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NEUROLINGUISTIC EVIDENCE FOR SYNTACTIC PASSIVE

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1. INTRODUCTION

This paper attempts to show how data from neuropsychology bear on a central issue in generative linguistics, namely, syntactic passive formation. The data discussed come from tests of linguistic ability in agrammatic aphasics, patients whose brain damage results in a structurally selective impairment of linguistic function.

The research presented here is in line with the tradition of research in psycholinguistics that attempts to evaluate theories of grammar through direct experimentation. Most of these attempts are based on results concerning the time-course of language comprehension. Well known among past attempts is the Derivational Theory of Complexity (see Fodor, Bever & Garrett, 1974 for an excellent review). More recent is the debate in the parsing literature concerning the fit between grammatical theory and experimental results (Berwick & Weinberg, 1984. 1985: Crain & Fodor, 1985; Frazier, Clifton & Randall, 1983; Freedman & Forster, 1985 among others). Our research paradigm, unlike those just described, is not based upon reaction-time data. We argue later that this difference is advantageous because it allows us to bypass certain problems that arise in the interpretation of reaction-time experiments in psycholinguistics.

Aphasic syndromes. Acquired aphasia is a condition that invariably results from physical damage to one or more of the language areas in the brain. Damage might be due to stroke, hemorrhage, tumor, protrusion wound and the like. The classical syndromes are Broca's aphasia, Wernicke's aphasia, Conduction aphasia and global aphasia, where the standard clinical literature classifies Broca's aphasia as a disturbance in speech production,

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Wernicke's aphasia as a comprehension deficit and conduction aphasia as a repitition deficit (see Goodglass & Kaplan, 1972, for clinical details). Such classifications, however, are of little interest in the present context, as no structural variables are introduced. The phenomenon of agrammatism, on the other hand, is of considerable syntactic interest.

Agrammatism. Agrammatic patients, a subclass of Broca's aphasics, are commonly characterized as lacking facility with syntactically complex structures. In general, they produce telegraphic speech -- that is, short utterances in which grammatical formatives are either missing or erroneously chosen. Traditionally, their comprehension has been taken to be intact. Yet, recently, this has been shown to be incorrect (e.g., Caramazza & Zurif, 1976; Schwartz, Saffran & Marin, 1980). As it turns out, agrammatic comprehension of certain structures is far from perfect. Furthermore, the formal characterization of this comprehension deficit is along syntactic lines.

This means that agrammatics can comprehend some syntactic structures perfectly, while demonstrating imperfect comprehension of other structural types, including the passive. If these patterns of behavior reflected sentential complexity as computed by, say, sentence length or number of embedded clauses, then they would bear little relevance to theories of syntactic structure per se. But, in fact, agrammatic behavior patterns in a syntactically principled fashion. A structural characterization of the agrammatic deficit, then, has clear implications for the cerebral organization of specific principles of syntactic processing. In presenting data obtained from experimentation with a brain-injured population, we are, in effect, adhering to the assertion that a theory of syntax is at base a theory of mind and linguistics, a branch of psychology.

Breakdown compatibility. This research program has the following objective To use the characterization of the agrammatic deficit to evaluate theories of language structure. Namely, we presume that an apt description of agrammatic behavior will impose non-trivial constraints on linguistic theory. It is not disputed, by way of analogy, that theories of syntax are constrained by considerations of acquisition-compatibility: Under the prescripts of explanatory adequacy and feasibility (cf. Chomsky, 1965), an acceptable theory of grammar is constrained to account for just those languages that are learnable under the conditions on language learning imposed by human nature, such as limitations on computation and memory, and an environment of limited positive input. So, we argue, theories of syntax are likewise constrained to be breakdown-compatible. That is, in a legitimate theory, the patterns of grammar dissolution observed in aphasia will be naturally stabable and in readily available terms.

Linguistic theory, from this point of view, is not only about the speaker's knowledge of his language, but is also held accountable for patterns of selective impairment. Specifically,

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we have available a general method for the evaluation of
linguistic theories against data from aphasia: As a preliminary
step, find out whether a given pattern of selective loss is indeed
structural. If it is, state a descriptive generalization over it,
one that accounts for the aberration along
syntactically-principled lines. Then derive and test predictions
about aphasic behavior on additional structures   Finally, check
whether or not the characterization you end up with is naturally
statable within the chosen grammatical theory.

