BRAIN AND LANGUAGE 10, 132–144 (1980)

Effects of Sentential Stress and Word Class upon Comprehension in Broca's Aphasics

DAVID A. SWINNEY

Tufts University

EDGAR B. ZURIF

Aphasia Research Center, Boston University School of Medicine, and Boston V.A. Hospital

ANNE CUTLER

Centre for Research on Perception and Cognition, Laboratory of Experimental Psychology, University of Sussex

The roles which word class (open/closed) and sentential stress play in the sentence comprehension processes of both agrammatic (Broca's) aphasics and normal listeners were examined with a word monitoring task. Overall, normal listeners responded more quickly to stressed than to unstressed items, but showed no effect of word class. Aphasics also responded more quickly to stressed than to unstressed materials, but, unlike the normals, responded faster to open than to closed class words regardless of their stress. The results are interpreted as support for the theory that Broca's aphasics lack the functional underlying open/closed class word distinction used in word recognition by normal listeners.

INTRODUCTION

Descriptions of the language disorder associated with Broca's aphasia (a clinically diagnosed syndrome involving damage to the anterior portion of the left hemisphere) have traditionally held that while there is obvious impairment to production abilities, comprehension remains relatively intact. This conclusion derives from a long history of clinical reports and experimental investigations which have documented the agrammatic, labored speech, and, by contrast, the reasonably operational receptive

This study was supported in part by NINCDS Grant 11408 to the Boston University School of Medicine and by HEW Grant 1S07 RR07179-01 to Tufts University. The authors thank Michael Cicone for his help in gathering data for this study. Requests for reprints should be sent to Dr. David A. Swinney, Psychology Department, Paige Hall, Tufts University, Medford, MA 02155.

0093-934X/80/030132-13$02.00/0

abilities in Broca's aphasics (see, e.g., Lenneberg, 1973; Lock, Caplan, & Kellar, 1973; Weigl & Bierwisch, 1970; Weisenburg & McBride, 1935; see also Goodglass, 1976, for an historical review).

Recent investigations, however, suggest that a far greater underlying comprehension impairment exists than has been previously recognized, and in particular that these comprehension difficulties parallel those of the productive disorder (Goodglass, 1976; Goodenough, Zurif, & Weintraub, 1977; Zurif & Blumstein, 1978; Zurif, Caramazza, & Myerson, 1972). This evidence provides a picture of impairment involving the recovery of appropriate grammatical structures, a problem which becomes particularly apparent in comprehension situations where semantic constraints alone fail to predict syntactic structure. While a number of explanations are available which account for portions of these data, as a whole they appear to argue that some aspect of the underlying grammatical (syntactic) processing is disrupted in Broca's aphasia—not simply motoric processes (e.g., Caramazza & Berndt, 1978; however, see Kean, 1978, for an alternative view.) More specifically, work reported by Zurif and Blumstein (1978), Bradley (1978), and Bradley, Garrett, and Zurif (1978) suggests that the grammatical impairment exhibited by Broca's aphasics may be related in large part to the manner in which open class and closed class vocabulary are used by the sentence comprehension and production devices.

The open/closed vocabulary class distinction has a long history of attention from both linguistic and psycholinguistic researchers. The open class vocabulary constitutes a large, open set of elements (to which new items are regularly added) which typically belong to the major grammatical categories and which have widely varying lengths and frequencies. Open class words are often considered to be those which bear reference and carry the major semantic informational load in communication. The closed class vocabulary, in contrast, consists of a small number (not more than 250 or so words in English) of relatively short, high frequency (in general) words which constitute a fixed (closed) class in the language. These words, whatever their semantic content, typically belong to the minor grammatical categories (determiners, prepositions, articles, etc.) and they appear to have the major function of providing structural information in sentence processing based on the sequencing constraints which they create. For example, these words allow facilitation of the structural analysis of a sentence by (among other things) aiding in the assignment of a unique form class designation for the open class words (which are commonly ambiguous with respect to form class). See Garrett (1975, 1976) for further discussion of important distributional differences between open and closed class words.

