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Paragrammatisms*

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Abstract

Grammatically incorrect sentences (paragrammatisms) are characteristic of the spontaneous speech of fluent aphasics. The paragrammatisms produced by five neologistic jargon aphasics are analysed and compared to the paragrammatisms of four normal control subjects. We show that the paragrammatisms of the aphasics are qualitatively identical to the grammatical errors of normal subjects, although they are much more frequent. The reason for this is discussed in terms of models of speech production; we argue that paragrammatisms are a consequence of a breakdown in the control processes.

Introduction

The characterisation of grammatical processes in models of speech production has typically been motivated by consideration of errors in normal speech, but recently support has been sought also in the specific deficits observed in the speech of "agrammatic" aphasic patients (Garrett, 1982; Schwartz, 1987). In this paper, we test the adequacy of models of speech production against a

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different class of patient and attempt to find a unified account for grammatical errors in aphasic and normal speakers.

The term "paragrammatism" has two distinct, but related senses. In the first sense a paragrammatism is a kind of utterance; it denotes simply a type of syntactic error in which word order, syntactic structure or grammatical morphology is disturbed. It leaves open the question as to whether the presence in speech of these errors is the signature of an aphasic syndrome. Kleist (1916) who introduced the term used it in a different sense: here paragrammatism denotes an aphasic syndrome[1] in which there is an expressive disturbance characterised by the presence of these errors. It is distinguished from "agrammatism" in that paragrammatism presents confused and erroneous syntax and morphology instead of an absence of grammatical structure, omission of grammatical particles and "telegraphic" style in speech. Kleist claimed that this syndrome is further contrasted with agrammatism by being associated with impaired comprehension typical of Wernicke's aphasia and is consequent upon damage to the temporal region of the cortex, rather than the frontal regions.

Now, although the distinction between agrammatic and paragrammatic speech appears straightforward, it has been realised since at least Isserlin in 1922 that errors of both kinds can occur together in the speech of a single patient. Weisenburg and McBride, for example, wrote in 1935,

> Agrammatism ... is often somewhat complicated by confusions characteristic of paragrammatism. Furthermore, the style is never that of a perfect telegram, nor is there conscious omission of all but essential words. (p. 61).

Moreover, reduced syntactic structure and omission of grammatical particles can be found in patients with fluent, generally paragrammatic speech and poor comprehension (see below).

The appearance of incorrect syntactic structure can come about by the presence of, say, a noun in place of an adjective or the wrong inflected form of a verb, both of which may be the result of an error of lexical selection. Indeed, the omission of words may lead to a structural error, and it will be a delicate matter whether this is to be ascribed to reduced, agrammatic, syntax or to confused, paragrammatic, syntax.

These problems in the classification of errors become crucial when one tries to identify the functional disorder underlying the disturbance in speech. Pick (1931), for example, attributed paragrammatic errors to a disturbance in the formation of sentence schemata, whereas verbal paraphasias were attri-

[1]Kleist's data in fact comes from psychiatric patients, and not aphasics. He believed that the aphasic disorders could be seen in 'purer' form in psychiatric patients.

buted to the disturbance of a quite separate stage in the translation of thought into speech, that of word choice. Where the substitution of a single word would turn a paragrammatic string into a legal sentence, are we to attribute the error to the formation of the schema or to the choice of word?

More generally, for paragrammatism to make sense as a syndrome, a different account for reduced structure and the omission of grammatical particles must be offered from the account offered for confused syntax, morphology or word choice.

Apart from Pick and Kleist, the literature on aphasia, though full of accounts of agrammatism, has little to offer by way of a theory of paragrammatism. There seem to us four broad options consistent with available data and ideas about the nature of aphasic speech disturbances. These hypotheses are as follows:

(1) Syntactical disturbance. Along the lines suggested by Pick (1931), this would consist of a failure of inhibition at the level of the formation of sentence schemata, and lead to the construction of incorrect grammatical structures. Rather than a failure of inhibition, Kleist (1916) considered that paragrammatism resulted from 'irregular arousal' of sentence schemata.[2] An alternative formulation of a syntactic deficit would be to claim either that the rules for generating phrase markers have been corrupted, or that constraints on generation ("filters" in modern terminology) have been lost. This hypothesis would predict a quite general failure to produce grammatical output, with perhaps only simple heavily-used constructions being produced correctly. Recent accounts of agrammatism (Bradley, Garrett, & Zurif, 1980; Cooper & Zurif, 1983), propose that a syntactical disturbance may be located in an impairment in the correct use of morphemes carrying the major burden of grammatical structure—"function" or "closed class" words, and bound grammatical morphemes.

(2) Lexical selection impairment, but with no deficit in syntax as such. All paragrammatic output can be reanalysed in terms of word selection errors. Here one might predict that word-finding difficulty and/or the incidence of neologisms (believed by Butterworth, 1979, for example, to mask a word-finding problem) are associated with the incidence of paragrammatisms.

(3) Monitoring failure. Paragrammatisms result from a failure in the monitoring of output. In normal subjects, this monitoring mechanism prevents overt errors in speech production; in paragrammatic patients, grammat-

[2]Kleist in fact argued that all the characteristics of Wernicke's aphasics reflect 'irregular activation', but at different production levels. At a 'sentence schema' level this gave paragrammatisms; at the level of word-finding paraphasias, and at the level of sound finding (*Lautfindung*) phonemic errors.

ical errors which are normally edited out somehow get through. To the extent that the mechanisms for monitoring one's own speech also serve to comprehend other people's (as claimed for normal speakers by Levelt, 1983 and for fluent aphasics by Ellis, Miller, & Sin, 1983), then paragrammatic speakers should show poor auditory comprehension. And they should show other kinds of failures to edit speech errors by, for example, producing neologisms. Kinsbourne and Warrington (1963) are among many who see fluent neologising speech as resulting from impaired monitoring and a general inability to inhibit incorrect output.

This does not exhaust the possibilities, of course. Pick, following Freud (1891), saw close parallels between aphasic errors and the slips of the tongue normal speakers are prone to. In both, a transient attentional disturbance, leading to a failure of inhibition at one or more stages in the speech production process, could play a role. If it is the case that paragrammatic errors are qualitatively identical to normal errors, this would strongly constrain the kinds of account appropriate to the aphasic case (see Butterworth, 1985). It is clear that normal speakers do make slips resulting in errors of syntax and grammatical morphology, as has been attested in the collections made by numerous students of slips of the tongue (Fromkin, 1973, 1980; Garnham, Shillcock, Brown, Mill, & Cutler, 1982; Meringer & Mayer, 1895; Garrett, 1980, 1982; etc.) Specific proposals have been offered to explain some errors of word order by Fay (1982), Butterworth (1982, 1985) and Harley (1985). Interestingly, in these proposals, the presence of error is not attributed to a deficit in syntactic processing as such, or to impaired lexical selection, but to the blending of two or more well-formed sentences. Butterworth (1985) applies this approach to the analysis of the speech of one jargon aphasic patient. He argues that there is no intrinsic impairment of language processing, including syntactic processing, but transient failures of *control*, of the kind observed in normal slips of the tongue. The production of paragrammatisms has to do with the speech production processes themselves, and not with external monitoring; and in general, he maintains (as does Laver, 1980, for example) that speech monitoring mechanisms are independent of comprehension processes. Hence (4):

(4) Control impairment. Paragrammatisms are just normal slips of the tongue, and paragrammatic patients simply produce more of them than normal speakers. Construing this more broadly than Butterworth (1985), can aphasic paragrammatisms be analysed in terms of the mechanisms of normal errors? The relevant mechanisms are, briefly,

- word omission
- word substitution
- word movement
- sentence blending.

It also needs to be established whether the constraints on these processes found in normal speakers are found also in our aphasic population: whether the same kinds of words are omitted, moved or substituted and in the same ways; and whether sentence blending follows the same pattern.

In this study, we analysed 11,000 words from the speech of five fluent neologising aphasic patients, and for comparison, about 12,000 words from four normal speakers. From this corpus, we identified all the sentences that are ungrammatical with respect to the speaker's own dialect. These sentences were assigned to the following categories (for details see Analysis below):

- open class lexical errors
- closed class lexical errors
- errors of grammatical inflexion
- constructional errors (constituent order violations etc.)
- residual errors.

Since we cannot assume that all patients who produce paragrammatisms will produce grammatical errors of the same kind, the data from each patient is presented individually. In addition to these speech disturbances, the ability, if any, of patients to produce correct grammatical output was examined. We also, where possible, assessed the comprehension abilities of the patients.

The four hypotheses above make clearly different predictions as to the pattern of paragrammatic error that should be found.

(1) Syntactical disturbance. Lexical errors should not exhaust the types of error found. There should be a particular impairment in the control of closed class words and inflexions. Correct long or complex sentences should not be observed.

