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Research Article

Formulaic Language in Parkinson's Disease and Alzheimer's Disease: Complementary Effects of Subcortical and Cortical Dysfunction

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Purpose: The production of formulaic expressions (conversational speech formulas, pause fillers, idioms, and other fixed expressions) is excessive in the left hemisphere and deficient in the right hemisphere and in subcortical stroke. Speakers with Alzheimer's disease (AD), having functional basal ganglia, reveal abnormally high proportions of formulaic language. Persons with Parkinson's disease (PD), having dysfunctional basal ganglia, were predicted to show impoverished formulaic expressions in contrast to speakers with AD. This study compared participants with PD, participants with AD, and healthy control (HC) participants on protocols probing production and comprehension of formulaic expressions.

Method: Spontaneous speech samples were recorded from 16 individuals with PD, 12 individuals with AD, and 18 HC speakers. Structured tests were then administered as probes of comprehension.

Results: The PD group had lower proportions of formulaic expressions compared with the AD and HC groups. Comprehension testing yielded opposite contrasts: participants with PD showed significantly higher performance compared with participants with AD and did not differ from HC participants.

Conclusions: The finding that PD produced lower proportions of formulaic expressions compared with AD and HC supports the view that subcortical nuclei modulate the production of formulaic expressions. Contrasting results on formal testing of comprehension, whereby participants with AD performed significantly worse than participants with PD and HC participants, indicate differential effects on procedural and declarative knowledge associated with these neurological conditions.

Clinical descriptions of formulaic language in aphasic speech have flourished for more than 150 years under a wide variety of terms. *Formulaic language*, in its modern conception, consists of fixed, unitary expressions known to a language community with their characteristic form, meaning, and usage conditions. Typical examples are conversational speech formulas ("You betcha," "You've got to be kidding," and "Say what?"), expletives ("heck"), idioms ("as the crow flies," "That's the way the cookie crumbles"), proverbs ("When it rains, it pours"), and other conventionalized expressions ("all things being equal," "in the meantime," and "the long and the short of it is"; Altenberg, 1998; Biber, 2009; Kuiper, 2004; Wray, 2002). These expressions share the features of fixed or canonical form; conventionalized, often nonliteral meaning; and specific relations to discourse context.

As reviewed in Van Lancker (1973, 1975, 1994), formulaic language has its venerable beginnings in observations by J. Hughlings Jackson (1874a/1932, 1874b/1932), who labeled the preserved expressions seen in adults with language disability following left-brain damage *automatic* or *nonpropositional speech.* Examples cited by Hughlings Jackson include phrases belonging classically to the conception of formulaic expressions: "Take care," "That's a lie," "Good bye," "Oh dear," and "Bless my life." These, Hughlings Jackson (1874b/1932) maintained, "are made possible by the right side of the brain" (p. 183). Since that time, aphasiologists have invariably alluded to preserved formulaic expressions in their descriptions of aphasic speech following left-hemisphere damage. Bay (1964) isolated swearing, salutations, automatisms, and stereotyped reactions as preserved in aphasia;

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Gloning, Gloning, and Hoff (1963) referred to semiautomatic sentences of casual conversation; Critchley (1970, p. 189) enumerated examples of "holophrastic word-cluster(s) … reiterated in a stereotyped fashion"; Pick (1931) excluded sentences that are "automatic" from his speech production model; Head (1926, p. 90) identified formulaic expressions as those that are "uttered with greater ease and certainty" by persons with language disorders; Luria (1966) noted how verbal stereotypes are often retained; and Goodglass and Mayer (1958, p. 101) reported that the person with aphasia "performs most readily in an automatized or otherwise highly structured speech situation." A comment resonant with modern views of formulaic language (Van Lancker, 1988) arose from Alajouanine (1956, p. 28), who endorsed the superior effectiveness of "emotional, expletive, interjectional, automatic, and habitual language" in aphasic speech and described speech in agrammatic aphasia as halting and telegraphic with the exception of "stereotyped familiar expressions" such as "I don't know," "How are you today?" and "Oh boy" (Myerson & Goodglass, 1972, pp. 41–42).

In their study of anomia, Wepman, Bock, Jones, and Van Pelt (1956) observed that speech production in anomic aphasia is made up primarily of "the conventional formulae of language" (pp. 476–477). Espir and Rose (1970) listed nonintellectual speech, including ejaculations, expostulations, and social gestures of speech. Goldstein (1948, p. 25) repeatedly observed that emotional language and "other speech automatisms" are less impaired in aphasia. In a related viewpoint, Nespoulous, Code, Virbel, and Lecours (1998) referred to a contrast in aphasic speech between referential and modalizing verbal behavior, where modalizing behavior includes an assortment of formulaic expressions. The first formal approaches to examining formulaic expressions in aphasia were provided by Code (1982) and Blanken (1991) using surveys and by Lum and Ellis (1994) in a controlled study of production. Any clinician interacting with persons suffering from a language deficit following left-hemisphere damage has experienced a contrast between abilities for producing novel (propositional) speech and a very broad range of formulaic (overlearned) expressions. Thus, the saliency of formulaic expressions in aphasic speech has been broadly observed and well described.

It has been an ongoing interest in our laboratory to verify these anecdotal, clinical observations about the preservation of formulaic expressions in aphasia with quantitative studies in healthy speakers and speakers with language disorders, leading to a credible model of the functioning of formulaic language in the brain. We have examined the spontaneous speech of persons with left- or right-hemisphere damage following stroke to further examine Hughlings Jackson's proposal that such preserved speech relies at least in part on right-hemisphere function (see also Czopf, 1981; Graves & Landis, 1985). In an analysis of spontaneous speech from 15 individuals, the first study (Van Lancker Sidtis & Postman, 2006) reported a significantly greater proportion of formulaic speech in speakers with left-hemisphere damage than in healthy speakers, whereas individuals with right-hemisphere damage produced significantly fewer formulaic expressions than both comparison groups. Supporting a role of the right hemisphere is a description of preserved formulaic expressions in a normally developing right-handed adult who underwent left hemispherectomy for treatment of a glioma (Smith, 1966). Other case reports of left (dominant) hemispherectomies described preserved formulaic expressions, including swearing and whole phrases such as "I don't know," "Put me to bed," and "I don't want any" (Crockett & Estridge, 1951; Gott, 1973; Hillier, 1954; Zollinger, 1935).

