

## Language Deficits and the Theory of Syntax

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A new structural account of agrammatism is proposed, which analyzes the deficit in terms of one current theory of syntax. First, the motivation for accounts of this kind is given. Then, a variety of experimental findings from sentence comprehension in agrammatism are examined and accounted for in a unified way. It is shown that a minimal change in the syntactic model (achieved by imposing a special condition on a construct called *trace*), results in a model which accounts for all the data at hand. A number of possible objections to this proposal is then examined, and reasons are given to dismiss these objections. Also, it is shown that this proposal is preferable to other structural accounts which have been recently proposed. Finally, the empirical consequences of this account are discussed, with a special emphasis on the implications for models of language processing. © 1986 Academic Press, Inc.

### INTRODUCTION

A brief survey of recent developments in aphasiology reveals a shift in the theoretical focus: earlier discussion centered around the involvement of the different linguistic *activities* in the aphasic deficit (speaking, listening, reading, writing, etc.); by contrast we now see an increasing number of studies that focus on the impairment of linguistic *elements* (lexical categories, inflections, etc.). This shift is hardly surprising if looked at against the background of cognitive psychology at large. Aphasiologists have obviously been influenced by cognitive theories at any given time,

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and as these change, so do theories about the representation of language in the brain.

The theory which has traditionally been held among neuropsychologists maintains that language is represented in the brain according to the various linguistic activities (see, e.g., Goodglass & Kaplan, 1979). Hence, what neuropsychologists should study is these activities and their impairment. Researchers have thus set themselves to study comprehension and production, reading and writing, and repetition and naming.

Current cognitive theories, however, maintain that the most central property of language is its *structure* (see, for example, Chomsky, 1980b; Fodor, Bever, & Garrett, 1974), rather than the fact that it can be practiced in a variety of ways. On this view, human linguistic behavior is governed by grammatical principles that are instantiated in a language processing device.<sup>1</sup> In order to explain this behavior, a theory of the properties of the linguistic *signal*, namely, a theory of grammar, must be referred to. So, any theory of linguistic behavior must take structural considerations into account.

Claims of this sort have no doubt brought about changes in the language sciences in general, and in psycholinguistics in particular. But although research interests have shifted in many circles from the language related activities to the nature of the information processing devices that are devoted to language, it is still far from clear how these putative devices relate to comprehension, production, reading, and writing. This, in spite of the fact that the properties of the signal transmitted through each modality are obviously the same. It is possible that there are completely distinct systems for comprehension and production, as well as for the rest of the activities; it may also be the case that these activities are governed by the same processing device (except those low-level aspects of each that must have special machinery, but are not crucial for language per se, i.e., motor commands, etc.). The debate on this question remains unresolved, the arguments being largely methodological (see Garrett, 1982 and Caramazza & Berndt, 1985 for opposing views). In any event, what is crucial to note is that the psycholinguistic approach just described attempts to resolve such questions by looking both at properties of the linguistic signal, and at the manner by which it is processed by the human user. Yet in doing so, it does not deny the possible interest in the various activities. Rather, it augments the traditional analysis with powerful grammatical tools.

In this context, the study of aphasic deficits can be of great significance, due to the two facets of language breakdown: first, it might be a breakdown of the processing system, changing the manner by which the linguistic

<sup>1</sup> Whether this device is unique to language or not, is an empirical question. See Fodor (1983) for a view that it is; but see also Section 5.1 below.

signal is analyzed on-line. In this case, the deficit can be observed experimentally by measuring, say, the time course of language processing in aphasia (e.g., Bradley, Garrett, & Zurif, 1980; Swinney, Zurif, Rosenberg, & Nicol, 1984). But the deficit may have a second aspect: the structural properties of the aphasic language may now be different from those of normal language (a possibility that traditional accounts do not consider). This could be due to either a loss of grammatical knowledge *per se*, or a disrupted processor, that now outputs distorted information resulting in abnormal internal representations, which play a causal role in the production of aberrant sentences, and in the abnormal performance on tasks that require comprehension (Caramazza & Zurif, 1976; Schwartz, Saffran, & Marin, 1980; and many others).

