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Comprehension of Familiar Phrases by Left- but Not by Right-Hemisphere Damaged Patients

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Single words, familiar phrases (idioms and speech formulas), and novel sentences (matched to the familiar phrases in length, frequency, and structure) were selected for a picture-matching auditory comprehension task and administered to left- and right-brain damaged (LBD, RBD) subjects. The groups did not differ in single word comprehension. A 2 × 2 ANOVA revealed opposite patterns on the two other tasks, with LBD subjects performing worse on novel than familiar phrases, and RBD subject impaired on familiar phrase but not on novel sentence comprehension. The role of grammatical/referential vs. holistic/inferential meaning in left and right hemisphere function is discussed.

Overlearned, familiar phrases, also termed "automatic speech,"[1] are often selectively preserved in aphasia, and exemplary lists of residual phrases of this type have been included in clinical descriptions from the time of Broca. This phenomenon appears to be quite general and cuts

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[1] We prefer the term "formulaic speech," and use "familiar phrases" to refer generically to the overlearned, holistic expressions that characterize this language behavior, including, *inter alia,* social interaction formulae (e.g., greetings), expletives, overlearned lists and serials (e.g., days of the week), song lyrics, proverbs, and idioms.

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across aphasia type: fluent aphasic patients have been observed to use formulaic speech amidst otherwise paraphasic and neologistic output (Bay, 1964; Luria & Tsvetkova, 1968); anomia is often not extended to formulaic speech (Bay, 1963; Wepman, Bock, Jones, & Van Pelt, 1956); and in conduction aphasia, repetition of familiar phrases was found to be significantly better than repetition of novel phrases (Canter, Coughlin, & Van Lancker, 1978). But the most striking incidence is in the nonfluent and global aphasias, where, despite severe impairment in production of words and novel utterances, these overlearned utterances are produced with normal prosody and fluent articulation, such that rudimentary communication is often achieved. In fact, the differences between formulaic and novel speech in fluency, articulatory precision, prosody, pragmatic characteristics, and communicative effectiveness are so striking as to suggest that different cerebral mechanisms are involved.[2]

The theory that familiar phrases are processed differently from novel phrases agrees with data from psychological studies of normal subjects, which show systematic processing differences between novel and familiar expressions in children (Vihman, 1982; Pollio & Pollio, 1974; Wong Fillmore, 1979; Peters, 1977, 1983) and adults (Osgood & Hoosain, 1974; Horowitz & Manelis, 1973; Gibbs, 1980; Pickens & Pollio, 1979; Lieberman, 1963; Van Lancker, Canter, & Terbeek, 1981; Simon, 1974). In all these studies, novel expressions were observed to be processed—categorized, recognized, learned, and/or remembered—in terms of their individual component parts and constituent structure, whereas familiar expressions presented in a same paradigm were processed as unitary wholes, without comparable attention to constituency.

These observations in normal and aphasic speakers suggest that familiar phrases are unlike novel phrases (1) in their linguistic structure and (2) in their cerebral representation. Because of their formal similarities—both words and familiar phrases constitute single, grammatically unanalyzed units—it has been proposed that familiar phrases are processed like single words. In support of this proposal, two studies using a lexical decision task, one of normal subjects (Swinney & Cutler, 1979) and the second conducted on aphasic patients (Dronkers, 1984), led to the conclusion that familiar phrases are processed more like single words than like syntactic phrases of comparable length and complexity.

The second point, that familiar phrases are represented differently in the brain from novel expressions, can be traced back to the writings of Jackson (1878). Two possible theories of the neurological representation of familiar phrases must be considered. First, parallel to the suggestion that familiar phrases are structurally similar to single words, it has been

[2] Notable exceptions to these observations are found in the single-syllable, nonsense recurrent utterances of some globally aphasic patients, who utilize stereotyped intonation patterns and a limited repertory of phrase-lengths (De Bleser & Poeck, 1985; Poeck, De Bleser, & Grat von Keyserlingk, 1984).

proposed that these share neurological substrates. That is, while the ability to concatenate words into syntactic strings appears to be mediated by the anterior left frontal lobe (e.g., Mohr, 1976), the production of single words can be disrupted by focal damage to widespread areas of the left hemisphere (Benson, 1979). Thus, given that the ability to produce single words is disturbed by damage to different areas of the brain, and that, therefore, no specific region of the left hemisphere has been thought to be the "locus" of naming (Knopman, Selnes, Niccum, & Rubens, 1984), it might be concluded that formulaic speech, like naming, is diffusely represented in the left hemisphere.