(2) Lexical selection impairment. Paragrammatisms analysable in terms of a single wrong word should predominate, and they should be associated mainly with open class words—nouns, verbs and adjectives—which are the ones typically involved in lexical selection error and in neologistic items. Speakers who are particularly impaired on lexical selection should also be those producing the most paragrammatisms. Thus, to the extent that neologising reflects lexical selection impairment, the incidence of paragrammatism should be correlated with the incidence of neologism. There should

be few, if any, constructional or residual errors. No association with poor comprehension is predicted, nor is there any reason why complex sentences should not occasionally be produced correctly.

(3) Monitoring failure. This predicts that all our patients should have poor comprehension. If this failure is general, then the degree of monitoring impairment, evidenced in the rate of neologisms, should correlate with the rate of paragrammatisms.

(4) Control impairment. There is no reason for the rate of paragrammatisms to correlate with neologisms or comprehension. Patient errors, though more frequent, should be of the same types as normal errors, and should pattern in the same ways.

Subjects

Five patients were selected for the presence of grammatical errors in their speech. An extended sample of their speech is presented in their case details.

For comparison purposes, the speech of four normal subjects ('Controls') was analysed. No attempt was made to match these subjects with the patients. IR was a 29-year-old male solicitor at the time of testing; CP was a 57-year-old retired woman with High School education; DG was a 27-year-old graduate student and JA was a 29-year-old teacher with education to Master's level. The comparison sample was taken from a study of speech planning carried out by Ms Helen Petrie as part of her Ph.D. work (under the supervision of the first author). Further details can be found in Petrie (1987).

Patients

1. NS

In September 1979, when working as a scaffolder NS was struck on the head with a heavy weight and fell 40 feet to the ground. On admission to hospital he was unconscious with fixed pupils, but he was restless and moving all four limbs. X rays showed a comminuted fracture of the left side of the skull, depressed fracture of the left temporal bone, fracture of the left orbit, and a fracture of the first rib. A CAT scan showed bilateral temporal lobe contusion. Two weeks later he was conscious and obeying simple commands; a left hemiparesis had become apparent with increased tone and brisk reflexes on that side. The interview on which this analysis of his speech is based took place in the middle of November 1979 (i.e., 8 weeks post onset). At this point his hemiparesis had resolved, and he was walking normally. His speech was

fluent and neologistic. At this time, an attempt was made to assess his aphasia using the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1972), but he was not very cooperative. In the 'word discrimination' section he pointed to all named pictures, actions, letters, colours, and shapes correctly, indicating reasonable single word comprehension, but he was unwilling to be involved in any further testing of comprehension. He was unable to name any pictures, actions, colours or shapes; errors were mostly neologisms. Repetition was sometimes paraphasic and strongly 'augmented' (e.g., 'glove' → 'that's right; a glove or an /æstək/'). He could match single written words to pictures and read letters, words or sentences aloud fluently. It was not clear how much he understood of this. He was euphoric and sometimes aggressive; he denied that he had any language difficulty, and discharged himself (against medical advice) two days after this interview:

> E: What happend to you?
> NS: Across the star road there used to be one – one l-lavender you know for the spray – the top road, the top lavender /ˈhaɪdreɪ/
> E: Hydrate?
> NS: Yeah the hydrate. There was a very small /rʌd/ with some toy /ˈæb reɪ/ in, and they were put across the high field – put the /lʌdz/ on, but they were all put on a—er—a wall, actually, a high wall which was up—above the first rail, and they /dɪˈfaɪdɪd/ to put silkworms on there which were hydrated—they were electric /reɪdz/ with big holes in and they were just /reɪst/ up and put over two /baɪlz/ which were already /sneɪkt/ in.

2. JF

In October 1978, JF fell 20 feet onto a concrete floor. On admission to hospital he was deeply unconscious, but responding to painful stimuli. All reflexes were brisk and his pupils were equal and responding sluggishly to light. X rays showed a left parietal fracture, fractures of the first four lumbar vertebrae and the left femur. Two days later his left parietal wound was opened and some clot removed. A CAT scan showed severe bilateral temporal lobe contusion with an indriven fragment of bone in the left temporal lobe.

This analysis is based on an interview in February 1979 (about 4 months post onset). Apart from slightly brisk reflexes, and neologistic jargon aphasia, his neurological signs were normal. A CAT scan showed infarction in the left posterior frontal and left anterior temporal regions. He was assessed on the BDAE. Comprehension of single words was good: he was correct on 34/36 items in the 'word discrimination' section, and 19/20 body parts. On a set of auditory commands used in that hospital he managed 10/10 including the

most complex—'Wave your hand, nod your head and close your eyes all at the same time'. On the BDAE 'complex ideational material' he scored 6/12, but this may be because he had particular difficulty in using 'yes' and 'no' correctly. Naming was poor; he managed only one object and two actions correctly; he failed on all colours and shapes. He repeated all single words and 'high probability sentences' correctly but failed on all the 'low probability sentences'. Repeated presentation of a sentence just beyond his span did not result in any improvement in performance. He could read most single words aloud and match them to pictures; it was noted that when he misread them (e.g., DRAINPIPE → '/dreɪnpɪɑʒ/') he failed in word-to-picture matching. He could spell short words out loud correctly, but when he wrote them incorrect letters sometimes intruded (e.g., 'comb' spelled aloud correctly, but written as CORB). He was usually aware of these errors and tried to improve them. His spontaneous speech was fluent and neologistic, with a 'prediliction neologism' ('/lɪ'kjʊə/'); 28% of his neologisms were related to this. He was aware that he spoke jargon.

> (talking about rain)
> JF: ... when the /vaɪs/ is coming down
> E: What's vice?
> JF: Well, I mean—well it's /blaɪm/ you know, like a—like a well what do you say, um—/lɪ'kjʊə/. You know when you /dɪhaun/ you always get the um—I know what you really call it—/bə/ I would have if I'd kept in /bɛdjʊ'eɪʃən/ all the time. I should be able to—er—/ɪd/ you get nice? /kʊdə—gʊdneɪʃən/ you know. Nice, nice /laɪʃ/—marvellous. Wet, wet.

3. KC

In 1975 KC developed transient right sided weakness and severe Wernicke's aphasia as a result of an occlusive left hemisphere cerebro-vascular accident. His auditory comprehension of language was severely impaired, picture naming and oral word reading were impossible. His speech was fluent and neologistic; the neologisms were sometimes phonologically related to a presumed target, but the majority were not. This analysis is based on a conversation recorded 2 months after onset; for a full analysis of this speech sample see Butterworth (1979).

> E: What was your job?
> KC: I could when I was a boy about three /nʌks/ years. I was very very deeply er as a /'mɛdlʌnd/ of the London er General /'vɛklɛs/—the /'læklə/—the er general /'ɛksli/. yes, that the great thing, quarter place in /'zimlɛs/ the great /'zimlɛs/, where I used to work with hundreds and hundreds, for many years. And for

years and years I was once a speaker there as a solicitor by /ˈækupʌn/. I used to known them all in /ˈzækləɪnd/ ...

4. DJ

In May 1982 DJ suddenly developed a dense right hemiplegia and dysphasia. He was found to have suffered a left intracerebral haemorrhage. Initially speech was fluent and grammatical with many neologisms; auditory comprehension was severely impaired. His comprehension improved rapidly and by July he pointed to 29/36 objects in the 'word discrimination' section of the BDAE; one month later he made no errors on this section. This analysis is based on two recordings of his spontaneous speech in July and August 1983; his speech was fluent and neologistic. Neologisms were mostly phonologically related to the target. He was aware of, and frustrated by, his aphasic speech.

(Cookie Theft)
DJ: It's—it's a young girl trying to nick a bit of /tʃʊkɪ—tʃʊkɪdʒæn/ and that piece of cake or something. The bo's—the boy's up there. She's got a hand up to take a—what is that, what is that—/kə, kə/ cookie cookie. She's wants a cookie. He's up there, up the /tʃæsˈstrəl/. Has he got his hand up, he's about to drink and a cake. He's took one down and with that the /strɔn stɪkdiŋk smɔ smɔl/. So he's nearly fell down. At the same time his wife is /fʌslɪ/ gr-growing his washing /kʊən/. It's all wet ...

5. KP

At the end of June 1980 he suffered a ruptured right middle cerebral aneurysm which was clipped 10 days later. Oedema developed after the operation and his condition deteriorated, and KP developed a right hemiplegia. A CAT scan 2 weeks later showed 'bilateral areas of low attenuation involving much of the right hemisphere and the parieto-occipital region on the left'. A further scan 2 months post onset showed mature infarcts in the right middle cerebral artery territory and the left parieto-occipital region. He was very restless, noisy and confused.