Given these two possible sources of impairment, one has to carry out two respective deficit analyses: one that would yield a model of the impaired processing components, and another to characterize the structural deficit. It is important to note here that there is no logical necessity that both types of impairment be found. There could, in principle, be a deficit stemming from one type, the other, or both. This is an entirely empirical issue. So, while constructing models of the processing deficit, one must consider many issues in *normal* language processing. After all, we are dealing with an acquired pathology. Equally, structural characterizations of aphasic language must be done in relation to models of normal language structure—linguistic theories. In fact, this is precisely what a deficit analysis is: the characterization of an impairment (to psychological processes, to knowledge, to activity) in relation to theories of the normal case.

Suppose we had a processing as well as a structural analysis of an aphasic syndrome. A question immediately arises concerning the proper relation between the two. Naturally, the first answer that comes to mind is that they must be compatible with one another. Indeed, this is the position advanced by several recent authors (Kean, 1980; Lapointe, 1983). But to actually have the two models constrain each other, one needs, first of all, an independently motivated model of either type. Moreover, any effort to have processing and structural analyses constrain each other has an extra assumption built into it, that the structural deficit and the processing deficit come from the same source, and are not independent. Though plausible, this assumption is not necessarily true. In fact, there is no available compelling evidence for or against it, to my knowledge.<sup>2</sup>

The upshot of all this is that the aphasic deficit should be studied from both the structural and the processing points of view independently, without ruling out the possibility of reducing one account to the other at some future point.

<sup>2</sup> But see Section 5.1 for further discussion. See also Grodzinsky (1985).

This paper is dedicated to the structural properties of language in agrammatic aphasia. Several studies of this kind have been carried out in recent years, attempting to account for agrammatism from the point of view of theories of language structure (Kean, 1977, 1980; Caplan, 1982; Lapointe, 1983; Grodzinsky, 1984a). Like these studies, this paper deals only with a subset of the known agrammatic phenomena. Consequently, the above proposals are discussed only insofar as they have direct bearing on the issues raised here.

What I do below, then, is examine one issue in agrammatic syntax, and give it a fairly detailed treatment. I begin by presenting some (rather scattered) evidence regarding the structural deficit in agrammatism. I examine several possible accounts of this deficit, some of which are stated in linguistic terms, others, in terms of heuristic strategies that the patient is assumed to employ. After rejecting these accounts, a new account is proposed, consisting of a condition on a level of representation in the theory of syntax. This account is then supported by further evidence, both theoretical and empirical, and several conclusions are put forth. Finally, some empirical consequences are considered.

## 1. SOME PLAUSIBLE, YET FALSE, ACCOUNTS OF AGRAMMATIC PERFORMANCE

**1.1.** Consider, first of all, some data obtained by Schwartz et al. (1980) and by Futter and Caplan (1983) regarding the comprehension of passive constructions by agrammatic aphasics.<sup>3</sup> Both studies have found that these patients' performance is virtually normal on active and semantically reversible passive sentences. However, the same patients have great difficulty understanding passives, once all semantic cues have been removed.<sup>4</sup> So, if presented with sentences like those in (1), they seem to interpret them normally:

- (1) a. The boy kicks the ball.
- b. The ball is kicked by the boy.

But upon being confronted with sentences like

- (2) The boy is pushed by the girl.

their ability to assign the correct interpretation is drastically diminished.

**1.2.** This finding provides *prima facie* evidence that the deficit here is syntactic. But what is the precise nature of this deficit? I will consider several options.

<sup>3</sup> Similar findings have been obtained by Ansell and Flowers (1982). However, these cannot be considered here, since this study did not test agrammatic patients only, but rather a mixed group of aphasic patients.

<sup>4</sup> The Schwartz et al. (1980) study used a picture-matching paradigm, while the Futter and Caplan (1983) study involved the manipulation of stuffed animals to act out the scene described in the sentence, which was read aloud to the subject.