Further clinical observations in persons with Parkinson's disease (PD; Illes, 1989) and a published report of diminished formulaic expressions following a focal stroke to the basal ganglia (Speedie, Wertman, T'air, & Heilman, 1993) led us to examine the role of subcortical structures in formulaic language production. A study of spontaneous speech obtained from case studies in our clinic supported the previous findings: Proportions of formulaic expressions were elevated following left-hemisphere focal lesions and significantly impoverished in right-hemisphere focal lesions, and, as a new discovery, diminished proportions of formulaic expressions were associated with focal subcortical damage (Sidtis, Canterucci, & Katsnelson, 2009; Van Lancker Sidtis, Cameron, & Sidtis, 2012). Other clinical studies lend indirect support to a role of subcortical structures in the production of formulaic expressions (Van Lancker, Bogen, & Canter, 1983; Van Lancker Sidtis, McIntosh, & Grafton, 2003). These converging findings led to a brain model describing formulaic language as modulated by a right hemisphere and a subcortical system.

Implied in this perspective is the notion that formulaic and novel language depend on differentiated mental and cerebral processes. Numerous studies point consistently to this conclusion. Evidence from surveys (Gibbs, 1980; Hallin & Van Lancker Sidtis, 2014; Reuterskiöld & Van Lancker Sidtis, 2013; Van Lancker Sidtis, Kougentakis, Cameron, Falconer, & Sidtis, 2012; Van Lancker Sidtis & Rallon, 2004; Yang, Ahn, & Van Lancker Sidtis, 2014) confirms that people know formulaic expressions in their shape and meaning and can identify them as such, distinguishing them from (matched) novel expressions. Early studies revealed differences in pronunciation and perception between matched novel and formulaic exemplars (Lieberman, 1963; Van Lancker, Canter, & Terbeek, 1981). A study investigating the intelligibility of formulaic and matched novel utterances in a condition of masked auditory presentation revealed significantly higher transcription performance for formulaic expressions, further substantiating the claim that these are stored as unitary expressions (Rammell, Pisoni, & Van Lancker Sidtis, 2014).

The unique structural characteristics of various kinds of formulaic expressions have been revealed through a body of linguistic, sociolinguistic, and psycholinguistic endeavors that is too large to review extensively here (studies of healthy speakers include those by Bell & Healey, 1992; Cowie, 1992; Cutting & Bock, 1997; Gibbs, 1980; Nunberg, Sag, & Wasow, 1994; Schmitt & Carter, 2004; Tannen, 1989; and Tannen & Öztek, 1981; for review, see Van Lancker

Sidtis, 2004, 2008). Numerous analyses of large written and spoken corpora have sought to identify and categorize formulaic expressions in normal language use (Aijmer, 1996; Altenberg, 1998; Fellbaum, 2007; Moon, 1998a, 1998b; Sinclair, 1987). Following James (1895), Bousfield (1953), and Miller (1956), Simon's (1974) article described memorial "chunks" as units of processing: When people are asked to remember and recall a spoken list of items, the number of recallable items—or chunks—is nearly the same for syllables, words, compound words, and idiomatic phrases. Psychological studies reveal reliable performance differences between formulaic and novel exemplars, attesting to the holistic structure of the formulaic expressions in the speaker's competence as contrasted with compositional processing of matched novel expressions (Conklin & Schmitt, 2008; Horowitz & Manelis, 1973; Jiang & Nekrasova, 2007; Libben & Titone, 2008; Osgood & Housain, 1974; Pickens & Pollio, 1979; Swinney & Cutler, 1979). These studies are supported in the visual mode by results demonstrating the significant perceptual effects of processing known holistic configurations in contrast to constituent details (Poljac, de-Wit, & Wagemans, 2012; Pomerantz, 1986; Pomerantz, Sager, & Stoever, 1977).

Thus, there is ample evidence that these contrasting modes—formulaic and novel—are distinguished by different properties in language competence. Most expressions are newly created according to grammatical rules accessing a mental lexicon; this can be called the *novel* or *combinatorial mode,* whereby an utterance is produced or perceived according to the open choice principle (Erman & Warren, 2000; Sinclair, 1991, pp. 109–115). Formulaic expressions, on at least some level of mental representation (see Sprenger, 2003), are unitary and known (Sprenger, Levelt, & Kempen, 2006) and conform, using the duality mentioned in the literature (Pawley & Syder, 1983), to the idiom principle. Linguists Jespersen (1933), Bolinger (1964, 1976, 1977), De Saussure (1968), Lyons (1968), and Weinreich (1969) and psychologist Lounsbury (1963) made this same distinction. Formulaic expressions typically have a stereotyped form, a conventionalized meaning (often beyond the direct lexical meaning), and an appropriate context (with requirements for register, function, and usage), all of which are known to native speakers of a language (Fillmore, 1979; Kuiper, 2007).[1] Formulaic language serves a range of communicative purposes, including allowing processing time during fluent speech, bonding, humor, deflection from conflict, and identification with others (Bell & Healey, 1992; Fillmore, 1979; Kuiper, 2004; Nespoulous et al., 1998; Oppenheim, 2000; Schmitt & Carter, 2004; Wray & Perkins, 2000).

We consider these perspectives to be of crucial importance to the evaluation and treatment of persons with speech and language disorders. In our studies of normal use of formulaic expressions, we have quantified incidence in spontaneous speech corpora obtained from 28 healthy, native American English–speaking adults of different ages, yielding an average proportion of 23.8% of words in formulaic expressions across spoken discourse samples in five studies (Bridges & Van Lancker Sidtis, 2013; Bridges, Van Lancker Sidtis, & Sidtis, 2013; Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006; Van Lancker Sidtis & Rallon, 2004). Other estimates of the proportion of formulaic language in normal usage range from 21% to 80% depending on style and type of discourse as well as formulaic categories selected for analysis (Biber, Johansson, Leech, Conrad, & Finegan, 1999; Erman & Warren, 2000; Foster, 2001; Hill, 2001; Howarth, 1998; Oppenheim, 2000; Sorhus, 1977; Van Lancker Sidtis, 2010). Formulaic expressions are important to clinical work because they make up a large part of language use, with estimates of total counts of expressions speculated to be between 100,000 and 300,000 available to the language user (Jackendoff, 1995; Kuiper, 2009). Given this significant presence in natural speech, an understanding of mental and neurological processing of formulaic language is of high importance to language evaluation and rehabilitation.