A month later he was transferred to the Eastern Hospital for rehabilitation. He was very confused and uncooperative; he showed no evidence of language comprehension and his spontaneous speech was confined to phonemic jargon. As his physical condition improved and his confusion lessened it became apparent that his main problem was a severe aphasia, with profound difficulties in comprehension of spoken and written language. After 5 months he was discharged home; no formal testing of language had been possible. However his speech was now fluent neologistic jargon, and he seemed able, on

occasions, to follow the general drift of a conversation. The speech sample on which this analysis was based was recorded in December 1983; no recent formal language assessment is available. KP is severely anomic; he named no pictures from the Western Aphasia Battery. He failed to repeat any single words; language comprehension is very limited, but KP is very sociable and adept at following the drift of a conversation. He is acutely aware of his difficulty.

> E: Can you describe your family?
> KP: er well we've got Holly, Holly, and she's a nice girl. And little boy /əz/ Neville, little boy, yes. He's sort of /ʌn/ there. um he looks .. he's sitting here actually. Here he is /ˈlæmdəswa?/ and he er he looks wonderful but he isn't. Holly, she's /gɒ?sɒn/ the new one. She's gotta be ding dong dong, ding dong dong, what's it call itself? Little boy is—little boys are not—what d'you call it?

Method

Samples of at least 1300 words of unrehearsed conversational speech were recorded for five aphasics and four normal subjects, though for two aphasic subjects some picture description material was included. These samples were transcribed and then analysed for the presence of paragrammatic errors and neologisms. See Table 1 for a summary.

As can be seen from Table 1, there is no correlation between the rate of neologisms and the rate of paragrammatisms (Spearman $r = -.10$): thus, for example, the most neologistic patient (KP) has the second lowest rate of paragrammatisms.

Analysis

In this study, we were looking only for errors which rendered the speech ungrammatical; ungrammatical that is with respect to the dialect of the subject. We also recorded neologisms, which were defined as word-forms not found in the Oxford English Dictionary; modern slang, technical words, or a speaker's dialect form were counted as correct. The presence of one or more neologisms in a sentence does not, of itself, make the sentence paragrammatic. However when neologisms were inflected, and where a grammatically correct form was determinable from the context, the error would be counted as paragrammatic (see 3b below). Substitution of words from major word categories by other words from the same category, resulting in a semantically

Table 1. *The corpus analysed: number of words, together with the incidence of neologisms and paragrammatisms in the sample, for five aphasic and four normal control subjects*

	Words in sample	Neologisms	Neologisms per 1000 words	Paragram-matisms	Paragram-matisms per 1000 words
Patient					
NS	2,275	141	62.0	33	14.5
JF	1,832	97	52.9	32	17.5
KC	2,230	164	73.5	85	38.1
DJ	3,097	55	17.8	53	17.1
KP	1,395	112	80.5	21	15.1
Total	10,829	569		226	
Mean			52.5		20.5
Control					
CP	1,896	–	–	5	2.7
JA	1,744	–	–	6	3.4
DG	4,332	–	–	13	3.0
IR	4,672	–	–	15	3.2
Total	12,644			39	
Mean					3.1

uninterpretable, but grammatically coherent sentence would not be counted as a paragrammatism.

Errors were divided into five broad categories:

(1) Open class lexical errors—where the substitution, omission or addition of a single noun, verb, adjective or some adverbs rendered the sentence ungrammatical;
(2) Closed class lexical errors—where the substitution, omission or addition of a single preposition, pronoun, determiner, quantifier, conjunction or some adverbs (e.g., "not", "only") rendered the sentence ungrammatical;
(3) Inflexional errors —where the substitution, omission or addition of an inflexional affix rendered the sentence ungrammatical;
(4) Constructional errors—where the order of words or other determinable grammatical process yielded an ungrammatical sentence. This includes the putative blending of two or more sentences;
(5) Residue—other ungrammatical strings not falling into categories 1–4.

Our classification principle assigned strings falling into more than one of these categories into the most lexical. That is, if a string could be explained by the substitution, omission or addition of a single word or inflexion, this was the preferred classification. It offers a conservative account of the disturbance leading to the error. For example,

1a.6 They're not prepared to be of *helpful*

could be analysed as a blend of two alternative ways of saying the same thing:

"They're not prepared to be *of help*."
"They're not prepared to be *helpful*."

This kind of blend has been extensively documented by Fay (1982). However, in this study, it has been classified as a lexical substitution error.

Some errors classified as major category substitutions in neologistic patients may in fact be neologisms that just happen to sound like real words—what Butterworth (1979) has termed "jargon homophones". "Shaft" in 1a.4, could be such a case. Phonemic distortions may also give rise to the appearance of a category error. "Ear" in 1a.3 could be a phonemic paraphasia of "hear"; in which case it should have been classified as a subcategory error of "hear" or "quite". However, these possible explanations depend on untestable assumptions about the speaker's target, and it seems to us a better strategy to assume that when the speaker produces something that sounds like a real word, then it is a real word that he has produced.

Altogether, we identified 226 paragrammatic errors in the patient corpus, and 39 in the control corpus. A summary is given below.

Further examples and details follow. For each type of error, we will, where possible, give one example from each of the aphasic speakers, and an example from the control subjects.

1. Open class lexical errors

1a. Major syntactic category substitution errors. In these, the speaker substitutes a word of the wrong syntactic category, for example, uses a noun where he should have used an adjective—e.g., in 1a.1.

Examples

Patients
1a.1 NS: not very *deal* at the moment
(A → N)
1a.2 JF: Yes, I quite *ear*

Table 2. *Types of paragrammatism*

Error types	Patients					Patient total	Controls
	NS	JF	KC	DJ	KP		
Open class							
Category	3	4	7	2	1	17	3
Subcategory	6	2	9	5	–	22	2
Omission	–	1	12	4	–	18	1
Addition	–	–	–	–	–	–	1
Closed class							
Category	–	–	–	–	–	–	1
Subcategory	5	4	6	5	1	21	5
Omission	4	6	8	6	5	29	9
Addition	–	–	1	2	–	3	1
Inflexional	7	9	18	18	4	56	9
Constructional	3	4	12	6	8	33	5
Residue	5	2	12	6	2	27	2
Totals	33	32	85	53	21	226	39

(V → N)
1a.3 KC: and I want everything to be so *talk*
(A → V)
1a.4 DJ: Anyway, the police are still getting very *shaft* about that
(A → N)
1a.5 KP: It happens very *good*
(ADV → A)

Control
1a.6 IR: They're not prepared to be of *helpful*
(N → A)

Seventeen examples of this error were found in the patient data, and three in the control data. All patients produced at least one such error. (The numerical results for all error types are summarised in Table 2.)

1b. Subcategory errors. In these, a word with the correct part of speech—major category— is chosen, but its subcategorisation is inappropriate in context. These errors are largely restricted to verbs and adjectives. An example would be where a transitive verb is chosen in a context with no direct object.

Naturally, in such a case an alternative analysis is that there is a NP omission; but since a NP is potentially more than one word, and since the omitted item is matter of speculation, the single word error analysis is preferred. In 1b.2, for example, the verb "sun" is transitive and can take either the reflexive—the single word "himself"—or a multi-word NP—e.g., "his pale, but muscular, torso"—as an object. Context information in this instance does not decide between reflexive or NP deletion on the one hand, and, on the other, the erroneous selection of "sunning" for, say, the subcategorically correct "sunbathing".

Examples

Patients
1b.1 NS: and *end* back down and then out
1b.2 JF: I think he's *sunning*[3]
1b.3 KC: I would be *grateful* to do anything which I should do[3]
1b.4 DJ: She was *handled* to look at the books a bit

Control
1b.5 CP: There will *become* a time

Four out of five patients produced 22 errors of this type; controls, 2 errors.

1c. Open class omissions. These are errors where a noun, verb or adjective has been omitted. This usually means that a whole phrase—NP, VP or AP—is missing which could contain material in addition to the lexical head of the phrase. Where there is a phrase missing whose content is completely conjectural, as in 1c.1, this counts as a lexical omission since there is at least some lexical material omitted.

Examples

Patients
1c.1 JF: I've done no end _____
(PP?)
1c.2 KC: I had _____ from that man who- whom is on his own.
(N or NP)
1c.3 DJ: Do you _____ nothing about pubs?
(V – "know")

Control
1c.4 DG: So arguments over who should use the phone and whether so

[3]A reviewer pointed out that both 1b.2 and 1b.3 are almost possible in American English. In British English they are, however, both clearly unacceptable.

and so was allowed to use the phone and so on _____
(VP)

Out of the 18 strings containing omissions in the patient data, 6 involved nouns or NPs, 8 involved verbs or VPs, 1 an adjective, 2 adverbs and 1 a PP.

1d. Open class additions. No examples were found in the patient corpus, and only one in the controls' speech. In this, there is an additional main verb, past tense of "have", which some might treat as a closed class item—see below.