**1.2.1.** The first possibility that comes to mind, is that since in speech agrammatic aphasics tend to omit inflections, prepositions, and the like (see, for example, Goodglass & Berko, 1960; Geschwind, 1970), then they are also unable to attend to these elements in comprehension (see Goodenough, Zurif, & Weintraub, 1977). Consequently, the sentence they would have for interpretation, in the case of a reversible passive, would be something like

(3) . . . boy . . . push . . . girl . . .

which now looks like an impoverished active, and thus their poor performance is explained. This explanation may also be appealing from a formal linguistic point of view, because there is at least one account which would predict it. Kean (1977, 1980) has claimed that the phonological contrast between phonological words and clitics must be used to account for patterns of omission in agrammatic production; this conclusion follows, as Kean shows, from a particular definition of word boundaries, proposed by Chomsky and Halle (1968, p. 366). The claim is that the omitted elements are (all and only) clitics, and thus the deficit is accounted for in a straightforward, yet formal, fashion. Extending Kean's account to comprehension, one would predict precisely the possible result I just described, namely, that a reversible passive would be represented as an impoverished active.

Such an explanation can be readily falsified, however, as it predicts that in passives, the patients would consistently invert the thematic roles, that is, upon being presented with a passive, the AGENT (namely, the actor) will always be interpreted as THEME (namely, the acted-upon), and vice versa. This prediction is false, because both studies have found that the patients perform *randomly* on such constructions. That is, they do not know which noun should be chosen as agent. We can thus safely reject this explanation.<sup>5</sup>

**1.2.2.** A second possible explanation has been suggested by Caplan and Futter (1986). Analyzing the comprehension performance of an agrammatic patient on a wide variety of syntactic structures (all of which appear in semantically reversible sentences), they observe that "in essence, what we see are regularities in performance which depend upon the syntactic structures of the sentences presented, but which are not completely determined by the structures themselves in the normal way these structures determine meaning." They then proceed to state a general principle which would serve as a descriptive generalization of the facts observed. This is an algorithm by which the patient presumably assigns (consciously or unconsciously) thematic roles to noun phrases in positions

<sup>5</sup> For the sake of precision, of six patients tested on actives and passives, all performed randomly on the passives, and only two did not perform significantly better on the active sentences.

in the sentence: "Assign the thematic roles of agent, theme and goal to N1, N2 and N3 in structures of the form N1-V-N2-N3, where  $N_i$  does not already bear a thematic role."

There are several problems with this account. To begin, the first statement quoted above does not specify the extent to which the syntactic structure of a sentence determines interpretation, and how it interacts with, or is augmented by, "linear considerations." Equally unclear is the descriptive generalization: it provides "default" assignment of thematic roles, without stating the conditions under which this default is invoked. That is, no mention is made of how thematic roles are assigned otherwise, and what formal representation of the structural relations among constituents must be assumed for this thematic role assignment to be possible. Clearly, the "normal" assignment of thematic roles (normally by a verb to its complements and by verb phrases to subjects, see Chomsky, 1981 and subsequent literature) is defined over relations among constituents (e.g., Government), which are commonly represented by hierarchical "tree" structures.

Second, and as Caplan and Futter themselves would acknowledge, their analysis does not predict the whole range of data they present. Crucially, in my opinion, it does not account for what is probably the most stable finding about agrammatic comprehension: the random assignment of thematic roles to reversible passives and to object relatives which are center embedded by the patients (see, for these findings, Schwartz et al., 1980; Caramazza & Zurif, 1976; Grodzinsky, 1984b; Wulfeck, 1984).

Third, and most important, is a methodological problem. Namely, this analysis attempts to assume the *minimal* structural representation for the patient, hence *maximal* deficit. This, I believe, is a flaw.

I take it that the whole point of doing research on language deficits (beyond that part of it which is intended for clinical use), is to achieve some understanding of the structure of the mind via its breakdown patterns. It follows, then, that every account of a deficit must be done in relation to what is believed to be the normal case. Consequently, a deficit analysis should assume maximal similarity to normal. This is the only way to assess the deficit precisely, namely, by examining the difference between the normal and the pathological. Any other analysis would lead to a dead end. True, it might provide an adequate description of the pathological *performance*, but not of the deficit. It seems to me that the above analysis is, perhaps unintentionally, an attempt at the former.

Let us now consider a third possible account. For that, some syntactic analysis needs to be entered.

## 2. AN ALTERNATIVE ANALYSIS

In this section I first present the analysis given to the passive construction by one current linguistic theory. I then use this analysis for the structural

account of agrammatism. The discussion is somewhat technical (though precision and generality are sacrificed for clarity), and I discuss, first of all, some concepts and principles in that theory which are crucial for present purposes. Naturally, a presentation of the whole theory of syntax cannot be provided, and I will thus outline only those subparts of the theory which are directly involved in my account. It will be shown that a minimal change in the operation of some part in the theory brings about general changes in the theory that account for the agrammatic deficit.

