CHAPTER

25

Syntactic Facility in Fluent Aphasia

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Most studies of syntactic competence in aphasia have focused on nonfluent or agrammatic aphasia (Caramazza and Zurif, 1976; Schwartz, Saffran, and Marin, 1980; Caplan, 1983; Grodzinsky, 1984). The syntactic knowledge of individuals with fluent aphasia has received much less attention in the literature. This is due in part, perhaps, to the traditional association of nonfluency with agrammatism, as opposed to fluent output associated semantic deficits (e.g., Goodglass, Quadfasel, and Timberlake, 1964; Goodglass and Kaplan, 1972). Studies of syntactic production in fluent aphasia report somewhat conflicting findings. While Buckingham and Kertesz (1974) described the spontaneous speech of Wernicke's patients as containing intact grammatical structures, others have found restricted ranges of sentence types and/or a tendency to use concatenated clauses rather than more complex clausal embedding (Gleason, Goodglass, Obler, Green, Hyde, and Weintraub, 1980; Martin and Blossom-Stach, 1986).

This study investigates the extent to which syntactic abilities are either preserved or disordered in fluent aphasia, regardless of the presence or absence of other symptomatology. Two types of aphasia are studied here, which on the surfacce present very difficult clinical pictures: Wernicke's aphasia and anomic aphasia. Several questions regarding the syntactic constructions found in the spontaneous speech of these aphasic individuals are examined. First, is syntactic facility preserved in the fluent aphasias? Syntactic facility is defined here as the ability to produce a range of sentence types, from simple sentences to multiclausal and embedded constructions. Second, do these patients produce utterances that contain syntactic errors (as opposed to morphological errors or utterances ill-formed due to paraphasias or neologisms)? Third, if there is a normal range of syntactic constructions, is it the case that the majority of their utterances are "simple" in structure, or do they produce embedded/multiclausal constructions to the same extent as found in non-neurologically impaired controls?

A second area of investigation is the neuroanatomical and neurophysiological correlates of fluency. While fluent aphasias are primarily associated with posterior lesions, there is some evidence from PET studies to suggest that frontal hypometabolism can be found even in individuals with fluent aphasia (Metter, Kempler, Hanson, Jackson, Mazziotta, and Phelps, 1986). The questions addressed here are (1) are there significant neuroanatomical/neurophysiological differences found between fluent aphasia subjects (here, between Wernicke's and anomic types), and (2) is frontal hypometabolism, suggested as being associated with difficulties in sequencing speech output (Metter, 1987), associated with poorer syntactic facility in spontaneous speech?

METHODOLOGY

SUBJECTS

Eleven fluent aphasic individuals (six anomic and five Wernicke's cases) and six normal controls were selected for participation in the study. All of the subjects in the study were right-handed males, and all were native speakers of English. The aphasic subjects were tested using the Western Aphasia Battery (WAB) (Kertesz, 1982) and were selected on the basis of their score on the fluency measure (all had scores of at least 5 out of a possible 10 points). They were subsequently classified as having either Wernicke's or anomic aphasia based on their WAB profile. All of the aphasic subjects had at least some intelligible speech. The data on the subjects are presented in Table 25-1. The anomic subjects ranged in age from 56 to 63 ($\bar{X}$ = 63.67), the Wernicke's from 53 to 74 years ($\bar{X}$ = 66.4) and the normal subjects somewhat older (range = 70–76; $\bar{X}$ = 72.17).

SPEECH SAMPLES

The speech samples were collected as part of a larger data base on the speech of aphasic individuals. Each subject was asked open-ended questions concerning their family, occupation, hobbies, and medical history. The samples thus contain narrative portions interrupted as appropriate by questions or comments by the examiner. In addition, each subject was asked to describe the Cookie Theft picture (Goodglass and Kaplan, 1983). The samples were recorded on an Ampex AG-600 reel-to-reel tape recorder in a sound-treated test booth.

