tracks to the Irish were…St. Teresa's. I guess I didn't want to mix…mix…And I went to Paul Revere High School..or Paul Revere Grammar School. And…half way through grammar school my mother had a stroke and.. and.. well she got pregnant and then when she was telling my brother she had a stroke And.. it was a matter of taking care of.. my mother and and growing up at the same time. And after being.. after her being paralyzed for several years she had another se.. she had another seizure and she succumbed to it. And.. then the family broke up. I went to live with my godmother. And then…my godmother I went to live with my aunt and uncle in New York…New York I went to another uncle and aunt in California. And then the war come up..came came upon us and I guess everybody joined the and I left high school and joined the service also. And I spent I served years in the Navy as a radio operator…which was a nice a nice…can't say that it's a trade, more or less a specialty…It's…a was a good specialty…mainly because it was clean…typewriters and paper and and that kind of stuff.

Exp: When you got out of the service what kind of work did you do?

RHP: I got out of the service. I went into went into the labor force and…worked on Suffolk Downs for for a while and…and my father got me being an electrician..he being an electrician he got me in the into the electrical union and I put in a four-year apprenticeship course and went into the field of electricity.. and earned a living.. earned a good living and the time I graduated is when I had my stroke. And the day I was having my.. the day I had my stroke I was going to work in the morning…the last Friday before the weekend holiday…which I had planned to go to the White Mountains for for the weekend…and…c'est la guerre.

Exp: What kind of work did you do as an electrician?

RHP: I installed base weights and fixtures and maintained the the eq equipment… hanging fixtures…hanging lights…put in motors…wiring 'em up…firing… well firing up transformers…putting cables through pipes. I put the first light in the.. the Callahan Tunnel. You know those those long tubes? Well they go from from one box to another box. Each each fixture has a has a box on it. The next time you go through you'll see a yellow box on the end. And and there's three wires going through there in most places and what and what we ha..had to do was to get the right combination because when you throw the switch maybe you don't want them all on you just want certain sections.. maybe one group or every other group and you have to.. you have to wire 'em up accordingly. So as to make your connections you have to know what what wires you're going to put onto that that particular fixture so when they throw the switch that light will go on because you want it to go on or it won't go on if if they turn the switch off. They call them banks. If they only want 15 banks on in the tunnel like at night say from from 2 to 4 o'clock in the morning they don't want every light lit. They want cer.. certain banks

maybe every other bank on. That way it cuts down electricity. And there's still ample lighting…

APPENDIX C

Discourse Sample from Participant with Left Hemisphere Damage

Repetitions are underscored.

Experimenter (Exp): Tell me about your family.

Left Hemisphere Participant (LHP): Wanna know about my hou-my…my…people I know? I don't have any going right now.

Exp: No family at all?

LHP: No.

Exp: How about your family when you were growing up?

LHP: Nice people. I had my father, my mother and two…three brothers. Good family, good family.

Exp: And where are they now?

LHP: One brother's still in the s-one…one…one in the service. Next (unintelligible proper name) and another brother he quit…no he died. Very nice felly we got.

Exp: Right now you have a girlfriend?

LHP: I have many girls.

Exp: I thought you had one special girlfriend.

LHP: Ya. She's pretty good.

Exp: Can you tell me about her?

LHP: Oh she has a pretty good job. She works as a…This other guy down here that's sacia-socha worker. Sa-

Exp: Social worker?

LHP: No no no…

Exp: That's her job?

LHP: Ya ya, she likes it. She likes her job. She has done a lot for me while I was over here. Did very good getting me…getting me back when I needed…anything I need. I was in the service. Then I…became a truck driver.

Exp: Tell me about truck driving.

LHP: I liked it.

Exp: What did you do?

LHP: Drove everyplace.

Exp: Like where? What exactly did you do?

LHP: The big trucks…big trucks. Get em all…all over the country…all over the country. Very good job.

Exp: What kinds of things would you take?

LHP: Shoe…shoes. Ya. Shoo-foo-foos…like sh- I don't know the name of it. That's what we use all the time.

Exp: What kind of work did you do in the service?

LHP: I was a shook-no…no…I was in the…I was a driver. Yes.

Exp: What did you drive?

LHP: I used to…the truck that…behind where the…where all the airplanes went. I used to move them in and out.
Exp: Move the planes in and out?
LHP: Ya.
Exp: How would you move the planes?
LHP: From one spot to another
Exp: Did you use some kind of truck?
LHP: Ya you…oh ya you…you have a truck to do that. I don't do like a truck no. I just move that myself. You see em down…at…
Exp: the airport
LHP: Ya. Right.