There are problems with a theory that proposes a parallel between single words and familiar phrases in cerebral representation. Unexplained, for example, is the fact that formulaic speech is frequently preserved—produced with ease and fluency—when single word production is severely impaired. Often when an aphasic patient cannot spontaneously name or refer to common objects, he/she can do serial counting, and use expletives and social interaction formulas. Therefore, it appears that abilities to produce formulaic speech are even less vulnerable to loss resulting from left hemisphere damage than is the production of single words. These clinical observations point to the second possibility: the role of the right hemisphere in familiar phrase processing.

Several other clinical observations implicate the right hemisphere in the production of familiar phrases. First, as mentioned above, residual formulaic speech has been observed in all types of aphasia, implying its presentation following left hemisphere lesions of varying location and size. Second, studies using the Wada procedure reported continued aphasic output during anesthetization of the left (dominant) hemisphere (Kinsbourne, 1971; Czopf, 1981), implying that residual aphasic speech was represented in the right (unanesthetized) hemisphere. Further, a callosal sectioned patient was reported to speak via right hemisphere mechanisms (Levy, Nebes, & Sperry, 1971), and several clinical cases have been reported in which the nondominant right hemisphere was the site of aphasic speech (Landis, Cummings, & Benson, 1980; Cummings, Benson, Walsh, & Levine, 1979). Right hemisphere activation during automatic speech was observed in a blood flow study (Ingvar & Schwartz, 1974; Larsen, Skinnoj, & Lassen, 1978). In addition, several left (dominant) hemispherectomized adults with little or no propositional speech were observed to produce fluent, normally intoned formulaic speech (Crockett & Estridge, 1951; Hillier, 1954; Smith, 1966, 1974; Bogen, 1973). These facts tend to support an alternate view of formulaic speech which associates its cerebral representation with the right hemisphere (Jackson, 1878; Van Lancker, 1973, 1975, 1986).

Most observations of preserved aphasic *production* of familiar phrases are anecdotal, as it is difficult, when dealing with a disorder as individual as aphasia and a phenomenon which is unique in every patient (i.e.,

patients seldom utter the same set of overlearned phrases), to directly compare and contrast abilities to produce familiar and novel utterances. Similarly, the theory which attributes control over familiar phrases to the nondominant hemisphere is difficult to test since right hemisphere patients are not usually aphasic, and subtle variations, such as diminished use of familiar phrases, would be difficult to observe and quantify.

As well known as this differential in aphasic ability is in *production,* little information on aphasic *comprehension* of familiar phrases is available. In order to systematically compare novel and familiar phrase knowledge, a comprehension test was needed. Such a test could be used to examine the hypothesis that novel and formulaic expressions have different cerebral representations in the left hemisphere or, alternatively, that the right hemisphere plays a role in familiar phrase comprehension. First, we could observe whether performance on familiar phrases was more like that on single words or on matched novel phrases. The finding that preserved ability for familiar phrase comprehension occurs alongside an impairment in syntactic processing in left-brain damage (LBD) would support the hypothesis that formulaic expressions are represented differently from novel language. The hypothesis of a right hemisphere involvement would be supported if an impairment in familiar phrase comprehension were observed in right-brain damage (RBD), but not if a preserved ability for familiar phrase recognition occurred in RBD. These hypotheses could be assessed by testing unilaterally left- or right-brain damaged subjects on comprehension of single words, familiar phrases, and novel phrases matched to the familiar phrases in length, number of words, and surface phrase structure.[3]

METHODS

Subjects

Experimental subjects were 39 consecutively available, right-handed, native speakers of American English (5 females, 34 males). All subjects had normal vision with corrective lenses, and none had a hearing impairment sufficient to interfere with speech perception. Age ranged from 45 to 80 years (mean age = 62.8); education ranged from 10 to 19 years. There were 28 subjects in the LBD group, with a mean age of 62.3, and an average of 63.5 months since onset of lesion. All were aphasic: aphasia type was diagnosed by a speech-language clinician using standardized instruments (The Boston Diagnostic Aphasic Examination and the Western Aphasia Battery). Eight patients had fluent aphasia, 10 had nonfluent aphasia, 5 were primarily anomic, 3 were globally aphasic, and 2 were mixed. The 11 subjects in the RBD group had an average age of 63.4, and a mean time-post-onset of 19.5 months. All had unilateral, focal lesions as a result of a cerebral vascular accident, as determined by radiological reading of CT-scans and neurological examination. Diagnosis

[3] The familiar-phrase-as-single-word hypothesis entails that familiar phrases do not have grammatical structure in the sense that novel expressions do, but that they are processed as unitary single elements. That is, applying standard grammatical processes to a familiar phrase, such as "She has him eating out of her hand" will result in a wrong interpretation. But for experimental purposes, the surface "structures" of the familiar phrase stimuli were matched to a parallel set of novel phrases.