Only recently, however, has evidence other than the already noted distributional characteristics been found to support an hypothesis that open and closed class vocabulary are actually treated differently in the mental lexicon. Garrett (1975, 1976), for example, has reported major differences in the manner in which open and closed class items participate in speech production errors. Speech errors in which open class words swap places (e.g., "wait'll you see the one I kept pinned on the *room* to my *door*") typically maintain form class and can occur across clause boundaries. Garrett calls these 'exchanges." Closed class words are involved in a different type of place swapping (which Garrett calls shifts) in which clause boundaries are never crossed and movement is very local—sometimes merely involving movement across a very few places (e.g., "who did you say else was coming" said for the intended "who else did you say was coming.") On the basis of this and other evidence, Garrett has argued that closed and open class materials have differing modes of storage, representation, and access in the mental lexicon.

Bradley (1978) has extended this work into the realm of word recognition with a comprehensive set of experiments. Of particular relevance here is her finding that lexical decisions to open class words display an inverse relationship with frequency, but that latencies for lexical decisions made on closed class materials are nearly constant over their entire frequency range. On the basis of these results, Bradley claims that open and closed class items are dealt with by different access and recognition systems in the normal listener/speaker at an *early stage* in the comprehension process (Bradley, 1978).

Broca's aphasics, however, differ significantly from normals in the way they perform lexical decisions to open and to closed class materials; a strong inverse relationship is found between frequency and decision time for *both* classes of words by Broca's aphasics (Bradley, 1978; Bradley, Zurif, & Garrett, 1978). We might reasonably conclude from this work that these aphasics have damage to the special access and recognition processes which normal listeners use for closed class materials; by default, they are forced to treat closed class words like they do any open class word, at least during early lexical processing stages. As a consequence aphasics may be limited in their ability to use closed class words to provide grammatical constraints on the assignment of open class word forms to structural descriptions of sentences. Note that the claim here is that aphasics may not be able to utilize the special lexical access and processing routines that will enable efficient grammatical performance, a situation which could certainly account for the agrammatism that has been noted in both expressive and receptive modes. This is not to say that aphasics will not be able to distinguish open/closed class materials at some level of processing. However, such distinctions may well be far removed from the normal sentence processing routines.

Unfortunately, there are serious considerations that prevent immediate and direct translation of these findings (which derive from examinations of the visual processing of isolated lexical items) to the auditory comprehension of sentences; processes which are apparently important for dealing with isolated items can often fail to be of significance in other, more comprehensive, functions. A factor which requires particular attention in this regard is the role of sentential stress in the comprehension of open and closed class vocabulary. Major sentential stress falls far more often on open class than on closed class words in sentences, creating a potential confounding of stress and form class in examinations of sentence comprehension. Certainly, we do know that the language processing device uses some knowledge of the distributional differences of stress on open and closed class words; Cutler (in press) has pointed out that the speech error exchanges reported by Garrett (1975) which involve open class words preserve the original intended sentential stress pattern, but when closed class words undergo speech error shifts, they carry their stress levels with them, so that the sentence stress pattern changes.

We might suppose, then, that the comprehension device uses sentential stress to predict open/closed class differences as well as informational content differences during ongoing comprehension. Cutler and Foss (1977) investigated this hypothesis using a phoneme monitoring task. In this, subjects are asked to listen to and to comprehend sentences and, simultaneously, to detect a specified target phoneme beginning some word in the sentence. Reaction time to detect this target has been argued to be a function of the difficulty of sentence processing at the point at which the target occurs (Foss, 1969; Foss & Swinney, 1973). Using this task, Cutler and Foss (1977) found that while reaction time to both open and closed class items was faster when they were stressed than when they were unstressed, there was no open/closed class reaction time difference independent of stress. That the effects of stress apparently obscure any open/closed class processing differences in normal comprehension may, in fact, be the end result of having specialized and different processes for the access and recognition of closed and open class materials. That is, the separate retrieval routines may ensure that both vocabulary types present equivalent processing loads to the sentence comprehension device, independent of other cues (such as differential stress). If so, the role of stress may be (among other things) one of providing a cue as to which class of word to expect. However, one would not expect to see word class differences in measures of sentential processing difficulty unless some aspect of these specialized recognition routines is disordered.[1]