The findings from agrammatic aphasia presented here evidence
a distinction between the ability to comprehend adjectival passive
on the one hand, and verbal passive on the other. Moreover, they
point to the need for a generalization of the form expressed by
move-alpha. It follows, then, that a breakdown-compatible theory
of grammar will accomodate this distinction -- and along
derivational lines. While transformational theories meet this
requirement, ascribing adjectival passives to lexical derivation
and verbal passives to syntactic derivation, strictly lexical
theories do not.

2. PRIOR EXPERIMENTATION

Experimental tasks that test agrammatic comprehension
usually ask of the patient that he choose from a set of pictures
the one picture that displays the meaning of a sentence.
Sentences are semantically reversible (i.e., the correct
intepretation cannot be inferred from just the content of the
lexical items in question) and are presented either orally or
visually. In order to perform well on such a task, the patient
must arrive at correct thematic interpretations for most or all of
the sentences presented to him. It turns out that the results of
such experiments depend overwhelmingly on the structural type of
the sentences being presented. Specifically, agrammatic
performance on tests of thematic interpretation reveals the
following pattern: While active, subject relative, and subject
cleft constructions (as exhibited in (1) on the handout) elicit
better-than-chance or good comprehension:

1
(1) a. The boy pushed the girl ; .
                                        2
    b. The boy who pushed the girl was tall .
                                    3
    c. It was the boy who pushed the girl .
                                      4
    d. Show me the boy who pushed the girl .

Passive, object relative and object cleft constructions (as seen
in (2)) educe at-chance, or guessing, performance:

5
(2) a. The girl was pushed by the boy .

6
b. The girl who the boy pushed was Chinese .
7
c. It was the girl who the boy pushed .
8
d. Show me the girl who the boy pushed .

Trace deletion. Our analysis of the performance contrast between (1) and (2) follows that proposed by Grodzinsky (1986) -- that is, a descriptive generalization over agrammatic performance patterns based on the Government-Binding framework (Chomsky, 1981). Namely, it is suggested that the problem agrammatics have with the sentences in (2) reflects incomplete S-structure representations. In particular, what these representations appear to be lacking are traces or, equivalently, the chains associating empty categories with their antecedents or operators.

Note that all the sentences in (2), but not those in (1), contain traces in object position, according to a transformational analysis. (2a) contains a trace of NP-movement, while (2b), (2c) and (2d) contain traces of wh-movement. (1b) through (1d) may or may not contain traces in subject position of the embedded clause, depending upon the existence of vacuous wh-movement.
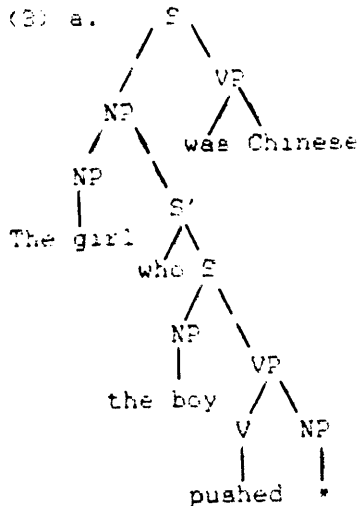
According to the trace deletion hypothesis, agrammatics fail to represent the A-function chain formed in the derivation of a verbal passive such as (2a). As a consequence, normal theta-role assignment to the subject of the passive is blocked. It is argued that the agrammatic avails himself of a linear cognitive strategy for thematic interpretation, one that associates clause-initial positions with agenthood, similar to that proposed by Bever (1970). His chance-level performance on passives and object gap constructions, then, reflects a conflict between use of unimpaired syntactic principles, which make the object of the preposition by available as agent, and use of the said default strategy to theta-mark clause-initial NPs. It is this conflict which forces the patient to guess between two thematic interpretations. Two NPs are made available as agent in (2a) -- the boy, as object of by, receives a theta role grammatically and the girl, as clause-initial NP, receives a theta role by default. In the cases (1b) through (1d), however, no such conflict arises. If the linear default strategy is indeed activated, it results in a correct assignment of thematic roles   In these cases, the clause-initial NP is in fact the agent.