Fifty of each patient's utterances were selected for use in the data analysis. The utterances were consecutive to the degree that this was possible, but certain types of utterances were excluded from this corpus; "yes," "no," formulaic phrases ("I'm fine," "I don't know"), and interrupted (and thus unfinished) utterances were not used. However, sentences containing jargon or neologisms were included. Intonation was used as a guide in determining utterance boundaries when jargon was present. Seven of the patients and all of the control subjects had sufficient samples of conversation such that all of the analyzed utterances were taken from that section of the speech sample; four of the speech samples of the aphasic individuals (three anomics and one Wernicke's case) were insufficient in length; in these cases the Cookie Theft description was used to supplement the sample. The samples were then analyzed for the following:

TABLE 25-1. BACKGROUND INFORMATION ON APHASIC AND CONTROL SUBJECTS

Subject	*Aphasia quotient*	*Age*	*Months post-onset*
	ANOMIC GROUP		
A1	86.6	73	32
A2	84.2	67	68
A3	72.4	60	70
A4	95.4	63	1
A5	86.1	63	8
A6	96.4	56	52
$\bar{X}$	86.85	63.67	38.5
SD	8.73	5.85	29.74
	WERNICKE'S GROUP		
W1	38.4	63	2
W2	22.7	53	2
W3	45.1	73	1
W4	57.0	74	32
W5	45.0	69	1
$\bar{X}$	41.58	66.4	7.6
SD	12.56	8.65	13.65
	CONTROL GROUP		
N1		73	
N2		70	
N3		71	
N4		73	
N5		70	
N6		76	
$\bar{X}$		72.17	
SD		2.14	

1. *Syntactic range:* Each sentence in the sample of 50 utterances was coded for syntactic type (sentence type categories are listed in Table 25-2 along with examples of each taken from the samples). All subjects had utterances that were not codable on this measure because they were not complete sentences (e.g., responses to questions and otherwise appropriate sentence fragments). Utterances could be coded more than once (e.g., if they contained a relative clause and an adverbial clause, both were scored). It is important to note that utterances were scored only if enough of the utterance was intelligible to determine the sentence type. Thus, this

TABLE 25-2. SENTENCE TYPES USED IN CALCULATING SYNTACTIC RANGE

(All sample utterances are from aphasics with the exception of #4.)

1. Simple S
   "I don't /kæʃ/ in a /bɛrɪŋ kæʒnəˆ/ in the /peɪgəˆ/."
2. Conjoined S (with *or, and,* or *but*)
   "We took great big people, things, and we, we made things and big things."
3. Questions (yes/no and *wh-* Q's)
   "What time am I /kəˆmɛfən/?"
4. Subject relatives*
   "The one that lives in McKowan, he's completely retired."
5. Object relatives*
   "She's got, uh, /s/, her, uh, thing that she goes into."
6. Same subject infinitival clauses*
   "This afternoon I'm gonna get a food."
7. Different subject infinitival clauses*
   "Christ, it was so hard to sell the big American dar, I sold Toyotas."
8. Passives
   "What can it be heard that (ðɔrnI bɔrd/ in /əgæs/?"
9. Other topicalizations*
   "It's her, her /s/ son, he's he'd runned a /k/, a car."
10. Comparatives*
    "Cars were . . . worth /mʌʔ/ more /ə/ here than were, they were back east."
11. Indirect discourse*
    "So they said, well, uh, we, we, we can, we can . . . why don't you merge with us?"
12. Adverbials* (time, place or manner clauses)
    "After I graduated from /pfrɛIzIr/, I went to the war."
13. Other complements*
    "I don't know what to say about it."

* Indicates construction type included in calculation for percent embedded/multiclausal

represents a conservative measure of the ability of the Wernicke's subjects; these subjects had smaller intelligible samples in which to demonstrate their syntactic range due to the elimination of utterances that were not codable because of the quantity of jargon.

2. *Syntactic well-formedness:* For this score, only errors related to the actual syntactic structure were counted, such as relative clauses missing a required head, and other missing or misplaced constituents. Because this analysis focused on the extent to which syntactic knowledge could be impaired or preserved, neither jargon nor errors on morphology (e.g., subject-verb agreement, tense, noun plurals) were counted as errors in this category.

3. *Percent of sample embedded/multiclausal:* To investigate the possibility that the samples were largely composed of "simple" constructions, an overall percentage of the sample that contained constructions classified as embedded, multiclausal was calculated (see Table 25-2 for a list of which constructions were included).