[1] It should be noted that Cutler (1976) has found that the effects of sentential stress in the monitoring study are not simply the result of differences in perceptual clarity; when the stressed and unstressed targets are replaced by a target with neutral stress, the surrounding intonation contour remains sufficiently predictive to produce the basic reaction time/stress effect. In fact, Cutler and Foss (1977) suggest that the effect of sentential stress as revealed by the phoneme monitoring task may basically be a semantic effect representing a search for

The question that presents itself, then, has two integral parts. First, do agrammatic aphasics operate differently than the normal listener on open and closed class items *during* sentence comprehension? And, second, do aphasics respond to stress on these materials in the same manner as do normal listeners?

With respect to the second part of the question, there is some evidence that Broca's aphasics might be able to use stress cues to word class (albeit in a manner different from that in which normal listeners use these cues). It is known that disordered patients (aphasics in particular) can often use cues and skills which are of minor importance to the unimpaired in order to enhance their performance (see, e.g., Goodglass, 1968; Swinney & Taylor, 1971). The cues provided by stress are readily available for use by aphasics, as they have been shown to be predominantly processed by the intact right hemisphere (Blumstein & Cooper, 1974; Zurif, 1974). And, given the demonstration that Broca's aphasics can use stress to distinguish between nouns and verbs (Blumstein & Goodglass, 1972), it may be expected that they will also be able to use this cue to differentiate closed from open class vocabulary items, and thus carry out at least limited syntactic analyses. On the other hand, it is possible that the Broca's aphasics' inability to separately access open and closed class vocabulary items may result in a syntactic limitation that overrides cues provided by stress. Further, it is even possible that intonational cues may be over-relied upon by aphasics, resulting in inappropriate application of predictions about word class usage.

In order to judge the relative merits of these alternative possibilities, we examined the processing of sentential stress and open/closed class distinctions in both Broca's aphasics and a normal population with an on-line sentence processing task. Because monitoring for a phoneme in ongoing speech is a difficult task, a similar but less demanding task, word monitoring, was utilized in order to minimize error responses by the aphasics. Word monitoring has been found to reflect sentence processing difficulty in much the same way that phoneme monitoring does (Foss, Starkey, & Bias, 1975). Clearly, however, this task is not identical in nature to the phoneme monitoring task in terms either of the range of variables to which it is sensitive or the conditions under which maximum sensitivity to sentence processing load is attained. It is to be expected, for example, that knowing in advance the actual word one is listening for will allow the listener to make much greater use of semantic and syntactic cues than just knowing the initial sound of the target word. In monitoring for open class words, for example, there may be sufficient semantic and syntactic cues to

sentential focus, which typically occurs, of course, on open class words. Cutler and Fodor (in press) have bolstered this argument by demonstrating that changes in focus independent of changes in stress produce the indicated effect in the phoneme monitor task with normal subjects.

predict occurrence of these words with a high degree of accuracy, regardless of whether they received stress or not. At least, this may well be the case for normal subjects who are unimpaired in their ability to make use of the syntactic and semantic cues provided by sentential contexts. This would imply that open class words may be so easy for normal subjects to locate that the stress effect reported by Cutler and Foss (1977) could be overriden and the difference between stressed and unstressed open class words could thus disappear. We would not, however, expect the stress effect which Cutler and Foss found for closed class words in phoneme monitoring to disappear in this word monitoring task, since closed class items are far less predictable from context.

In all, however, tne word monitoring task appears well suited to our needs. It provides a measure of on-line sentence processing, it is within the capabilities of aphasic patients, and it is sufficiently sensitive to reflect the processing characteristics that are of particular interest here: the relative availability of open and closed class words to aphasic and normal subjects, and any interaction of this process with sentence stress.