Example

Control
1d.1 IR: They were all *had pleasant sandy beaches.*

No correction intonation was detectable after "were" or "all". An alternative analysis would be that this is a sentence blend error of "were all" and "all had", where interestingly "all" would function as a NP complement of the verb "were", and as part of the subject in the construction "They all had". Our minimal change criterion, however, rules out this option.

Overall, open class lexical errors accounted for 21% of the patients' paragrammatisms and 17% of the control subjects'.

2. Closed class lexical errors

2a. Category substitutions. This is where, for example, a pronoun is substituted for a preposition, or an auxiliary verb for a determiner. None were observed in the patients' corpus and only one in the controls'. This was:

Control
2a.1 IR: ... but I mean aggression *of* something I dislike
(V → P: "is" → "of")

2b. Subcategory substitutions. In these, although a word from the correct major category has been selected, e.g., a preposition, it is from the wrong subcategory in the syntactical context.

Examples

Patients
2b.1 NS: It'd take me at least 5 minutes *to* my house down to the bus station
(*from*)

2b.2 JF: The grapefruit is in and come *out*
(*up*)
2b.3 KC: I was fed up *to* all of them
(*with*)
2b.4 DJ: There's one works for a person *which* is the governor
(*who*)
2b.5 KP: It's annoying *to* that
(*about*)

Control
2b.6 CP: But it seems to me that *this* is a bit silly to base a play on that
(*it*)

As with all assignments to error categories, 2b.6 is tentative. One alternative would be if "this" had been raised by tough-movement to yield the well-formed clause "this is a bit silly to base a play on" making the final "that" a closed class addition (type 2d).[4]

2c. Omissions. Here a closed class item is omitted.

Examples

Patients
2c.1 NS: where someone and ____ girls, perhaps like to read that ...
DET
2c.2 JF: that ____ about right, ten a day
COPULA
2c.3 KC: Thank you very much for allow me ____ see you
TO (and "-ing" omission on "allow")
2c.4 DJ: ____ Boy and the wife
DET
2c.5 KP: Oh that's ____ bag, isn't it?
DET

Control
2c.6 JA: She also, I would like to think, when ____ makes a friend, is probably a friend for life
PRO

As in 2c.6 missing pronouns in relative clauses can appear to be illegitimate gaps. On this interpretation they correspond to illegally *filled* gaps (see 4c

[4]We are grateful to an anonymous referee for suggesting this and other potential analyses.

below), but, because of our categorisation principle, we prefer categorising these as closed class omissions.

2d. Addition. Only two patients produced these errors, and one control. Some errors we have categorised as sentence blends may also fall into this category, for example 4a.1 below. We have, further, separated off a special category of additions of lexical items in positions in relative clauses which should be gapped, in section 4c below.

Examples

Patients
2d.1 KC: Yes, that *the* great thing
DET (alternatively "is" omission)
2d.2 DJ: I am also *on* a tenant
P (He is indeed a tenant of a pub)

Control
2d.3 DG: He always wants to make sure he's winning *about* something
P

Overall, these closed class errors constitute 25% of all patients' paragrammatisms, and 45% of all controls'.

3. Inflexional errors

Inflexions can be wrong in two main ways. First, the word carrying the inflexion may be well-formed, but it is inflected inappropriately for the syntactic context. For example, a noun may be marked as a plural when the context clearly indicates a singular, e.g.

A solitary mice was chased by the cat.

Whether such errors result from the misapplication of a special process which adds the inflexion, as claimed by Garrett (1980, for example) or whether they are a species of lexical substitution, is a matter of debate (see Butterworth, 1983).

Second, a word may be inflected so as to indicate, say, the correct number, but the combination of stem and inflexion happens to be incorrect in English, e.g.

Both the mouses were chased by the cat.

We call these "formation errors" and they have been adduced as evidence for a process of routine inflexion addition. Both kinds of error are found in our data.

We examined omissions, as well as substitutions and additions, of inflex-

ions since English is a language where many noun and pronoun cases and verb conjugations are bare stems carrying no special inflexion, so inflexional omissions may be just as revealing of processing problems as inflexional additions and substitutions. In the case of the patients, we also examined the control of inflexion on neologisms where some processes may be displayed more clearly.

3a. Inflexional errors on real stems

Examples

Patients
3a.1 NS: and he go__ and set__ on
Omission of 3rd person singular
3a.2 JF: want a good towels, yes
Addition of Plural
3a.3 KC: I do have them at home, and then they're lended
Past participle formation error
3a.4 DJ: He's went to picks the [dɪkɪz]
Past tense instead of participle; Addition of 3rd singular
3a.5 KP: Right, and I wented with [ɪtʃ ʃɪtʃ]
Past tense formation error

Control
3a.6 DG: talking about very similar kind__ of competitive power games
Omission of plural

3b. Errors in inflecting neologisms. Although neologisms were found in all our patients, only three made identifiable mistakes in inflecting them. Note that we have always adopted a conservative criterion in classifying these errors: thus we assume that in 3b.2 '/trɪndl/' does not have an unmarked plural (like SHEEP), and in 3b.3 that '/zɒnɪks/' is not an infinitival form ending in -s (like TRANSFIX).

Examples

Patients
3b.1 NS: She have been used or [ə·blaɪð__]
(Tense/aspect)
3b.3 JF: A pair of swimming [trɪndl]
(Omission Plural)
3b.3 KC: There, where I was able to [zɒnɪks] ..
(Addition of -s)

Inflexional errors accounted for 26% of the patients' paragrammatisms and 21% of controls'.

4. Constructional errors

The most striking paragrammatisms are those which cannot be explained in terms of an error of single word or inflexion, and seem to result from mistakes, not in the choice of items to go into a sentence, but in the process of constructing the sentence itself. The processes underlying a good proportion of these are inscrutable, and have been consigned to the Residue category (see below, 5). However, we have some confidence in attributing the majority to one of three categories—sentence blending, problems with gaps, and problems with tags.

4a. Sentence blends. Fay (1982) describes two kinds of blend: 1. "splice blends" where part of one sentence is spliced onto the end of another, 4a.2 is an example; 2. "substitution blends" where part of one sentence replaces part of another, 4a.1 is an example. However, with sufficient ingenuity most errors could be assigned to this category, therefore we defined three criteria to make our interpretation more rigorous, restrictive and plausible. These are

1. that the two putative sentences are near synonyms;
2. that they share words in the environment of the splice or substitution;
3. that the resultant string cannot be explained as the substitution or omission of a single word.

Examples

Patients

4a.1 NS: Isn't look very dear, is it?
ISN'T VERY DEAR, IS IT?
Doesn't LOOK VERY DEAR, does it?

4a.2 JF: I mean they don't get very wet through
THEY DON'T GET VERY WET
THEY DON'T GET WET THROUGH

4a.3 KC: I'm very want it
I'M VERY keen on IT
I WANT IT

4a.4 DJ: I've got a publican
I'VE GOT A pub
I am a PUBLICAN

Controls

4a.5 IR: They were all had pleasant sandy beaches
THEY WERE ALL PLEASANT SANDY BEACHES
THEY ALL HAD PLEASANT SANDY BEACHES

4a.6 DG: The father's imagination is tends to frequent the bar
THE FATHER'S IMAGINATION IS frequenting THE BAR
THE FATHER'S IMAGINATION TENDS TO FREQUENT THE BAR

4b. Tag errors. To construct a correct tag question, it is necessary to (a) copy the subject pronoun from the main clause, or convert subject NP into the appropriate pronominal form (b) copy the auxiliary from the main clause, or insert the auxiliary *do* if there is no auxiliary, maintaining tense, aspect and number of the auxiliary, and (c) change affirmative to negative, or negative to affirmative. These errors involve, of course, closed class substitutions (4b.1–4b.4) and omissions (4b.1), but merit separate listing since tags often present the unusual occurrence of two errors very close together (4b.1 and 4b.3) and at least one patient (KP) seemed to have special difficulty with this construction.

Examples

Patients
4b.1 JF: He's um—it looks as if he's sitting, does__ he? (Wrong pronoun—presumably copied from subordinate clause—and missing negative).
4b.2 JF: He likes swimming, didn't he?
(Wrong tense)
4b.3 KP: But it's silly, aren't they?
(Wrong number on auxiliary and pronoun)
4b.4 KP: Now it's gone nasty, isn't it?
(Wrong auxiliary, should be "hasn't").

Examples of such errors in normal speakers have been reported in, for example, Garnham et al. (1982); our normal subjects made no tag errors, and, of the patients, only two errors of this kind. In fact, KP produced a high number of tag errors (8), but the majority of his tags (20) were correctly formed. (We wondered wether KP had simply forgotten the relevant parts of the main clause by the time he came to construct the tag; in this case his difficulty with tags would reflect a deficit in 'working memory' (cf. Linebarger, Schwartz, & Saffran, 1983). We might then expect errors to be more likely when the tag was farthest from the auxiliary. However, the mean number of words between the auxiliary and the tag was similar for the correct (2.6) and incorrect (2.3) tags.)