**2.1.** In one current syntactic theory (Chomsky, 1981), known as the theory of Government and Binding (GB), syntax is organized in several levels of representation, that are related to one another by rules. The application of these rules (most notably, transformational rules) is highly constrained by a set of principles, or subtheories, which are independent of one another. As a consequence of this organization, no rule is obligatory, and the principles determine the well formedness of a given structure at any level.

A specification of some of those principles, which are relevant in the present context, follows directly.

The analysis here will depend crucially on the notion of *thematic* (theta) role of noun phrases. These are semantic functions, drawn from a finite universal inventory, and the central ones are AGENT—actor, THEME—acted upon, GOAL and SOURCE (see Jackendoff, 1972). Noun phrases are assigned theta roles by assigners, which are, normally, the categories A, N, V, P, VP.

A principle called the theta-criterion (Chomsky, 1981) ensures that assigners and assignees are compatible, and that they stand in the right structural relation (Government) to one another. It is a criterion in that it marks as ungrammatical every structure where there is incompatibility between assigners and assignees at any level.

So, for example, the sentences in (4) are ruled out (at all levels of syntactic representation) because both verbs, being transitive, assign a theta-role to their object, which is missing here:

- (4) a. \*John hit  
b. \*John fixed

In sum, theta theory specifies the set of thematic roles and how they are assigned, as well as a criterion of well formedness vis a vis these roles.

Another relevant subtheory is the theory of Case (Chomsky, 1981; Rouveret & Vergnaud, 1980). It basically specifies Case assigners (where Case is an abstract entity which may have an overt phonetic realization, as in case-inflected languages, the Slavic ones, for example, or can be marked only at the syntactic levels, without being overt, as in English). Here, too, Case assigners are specified—V, P, INFL (the abstract in-

flectional marker),<sup>6</sup> and a criterion of well formedness is stated, known as the Case filter, given in (5)a, and stated in words in (5)b:

- (5) a. \*NP<sub>[+phonetic, -Case]</sub>  
 b. Every phonetically realized NP must have Case.

Again, the Case filter is a well-formedness criterion, in that it marks each structure which violates it (i.e., which contains a phonetically realized NP without Case) as ungrammatical.

To take an example, the contrasts in (6) are consequences of the Case filter:

- (6) a. Rome destroyed the city  
 b. \*Rome's destruction the city  
 c. Rome's destruction of the city

What is at issue here, is the noun phrase *the city*. In (6)a, it receives Case from the verb. In (6)b, however, it does not get Case because the noun *destruction* is not a Case assigner. Thus, the Case filter is violated, and the ungrammaticality follows. In (6)c, however, the preposition *of*, which is a Case assigner, has been inserted, and the structure is grammatical because the NP *the city* is now [+Case].

The last notion from linguistic theory that I would like to mention is the transformational rule of Move-alpha. This rule is an optional rule which permits the movement of constituents almost freely in a structure, and the grammaticality of the resulting structures at every level is determined by the subtheories such as those I discussed. This rule has two important properties: first, it is considered as a mapping of representations from D(eep)-structure onto S(urface)-structure; second, a *trace* (i.e., an abstract marker which is not phonetically overt) is left at the position vacated by movement, which is usually linked (by some indexing mechanism) to the position that the moved element now occupies.

Now, with the aid of these tools, we can proceed to the analysis of passive constructions in the Government and Binding theory.

2.2. Current linguistic theory provides the following analysis of passive sentences (see Chomsky & Lasnik, 1977; Chomsky, 1981; Marantz, 1982): the base (the phrase structure component) generates D(eep)-structures such as

- (7) [e] were [[purchased] horseradishes]

where [e] stands for an unfilled, yet structurally represented position (in this case, the subject position).

<sup>6</sup> INFL is a syntactic category in the theory which marks inflection abstractly (at the syntactic level). It is defined over tense and agreement. In some languages, e.g., the Semitic ones, it is phonetically almost always realized. In others, like English, it is not always overtly marked, but is represented abstractly in the syntax, where it plays an important role.