This study examined two hypotheses. First, it was predicted that persons with damage to subcortical structures would have diminished proportions of formulaic expressions in their spontaneous speech when compared with healthy speakers. This hypothesis was tested by examining naturalistic speech samples obtained from persons with a diagnosis of PD, which is characterized by dysfunctional basal ganglia. A corollary prediction related to this hypothesis was that subcortical disability affects production and not comprehension or knowledge of formulaic expressions. The second hypothesis stated that persons with cortical dysfunction pursuant to a diagnosis of probable Alzheimer's disease (AD) would reveal the converse picture: abundant production of formulaic expressions coupled with deficient meaning comprehension. That is, the second hypothesis predicted that persons with cortical damage would have elevated proportions of formulaic expressions in their spontaneous speech when compared with healthy speakers but that relative failures of recognition and comprehension would emerge. This hypothesis was based on the fact that the basal ganglia are intact far into the progression of AD alongside deteriorating cortical structures.

Method

Participants

All studies were performed on native speakers of American English, which we define as having spoken English since infancy, having at least one native English-speaking parent (usually both parents) in the home, and having been educated since preschool in the United States. All participants had hearing and vision (with corrective lenses) within normal limits by self-report. Sixteen persons diagnosed with idiopathic PD (six women, 10 men) with a mean age of 66.7 years (range = 46–81 years) and a mean

[1]Many formulaic phrases have a specific prosodic and phonetic shape as well as a unique vocal quality, as in the phrase "fuhgeddaboudit," as derived from "forget about it" (Ashby, 2006; Hallin & Van Lancker Sidtis, 2014; Lin, 2010; Van Lancker Sidtis, 2006).

of 16.7 years of education (range = 12–21 years) were recruited, consented, and were tested following institutional review board procedures. All were right handed except for one participant of unknown handedness. Mean time after onset of diagnosis was 8.1 years (range = 1–19 years).

Twelve persons (nine women, three men) diagnosed with probable AD, all right handed, with a mean age of 77.9 years (range = 57–90 years) and a mean of 14.2 years of education (range = 11–18 years) were recruited, consented, and were tested following institutional review board procedures. Time since diagnosis was obtained for five of the AD group participants; the mean was 5.4 years (range = 2–12 years). Participants were recruited into the present study from a larger pool of individuals who underwent assessment of memory and cognitive status through the Memory Education and Research Initiative (founded and managed by J. J. S.) at the Nathan Kline Institute. Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) scores were recorded for nine participants in the AD group; the mean score was 21.8 (range = 16–28). All individuals in the PD and AD groups were diagnosed by a neurologist and evaluated by a licensed neuropsychologist (J. J. S.) and were receiving ongoing care. Extensive screening during the intake procedures ruled out any other neurological or health conditions pertinent to the study goals.

Eighteen individuals (12 women, six men) with a mean age of 69.6 years (range = 50–83 years) served as the healthy control (HC) comparison group. Years of education were recorded for all but one participant, yielding a mean of 15.4 years of education (range = 12–20 years). All but two participants were right handed, and, following extensive screening regarding their background, none reported previous neurological or psychiatric conditions.

Some participants were seen at the Nathan Kline Institute. For participants with limited transportation options, the examiners visited their place of residence or other location that was quiet and convenient. All sessions were completed in one or two visit(s) and were recorded using a Shure (Niles, IL) headheld microphone. Responses were also recorded on a Marantz (Kanagawa, Japan) Professional CD recorder and a Marantz digital recorder to ensure that primary and backup recordings were obtained.

Materials and Procedure

Assessment of Cognitive Status

Considering that a key characteristic of formulaic expressions is familiarity in the form of personal relevance, a specialized research protocol was designed to probe recognition of personal familiarity for another kind of stimuli: the Famous Names and Faces Test (FaNFaT; Van Lancker, 1995), which was given to all participants. Processing personally relevant information is a neuropsychological function that is lost in agnosias and other neurological disorders (Cummings, 1993; Cutting, 1990; Van Lancker, 1991). Also, in order to assess cognitive status of the study participants, subtests of the Arizona Battery for Communication Disorders of Dementia (ABCD-2; Bayless & Tomoeda, 1993), a standardized protocol for dementia, were administered. Published normative data accompanying the ABCD-2 were used to assess cognitive status of the participants. The ABCD-2 was conducted only on PD and AD groups.

FaNFaT

The FaNFaT was used as an additional measure to test the parameter of personal familiarity as well as visual acuity. Target items were selected following familiarity ratings by 70 healthy individuals ages 55 years and older (Drake, Van Lancker, & Pachana, 1997). Twenty-four names of prominent personalities in sports, entertainment, politics, or the media were spoken by the examiner, and participants were instructed to point to the correct facial photograph among a set of four possible responses. For example, the examiner said "Audrey Hepburn," and the participant pointed correctly to the corresponding picture on the lower left quadrant (see Figure 1). In addition, participants provided a confidence rating for each trial on a scale of 0 to 4 (0 = *no idea,* 1 = *not sure,* 2 = *reasonably sure,* 3 = *very sure,* and 4 = *absolutely sure*; see Figure 1).

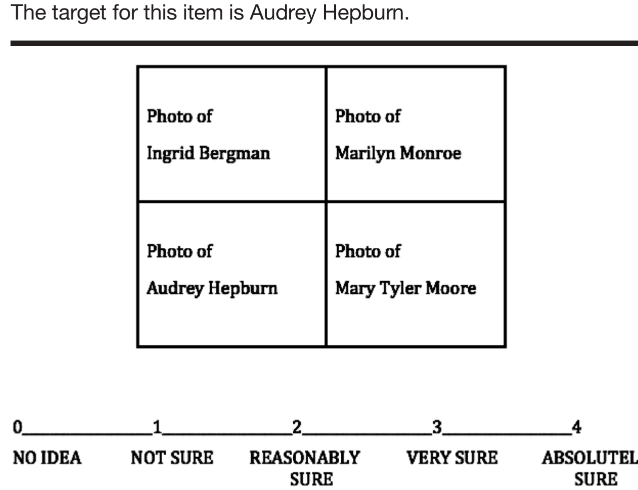
Scores reflected percentage accuracies in name and picture matching as well as average confidence ratings. The FaNFaT measured the familiarity parameter in the visual mode.