4c. Illegal NPs in relative clause gaps. The relative pronoun heading a relative clause indicates that there is a "gap" in the clause whose grammatical

role is filled by that relative pronoun. In some accounts, the relative is held to have "moved" from the position where the gap is. Thus in the sentence

The boy whom the girl kissed ____ was angry

there is a gap for the object of "kissed" in relative clause. The object is, however, designated by "whom", and, in English, this gap cannot be filled, even by an appropriate pronoun, hence

*The boy whom the girl kissed him was angry

is ungrammatical. The examples below show addition of both closed and open class items; and it may be that they should be treated as species of categories 1d and 2d, but the fact that these special sentence positions are filled by different kinds of item hints at the possibility that some common error underlies them. If patients have difficulty in holding markers in memory, gaps might present them with particular difficulty. Errors of this kind were found in the speech of both patients and controls.

Examples

Patients

4c.1 NS: Well sometimes you'll find some of these big grass glasses that something's put underneath it.

4c.2 KC: But there are a few [z mr z] occasionally that I've just looked at [ˈzʌmtrɛks] and that

4c.3 DJ: There's one works for a person which is the governor which he has a lot of people work for them

Control

4c.4 IR: at somewhere I can't remember which we walked down there

4d. Pronoun-headed relative clause in object position. Relative clauses modifying pronouns can occur when the pronoun is in subject position, but not in object position. We have come across no syntactic account of why this is the case. Pronoun headed relative clauses are usually restrictive, and the control example, as can be seen from the context, was intended to be nonrestrictive; this suggests that a pragmatic explanation may turn out to be the appropriate one. In any event, we include these two examples—the only ones in our corpus—since the patient example, if there had been no corresponding control error, might have indicated a qualitative difference in error types.

Example

Patient
4d.1 KC: And I'm only just returned it that had happened to me.

Control
4d.2 DG: She was talking about power games being played where she worked. The woman there was very jealous of her who was new in the office.

Constructional errors of all these types constituted 15% of the patients' paragrammatisms and 12% of the control subjects' paragrammatisms.

5. Residual paragrammatisms

Naturally, there were some grammatical errors which did not fit into any of the above categories. These are for the purposes of this study assigned to residual category. Most of these errors, we suspect, are sentences which contain multiple errors. Perhaps subsequent work will find a better analysis for them.

Examples

5a.1 NS: They were snake ... they were lodged, lodged rose in bin
5a.2 KC: There was the one of indicate of ['vɪntri] of foxing with one sort of matters from one orders
5a.3 KP: Very have happens

6. Intact syntactic abilities of the patients

In order to assess the extent to which syntactic abilities have been affected by neurological damage, it is necessary not only to identify those constructions where malfunctions of the sentence formation processes have occurred, but also those where it has not. Any assumption of an intrinsic deficit in these processes will be challenged by evidence of intact performance.

We have analysed two aspects of the patients' speech in which a substantial number of errors of performance have occurred, namely, construction of complex sentences and the use of inflexions; in particular, of inflexions on neologisms where one might expect speech production processes will be showing the greatest impairment.

6a. Complex constructions. All patients were able to produce correctly long and complex sentences, with multiple interdependencies of constituents.

As the following examples show, unimpaired syntactic constructions can be produced even when the meaning of the sentence is seriously awry; when, that is, semantic and pragmatic constraints on output seem not to be functioning effectively.

Examples

6a.1 NS: My father, he is the biggest envelope ever worked in Ipswich. He strikes every competition and constitution that's going. He's got everybody situated and they've got to talk to him.
(Intact: left dislocation; superlative subordinate clause formation; subject relative clause; infinitival phrase; anaphors; coordination)
6a.2 JF: He isn't covered up, is he? You'd think he'd have a cover, wouldn't you? He looks as if he's thinking about something.
(Intact: Tag question formation; subordinate clauses; negation; VP complements)
6a.3 KC: I'm very irritated with most people who are near me—the woman who comes and so on, you know, and somebody else; but they—if only they could [meɪ] me a little lane where I could get my little bit of /mɒtrænd/. I've got a lovely bit; just right.
(Intact: subject relatives; "if" subordinates; locative relative; sequence of tenses)
6a.4 DJ: On the left side, there's two people talking, not taking no notice. The first bloke in the car, he- he's shaking his fist as he wants to get past, which he can't.
(Intact: Preposed PP; left dislocated appositive NP; sentence relative)
6a.5 KP: They're very nice because they're very very pleasant there.
What is this in here? I don't know its name. Well, you can't do that, can you?
(Intact: subordinate clause; Wh-question formation; negation; tag question with modal)

6b. Inflecting neologisms. It has been argued by Butterworth (1983) that inflected forms of words could be selected whole from the mental lexicon. If so, the appearance of correctly inflected forms may tell us more about lexical selection than the intactness of syntactic control of inflexional processes. More informative are inflected neologisms, which cannot be selected whole from the lexicon.

All patients were able correctly to inflect neologisms, as can be seen from the following examples where the context provides clear indications as to the appropriate form of inflexion.

Examples

Patients

6b.1 JF: with a pair of /lɒɪsɪz/ or whatchemecallem
(Correct: Pluralisation of noun)
6b.2 JF: this person is /raʊndʒɪŋ/
(Progressive aspect of verb)
6b.3 JF: you get /dæbd/ up
(Past participle)

6b.4 NS: put over two /baɪlz/ that were /sneɪkt/ in
(Pluralisation of noun; past participle)
6b.5 NS: Mr. Lavender, he did drive all the /aɪənvɔlz/
(Pluralisation of noun)

6b.6 KC: when she /wiksəz/ a /zen/ from me
(Third singular present tense; singular noun)
6b.7 KC: I was /pleɪzd/ to see the other /dɒkjumen/
(Past participle; singular noun)

6b.8 DJ: There's a bloke trying to sell /peɪtəz/
(Pluralisation of noun)
6b.9 DJ: She then /dɪfraɪdɪd/ that ...
(Past tense)

6b.10 KP: You see nice /peɪpəneəz/
(Pluralisation of noun)

Only three of the patients made inflexional errors on neologisms (see 3 above), and in general they have good control of inflexional processes. The data on inflexions on neologisms is summarised in Table 3.

Thus, it is clear that our patients are able to use grammatical rules correctly

Table 3. *Inflexional suffixes on neologisms*

	NS		JF		KC	
Suffix is	Present	Absent	Present	Absent	Present	Absent
Obligatory	10	*2*	7	*5*	45	*1*
Indeterminate	8	30	0	24	10	20
Prohibited	*2*	45	*0*	16	*10*	32

Errors are in italics.

in constructing complex sentences and in generating grammatical inflexions for novel lexical forms, even though they are five times as likely as our controls to make errors of grammar.

Discussion

It is now possible to evaluate the four hypotheses outlined in the introduction to explain the occurrence of paragrammatic errors in aphasic speech.

1. Syntactical disturbance

According to this hypothesis, at least some rules for generating—or admitting (see Gazdar, 1982, p. 137ff.)—constituent strings have been lost or corrupted. This hypothesis makes five predictions:

(1) Incorrect lexical selection will not exhaust the kinds of paragrammatism found.
(2) To the extent that "closed class", or "function", words carry the burden of syntactic structure in the construction of syntactic frames for output (Garrett, 1980), these, rather than nouns, verbs and adjectives, should be particularly implicated in paragrammatic speech.
(3) Constructions involved in errors will not be produced correctly.
(4) Long, complex sentences will not be produced correctly.
(5) Aphasic paragrammatisms will be different in kind from those found in normal speakers, where presumably rules are intact.

Certainly, lexical errors do not exhaust the kinds of paragrammatism found. Single word errors constitute less than half (110/226) of all paragrammatisms. However, these single word errors are not especially related to the use of closed class words (53/110), as Prediction (2) above claims.

To evaluate comprehensively the third prediction, it is necessary to assign a full syntactic analysis to all constructions in corpus, and to categorise them into those always produced correctly, those never produced correctly and those sometimes produced correctly. The prediction claims that there should be at least some entries in the second category. Even if this were the case, it remains an open question as to whether a larger sample would contain correctly produced exemplars of the offending constructions. Since taxonomies exist for at best a fragment of (standard) English this task is impossible. Rather than attempt it, we have chosen to focus on a few types of construction which show errors, and where the analysis is fairly straightforward. Grammatical inflexions, though liable to error, are typically produced correctly, even

on neologistic stems (see Sections 3 and 6 above). Complex constructions involving relative clauses and tag questions are used correctly by the patients producing the errors (see Analysis Sections 4 and 6 above).