METHOD

Materials

Eighteen open class words and eighteen closed class words were chosen as the target materials for this study. Two sentences, differing only in placement of sentence stress, were constructed for each word. In one, main sentential stress was on the target word and, in the other, stress was on a nearby word, thus causing the target word to be unstressed. All sentences were judged to have normal (permissible) intonation contours by two judges, and all materials consisted of common vocabulary and syntactic structures.

A single tape recording was constructed from these materials. It consisted of two equivalent halves. In the first half, there were nine of the content word sentences and nine of the function word sentences, both containing stress on the target word, along with the unstressed target word sentences for the remaining nine open class and nine closed class words. These were recorded, along with seven filler sentences, in random order on the tape. The second portion of the tape consisted of the versions of each target word sentence which had not been used in the first half of the tape, along with six filler sentences, all recorded in random order. Thus, the two sentences for each target word always occurred in different halves of the experiment, and experimental conditions were equally represented in each half of the experiment. Materials were recorded by a male speaker of standard American English. See Appendix for list of all experimental sentences.

Subjects

Eight right-handed patients from the neurological ward of the Boston V.A. Hospital who had been diagnosed as Broca's aphasics in clinical workups with the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972), and who had had either brain scan or CT scan verification of left anterior damage, served as subjects in this experiment. Each of these patients presented agrammatic, labored speech in the context of relatively intact comprehension. In addition, eight right-handed Boston V.A. Hospital patients with no history of neurological involvement or sensory impairment, but of roughly the same age as the Broca's aphasic subjects, served as nonimpaired controls.

Procedure

Subjects were tested one at a time. Testing was completed in one half-hour session. Subjects were told that they were to listen carefully to each sentence and to try to understand it. In addition, they were told to listen for a target word which was specified before each sentence, and to press a button as soon as (or if) they heard that word in the sentence. (The filler sentences did not contain the specified target; this was a control to prevent undue anticipation on target bearing sentences.) The sentences were presented binaurally over headphones. A 1000-hz signal was placed coincident with the onset of the target word in each sentence. This signal, which was inaudible to subjects, initiated a timing cycle that was terminated by the subject's button press. Reaction time data were collected.

RESULTS

Mean reaction time was computed for each experimental condition for each subject. The overall means for the four experimental conditions for each group of subjects (aphasic and control) are displayed in Table 1.

An analysis of variance involving subjects as a random factor was computed from means calculated for each subject for each experimental condition. The main effect for Groups (Aphasics vs. Controls) was significant, $F(1, 14) = 37.08, p < .0001$, as were main effects for Word Type, $F(1, 14) = 16.3, p < .001$ and Sentential Stress, $F(1, 14) = 17.4, p < .0009$. All interactions were also significant at the alpha level of .05 or better.

As the experimental groups differed significantly, independent analyses were performed on data from the Broca's aphasic and the normal control groups in order to examine the comparisons of interest for each group. In both of these, Min F' values (Clark, 1973) were computed from independent analyses involving subjects and language materials as random factors.

For aphasic subjects the Word Type main effect was significant, Min $F'(1, 17) = 7.634, p < .025$ as was the Sentential Stress main effect, Min $F'(1, 13) = 8.04, p < .025$. The Word Type × Sentential Stress interaction failed to reach significance for either the analyses involving subjects, $F(1, 7) = 1.5$, or for that with language materials, $F(1, 17) = 1.87$, as random factors.

TABLE 1
MEAN REACTION TIMES (MILLISECONDS) FOR THE WORD TYPE × TARGET STRESS CONDITIONS FOR APHASIC AND CONTROL SUBJECTS

	Broca's aphasics		Normal controls	
	Word type		Word type	
Target stress	Open	Closed	Open	Closed
Stressed	460	519	272	264
Unstressed	508	625	267	314