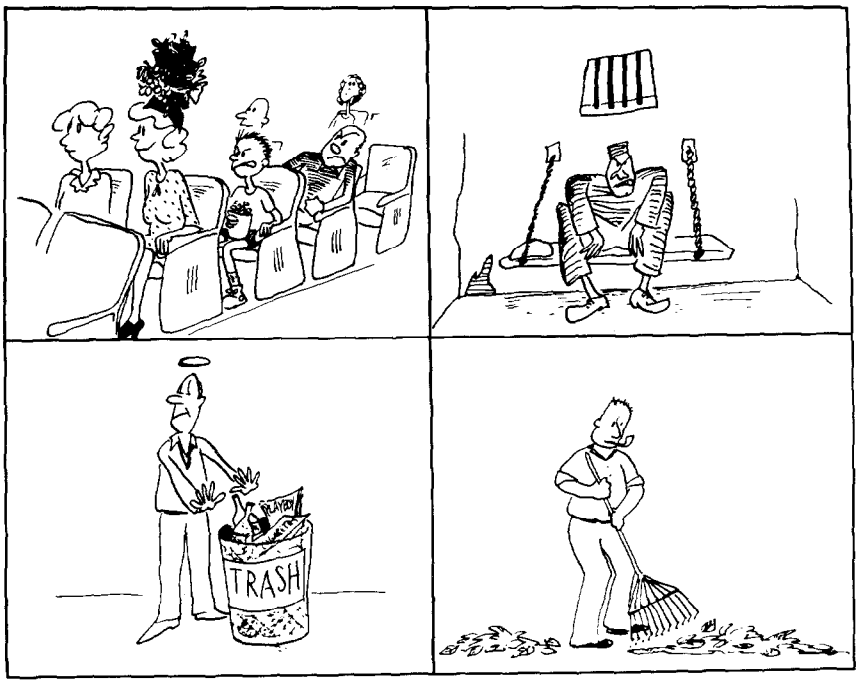

FIG. 1. A response sheet for the familiar phrase "He's turning over a new leaf."

was always consistent with EEG records and neuropsychological testing (Wechsler Adult Intelligence Scale, verbal and visual memory tests, and visuospatial construction).

Normal control subjects were 50 adults (36 females and 14 males) ages 45–82) mean age = 62.2), with 11–19 years of education.

Materials

Ten single words (e.g., concrete nouns such as *bird, telephone*); 20 familiar phrases (e.g., "He's turning over a new leaf," "While the cat's away, the mice will play"); and 10 novel sentences comparable in length and surface syntactic structure and comprised of words with similar text frequency-counts to the familiar phrases (e.g., "He's sitting deep in the bubbles," "When the happy girl pushes, the angry boy swings") were selected and 4 line drawings were prepared for each item. Foils (wrong answers) in the word test were semantically related items. Foils in the familiar phrase portion of the test included one literal response item (e.g., a man raking leaves for "He's turning over a new leaf"), one related or opposite in meaning (e.g., an angry, defiant convict sitting in a prison cell bunk), and an irrelevant item (e.g., people sitting in a movie theater). (See Fig. 1.) All three distractor items for the novel sentences were permutations of grammatical roles (e.g., agent and patient reversed) or adjective mis-assignments (e.g., "When the happy girl pushes, the angry boy swings" includes a picture of an unhappy girl pushing a boy, etc.).

Each patient received two practice items for each stimulus set and then a set of 10 words, 10 familiar phrases, and 10 novel sentences. Two sets of materials were prepared for the familiar phrases to ensure that there was no effect of individual phrases and/or distractor items. The two sets were alternated between consecutive patients. Because no such effect was observed, the data were pooled for analysis.

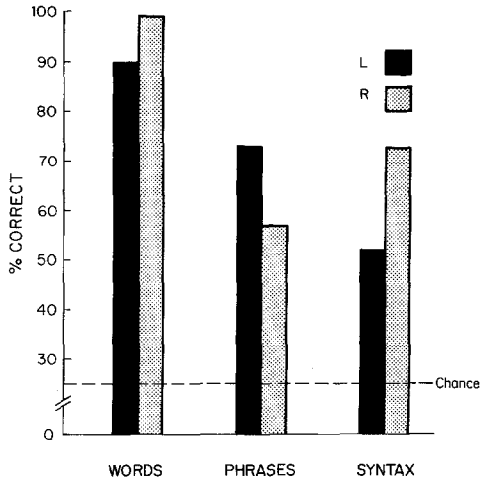

FIG. 2. Mean scores on words, familiar phrases, and novel sentences for LBD and RBD groups.