Finally, guessing performance on the rest of the structural types exhibited in (2b) through (2d) is predicted along the same lines of analysis. In (2c) for example, two NPs are agents with respect to the relative clause: the girl, since the operator in COMP fails to be coindexed with the embedded object position, and the boy, due to application of the clause initial NP-equals-agent strategy. The trace deletion analysis also obtains in additional
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results, not to be discussed here .

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Attributing traces to the S-structure representations of (1b), (1c) and (1d) is not essential for their correct interpretation. The S-structure traces in (2), however, are necessary for proper thematic interpretation. Without the wh-trace, (2b), for example, would have the representation diagrammed in (3a):

(3) a.

```
              C
            /   \
           /     VP
          NP    /  \
         /  \  was Chinese
        NP    \
        |      S'
     The girl /\
            who  C
               /  \
              NP    \
              |     VP
           the boy /  \
                  V    NP
                  |    |
               pushed  *
```

Due to the absence of the trace, which is marked by an asterisk, the head of the relative clause is blocked from acquiring the theta-role of the object of the verb pushed. In general, if traces are deleted from the representation of a given structure, then theta-role assignment in that structure is restricted to lexical NPs in thematic (D-structure) position.

The prediction. The account makes predictions about agrammatic performance on any of a number of syntactic constructions. In this context, however, the key prediction borne by this account is the following: Adjectival passives, which are argued to be projected directly from the lexicon, are free from the trace-deletion distortion of structural representations because they contain no traces. Therefore, they should be correctly interpreted by agrammatics. It is this prediction that we set out to test, the implication of our experiment being that if lexical passives are indeed found to pattern with actives and subject relatives, then the trace-deletion hypothesis is affirmed. Furthermore, any theory of grammar which decouples adjectival and verbal passives according to lexical versus syntactic derivation passes a test of breakdown compatibility.

Breakdown compatibility proves to be a non-trivial constraint on syntactic theory. Lexical Functional Grammar is prevented from stating a generalization over verbal passives and object relatives. Instead, it forces a generalization over adjectival and verbal passives -- namely, lexical derivation (Bresnan, 1982). (4) summarizes how structural types pattern within GB theory and within LFG:

(4) a. John was interested in Mary.   GB:lexical   LFG:lexical
    b. John was kicked by Mary.   syntactic   lexical
    c. The man who Mary kicked was tall. syntactic   syntactic

    We have tested this paradigm with agrammatics. The
motivating question is whether, from a psychological point of
view, lexical and syntactic rules tap different aspects of
linguistic capacity. Before discussing the details of our
experiment, there are a few syntactic issues to be examined.

3. THE SYNTAX OF PASSIVE

    That there are two types of passive in English is generally
not disputed. We now take a brief look at the syntax of
adjectival and verbal passives, summing over work by Siegal
(1973), Wasow (1977) and many others since. Both adjectival and
verbal passive formation are analyzed as undergoing a preliminary
lexical process, the attachment of the passive suffix. This
morphological change results in the category shift illustrated in
(5),

(5) [+V,-N] --> [+V]

and affects the inherent case-assigning and thematic properties of
the verb. With respect to verbal passive, the absorption of case,
along with suppression of the external theta-role, causes
NP-fronting of the direct object in syntax.

    <u>Adjectival passive.</u> Adjectival passive formation, on the
other hand, involves a further category transition in the lexicon,
viewed in (6),

(6) [+V] --> [+V,+N]

whereby the participle is marked as an adjective and the
complement position is eliminated. It appears that this second
lexical shift can come about in two ways.

    The majority of participles that are potentially adjectival
can distribute either as verbal passives or as adjectives. Since
the [+V] category derived in (5) is not specified as to [+/-N], it
is not prevented from playing an adjectival role. Thus, the
sentence "The store was closed" is ambiguous between verbal and
adjectival readings. Once a <u>by</u>-phrase is inserted, however, the
transitive nature of the base verb is realized. So the
S-structure representation of "The store was closed by the
storekeeper" contains a trace in object position of the base
verb. In these cases, the category shift in (6) is determined by
the absence of a <u>by</u>-phrase. A subset of the class of psych-verbs
comes under this description. These participles include <u>pleased</u>,
<u>interested</u> and <u>amused</u>. This set can also be seen to have an
underlying adjectival bias, whereby the passivized form of the
verb seems to be more common than the active form. Also, use of

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the by-phrase with these participles is slightly awkward. Examine
the sentences in (7):

(7) a. John was interested in Mary.
   b. Mary interests John.
   c. John was interested by Mary.