For the normal control subjects, there was not a significant main effect for Word Type under either analyses employing subjects or language materials as random factors (F (1, 7) = 3.02, F(1, 7) = 2.4, respectively). The main effect of Sentential Stress was significant under Min F' analysis, Min F' (1, 22) = 4.39, $p < .05$. The Word Type × Sentential Stress interaction was significant under both analyses employing subjects as a random factor, $F(1, 7) = 21.85, p < .002$ and that with language materials as a random factor, $F(1, 17) = 4.47, p < .05$, however, it did not reach significance under Min F' analysis, Min F' (1, 22) = 3.57. In order to examine the interaction more closely, planned t tests were performed on individual comparisons in these data. These revealed that reaction time to closed class items was significantly faster when they were stressed than when they were unstressed, $t(7) = 7.83, p < .0001$. However, this same comparison for the open class materials was not significant, $t(7) = -0.528$. In addition, while there was no significant difference between open and closed class materials when both were stressed, $t(7) = 0.60$, reaction times were significantly faster for open than for closed class materials when they were unstressed, $t(7) = 3.81, p < .007$.[2]

An analysis was also performed on the errors made in word target detection (trials in which the target was present, but was not detected). Inferential statistical analyses on these data were performed on percentage error scores which had undergone arc–sine transformation. This analysis revealed no significant difference between the average number of errors for open and closed class materials for the normal subjects (0.7 and 4.8, respectively), $t(7) = 0.86$. However, for the Broca's aphasics there were significantly more errors made to closed class items (an average of 24.6) than to open class materials (an average of 2.4), $t(7) = 6.31, p < .001$.

DISCUSSION

It is clear that Broca's aphasics demonstrate a different pattern of processing for open and closed class materials under varying conditions of

[2] It is worth noting that the failure to find a word class effect for the normal control subjects is not the result of a floor effect on reaction times to a word monitoring task. In a recent unpublished study by the first author employing a word monitoring task and a simplified set of sentences to examine the role of sentential stress and word class in children's comprehension, a set of 12 college age students participated as control subjects. These subjects heard the sentences under two conditions: One was a normal listening situation and the other involved adding sufficient noise to the signal to nearly (but not completely) mask the materials. The stress and word class variables held identical relationships in each of these presentation conditions, although the mean latencies in the degraded signal condition were about 220 msec longer than those in the normal listening condition. Importantly, the relationship between stress and word class in both the degraded and normal conditions was exactly the same as that displayed by the present control subjects. This pattern of results, then, is independent of any floor effects in the word monitoring task.

sentential stress than do neurologically intact listeners. The results obtained for our normal subjects replicate the previous findings (of Cutler and Foss; 1977) that there is a stress effect, but no main effect for word class for college age listeners performing in a phoneme monitoring task. That is, data from these control subjects show no overall effect for word class independent of stress during ongoing sentence comprehension. There is, however, a main effect of stress. This effect, as anticipated, is carried by the closed-class materials in this experiment; stressed closed class items are responded to more quickly than unstressed closed class items. It should be noted that the anticipated effect in which speed of recognition for the unstressed, open class words in this task was about the same as that for stressed open class items (a result which represents the only deviation from the Cutler and Foss, 1977, phoneme monitoring results) does nothing to reduce our opinion of the importance of stress cues for sentence comprehension. Normal listeners use stress as a major cue for establishing expectations about sentence recognition; they expect sentential stress to fall on, among other things, the open class materials in the language and they treat any stressed item as a potential carrier of important contentive material. When a closed class item happens to carry stress it then receives the special attention typically reserved for open class word forms.

In contrast to the results of the normal subjects, the agrammatic Broca's aphasics demonstrate quite a different pattern of reaction time results. Whereas the normal subjects display no word class effect, the aphasics demonstrate a major effect for word class during sentence processing, one that is independent of the effect of stress. Thus, open class words are consistently responded to more rapidly than closed class words for these subjects. This contrast between the normal subjects and the Broca's aphasics also emerges in the analysis of word target detection errors. While normal subjects showed no difference in the number of errors to open and closed class items, Broca's aphasics made significantly more errors on closed class than on open class materials, again, independent of stress.

The Broca's aphasics also show an overall stress effect; unlike the normal subjects, however, they show as strong a stress effect for open as for closed class words. This suggests that they are unable to use the semantic and syntactic cues as to location of open class target words which normal listeners appear to use most effectively.