In general, as we have tried to demonstrate for each category of error, those constructions involved in patients' paragrammatisms are also found in the paragrammatisms of our normal control subjects.

Thus we have to conclude that there is little support for the idea that aphasic 'paragrammatisms' arise as a consequence of some permanent loss or corruption of grammatical rules or grammatical knowledge. However, an account in terms transient impairments specific to grammar, like Kleist's idea that paragrammatism arises from the "irregular arousal" of sentence schemata (see above p. 3), is largely immune to these criticisms. Unfortunately, this idea has not been developed in detail by Kleist, or anyone else, and it may turn out to be a version of the hypothesis of control impairment (see below).

2. *Lexical selection impairment*

Although nearly half of all paragrammatisms can be accounted for in terms of a selection failure concerning a single word, the other half have no account under this hypothesis. Moreover, to the extent that neologisms indicate a deficit in lexical selection, there is no significant correlation between the rate of neologising and the rate of paragrammatisms. Nor is there a positive correlation between the rate of neologising and the proportion of paragrammatisms attributable to lexical selection errors alone (see Table 4).

We can thus find little support for a lexical selection deficit lying at the root of the grammatical errors.

Table 4. *The incidence of neologisms and lexical paragrammatisms*

Patient	Words in sample	Neologisms	Neologisms per 1000 words	Lexical paragrammatisms	Lexical paragrammatisms per 1000 words
NS	2,275	141	62.0	18	7.9
JF	1,832	97	52.9	19	9.3
KC	2,230	164	73.5	43	19.3
DJ	3,097	55	17.8	24	7.7
KP	1,395	112	80.5	7	5.0
Total	10,829	569		111	
Mean			52.5		9.8

3. Monitoring failure

According to Levelt (1983) a speaker monitors the correctness of his speech (not necessarily only after it has been emitted) using the same mechanisms as are involved in the comprehension of the speech of others. Ellis et al. (1983) suggest that one reason for the character of fluent aphasic speech is a monitoring failure due to a deficit in comprehension processes. However, Zangwill (1960) and Butterworth (1985) have already drawn attention to the lack of association between comprehension deficits and speech phenomena in fluent aphasics. Of the patients reported here, we were able to test the auditory comprehension of three, though not as fully as we would have wished (see 'case details' above).

NS scored perfectly on the single word picture pointing tests of the BDAE (Goodglass & Kaplan, 1972); but would not cooperate further. JF scored 34/36 on the same test, and 10/10 on Commands and 19/20 on Body Parts ($z = +1.0$), but only 6/12 on Complex Ideational stimuli ($z = -0.1$); in following a set of commands he scored 10/10 including the instruction "Wave your hand, nod your head and close your eyes all at the same time" (a feat of both language comprehension and physical coordination!). DJ scored well on single word comprehension (36/36 on the BDAE), and was able to follow all the commands apart from the most complex in the test, but including "Put the watch on the other side of the pencil and turn over the card." Both KC and KP had very impaired auditory comprehension, though no formal test results are available.

A wide range of comprehension abilities are, therefore, associated with paragrammatic speech, and at least two patients had good sentence comprehension. It is worth noting that all patients produced the same kinds of paragrammatic error, and there is no quantitative correlation between the degree of comprehension impairment and the incidence of paragrammatism. Moreover, the kinds of paragrammatism found in the patients were found also in our controls who, though not tested, can be presumed to have relatively intact comprehension.

It is clear that neologistic speech and paragrammatic constructions can occur in patients with good auditory comprehension, and good awareness of their problems, as well as in patients with disturbed comprehension or awareness ('anosognosia'). Thus comprehension dissociates from paragrammatic output, and to the extent that intact comprehension is necessary for intact monitoring, monitoring failure cannot be the reason for the speech patterns found here.

4. Control impairment and the adequacy of models of speech production

The control impairment hypothesis predicts that errors will be of the same kinds as are found in the speech of normal subjects, and that constructions involved in error will also be found correctly employed. These predictions are well supported by the data.

The error types are not only found in our control corpus, but correspond to types extensively documented in the speech error literature. For many of the types reported here, the mechanisms are simple and well-known: the substitution, addition or omission of single words or of inflexions, and the blending of two alternative ways of saying the same thing. Some complex constructional errors, involving relative clauses and tag questions, although documented elsewhere, are less easy to explain. Nevertheless, any explanation must be framed so as to account for the normal speech and its errors as well as aphasic speech. That is to say, we need a model of production in which to locate the malfunctions giving rise to the observed errors.

Since the data point to transient malfunctions of an intact system, rather than permanent disruption of specific components, we need to look to what Butterworth (1980, 1985) has called the processes which control the operation of components (or subsystems) of the speech production system. These processes involve the transfer of information between system components, the initiation and termination of component processes and the checking of the output of components (cf. Laver, 1980). Unfortunately, most current models specify only the direction of transfer of information, and neglect other control functions, so it is difficult to determine which patterns of error they would predict and which they would exclude.

In Pick's (1931) model of the "translation of thought into speech", processes correspond broadly to linguistic levels. The order in which these processes are carried out, and hence the transfer of information among them, is fairly flexible. Thus, for example, the formation of a "sentence schema" may precede or follow the selection of lexical items, according to which the speaker thinks of first, and information from the earlier process will constrain the operation of the later. These processes, and malfunctions of them, are, however, conceived of as being independent, so, for example, malfunctioning in sentence formation need not cause a malfunction in subsequent lexical selection. In such a case, the correct word would appear in the wrong syntactic structure. Alternatively, the correct sentence schema could be formed, but subsequent lexical selection might malfunction, and in this case, the wrong word would appear in the correct structure. The independence of levels would fit in well with our finding that error types—say, lexical vs. constructional—are uncorrelated. Pick also believed that a given patient might be prone to error at one level rather than another, so that one would find patients with almost exclusively constructional or almost exclusively lex-

ical types. This pattern, however, was not observed, though we do not rule out its possibility.

Pick postulates only one kind of control malfunction, and that is "disinhibition". This seems to mean the tendency at a given level to produce an output that is in some respects similar to what was intended, but not exactly what was intended. In terms of Butterworth's control functions, this would be interpreted as the loss of information from a higher level, reducing the constraints on the lower level, but also as a failure in the checking mechanism to reject unintended output. To the extent that errors bear some relation to the intended locution—e.g., semantic paraphasias, phonemic paraphasias and subcategory errors—this account is supported. For other errors, he postulates the convolution of malfunctions at more than one level. Thus neologisms are held to be the result of the mis-selection of a word (verbal paraphasia) followed by a phonemic distortion of this word (phonemic paraphasia), yielding an output apparently quite unrelated to the target. (For a critique of this explanation of neologisms, see Butterworth, 1979.)

An account purely in terms of disinhibition at independent levels runs into serious difficulties for several of the observed error types. Omissions, sentence blends, and relative clause errors seem impossible to explain within this framework. More generally, Pick does not make clear whether disinhibition at a given level can lead to an illegality at that level. Can the output from the lexical level be a nonword? Can the output from the sentence schema level be an ungrammatical string? The natural interpretation is that disinhibition can lead only to misselection of words or structures. Whence, therefore, come the constructional errors?

In a series of important papers, Garrett (1975, 1980, 1982) has developed a model to account for errors in normal speech, which has recently been employed in the analysis of aphasic speech (Schwartz, 1987). The grammatical structure of the output is specified in a number of steps:

> [1] Procedures applied to the Message level representation construct the first language specific level of representation. Three aspects of the process are distinguished: (a) determination of functional level structures [which define the basic grammatical relations realised in the sentence], (b) meaning based lexical identification, and (c) assignment of lexical items to functional structures; representation is syntactic.
>
> [2] Procedures applied to Functional Level representations construct a ['Positional Level'] representation which reflects utterance order directly. Four aspects of the process are distinguished: (a) determination of positional level phrasal frames specifying phrasal stress and closed class vocabulary, both bound and free, (b) retrieval of lexical forms, (c) assignment to phrasal sites, and (d) assignment of phrase elements to positions in the terminal string of lexically interpreted phrasal frames; representation is phonological. (Garrett, 1982, p. 67)

As far as the overall architecture of control is concerned, step [1] precedes and "dominates" (Butterworth, 1980) step [2], and the processes designated by parenthetical letters are independent of each other. Thus, at step [1], the lexical items identified in (b) may be assigned in (c) to the wrong functional role. This mistake will be carried down through the later steps (only [2] is described here) giving rise to a word exchange error at output. Similarly, at [2], lexical forms may be assigned the wrong phrasal sites giving rise to a "stranding" exchange like (Garrett, 1980, p. 202)

It waits to pay (Target: It pays to wait)

where stems are exchanged, stranding the bound morpheme "-s", in an otherwise correct structure.