It is evident from (7c) that use of the by-phrase actually tends
to force a transitive reading of the verb.

    Other participles appear to become unambiguously adjectival
prior to the effects of syntactic context. That is, they undergo
an additional morpheme affixation in the lexicon. Certain
morphemes, most commonly the negative un, attach to the front of
adjectives (as in unworthy) and neutralized participles (as in
unimpressed), but not to the front of verbs; (*unkill, for
instance, is not acceptable). The negative un is not to be
confused with the reversative un, which attaches to verbs, as in
unbutton, rather than to adjectives. In effect, the attachment of
these prefixes to [+V] can be analyzed as completing the
transition from verb to adjective in the lexicon.

    Unlike adjectives with passive morphology, examined above,
these participles co-occur freely with by-phrases. See, for
example, (8):

(8) The athlete was unequalled by his competitors.

It is clearly impossible to impose a transformational reading on
(8). Doing so would imply that (9) is an acceptable structure:

(9) *His competitors unequalled the athlete.

    In summary, the S-structure representations of adjectival
passives are equivalent to their D-structure. No movement occurs
in syntax and no traces or chains arise. (8) is clearly
base-generated. The crucial properties of adjectival passive,
then, are twofold: Elimination of the [NP,VP] position and
externalization of the internal theta-role. The first of these
stems from the lexical category shift from verb to adjective,
illustrated in (5) and (6). The second expresses the constraint
on adjectival passive to be predicated of the direct object of the
verbal root. (See Levin and Rappaport, 1986 for a detailed
account of adjectival passive formation.)

4. EXPERIMENT AND RESULTS

    Due to this analysis of adjectival passive -- namely, the
proposal that they are lexically derived and devoid of traces
whose deletion in agrammatism may interfere with correct
processing -- we predicted that adjectival passives should be
consistently and correctly interpreted by agrammatic aphasics,
despite the apparent similarity to their verbal counterparts.

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The experiment we are in the midst of entails six conditions, corresponding to six sentence types, seen in (10):

(10)
I.   agentive actives: The man is pushing the boy.
II. un-reversative actives: The mother unmasks the girl.
III. adjectival passives: The doctor was annoyed with the boy.
IV. unpassive: The woman was uninspired by the man.
V.   un-verbal passives: The girl is unmasked by the mother.
VI. agentive passives: The boy is pushed by the man.

20 sentences of each of the six types are presented to patients in random order. It should be noted that in order to preserve the adjectival reading, adjectives with passive morphology were presented without by-phrases; about, with, at, and in phrases were used instead.

So far, results largely concur with our predictions. Two patients have been tested. Both performed virtually identically. (11) is a table of results, coded for percentage of sentences correctly interpreted.

(11)
I.	agentive active:	92.5%
II.	un-active:	87.5%
III.	adjectival passive:	82.5%
IV.	unpassive:	57.5%
V.	un-verbal passive:	52.5%
VI.	agentive passive:	60.0%

These numbers reflect a clearcut distinction: above-chance performance on conditions I through III, and a sharp drop to chance-level performance on conditions IV through VI. Thus, we elicited good performance on both types of actives and on adjectives with passive morphology, as anticipated.

Unpassive. An unexpected result, however, is chance-level performance on unpassives co-occuring with by-phrases, like those in (12):

(12) a. The man was unconvinced by the woman.
     b. The queen was unimpressed by the king.

There are numerous ways to interpret this outcome. Patients might simply be insensitive to the un morpheme, as they are said to be to closed class vocabulary in general, thereby interpreting (12a) as (13):

(13) The man (was) convinced (by) the woman.

This seems unlikely, however, as patients do not report a mismatch between such sentences when tested and their pictorial representations. Furthermore, results from the un-reversative

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active condition indicate no such omission of the un prefix.
Finally, there is independent experimental evidence that
agrammatics are sensitive to the preposition by (Grodzinsky,
1984).