Portions of ABCD-2

Four subtests (Story Retelling, Comparative Questions, Repetition, and Generative Naming Semantic Category) from ABCD-2 were selected to probe cognitive functioning in individuals in the AD and PD groups. These results, referencing published normative data from the ABCD-2, provided adjunctive measures of the speech and language competency of participants in the two study groups.

The Story Retelling subtest required participants to immediately retell a short story read by the examiner,

Figure 1. Famous Names and Faces Test (FaNFaT) response card (copies of photos appear in the protocol) and certainty rating scale. In the FaNFaT, participants match a face to a spoken famous name and indicate certainty by pointing to a number on the scale. The target for this item is Audrey Hepburn.



including 17 information units. For each information unit, the participant received 1 point. A percentage correct was calculated and compared to norms provided by the ABCD-2 examiner's manual.

The Comparative Questions subtest involved answering logic-based yes–no questions comparing two items. For example, the participant would be asked a question of this format: "Is X -er than Y?" The participant was presented with six comparative questions, for which percentage accuracy was calculated.

The Repetition subtest required participants to immediately repeat five phrases of six syllables and five sentences of nine syllables. All items used real words combined grammatically but without any semantic meaning. For example, a practice trial of this subtest included a phrase with a semantically incoherent sequence in a form such as "gerund noun noun." Accuracy of repetitions was based on the number of syllables correctly repeated, with a maximum possible score of 75. Percentage accuracy of individual scores were then calculated.

Last, in the Generative Naming Semantic Category subtest, participants produced names of as many items as possible in a specific semantic category (e.g., animals) within 1 min. Scores were based on the number of items generated in the time allowed.

Structured Conversation

A structured interview in which the examiner followed a script of topics (see the Appendix) was used to elicit speech samples from participants. The examiner asked open-ended questions such as "Could you tell me a little bit about yourself?" and "What do you remember most about your days in high school?" The examiner followed this structure and content to maintain consistency across all conversations. The participants were all asked to answer freely and as naturally as possible. Responses were audio recorded without any time restrictions, and the interviews typically lasted 8 to 12 min. Speech samples were then transcribed by two native English-speaking trained research assistants. Any differences in transcriptions were mediated by a third member of the research team. Upon obtaining a total word count of the participants' responses, two other raters—also native speakers of American English—identified all formulaic utterances within each transcription, and all differences in categorization were systematically discussed and agreed upon by both raters. Formulaic expressions were identified by native speakers from knowledge and intuition, and selections were verified using formal and functional criteria as previously described in detail (Van Lancker Sidtis & Rallon, 2004). Formulaic language was identified and categorized into six categories: conversational speech formulas ("Nice to see you again"), conventional expressions ("as it were"), pause fillers ("like," "ya know"), discourse elements ("well," "so"), sentence stems ("I guess"), and idioms and proverbs. For this study, categories were collapsed. Proportion of words in formulaic expressions was obtained by dividing the total number of words in formulaic expressions by the number of words in the speech sample for each participant.

Formula Utterance Completion

Midway through the structured interview, the examiner asked participants to "remember some old sayings," during which the examiner said the first part and the participant was prompted to complete the last one or two words of the formulaic expression. For instance, the examiner said "Footloose and …" and the participant replied with "… fancy free." Ten familiar sayings were introduced to the participants in this manner, and participant responses were recorded. Scoring criteria for this task utilized a 2-point scale in which no or incorrect responses received 0 points, a partially correct response was given 1 point, and a correct response received the full 2 points. The appropriateness and accuracy of all responses were judged by two raters with 100% agreement.

Elicitation of Formulaic Expressions

Following the sentence completion session, the participant was verbally introduced to situational contexts to elicit formulaic expressions. For example, the participant was asked, "What would you say if you stepped on someone's toe in an elevator?" The examiner offered 12 social situations, and responses were recorded and evaluated for appropriateness and accuracy, again based on a 2-point scale in which no or incorrect responses received 0 points, a partially correct response was given 1 point, and a correct response received the full 2 points. The appropriateness and accuracy of all responses were judged by two raters, and any differences in scoring were systematically discussed and resolved, achieving 100% agreement.

Northridge Evaluation of Formulas, Idioms and Proverbs in Social Situations

The Northridge Evaluation of Formulas, Idioms and Proverbs in Social Situations (NEFIPSS; Hall, 1996)[2] evaluates recognition and comprehension of formulaic expressions given a specific social context using two different versions: A–Sentence Completion and B–Multiple Choice. In version A (Sentence Completion), the participant listened to the examiner's verbal presentation of each social situation and was prompted to complete the longer formulaic expression. For example:

> 5. Mary sees an old man standing on his head with a lampshade over his feet. Mary would probably say, "That's the darnedest _______ _______ _______ _______."

The expected response is "thing I've ever seen." Participants were permitted to follow the written version of the stimulus presentation. In version B (Multiple Choice), the participant listened to the same social situations introduced in version A but was asked to choose the correct verbal expression from a selection of five, as shown below:

> 5. Mary sees an old man standing on his head with a lampshade over his feet. Mary would probably say …

[2]Examples from NEFIPSS reprinted with permission of the author.

a. “I have seen lots of these before.”
b. “That’s a darling ring and very clean.”
c. “You think you’re ready to go, don’t you?”
d. “That’s the darnedest thing I’ve ever seen.”
e. “The lampshade on his head is two feet off the floor.”

The correct response is *d*. Participants completed version A first so that performance in sentence completion was not informed by the recognition task required by version B. To reduce a practice effect, version B was presented after other testing intervened. Scores were obtained by calculating percentage accuracy and were used for between-groups comparisons.

Formulaic and Novel Language Comprehension Test

The Formulaic and Novel Language Comprehension Test (FANL-C; Kempler & Van Lancker, 1996) was conducted to evaluate comprehension of formulaic versus novel language. Participants were shown four different line drawings, instructed to listen to the examiner’s verbal utterance of either a formulaic expression or a novel expression, and asked to identify which of the four drawings best represented the expression spoken by the examiner. Two practice trials were given for both formulaic expressions and novel expressions before beginning each section of 20 formulaic utterances and 20 novel expressions. The correct answers were provided and explained during the practice session. A percentage accuracy was obtained for formulaic and novel subtests and was utilized for within-group and between-groups comparisons.