Apart from these properties, Garrett has little to say about control functions in his model. As with Pick, it is unclear whether the component processes can produce illegal (as opposed to unintended) output. Erroneous stem assignments at the positional level may result in nonwords, like (Garrett, 1980, p. 197)

I've got a load of cooken chicked
(Target: I've got a load of chicken cooked)

but can a nonword be the result of (mis)retrieval of lexical forms? Can an ungrammatical structure be produced in the determination of positional level phrasal frames? Presumably not. In which case, the constructional errors observed in our data will not be predicted. The only way, short of defining the appropriate control processes on the model, for constructional errors to be produced is if the grammatical rules at the Functional or Positional levels have been permanently corrupted or lost; but this would predict that constructions found in this kind of error would never be produced correctly by a patient, nor would normal people make errors of the same kind.

Fundamental to Garrett's account, is the distinction between open and closed class morphemes. The selection of the former is quite independent of the latter, which are under the direct control of the syntactic processes used in the construction of positional frames. One striking feature of the observed error pattern is that category (but not subcategory) errors are confined to open class words. At first sight, this would support Garrett's distinction. However, these data may be artefactual since we relied heavily on closed class morphemes to determine syntactic category of the phrase in which they occurred, hence we would tend to classify a categorial mismatch between adjacent closed and open class words as an open class error. Secondly, our method is to count any output that sounds like a word as the word it sounds like. Now since neologisms overwhelmingly substitute for open class words (Butterworth, 1979) and phonemic errors overwhelmingly involve open class

words (Garrett, 1980), many of the items in open class positions that sound like open class category errors may in reality be categorically correct neologisms or phonemic paraphasias. Thus in

1a.3 KC: and I want everything to be so *talk*

the offending *talk* might well be "jargon homophone", i.e., a neologism that just happens to sound like the word "talk"; and in

1a.2 JF: Yes, I quite *ear*

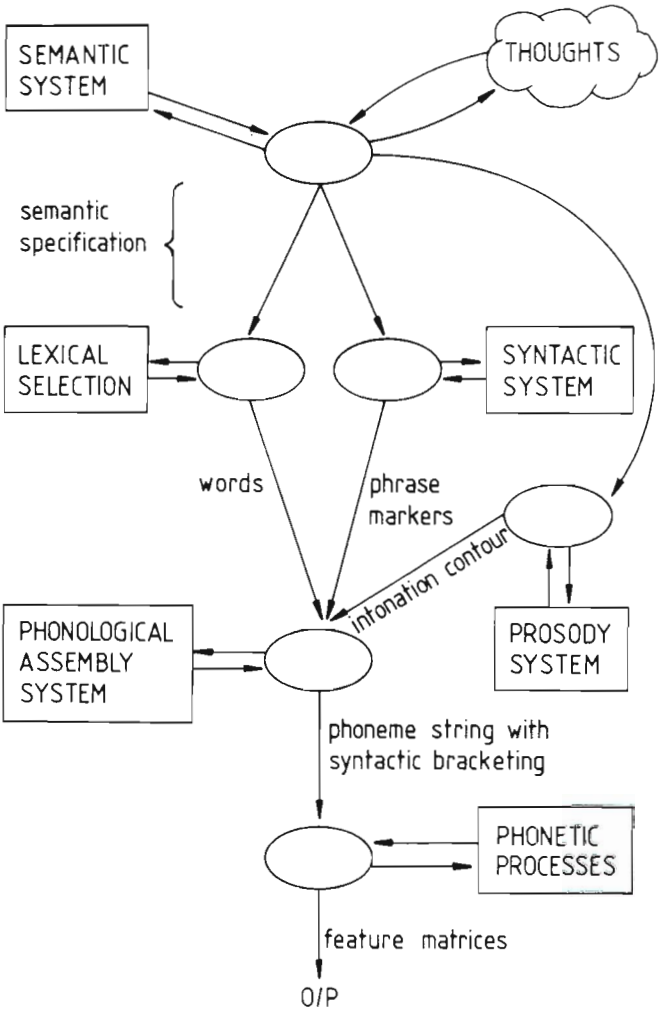
the offending *ear* could have been a phonemic paraphasia of the categorically correct "hear". However, we cannot know for sure what the speakers were doing, and we felt it better to follow the conservative research strategy of minimising the error ascribed to the speaker. Nevertheless, it is possible that closed and open class words do pattern differently, and methods may be developed to identify these differences with confidence.

In Butterworth's (1980, 1985) model of speech production, control functions are defined fairly explicitly in relation to the component processes in the production system. Like Pick, component processes, called "modules" are broadly equivalent to linguistic levels and are held to operate independently (see Butterworth, 1980 for a definition of independence).

The modules in Figure 1 can be briefly characterised thus:

The *semantic system* encodes a thought or intention into a semantic specification, which is interpreted by the next three systems in parallel;
The *syntactic system* produces a syntactic representation in the form of phrase markers—labelled brackets defining and ordering phrases for the clause to be produced;
The *lexical system* selects words from an inventory—a lexicon—in two stages. First, an entry from the "semantic lexicon" is accessed on the basis of the semantic specification; second, this entry is an address for the phonological form of the word in the "phonological lexicon". (For a justification of this division, see Butterworth, 1980, 1982, 1985; Howard, 1985a, b; Kempen & Huijbers, 1983; see also Garrett, 1982, described above.)
The *prosodic system* chooses an intonation contour appropriate to the semantics (e.g., statement vs. question) and the pragmatics (e.g., marking constituents as encoding new vs. old information).
The *phonological assembly system* merges the output of these three systems to yield a complex representation with words (hopefully) in the right phrases, and the principal intonational features (hopefully) on the right words. This representation will be a string of phonemes with morpheme and phrase brackets and intonational features marked on it.
The *phonetic system* erases the brackets, interprets the phonemes as phonetic feature matrices, taking into account intonational values and contextually-de-

Figure 1.



termined allophonic variation. This representation is what finally determines the action of the vocal musculature.

Each of these systems is subject to a *control system* (denoted in the figure by ovals); each of these has four functions:

1. an instruction to initiate the operation of the module;
2. the input from other modules that determines the operation of the module;

3. a check that the output from the module is correct and appropriate (see Butterworth, 1982, for details);
4. an instruction to terminate the operation of the module.

With this theoretical apparatus, we can formulate natural accounts of many features of the errors we have found. Globally, the independence of error types follows from the independence of the modules, and the presence of all aphasic error types in the comparison corpus will be a consequence of transient control malfunctions rather than permanent malfunctions in the systems themselves. Notice that these accounts are not vacuous: if, for example, particular error forms were found in one patient, but nowhere else, and if, moreover, the constructions found in errors were not found produced correctly in that patient's speech, this would point to an impairment in a particular system. Similarly, if two error types were highly correlated this would count against the independence hypothesis. It is still possible within the model, for one control oval only to be affected. This would be hard to distinguish empirically from a disorder in the associated system, though in this later case we would not expect to find constructions implicated in errors used correctly. Our data, however, indicate that all control ovals are similarly affected. Whether the control of nonlinguistic processes is also affected remains to be explored.

Admittedly, failure to find correlations in the scores of 5 subjects, does not constitute strong evidence for the independence of the underlying processes, but further support for this model—in contrast to the others—can be found in a more detailed consideration of the error types.

Omissions have natural control explanation: there could have been a failure in initiation of lexical selection, or a loss in the transfer from lexical selection to phonological assembly. The presence of inappropriate words could be the result of a failure in checking the output of lexical selection, or loss of information from the semantic specification which would mean that selection would be satisfied by a much wider range of candidates. Sentence blend errors could be the result of the overgeneration of material due to a failure to terminate the operation of systems when a candidate representation has been produced. Butterworth (1982) argues that two candidates are routinely produced by each system, and that checking consists of comparing them since it is unlikely that a system would make the same random error twice. If information is regularly lost in transfer between systems in aphasic patients, then the input to a system will be less detailed, and hence less constraining on the system's operation; in these circumstances, running the operation twice will be far more likely to yield a mismatch between the two versions, and a stringent check will require that the operations be repeated until a satisfactory match is achieved. However, given a poorly detailed input, a good match may take an unreasonably

long time to achieve for the usual match criteria, and in order to maintain socially acceptable levels of speech fluency, speakers may have to lower the criteria, or even, not check at all. In this case both candidates may be passed on to the next system (with the appearance of overgeneration) in sequence, yielding the successive utterance of two alternative ways of saying the same thing, or together, producing some blend of the two. There may be yet another reason for these patients to overgenerate. As they will probably have realised from their interlocutors' reactions, as well as from internal checking (if these mechanisms are still being employed), many of their utterances are uninterpretable. They may therefore adopt a strategy of making more than one attempt to communicate one message in the hope that one of them will be understood. The relation between sequential alternatives and blending comes out clearly in the following example:

> KC: I'm naughty there. I'm still naughty wrong, very naughty. I'm wrong.