As another explanation, perhaps the whole of the agrammatic
problem with syntactic passive is attributable to an insensitivity
to passive morphology. Yet this analysis fails to account for the
prior findings concerning object-gap relatives and clefts -- the
fact that agrammatics have difficulty with wh-constructions as
well as with syntactic passive constructions.

A third possible explanation for poor performance on
unpassives is that hypersensitivity to the by-phrase as a signal
of passive voice forces a transitive reading of the verb. This
analysis, however, falls short of explaining the relatively large
number of errors made by normal control subjects on unpassives.
The results from normals actually suggest difficulty with the
unpassive construction in general, a difficulty that perhaps gets
exacerbated in aphasia.

Finally, we are ready to consider the possibility that
unpassives, such as those that elicited chance-level performance,
are syntactically derived. Accordingly, the chance-level
peformance observed would follow from the deletion of traces in
the representations of these sentences. Although there is no
independent evidence to this effect, the application of the
general argument put forth in this paper forces us to consider
this possibility seriously.

Given that performance on unpassives was much poorer than
predicted, it appears that use of the un-reversative as a control
was inappropriate. As suggested by Beth Levin (personal
communication), unadjectives such as unhappy, would perhaps have
served that purpose better. These results, overall, suggest a
distinction between the linguistic mechanisms underlying
morphologically complex participles and other lexically derived
participles used as adjectives. Furthermore, they give evidence
for the sensitivity of agrammatics to passive morphology in
general.

5. CONCLUSION

Before concluding, we would like to contrast our claims with
other experimentally-based arguments. Most of these are, as we
observed in the beginning of this paper, based on evidence from
the time-course of langauge comprehension. This raises problems
concerning the relationship one assumes to exist between the
observed time-course of parsing and both the grammar and
machine-time as construed by the parsing model. It is often
argued (e.g., Crain & Fodor, 1985; Freedman & Forster, 1985) that
a difference in reaction (i.e., comprehension)-time between two
constructions implies a difference in the number of grammatical
operations involved in their respective derivations. Thus, a

given finding may be taken to confirm some theories or grammar while falsifying others. This, however, is true only if two auxiliary assumptions are made, as Berwick & Weinberg (1984) demonstrate quite convincingly. First, one must assume a theory of perceptual complexity that mimics, more or less, the theory of grammar. No independent motivation is usually given for this assumption. Second, one must assume a given time-value for each of the hypothesized processes; since it is difficult to tease these processes apart, the value assigned to each of them remains, in many instances, a wild card. Given these points, two unaccounted for degrees of freedom remain in the time-course argument. This makes it much less compelling than one would like it to be. Indeed, as Berwick & Weinberg show, small changes in the time-cost of a putative process may force a radically different interpretation. In contrast, the method used here makes no such assumptions. All one has to assume here is that breakdown patterns are telling us a relevant story -- to us, a plausible assumption in the framework of a naturalistic theory of grammar.

In summary, we have given evidence of differential agrammatic comprehension of lexical and syntactic passive. These findings support theories of grammar which can accomodate two generalizations: one drawn over structures generated directly by lexical mechanisms and the other, over structures involving movement -- that is, both wh-constructions and syntactic passive. Moreover, these findings provide a powerful argument for the neurological feasibility of such syntactic devices. If this argument proves to be in the right direction, then neurolinguistic findings should be examined thoroughly by theoretical linguists. Our evidence, for one, provides a **positive** answer to the question of whether or not lexical and syntactic rules tap different aspects of linguistic endowment.

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1. Caplan & Futter (1986); Grodzinsky, Finkelstein, Nicol & Zurif (1985).

2. Grodzinsky (1985).

3. Caplan & Futter (1986).

4. Grodzinsky (1985).

5. Goodglass (1968); Schwartz, Saffran & Marin (1980); Grodzinsky et al., (1985).

6. Caramazza & Zurif (1976); Grodzinsky (1985).

7. Caplan & Futter (1986).

8. Grodzinsky (1985.

9. See Grodzinsky et al. (1985) for an extension of both the data

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base and the analysis. In that paper, non-agentive as well as subject experiencer verbs are tested, and the analysis refined.

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