Results

Demographic Description

Age and education comparisons for the three groups revealed a significant difference in age between the HC and AD groups and between the PD and AD groups but not between the PD and HC groups (see Table 1). For education, the PD and AD groups differed significantly, with the PD group having a higher mean education. As the study utilized conversational data and recognition of well-known formulaic expression, these age and education differences were not held to present threats to validity in the study design.

Tests of Cognitive Ability: ABCD-2

Subtests of the ABCD-2 related to language were administered to participants with AD and participants with PD. As seen in Table 2, raw scores obtained from the individuals with PD were 13.4 (out of 17 points) for Story Retelling, 5.8 (out of 6 points) for Comparative Questions, and 67.1 (out of 75 points) for Repetition, and a mean of 10.5 words were produced on the Generative Naming Semantic Category subtest. Using these outcomes, the assessed individuals with PD fell within the “nondemented” category based on the norms provided, whereas all participants in the AD study group were classified as having mild AD.

FaNFaT

The FaNFaT revealed significant differences between the AD group and the other two groups—AD versus HC: recognition, $t(25) = 4.882$, $p < .001$, confidence ratings, $t(24) = 3.085$, $p = .005$; AD versus PD: recognition, $t(24) = 4.305$, $p < .001$, confidence ratings, $t(23) = 2.945$, $p = .007$—but no differences were found between PD and HC groups on either measure. Consistent with the diagnosis of dementia, participants with AD had reduced performance on famous-face recognition (61% correct) and lower confidence scores (2.5) compared with the other two groups (HC: 90% correct, confidence = 3.4; PD: 88% correct, confidence = 3.3). Poorer performance in the AD group could be due to reduced visual spatial ability, diminished cognitive resources, and/or a diminution of the familiarity sense (Mendez, Martin, Smyth, & Whitehouse, 1992). Memory deficits may also contribute to lower performance, but this is less likely because the famous faces were of long-term cultural prominence, and memory problems in mild AD tend to involve more recent memory.

Structured Conversation

From transcribed structured conversations, formulaic expressions were identified in order to determine numbers of words in formulaic expressions. The dependent variable in this measure was proportion of words in formulaic expressions out of the total spoken corpus for each speaker. For this measure, speakers in the AD group had a significantly greater proportion of words in formulaic expressions (see Figure 2) (31.4%) compared with speakers in the HC group (23.9%) and those in the PD group (15.7%; see Figure 3).

Table 1. Age and education (in years) of participants with Parkinson’s disease (PD), participants with Alzheimer’s disease (AD), and healthy controls (HC).

Group	*n*	Mean age (range)	Mean education (range)	Mini-Mental State Examination range	Mean TSD (range)
PD	16	66.7 (46–81)	16.68 (12–21)		8.9 (3–19)
AD	12	77.9 (57–90)	14.50 (12–18)	16–28	
HC	18	69.6 (50–83)	15.40 (12–20)		

Note. TSD = time since diagnosis. Significant differences were found for age: HC group versus AD group, $t(28) = -2.751$, $p = .01$; PD group versus AD group, $t(26) = -3.356$, $p = .002$. Significant differences were also found for education: PD group versus AD group, $t(27) = -2.267$, $p = .032$.

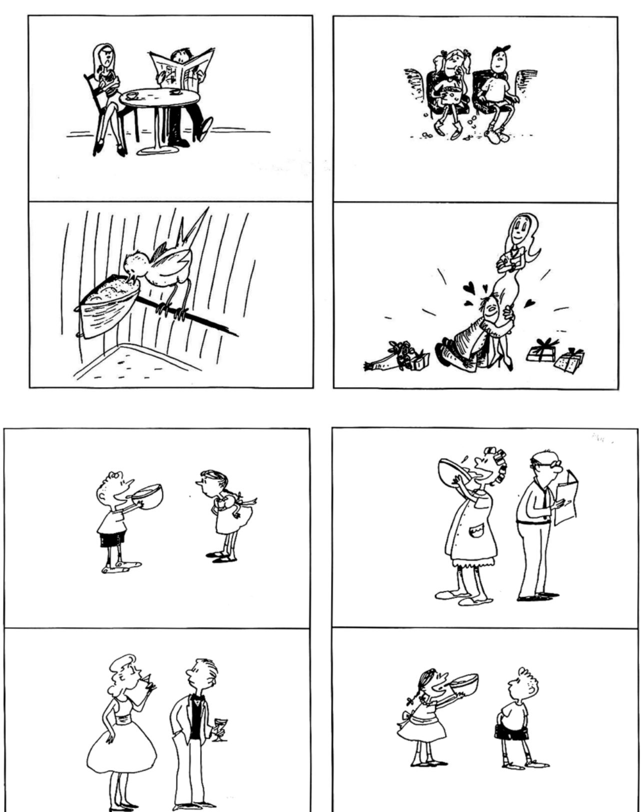
Table 2. Results from preliminary testing using four subtests from the Arizona Battery for Communication Disorders of Dementia in participants with Parkinson's disease (PD) and participants with Alzheimer's disease (AD).

Subtest	Group	Raw score (*SD*)	Classification
Story Retelling—Immediate (17 points possible)	PD	13.38 (2.2)	Nondemented PD
	AD	7.22 (4.2)	Mild AD
Comparative Questions (6 points possible)	PD	5.75 (0.5)	Nondemented PD
	AD	5.22 (1.1)	Mild AD
Repetition (75 points possible)	PD	67.13 (21.6)	Nondemented PD
	AD	56.29 (14.5)	Mild AD
Generative Naming Semantic Category (number in 1 min)	PD	10.50 (7.7)	Nondemented PD
	AD	7.44 (3.9)	Mild AD

Formula Utterance Completion and Elicitation of Formulaic Expressions

Results were obtained on the utterance completion (one or two words) and spontaneous elicitation portions of the interview. On the utterance completion task, HC achieved scores of 91% correct, participants with PD achieved 95% correct, and participants with AD achieved 62% correct (see Figure 4). For the elicitation task, HC achieved scores of 76% correct, participants with PD achieved 63% correct, and participants with AD achieved 62% correct. A mixed-design analysis of variance comparing task (completion vs. elicited) and group (HC, PD, AD) revealed a significant main effect of task ($F = 25.934$, $df = 1$, $p = .001$) and a significant group by task interaction ($F = 7.964$, $df = 2$, $p = .001$). Independent-samples *t* tests compared performance by the groups (see Figure 4). On the completion task, the HC and PD groups did not differ, but the AD group differed significantly from both the PD and the HC groups. A different profile emerged for the elicitation task: Scores for PD group differed significantly from scores for the HC group, but scores for the AD group did not reach significance for either of the other groups.