RESULTS

The group means and standard deviations are presented in Table 25-3. One-way ANOVAs were done for each of these scores to compare the performance of the anomic aphasic subjects, the Wernicke's aphasic subjects, and the control subjects. No effect was found for group on syntactic range ($F[2, 14] = .092$; $p < .91$), percent embedded/multiclausal ($F[2,14] = 1.179$; $p < .34$), or for utterances containing syntactic errors ($F[2, 14] = 3.21$; $p < .07$), although the last approaches significance (.05). Post-

TABLE 25-3. GROUP MEANS AND STANDARD DEVIATIONS ON SYNTACTIC MEASURES

Group	*Syntactic range (13 possible)*	*Percent embedded multiclausal*	*Syntactic error (N out of 50)*
Anomic			
$\bar{X}$	7.3	23.3	3.5
SD	2.1	10.3	3.3
Wernicke's			
$\bar{X}$	7.8	16.0	1.2
SD	1.8	7.9	1.3
Control			
$\bar{X}$	7.5	22.7	0.5
SD	1.5	7.2	0.8

hoc Fisher PLSD indicated that, for percent syntactic error, the anomic group differed statistically significantly from the normals ($p < .05$). This difference between the aphasic groups may reflect the fact that the word-finding difficulties of the anomic subjects may have led to omission of words crucial to syntactic well-formedness (e.g., an argument of a verb or even the verb itself). It is also possible that the jargon of the Wernicke's subjects obscured some possible syntactic errors.

NEUROIMAGING DATA: ANATOMICAL AND METABOLIC CORRELATES OF FLUENCY

Noncontrast computed tomography (CT) scans were done on each patient, with regions of interest rated on a five-point scale (Kempler, Metter, Jackson, Hanson, Riege, Mazziotta, and Phelps, 1988). Positron emission tomography (PET) NeuroECAT scans were also done on each of the aphasic subjects. F-18 Flurodeoxyglucose (FDG) was used with the patients scanned in a resting state with eyes and ears unoccluded. Metabolic ratios of portions of the left hemisphere to homologous portions of the essentially normal right hemisphere were calculated for 16 regions of interest (this is also described in Kempler et al., 1988).

The structural damage for both types of fluent aphasic subjects included here largely corresponds to that reported by Benson (1967), who found that fluent aphasia was associated primarily with lesions whose foci was posterior to the rolandic fissure (although several of our patients showed some damage also extending anterior to this point). A Mann-Whitney U procedure performed on the CT data revealed statistically significant differences between the anomic and Wernicke's aphasics in the degree of damage for three areas: F4, a high frontal area (two anomic patients had slight atrophy or damage; Wernicke's patients had none); Broca's area (B1); and the occipital region (both areas where some Wernicke's patients had mild to moderate damage, but anomics had none). For all other regions, there were no statistically significant differences found for the two groups. The group means on the metabolic data are much lower for the Wernicke's subjects throughout the temporoparietal area; however, the differences between the two aphasic groups was statistically significant in only one region: W1, in Wernicke's area, ($t[9] = 2.81$, $p = .02$).

Frontal metabolism was variable in the two groups, with two Wernicke's subjects and four anomic subjects demonstrating statistically significant metabolic depression in frontal and prefrontal areas. A study of the speech output of subjects with mild (anomic) aphasia (Illes, Metter, Dennings, Jackson, Kempler, Hanson, Mazziotta, and Phelps, 1988) indicated that there may be a decrease in the structural complexity of spontan-

eous speech associated with frontal hypometabolism. However, this study did not include Wernicke's subjects and did not examine the issue of the syntactic range of the subjects. To evaluate the relationship of the hypometabolism to syntactic facility in both types of fluent aphasic individuals included here, a one-factor ANOVA was used to compare the aphasic subjects grouped according to the presence or absence of frontal hypometabolism, regardless of their clinical diagnosis, on their syntactic range score. A statistically significant effect for group was found ($F[1, 9] = 11.38$, $p = .0082$), with the hypometabolic group scoring lower on this measure, although still within the normal range.

DISCUSSION

The major finding of this study is that fluent aphasics as a group demonstrate preservation of syntactic facility in spontaneous speech, with their utterances varied in structure and generally syntactically well-formed. Thus, at least on a task where fluent individuals are given few restrictions on the structure of their responses and are allowed to maintain some control of the topic, there are no statistically significant group differences on the measures of syntactic facility used here. These results are all the more striking in the face of the many other clinical and behavioral differences between not only the aphasic individuals and normals, but also between the two aphasic groups. These results suggest that the impression that the conversational utterances of fluent aphasic individuals are ill-formed is not attributable to a syntactic deficit, but rather to the jargon, neologisms, or word-finding problems that characterize these groups clinically.

Second, we found the lesions of our aphasic subject to be consistent with traditional association of fluent aphasias with posterior damage. We found few statistically significant structural or metabolic differences between the groups (in spite of the differences in severity of aphasia). Finally, functional integrity of the frontal area more than clinical typology appears to differentiate groups on the basis of their syntactic range, with decreased frontal metabolism being associated with a slightly decreased (but still normal) range of syntactic structures in spontaneous speech.