RESULTS

Results for LBD and RBD groups can be seen in Fig. 2. As intended in the design of the protocol, normal subjects performed nearly perfectly on all three tasks, achieving 100% correct on single words, 97.3% correct on familiar phrases, and 99.8% correct on novel phrases. No differences in performance associated with sex, age, or education were observed. Statistical analysis comparing the clinical populations revealed that the two groups showed opposite patterns of performance. On an analysis of variance (ANOVA) of RBD and LBD groups with repeated measures on the three tasks (words, familiar phrases, and novel sentences), a nonsignificant trend for an effect of group ($F(1, 37) = 3.15$, $p = .08$), a significant task effect ($F(2, 74) = 35.91$, $p < .001$), and a significant Group $\times$ Task interaction ($F(2, 74) = 17.44$, $p < .001$) were observed. Another ANOVA on repeated measures on the two tasks of interest, familiar phrases and novel sentences, resulted in another significant Task $\times$ Group interaction ($F(1, 37) = 35.69$, $p < .001$). The Group $\times$ Task interactions on both the 3-way and 2-way ANOVAS indicate different patterns of abilities for the two groups, with the LBD group more likely to preserve familiar phrase comprehension despite impairment to syntactic processing, while the RBD group showed selective impairment of familiar phrase comprehension (Fig. 3).

DISCUSSION

The finding that familiar phrase recognition is relatively less impaired than are syntactic abilities in LBD aphasic patients indicates that the

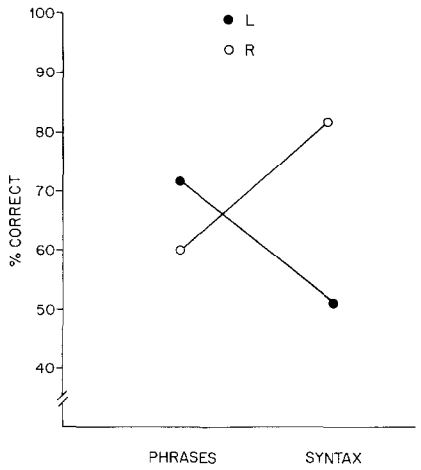

FIG. 3. Illustration of task differences for familiar phrases and novel sentences between LBD and RBD groups.

preservation of abilities for formulaic speech production in aphasia extends to comprehension. That is, this selectively preserved speech ability is not limited to performance of overlearned motor patterns, but represents an intact language ability cutting across input and output modalities.

These results support the hypothesis, derived from observations in production, that familiar phrases are stored and processed in the brain differently from newly generated language. In particular, that LBD and RBD patients show opposite patterns of performance on familiar phrase vs. novel sentence comprehension (Fig. 3) implies that the different neural substrates subserve these two language functions.

These results also show that RBD subjects have a language disturbance. The deficiency in familiar phrase comprehension associated with damage to the right hemisphere has not yet been described, although there are related observations. An impairment in comprehension of metaphors, many of which were frozen metaphors and therefore are very similar to familiar phrases in requiring an idiomatic and unitary interpretation ("He has a heavy heart"), was reported by Winner and Gardner (1977), and a deficit in idiom comprehension associated with RBD was reported by Myers and Linebaugh (1981). Similarly, a deficit in the ability of RBD patients to recognize nonliteral meanings has been reported by Brownell, Potter, Bihrle, and Gardner (1986). Related observations involving story interpretations, surprise, and humor have been also observed (Brownell, Michel, Powelson, & Gardner, 1983; Gardner, Brownell, Wapner, & Michelow, 1983); difficulties with making proper inferences in complex linguistic materials was described by Wapner, Hamby, and Gardner (1981). In fact, inferential reasoning may be a key factor in patient performance

in the present study, as the familiar phrases do all require some kind of inferential reasoning, as contrasted with the novel phrases, which involve mainly referential meanings and syntactic analysis.

It is not known whether the impairment in comprehension of familiar phrases extends to production in RBD patients. However, clinically observed deficiencies in this population in conversational turn-taking, which requires use of social interaction formulas, suggest that the deficit may involve both input and output (Foldi, Cicone, & Gardner, 1983; Jaffe, 1978; Myers, 1979).