These results obviously support the arguments put forward by Bradley (1978) and Bradley, Garrett, & Zurif (1979), who, as described above, suggest that Broca's aphasics have lost just those processing abilities that allow normal adult listeners to easily differentiate open and closed class words in visual word recognition. By extension the evidence suggests that Broca's aphasics cannot easily use closed class words for syntactic processing. This is not, of course, a claim that the closed class words themselves are lost, but rather than the special access and retrieval process which underlies their appropriate use in normal comprehension has been disrupted.

Our data reinforce this argument, and more importantly, extend it from visual recognition situations to the more common communication situation—that involving auditory sentence comprehension. Thus the agrammatic aphasic, who putatively lacks the special processes typically used for closed class materials (a deficiency resulting in a failure to distinguish closed from open class words), demonstrates a word recognition problem for these items that is reflected both in the reaction time and error data. By attempting to treat closed class words in the same manner as open class words, Broca's fail to use the closed class material efficiently in establishing sequencing constraints for an utterance, a factor which undoubtably adds to their sentence processing difficulties. Normal listeners, in contrast, shown no such difficulty—the process used for recognizing closed class words clearly allows them to be understood without any extra load being placed on the comprehension device.

Further, it seems reasonable to suggest that Broca's aphasics have no particular expectations as to the effect of stress in predicting form class differences. While they may use stress as a major cue for the location of important information (at least in part because stressed items are easier to attend to and to recognize), they do not specifically use stress to help distinguish word classes. This result merely serves to underline the word class results. As Broca's fail to process closed and open class items differently, a fact which argues that they no longer have some aspect of the fundamental underlying open/closed class distinction, they thus fail to utilize available stress cues which might provide form class information.

In summary, then, we feel that these results provide evidence in support of the theory that the agrammatism resulting from left anterior damage and exhibited by Broca's aphasics is a function of having lost the ability to make the underlying open/closed form class distinction; our finding allows extension of previous results into the realm of sentence comprehension—the situation from which the basic clinical diagnosis of agrammatism is derived.

APPENDIX: EXPERIMENTAL MATERIALS[a]

Target	Sentence[b]
1. ball	The umpire said a new báll was necessary. (O,H)
2. the	I think my bróther is the man for this job. (C,L)
3. keep	Does Jack really wańt to keep that old van? (O,L)
4. at	The family is already at́ the summer cabin. (C,H)
5. clean	The nurse brought a cléan ashtray and took away the full one. (O,H)
6. door	The secretary went to see íf the door was properly shut. (O,L)
7. but	The boy was a good driver bút his father still wouldn't let him have the car. (C,H)
8. is	The man who sells flowérs is the man I told you about. (C,L)
9. scrub	To get a floor clean you must really scrúb at it. (O,H)
10. my	The thieves were stealing mý car from the parking lot. (C,H)
11. can	I think the little boy can swiḿ across the river. (C,L)
12. old	The movie was about an old woḿan and a young man. (O,L)
13. this	What does the boss think of this idéa? (C,L)
14. in	Henry keeps his motorcycle iń his house. (C,H)
15. coat	I might buy myself a new cóat before the winter starts. (O,H)
16. bite	Some children are afraid that dógs will bite them and hurt them. (O,L)
17. and	The weather was stoŕmy and the watér was choppy. (C,L)
18. smart	Michael is fairly smaŕt compared with his relatives. (O,H)
19. are	The ticket seller says there aŕe still some seats left. (C,H)
20. cold	Sitting outside on a cold daý is sometimes unpleasant. (O,L)
21. his	The old man was surprised that his ticḱet had won the lottery. (C,L)
22. believe	People d́on't always believe the newspapers. (O,L)
23. big	The apartment was too biǵ for just one person. (O,H)
24. will	It is possible that the Democrat wíll be elected. (C,H)
25. that	The car I want is something like that one over theré. (C,L)
26. gift	A friend of mine was sent a gift last weék. (O,L)
27. by	The travelling salesman went bý the house but no one was home. (C,H)
28. quit	The coach told the quarterback to quít fooling around. (O,H)
29. because	John lost his girlfríend because he was always calling her up. (C,L)
30. was	The second baseman wás once the best player on the team. (C,H)
31. bad	The bathroom had a reaĺly bad smell in it. (O,L)
32. cat	The girl was upset to see a dead cát at the side of the road. (O,H)
33. your	The reporter wants to hear yoúr opinion about the election. (C,H)
34. may	The picnic next Sunday may take place desṕite the weather forecast. (C,L)
35. drink	Famous people often drińk quite a lot. (O,H)
36. truck	My father really likéd the truck that he used to drive. (O,L)
37. the	I think my brother is thé man for this job. (C,H)
38. cold	Sitting outside on a cold́ day is sometimes unpleasant. (O,H)
39. at	The family is already at the sumḿer cabin. (C,L)
40. ball	The umpire said a neẃ ball was necessary. (O,L)
41. is	The man who sells flowers iś the man I told you about. (C,H)
42. clean	The nurse brought a clean ashtŕay and took away the full one. (O,L)
43. keep	Does Jack really want to keép that old van? (O,H)
44. but	The boy was a good driv́er but his father still wouldn't let him have the car. (C,L)
45. can	I think the little boy cán swim across the river. (C,H)
46. door	The secretary went to see if the doór was properly shut. (O,H)