Figure 2. An example of a response sheet for the Formulaic and Novel Language Comprehension protocol (Kempler & Van Lancker, 1996), which tests comprehension of formulaic and matched novel expressions. Targets for this item are "She has him eating out of her hand" (top; formulaic expression) and "He sees her drinking from a bowl" (bottom; novel expression).



NEFIPSS

NEFIPSS provides brief scenarios and asks participants first to verbally complete an expression appropriate to the occasion (sentence completion task) and then, at a later time, to choose one of five expressions that best fits the social setting (multiple-choice task). This protocol was used to further examine competence for formulaic language, comparing AD, PD, and HC speakers. Participants with PD did not differ significantly from HC participants in

Figure 3. Proportion of words in formulaic expressions (FEs) in three discourse corpora obtained from a structured interview with three participant groups: healthy controls (HC), speakers with Alzheimer's disease (AD), and speakers with Parkinson's disease (PD). Significant differences were found between groups: AD versus HC, $t(25) = -2.353$, $p = .027$; AD versus PD, $t(23) = -4.919$, $p < .0001$; and PD versus HC, $t(30) = 3.821$, $p = .001$.

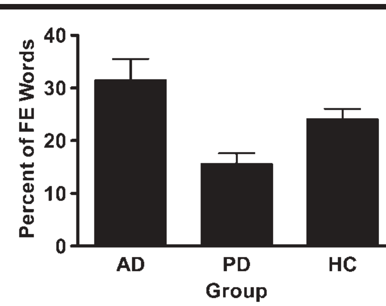


Figure 4. Elicitation and utterance completion obtained during a structured interview with three participant groups: healthy controls (HC), speakers with Alzheimer's disease (AD), and speakers with Parkinson's disease (PD). There were significant comparisons for the completion task—AD versus PD, $t(23) = 4.947$, $p < .001$; AD versus HC, $t(26) = 3.983$, $p < .0001$—and for the elicitation task—PD versus HC, $t(31) = 2.215$, $p = .03$.

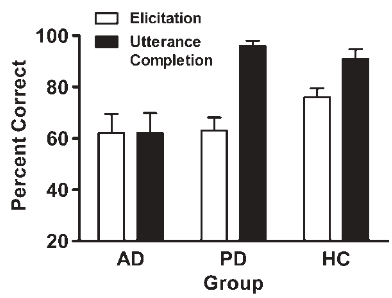
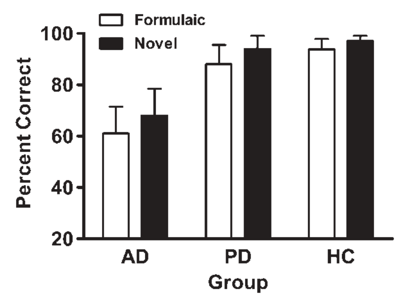


Figure 6. Formulaic and Novel Language Comprehension performance on novel and formulaic expressions in three participant groups: healthy controls (HC), speakers with Alzheimer's disease (AD), and speakers with Parkinson's disease (PD). HC versus AD on formulaic subtest, $t(28) = 5.491$, $p < .001$; HC versus AD on novel subtest, $t(27) = 4.357$, $p < .001$; PD versus AD on formulaic subtest, $t(26) = 4.176$, $p < .001$; PD versus AD on novel subtest, $t(26) = 3.423$, $p = .002$.



either the sentence completion or the multiple-choice tasks. In contrast, participants with AD differed significantly from both other groups on both tasks (see Figure 5).

FANL-C

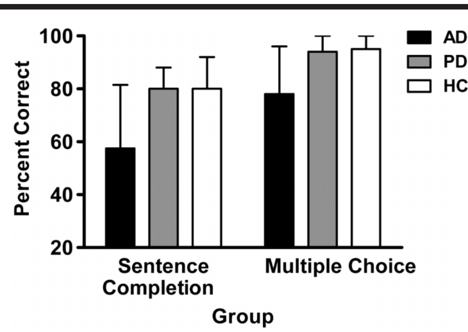
Results on the FANL-C (see Figure 6) were as follows: The PD group did not differ from the HC group on either the formulaic or the novel subtests. The HC group differed significantly from the AD group on both the formulaic and the novel subtests. The PD and AD groups also differed from each other on both subtests. Overall, the AD group made more errors than the other two groups.

Discussion

Demographic and Diagnostic Considerations

The AD group was significantly older and had more years of education than the other study groups. This was not understood to hold the possibility of a meaningful effect on the results. Tests of cognitive function in the AD group indicated a diminished ability to recognize famous faces when given the names of the people pictured, but performance was significantly better than chance (25%). Reduced performance in participants with AD likely reflects deficient face recognition (Roudier et al., 1998), diminished cognitive resources, and/or a diminution of the familiarity sense (Mendez et al., 1992). This difficulty presents often as the individual with AD loses the ability to recognize family members and other acquaintances. Results on the ABCD-2, a test of dementia, revealed cognitive impairment consistent with the diagnosis of dementia in the AD group but not the PD group.

Figure 5. Results from the Northridge Evaluation of Formulas, Idioms and Proverbs in Social Situations for sentence completion and multiple-choice tasks for three participant groups: healthy controls (HC), speakers with Alzheimer's disease (AD), and speakers with Parkinson's disease (PD). Significant differences were found for sentence completion—AD versus HC, $t(26) = 3.448$, $p = .002$; AD versus PD, $t(24) = 3.572$, $p = .002$—and for multiple-choice tasks—AD versus HC, $t(24) = 3.779$, $p = .002$; AD versus PD, $t(21) = 3.138$, $p = .005$.