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DISCUSSION

Q = question; A = answer; C = comments.

Q. Did you test syntactic comprehension in these patients?

A. Yes, that's the logical next step. I don't have the data here, but I can tell you that at least one of the Wernicke's patients was just untestable. We abandoned the test. Many of the Wernicke's subjects did quite poorly on the WAB.

Q. These patients certainly produce syntactically well-formed sentences, but were they using the sentence frames correctly?

A. Well we didn't, for example, do any kind of analysis that would show that it was appropriate to topicalize or appropriate to highlight an NP or use passive or anything like that. To be honest, a lot of the times especially with the Wernicke's subjects, they were off and running, and I wasn't exactly sure what the target or the topic was. I was glad I wasn't doing a lexical or a semantic analysis. So, no I really don't have anything to say about that. In a couple of cases real simple things come to mind, like they did ask a question when they should have asked a question. But other than that I don't think I really can comment.

C. I've had fluent aphasics who, in a constrained sentence production task where you give them an action picture and ask them to start a sentence with a particular noun that would require them to produce a passive sentence, instead produce an active sentence that's then inaccurate. So then maybe syntactic fluency would have been a better term than syntactic facility.

A. Actually, for what you're describing, the forced elicitation procedure, that kind of response is real typical of kids. I mean we don't ever use passives. It's not unheard of for a normal child and a normal adult essentially to reject the frame and just start over or to have trouble with that particular kind of task.

Q. I have two or three questions. First of all I wanted to ask you, did you look at word order at all, and did you see any departures from word order?

A. The primary syntactic error was omission of a required constituent. But the other that did occur was on word order, and there were only a couple. As I recall they had to do with a PP being kind of in a strange place, like at the beginning of the verb frame. There were a few of those errors, but they were relatively rare.

Q. Another critical issue is, how did you arrive at these 13 categories in terms of syntactic range? You say that there are no differences between clinical groupings within posterior aphasics, but if you looked at a different range, I mean outside of these 13, you probably could find something else.

A. Do you have a suggestion for kinds of construction that you feel is critical and was omitted?

Q. Well, I think that for the number of the dependent clauses and nonfinite clauses, for example, there are some differences. I did a number of studies, not in English but in Polish, which indicated there was impairment at the morphological level. At the syntactic level there was a very conspicuous reduction in syntactic range, so, you know,

there was no doubt about it that syntax was disrupted. And in view of this I wanted to ask you another question. If you looked at the question of omissions, as opposed to substitutions, what did you find out? Was there any pattern or were there any primary omissions?

A. I'd have to look over the data again, but I don't recall any instance where an incorrect type of word was substituted for a particular constituent. There was jargon, so maybe there was in that jargon a preposition where there should have been a verb. But I don't recall any instances where there was a wrong constituent used.

C. Because, again, in my data I found a lot of omissions and a lot of substitutions.

A. And these were Wernicke's and anomic subjects?

C. Yes, these were Wernicke's and anomic subjects, but speakers of Polish, a highly inflectional language.

A. It's always dangerous to take our good old analysis of English and make big generalities, but English morphology being as impoverished and English word order being as strong as they are, that may have something to do with differing results. I'd be interested to see your data.

C. I might have just one general comment about the use of production tasks. Unfortunately, well, maybe fortunately it doesn't pertain completely to your results because you get no differences among groups, but however, there's a perfect confound between the complexity of a sentence and it's length. And so more complex sentences are longer. And I think it's real, real difficult to tease those things apart when you have a free production task, and I think you have to be very careful when you do things like that; to consider that if you find some sort of impairment, you don't know whether that impairment has to do with a "syntactic" deficit or whether it's due to some type of deficit that has to do with the length of the utterance and has nothing to do with syntax at all.

A. I have two comments about that. At least in comprehension, there's a way for teasing that apart.

C. Sure, absolutely.

A. It was the case that the Wernicke's subjects seemed to be prototypical fluent aphasics. They did tend to have long utterances. Maybe what I should do is calculate some kind of MLU or measure of length. It's confounded; regardless of length, they produced complex utterances, but they certainly produced long utterances that went on and on.

C. Right, that's why it doesn't make it exactly. The comment I'm making would be a lot stronger if you had found, you know, these syntactic deficits in the fluent aphasics.