47. my	The thieves were stealing my cár from the parking lot. (C,L)
48. scrub	To get a floor clean you must réally scrub at it. (O,L)
49. this	What does the boss think of thís idea? (C,H)
50. coat	I might buy myself a néw coat before the winter starts. (O,L)
51. in	Henry keeps his mótorcycle in his house. (C,L)
52. old	The movie was about an óld woman and a yoúng man. (O,H)
53. smart	Michael is faírly smart compared to his relatives. (O,L)
54. and	The weather was stormy ánd the water was choppy. (C,H)
55. are	The ticket seller says there are stíll some seats left. (C,L)
56. bite	Some children are afraid dogs will bíte them and húrt them. (O,H)
57. big	The apartment was toó big for just one person. (O,L)
58. will	It is possible that the Démocrat will be elected. (C,L)
59. truck	My father really liked the trúck that he used to drive. (O,H)
60. his	The old man was surprised that hís ticket had won the lottery. (C,H)
61. quit	The coach told the quarterback to quit foolíng around. (O,L)
62. believe	People don't always beliéve the newspapers. (O,H)
63. that	The car I want is something like thát one over there. (C,H)
64. by	The travelling salesman went by the hoúse but no one was home. (C,L)
65. cat	The girl was upśet to see a dead cat at the side of the road. (O,L)
66. because	John lost his girlfriend becáuse he was always calling her up. (C,H)
67. gift	A friend of mine was sent a gíft last week. (O,H)
68. was	The second baseman was ońce the best player on the team. (C,L)
69. bad	The bathroom had a really bád smell in it. (O,H)
70. your	The reporter wants to hear your opiníon about the election. (C,L)
71. drink	Famous people often drink quíte a lot. (O,L)
72. may	The picnic next Sunday máy take place despite the weather forecast. (C,H)

[a] Accent indicates position of primary sentential stress.

[b] In presentation order: O = open, C = closed, H = high stress, L = low stress.

REFERENCES

Bradley, D. C. 1978. *Computational distinction of vocabulary type*. Unpublished Ph.D. dissertation, Boston, MA. Psychology Department, Massachusetts Institute of Technology.

Bradley, D., Garrett, M., & Zurif, E. B. 1979. Syntactic limitations in Broca's aphasia. In D. Caplan (Ed.), *Mental biology: Studies in maturation and language*. Edited from the MIT conference on language and maturation. Cambridge, MA: MIT Press.

Blumstein, S., & Goodglass, H. 1972. The perception of stress as a semantic cue in aphasia. *Journal of Speech & Hearing Research*, **15**, 800–806.

Blumstein, S., & Cooper, W. E. 1974. Hemispheric processing of intonation contours *Cortex*, **10**, 146–158.