Measures

The goal of this study was to continue probing the effects of brain dysfunction on performance of formulaic language. Formulaic expressions constitute about one fourth of natural discourse, implying importance for clinical evaluation and remediation of communicative disorders. Previous studies found that left-hemisphere damage was associated with increased proportions of formulaic language, whereas right-hemisphere and subcortical damage was associated with a significant decrease in formulaic language (Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006). In this study, abilities for use and comprehension of formulaic expressions were examined using measures obtained from spontaneous speech and formal testing in persons diagnosed with AD and PD and in HC participants. Previous measures from our laboratory identified an excess of formulaic expressions in persons with AD (Bridges & Van Lancker Sidtis, 2013) as well as impaired formulaic and recited speech in persons with PD (Bridges et al., 2013; Rogers, Sidtis, & Sidtis, 2009). Published results indicated a relative impoverishment of formulaic language in association with diffuse (Illes, 1989) and focal (Sidtis et al., 2009; Speedie et al., 1993) subcortical damage.

For this study, participants with AD and participants with PD were compared with matched HC participants. The prediction was that speakers with AD and speakers with PD would demonstrate contrasting performance on measures of formulaic language. We further predicted a double dissociation with respect to production and comprehension modes. Our hypotheses were derived from a model of brain function in which normal production of formulaic expressions is associated with intact basal ganglia and in which storage and retrieval of the expressions are cortically modulated, with important contribution by the cortical right hemisphere. Speakers with AD retain relatively intact basal ganglia until late in their progressing dementia but suffer from lateral and posterior cortical disorder; conversely, persons with PD suffer from dysfunctional basal ganglia but retain relatively intact cognitive function normally mediated by cortical areas.

For spontaneous speech, both hypotheses were supported by our results. The PD group produced a significantly lower proportion of formulaic utterances than the AD or HC groups, and the AD group produced a significantly higher proportion of formulaic utterances than both the PD and HC groups. Overuse of formulaic expressions, especially of conversational speech formulas, may contribute to the description of empty speech in AD speakers (Nicholas, Obler, Albert, & Helm-Estabrooks, 1985). In contrast, a subjective impression of terseness in conversation with PD speakers may be attributed in part to paucity of formulaic expressions.

These findings support a model proposing a role of the basal ganglia in the production of formulaic expressions (Van Lancker & Cummings, 1999). Characterizations of basal ganglia function refer to a distinctive capacity for overlearned and procedural behaviors (Graybiel, 1998; Marsden, 1982; Mishkin, Malamut, & Bachevalier, 1984; Saint-Cyr, Taylor, & Nicholson, 1995). Difficulties with initiating and producing organized or configured sequences have been reported in PD (Beneke, Rothwell, Dick, Day, & Marsden, 1987; Burleigh, Norak, Nutt, & Obeso, 1997; Georgiou et al., 1993; Weiss, Stelmach, & Hefter, 1997). Formulaic expressions are fixed, unitary forms and are likely produced in a routinized manner as whole vocal gestures or phonological units (Lin, 2010), implying compatibility with subcortical processing. In contrast, comprehension and recognition requires processing related to episodic and declarative memory (Ullman, 2004).

Results comparing formulaic utterance completion and spontaneous elicitation indicated poor performance on both tasks by the AD group. Likewise, a specific comprehension deficit in AD can be inferred from the performance of the AD group on both of the NEFIPSS protocols (Sentence Completion and Multiple Choice). Participants with PD performed nearly as well as the HC participants on both tasks. For the AD group, comprehension deficits were seen in performance on the FANL-C, which requires participants to match a picture to a formulaic or novel expression. The AD group performed significantly worse on both the formulaic and the novel utterance subtests, reflecting the cognitively impaired status of that group. Participants with PD performed as well as the HC participants on this comprehension task. These results are compatible with a view of defective storage and comprehension of formulaic expressions in association with cortical dementia but not subcortical impairment. Previous studies identified a selective deficit for comprehension of idioms and proverbs even in the earliest stages of AD diagnosis confirmed by biopsy (Kempler, Van Lancker, & Read, 1988).

Participants with PD performed worse than the HC participants on the spontaneous elicitation task but not on the utterance completion task or other tasks of formulaic language recognition or comprehension. Spontaneous elicitation requires initiation and full planning of a motor speech gesture, whereas the task of utterance completion provides a model of the expected response. Previous work has indicated an effect of task, whether spontaneous or performed following an external model, on motor and speech gestures (Kempler & Van Lancker, 2002; Sidtis, Rogers, Godier, Tagliati, & Sidtis, 2010). In contexts where participants must initiate, program, and plan a gesture—whether of gait, arm, or speech—performance is measurably worse than in contexts where a model, exemplar, guideline, or aid to the gesture is provided (e.g., Burleigh et al., 1997; Georgiou et al., 1993; Weiss et al., 1997). The sentence completion format facilitates initiation and provides an exemplar, whereas elicitation requires full initiation, planning, and execution.

Limitations of the Study and Clinical Implications

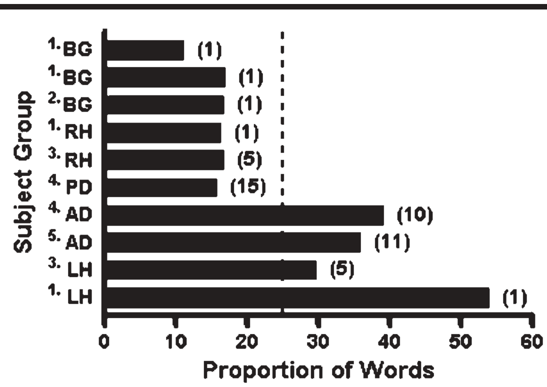
Limitations of this study include the selective scope of formulaic expressions and the challenge of formal testing to probe pragmatic function. In clinical evaluation, speech production may be found to consist of too many or too few formulaic expressions or of distortions of formulaic expressions. In treatment, use of preserved formulaic language competence may provide a major assist in rehabilitation (Stahl, 2014); poverty of such expressions should be rehabilitated to restore or enhance communicative competence. When properly examined and described, preservation, overuse, or deficient proportions of formulaic language can be seen to contribute to a medical diagnosis. Evaluation of language disorders is better informed when the distinction between competence in formulaic expressions and competence in novel expressions is considered. Rehabilitative treatment will proceed differently in approaching these disparate types of language ability. Because formulaic expressions are known to the native speaker (and novel expressions, by definition, are not), they can be used to facilitate language recovery. A recent study has demonstrated the efficacy of formulaic expressions in rehabilitating persons with severe aphasia (Stahl, Kotz, Henseler, Turner, & Geyer, 2011). It is useful to the clinician and significant others to recognize whether recovery of language following brain injury consists primarily of formulaic expressions or also includes the return of novel, grammatical language.