The theory that familiar phrases are processed like lexical units is not wholly supported by these results, because performance scores on familiar phrases and words were not parallel. The differences might be attributable to the fact that whereas familiar phrases are like words in *form* (i.e., they both comprise unitary, nonsyntactically analyzed wholes), they have different *semantic* properties. For example, familiar phrases are more semantically "complex" in containing a set of propositions (see footnote 4); they evoke meanings not derivable from the words themselves and therefore require inference.

That familiar phrases are processed like unitary, nonsyntactically analyzed elements is indirectly suggested by the findings in RBD subjects, if it can be inferred that the deficiency in familiar phrase recognition is attributable to the general impairments of pattern recognition associated with RBD (Bogen, 1969a, b; Levy, 1974; Bever, 1975; see review by Bradshaw & Nettleton, 1983). This modified version of the "familiar-phrase-as-single-word" hypothesis, which maintains that familiar phrases behave in performance like words *formally* (i.e., structurally) but not *semantically* is compatible with the Dronkers (1984) and Swinney and Cutler (1979) lexical decision findings (in which familiar phrases were responded to like single words), because in those studies the task was to make a response to the overall *form* but not to the *meaning* of the phrases. In contrast, in the experiment reported here, the task required subjects to process both the holistic form and the complex meaning of familiar phrases. This led to different results in the two experimental groups (see Fig. 3). Possibly, then, by a "chunking" hypothesis, the LBD group was at an advantage because the familiar phrases did not require syntactic analysis, whereas the RBD group was at a disadvantage because the phrases, structurally, required apperception of an overall pattern.

The stimuli used in this study were made up of a variety of familiar phrases. Most are common idioms ("She has him eating out of her hand"; "He's living high on the hog"). Idioms, by definition, trade in nonliteral, inferential meanings. Insofar as the notion of a nonliteral interpretation can be extended to speech acts, such as the performative utterances included in our stimulus set ("I'll get back to you later"; "The truth,

the whole truth, and nothing but the truth"), the familiar phrases tested here can all be said to require inferential or nonliteral meanings for correct interpretation. Thus *two* parameters inherent in the familiar phrase stimuli, separately or in combination, may be invoked to account for our findings: (1) the "chunking" hypothesis, which states that a key feature of the familiar/novel phrase contrast is the holistic/analytic one; and (2) the "nonliteral meaning" hypothesis, which states that the right hemisphere is specialized for recognizing inferential meanings, which are properties of idioms and speech acts but not of novel sentences. Much of previous research on the right hemisphere lends support to the second interpretation.

It is interesting to note that, although the meanings of the familiar phrase stimuli used in this study, as mentioned above, are quite complex, aphasics showed better comprehension of these than of novel expressions. This observation has implications for aphasic rehabilitation and family counseling. It may be demonstrated, in certain cases, that severely impaired aphasics have relatively preserved comprehension of formulaic speech, which is of considerable value and importance in everyday social interaction (Bolinger, 1976; Pawley & Syder, 1980; Fillmore, 1979; Jesperson, 1965; Tyler, 1978). Furthermore, the seemingly language-bereft individual may be able to comprehend quite complex "propositional" meanings,[4] when they are offered in the right kind of phrase. This information will be of value to the clinician designing a plan for therapy, and to the family of the patient.

Finally, these results add a few more lines to the unfolding story of the role of the right hemisphere in language and communication. The association of impaired comprehension of familiar phrases with RBD strongly suggests a role of the right hemisphere in the normal comprehension of formulaic speech. Its role in formulaic speech production is not clear, although the observations in Wada testing in aphasia and adult hemispherectomy speech mentioned above suggest that the right hemisphere functions as the substrate for such speech behavior, at least in abnormal conditions. Besides the role the right hemisphere plays in pragmatic parameters of language mentioned above, recent reports have indicated right hemisphere involvement in paralinguistic parameters of the speech signal such as emotional meanings (Wechsler, 1972; Van Lancker, 1980; Heilman, Scholes, & Watson, 1975; Ross, 1981, 1984; Bryden & Ley,

[4] Note that although the phrases of interest here are called "formulaic," they map onto complex "propositional" meanings. For example, "When the cat's away, the mice will play," means that when a person who is viewed as an authority by two or more subordinates leaves the area, those subordinates can be expected to engage in activities held by the authority to be unacceptable or reprehensible, and that they will do this with an air of "getting away with something" and so on. These kinds of meanings were incorporated into our drawings as far as was possible, and aphasic patients were seen to make a significant number of correct responses on these items.

1983; Kent & Rosenbek, 1982) and personal voice identity (Van Lancker & Canter, 1982; Van Lancker, Cummings, & Krieman, 1985; Van Lancker & Kreiman, 1986). In addition, the findings reported here suggest that the right hemisphere plays an important role in processing formulaic language.

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