Here, the blend is sandwiched between the two alternatives.

Some aspects of the error patterns, however, do not admit a natural account in this model. The relative clause errors are one such type. The problem here is that neither Butterworth, nor Garrett nor Pick, offer sufficient detail in their accounts of syntactic processing to predict the ways in which particular constructions may go wrong. This underdetermination of the models is also apparent when we try to explain category and subcategory errors with any degree of precision. For normal correct speech, the same category and subcategory constraints must apply to both lexical selection and the syntactic system, but in such a way as to permit the substitution errors here discussed, but also the word and morpheme movement errors documented in the speech literature (especially Garrett, 1980). Clearly, much more theoretical work is needed in this area.

5. General observations on syntactic disorders in aphasia

As Isserlin (1922) and Weisenburg and McBride (1935) have pointed out, paragrammatic and agrammatic phenomena may co-occur in the same patient. Our data reinforce this. All the features considered characteristic of "agrammatism" are found in these patients: omissions of open class words are frequent, and omissions of closed class words in fact constitute more than half (29/53) of the grammatical errors involving these categories; such omissions are held to be one characteristic of agrammatic speech (cf. Howard, 1985b). A second feature of "agrammatism" is the omission of inflexions, or to use stereotyped, especially "-ing" endings. In our paragrammatic patients,

however, no special tendency to omit rather than substitute or add inflexional material, was observed. It is therefore tempting to see the omission of closed class words and inflexions as being simply part of a continuum of error processes which include substitution and addition, where so-called "agrammatics" are at the end of the continuum where omission errors predominate (cf. Parisi, 1987).

The traditional notion of paragrammatism as a distinct pattern of aphasic impairment is not supported by this study. The speech phenomena are not peculiar to fluent aphasics, but are found in normals and some of them, at least, in dysfluent agrammatic patients. Nor is there a reliable association between a high incidence of paragrammatic errors and comprehension deficits. One can find paragrammatic errors also in the reported speech of fluent, nonneologistic patients with good comprehension—the so-called "conduction" aphasics—like EF, described by Kinsbourne and Warrington (1963); though the speech of these patients has not been subject to a sufficiently detailed analysis to allow a proper comparison.

The study of syntactic disorders in speech is, we believe, still in its early stages. A much more detailed analysis of syntactic errors is needed, in the context of a more detailed and explicit theory of syntactic production. We do not claim to have offered this theory, but we do think we have cleared some of the ground for its construction.

References

Bradley, D.C., Garrett, M.F., & Zurif, E. (1980). Syntactic deficits in Broca's aphasia. In D. Caplan (Ed.), *Biological studies of mental processes*. Cambridge, MA: MIT Press.

Butterworth, B. (1979). Hesitation and the production of verbal paraphasias and neologisms in jargon aphasia. *Brain and Language, 8*, 133–161.

Butterworth, B. (1980). Some constraints on models of language production. In Butterworth, B. (Ed.), *Language production Volume 1: Speech and talk*. London: Academic Press.

Butterworth, B. (1982). Speech errors: old data in search of new theories. In A. Cutler (Ed.), *Slips of the tongue and language production*. The Hague: Mouton.

Butterworth, B. (1983). Lexical representation. In Butterworth, B. (Ed.), *Language production Volume 2: Development, writing and other language processes*. London: Academic Press.

Butterworth, B. (1985). Jargon aphasia: processes and strategies. In S. Newman & R. Epstein (Eds.), *Current perspectives in dysphasia*. Edinburgh: Churchill Livingstone.

Cooper, W.E., & Zurif, E.B. (1983). Aphasia: information processing in production and reception. In Butterworth, B. (Ed.), *Language production, Volume 2: Development, writing and other language processes*. London: Academic Press.

Ellis, A., Miller, D., & Sin, G. (1983). Wernicke's aphasia and normal language processing: a case study in cognitive neuropsychology. *Cognition, 15*, 111–144.

Fay, D. (1982). Substitutions and splices: a study of sentence blends. In A. Cutler (Ed.), *Slips of the tongue and language production*. The Hague: Mouton.

Freud, S. (1891). *On aphasia*. Trans. E. Stengel. London: Imago. 1951.

Fromkin, V. (1973). *Speech errors as linguistic evidence*. The Hague: Mouton.

Fromkin, V. (1980). *Errors in linguistic performance: Slips of the tongue, ear, pen and hand*. New York: Academic Press.

Garnham, A., Shillcock, R.C., Brown, G.D.A., Mill, A.I.D., & Cutler, A. (1982). Slips of the tongue in the London-Lund corpus. In A. Cutler (Ed.), *Slips of the tongue and language production*. The Hague: Mouton.

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

Garrett, M.F. (1980). Levels of processing in sentence production. In B. Butterworth (Ed.), *Language production Volume 1: Speech and talk*. London: Academic Press.

Garrett, M.F. (1982). Production of speech: observations from normal and pathological language use. In A. Ellis (Ed.), *Normality and pathology in cognitive functions*. London: Academic Press.

Gazdar, G. (1982). Phrase structure grammar. In P. Jacobson & G.K. Pullum (Eds.), *The nature of syntactic representation*. Dordrecht: Reidel.

Goodglass, H. & Kaplan, E. (1972). *Assessment of aphasia and related disorders*. Philadelphia: Lea and Febiger.

Harley, T. (1985). *Speech errors and models of planning discourse*. Ph.D. Thesis, University of Cambridge.

Howard, D. (1985a). *The semantic organisation of the lexicon: Evidence from aphasia*. Ph.D. Thesis, University of London.

Howard, D. (1985b). Agrammatism. In S. Newman & R. Epstein (Eds.), *Current perspectives in dysphasia*. Edinburgh: Churchill Livingstone.

Isserlin, M. (1922). Ueber Agrammatismus. *Zeitschrift fuer die gesamte Neurologie und Psychiatrie, 75*, 332–416. (Ed. and trans. H. Droller, with D. Howard & R. Campbell, On Agrammatism. *Cognitive Neuropsychology, 2*, 303–345, 1985.)

Kempen, G., & Huijbers, P. (1983). The lexicalisation process in sentence production: selection at two removes. *Cognition, 14*, 185–209.

Kinsbourne, M., & Warrington, E.K. (1963). Jargon aphasia. *Neuropsychologia, 1*, 27–37.

Kleist, K. (1916). Ueber Leitungsafasie und grammatische Stoerungen. *Monatsschrift fuer Psychiatrie und Neurologie, 16*, 118–121.

Laver, J. (1980). Monitoring systems in the neurolinguistic control of speech production. In V. Fromkin (Ed.), *Errors in linguistic performance: Slips of the tongue, ear, pen and hand*. New York: Academic Press.

Levelt, W.J.M. (1983). Monitoring and self-repair in speech. *Cognition, 14*, 41–104.

Linebarger, M.C., Schwartz, M.F., & Saffran, E.M. (1983). Sensitivity to grammatical structure in so-called agrammatic aphasics. *Cognition, 13*, 361–392.

Meringer, R., & Mayer, C. (1895). *Versprechen und Verlesen: eine Psychologisch-Linguistische Studie*. Stuttgart: Goschen. (Reprinted Amsterdam: John Benjamins, with an Introduction by A. Cutler & D. Fay (1978).)

Parisi, D. (1987). Grammatical disturbances of speech production. In M. Coltheart, R. Job, & G. Sartori (Eds.), *The cognitive neuropsychology of language*. London: Erlbaum.

Petrie, H. (1987). Semantic and syntactic processes in speech production. Ph.D. Thesis, University of London.

Pick, A. (1931). *Aphasia*. Trans. J.W. Brown. Springfield, IL: Charles Thomas, 1973.

Schwartz, M.F. (1987). Spoken language disorders from the psycholinguistic point of view. In M. Coltheart, R. Job, & G. Sartori (Eds.), *The cognitive neuropsychology of language*. London: Erlbaum.

Weisenburg, T., & McBride, K.E. (1935). *Aphasia*. New York: Commonwealth Fund.

Zangwill, O. (1960). Speech. *Handbook of physiology: Neurophysiology III*. Baltimore: Waverly Press.

Résumé

Les phrases grammaticalement incorrectes (paragrammatismes) sont caractéristiques du langage spontané de certains aphasiques. Les paragrammatismes produits par cinq aphasiques à "jargon néologique" ont été comparés aux paragrammatismes de quatre sujets normaux de contrôle. Nous montrons que les paragrammatismes des aphasiques sont qualitativement identiques aux erreurs grammaticales des sujets normaux, mais qu'ils sont beaucoup plus fréquents. Une explication est proposée en termes de modèles de production de la parole; nous essayons de montrer que les paragrammatismes sont la conséquence d'une défaillance des processus de contrôle.