A Model

The unique properties of formulaic language are well accounted for by the proposal of a dual-process model of language (Heine, Kuteva, & Kalterböck, 2014; Hughlings Jackson, 1874a/1932, 1874b/1932; Van Lancker Sidtis, 2011, 2014; Wray & Perkins, 2000). In this model, formulaic expressions and novel expressions differ in how they are stored, processed, and learned. They serve an array of purposes and functions in communication (see Wray & Perkins, 2000). The more recent hybrid model suggests that formulaic expressions have at least two kinds (or "levels") of representations—one in holistic profile and another in compositional form (Sprenger et al., 2006). All of these perspectives agree that formulaic expressions differ in key characteristics from newly created grammatical expressions (Erman & Warren, 2000; Lounsbury, 1963; Wray, 2002) and that one of these characteristics is a Gestalt or holistic profile of the expression, or unitary representation in memory (Biber, 2009; Bolinger, 1976, 1977; Kuiper, 2009; Kuiper, Van Egmond, Kempen, & Sprenger, 2007; Rammell et al., 2014). The evidence reviewed above suggests that brain damage affects these two modes of language differently. This study provides further evidence that is consistent with a model of formulaic and novel language processing in the brain. The model proposes that formulaic language, having characteristics that set it apart from grammatical language, is modulated in important ways by right-hemisphere and subcortical systems.

The implications of this model for the evaluation and treatment of speech and language disorders following brain damage or developmental disorders are far reaching (Van Lancker Sidtis, 2012). Formulaic expressions constitute, on average, approximately 25% of speech in normal daily interaction, as measured in the spontaneous speech of normal speakers (Bridges & Van Lancker Sidtis, 2013; Sidtis et al., 2009; Van Lancker Sidtis & Postman, 2006; Van Lancker Sidtis & Rallon, 2004; Wolf, Van Lancker Sidtis, & Sidtis, 2014; see Figure 7). Too many or too few formulaic expressions, relative to normal measures, can be expected to affect communicative function.

Figure 7. Proportions of words in formulaic expressions in five populations, examined as single cases or groups, are given on the abscissa. Number of participants for each study is indicated in parentheses after bars. Populations are as follows: basal ganglia, focal subcortical lesions (BG); focal right-hemisphere damage (RH); Parkinson's disease, diffuse basal ganglia damage (PD); Alzheimer's disease, cortical damage (AD); and focal left-hemisphere damage (LH). Superscripts preceding group labels along the ordinate refer to publications reporting the relevant findings. The mean from 28 healthy control participants examined in five studies is indicated by the vertical dashed line. [1]Sidtis et al. (2009). [2]Van Lancker Sidtis, Cameron, et al. (2012). [3]Van Lancker Sidtis & Postman (2006). [4]Current study. [5]Bridges & Van Lancker Sidtis (2013).



Last, further studies are needed on the effects of brain damage and disability with respect to the several subcategories of formulaic expressions. How do pause fillers, swearing, idioms, conversational speech formulas, and conventional expressions differ in normal and pathological use? What brain structures subserve these subsets of formulaic language? There are many more questions to be pursued. We are currently developing clear and replicable criteria for identifying formulaic expression types and quantifying their proportional presence in speech and language pathologies.

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Appendix (p. 1 of 2)

Structured Interview for AD and PD Study

[Interviewer 1] Hello, Mr./Ms. ______________

1. How nice to meet you/see you again.
2. Won't you please [come in and] take a seat?
3. Did you have any trouble finding the office?
4. How are you feeling today?
5. Anything new?
6. Could you tell me a little about yourself?
7. How do you spend your average day?
8. What else do you do?
9. That's fine. Thank you.
10. That's a handsome/lovely _________ you are wearing!
11. What can you tell me about it?
12. Would you like some water?
13. Is that enough for you?
14. Let's try to remember some old sayings. I'll say the first part, and you try to finish it.
15. For example, I'll say "Footloose and …"
16. How about "Don't put the cart …"
17. "Don't put all your eggs …"
18. "People who live in glass houses …"
19. "That's the straw that …"
20. Great! [wait for response or comment]
21. It's amazing how many of those we all know!
22. Now, let me ask you, Mr./Ms. __________, what do you say when you hit your thumb with a hammer?
23. What do you say to friends celebrating their 50th wedding anniversary?
24. How about when your team wins the World Series?
25. And what do you say if you accidentally step on someone's toe in the elevator?
26. What about if someone bumps into you on the street? What would you say?
27. How about when someone honks their horn for a long time?
28. How about at the end of a meal, what might you say?
29. What's the song you sing to people on their birthday?
30. Can you sing it for me?

Appendix (p. 2 of 2)

Structured Interview for AD and PD Study

31. How about the most famous holiday song, Jingle Bells?
32. Can you sing that one also?
33. Very good! What do you think about that song?
34. By the way, what do you remember best about your days in high school?
35. Okay, that's great. Thanks for telling me about that.
36. How do you spell your last name?
37. Just a few more questions, if you don't mind.
38. Where were you born?
39. Do you have any children?
40. What are their names?
41. How about grandchildren?
42. What are they like?
43. Can you tell me their names?
44. What cities have you visited recently?
45. Have you visited any famous places or monuments?
46. Well, we're just about done here.
47. Let's call it a day, shall we?
48. Is there anything else you'd like to talk about?
49. Okay!
50. If we need to get in touch with you in the future, is it okay to call?
51. What's the best time to call?
52. Good.
53. Well, thank you so much for your help today!
54. Please accept this small token of my appreciation.
55. Would you like me to walk you back to the waiting room?
56. It's been a pleasure, Mr./Ms. _____________.
57. Bye bye for today.
58. You did a great job.
59. I enjoyed working with you.
60. It's so good of you to work with us on this.
61. Please be in touch if you have any questions.
62. Thanks again.
63. Take it easy, and have a good trip home.
64. Good bye.