Caramazza, A., & Berndt, R. 1978. Semantic and Syntactic processes in aphasics: A review of the literature. *Psychological Bulletin*, **85**, (4) 898–918.

Clark, H. 1973. The language-as-fixed-effect fallacy: A critique of language statistics in psychological research. *Journal of Verbal Learning and Verbal Behavior*, **12**, 335–348.

Cutler, A. 1976. Phoneme-monitoring reaction time as a function of preceding intonation contour. *Perception and Psychophysics*, **20**, 55–60.

Cutler, A. In Press. Errors of stress and intonation. In V. A. Fromkin (Ed.), *Errors of linguistic performance*. New York: Academic Press.

Cutler, A., & Foss, D. J. 1977. On the role of Sentence Stress in sentence processing. *Language and Speech*, **20**, 1–10.

Cutler, A., & Fodor, J. A. 1979. Semantic focus and sentence comprehension. *Cognition,* 7, 49–59.

Foss, D. J. 1969. Decision processes during sentence comprehension: Effects of lexical item difficulty upon decision times. *Journal of Verbal Learning and Verbal Behavior,* **8,** 457–464.

Foss, D., & Swinney, D. 1973. On the psychological reality of the phoneme: Perception, identification, and consciousness. *Journal of Verbal Learning and Verbal Behavior,* **12,** 245–256.

Foss, D., Starkey, P., & Bias, R. 1978. Sentence Comprehension Processes in the Preschooler, In R. N. Campbell and P. T. Smith (Eds). *Recent advances in the Psychology of Language: Formal and Theoretical Approaches.* New York: Plenum.

Garrett, M. 1975. The analysis of sentence production. In Bower, G. (Ed.), *The psychology of learning and motivation: Advances in research and theory.* New York: Academic Press. Vol. 9.

Garrett, M. F. 1976. Syntactic processes in sentence production. In R. J. Wales & F. Walker (Eds.), *New approaches to language mechanisms.* Amsterdam: North-Holland. Pp. 231–256.

Goodenough, C., Zurif, E. B., & Weintraub, S. 1977. Aphasic's attention to grammatical morphemes. *Language & Speech,* 11–19.

Goodglass, H. Studies on the grammar of aphasics. 1968. In S. Rosenberg & J. Koplin (Eds.), *Developments in applied psycholinguistics research.* New York: Macmillan.

Goodglass, H. 1976. Agrammatism. In H. A. Whitaker & H. Whitaker (Eds.), *Studies in neurolinguistics,* New York: Academic Press. Vol. 1.

Goodglass, H., & Kaplan, E. 1972. *The Assessment of aphasia and related disorders.* Philadelphia: Lea and Febigir.

Kean, M. L. 1978. The linguistic interpretation of aphasic syndromes: Agrammatism in Broca's aphasia, an example. *Cognition,* **5,** 9–46.

Lenneberg, E. H. 1973. The neurology of language. *Daedalus,* **102,** 115–134.

Locke, S., Caplan, D., & Kellar, L. 1973. *A study in neurolinguistics.* Springfield, IL: Thomas.

Swinney, D., & Taylor, O. 1971. Short term recognition search in aphasics. *Journal of Speech and Hearing Research,* **14,** 578–588.

Weigl, E., & Bierwisch, M. Neuropsychology and linguistics: 1970. Topics of common research. *Foundations of Language,* **6,** 1–30.

Weisenberg, T. S., & McBride, K. E. 1935. *Aphasia: A clinical & psychological study.* New York: Commonwealth Fund.

Zurif, E. B. 1974. Auditory lateralization: Prosodic & syntactic factors. *Brain & Language,* **1,** 391–404.

Zurif, E. B., Caramazza, A., & Myerson, R. 1972. Grammatical judgments of agrammatic patients. *Neuropsychologia,* **10,** 405–417.

Zurif, E. B., & Blumstein, S. E. 1978. Language and the brain. In M. Halle, J. Bresnan, & G. Miller (Eds.), *Linguistic theory and psychological reality.* Cambridge, MA: MIT Press.