In the passive case, the copula *be* (*were* in our case) does not assign theta-role to its subject (thus the subject of *be* is not a "theta-position," (i.e., a position to which a thematic role has been assigned). The object position, however, is a thematic position in the passive case, just like the object position in its active counterpart. However, the passive participle does not assign "structural Case" to its object (see Chomsky, 1980a; Rouveret & Vergnaud, 1980). So, a noun phrase in object position in a passive sentence will be marked [+phonetic, -Case], yet such a combination is ill formed by (5). Thus, to pass the Case filter, namely, the filter that requires all NPs with phonetic matrix have Case, *horseradishes* must move to the empty subject position via the transformational rule of Move-alpha. At this new position it will receive Case (from the Agreement or Tense features on the copula). So, S(urface)-structure representation of this sentence, namely, the representation after the transformational derivation had occurred, will now be

(8) [horseradishes] were [[purchased] t-t]

The movement leaves a trace in object position, which is coindexed (abstractly linked) with *horseradishes*, now in subject position. These two NP's (*horseradishes*, t) constitute a *chain*, which is an abstract object over which thematic roles are defined. Thus, *horseradishes* will in effect be assigned the theta-role of THEME; that role was assigned to the trace in object position, (which is a thematic position) and was transmitted, as it were, to the phonetically overt NP in subject position (which has no thematic role assigned to it directly).

To summarize, a passivized verb loses the ability to assign theta role to its subject, and the ability to assign structural Case to its object. Thus in order to receive Case (for it to pass the Case filter) the NP in object position has to move to subject position by Move-alpha, leaving a trace in object position, and thus a chain is formed, consisting of the moved NP and its trace. It is to this chain that the thematic role of THEME is assigned.

This is one instance of the general rule of movement in the Government and Binding framework. More details can be found in the references cited above.

Looking now at the S-structure representations of passive and active constructions, let us formulate, for expository purposes, some simple principles of theta-role assignment to these representations. These will be principles that relate S-structure positions and theta roles directly, just by looking at the relation between assigners of thematic roles and the positions of assignees:

- (9) a. Noun phrases in thematic positions have thematic roles assigned to them.
- b. A noun phrase in a non thematic position can inherit the

theta-role of a thematic position if, and only if it heads a chain that has a theta position as a member.

Whether a position is thematic or not is determined by the lexical properties of the assigners. So, the subject position in active sentences is a theta-position, but in the passive case, as we will see, the same position is not theta marked.<sup>7</sup>

These principles must follow from a general theory of theta-role assignment, and are presented here in this form just to show their possible interaction with S-structure representations of a limited number of constructions, namely those which are of relevance to the ongoing discussion.

**2.3.** Returning now to agrammatism, suppose that the unity of the trace/antecedent complex, or chain, is somehow disrupted, while the rest of the representation is left intact. This can be done in a number of ways. Let us assume, for the moment, that the trace with its index (or indices) is deleted from the representation, or at least is made invisible to the chain formation process.<sup>8</sup> We will return to this assumption later, and discuss it in detail.

Assuming this minimal disruption, one can now account for the agrammatic limitation in the following way: given a task which requires interpretation, like picture matching of passive sentences, the prediction is that the patient will see the first NP (namely the THEME) as a candidate for agenthood, because it is in the position of subject and is not a member of a chain which contains a trace in object position, thus complying with principle (9)a. On the other hand, the second NP (namely the AGENT) would also be a candidate for agenthood, because it is in a PP which has *by* as its head, thus complying with principle (9)b. Upon facing such a situation, the patient has no choice but to take a guess, and perform at chance level. In the *active* case, however, no problem should arise on this account, because no traces are involved in the representation,

<sup>7</sup> For simplicity, I restrict myself to cases where theta-roles follow from grammatical functions, such that SUBJECT→AGENT, OBJECT→THEME, etc. I do not discuss other cases, like the nonagentive passive *John was seen by Mary* or the Goal subject *John received a package from Bill*.

<sup>8</sup> A chain is a collection of traces and the NP to which they are linked (coindexed). Below is the definition of chain as given in Chomsky (1981):

$C = (\alpha_1, \dots, \alpha_n)$  is a chain if and only if

(i)  $\alpha_1 = \text{NP}$

(ii)  $\alpha_i$  locally A-BINDS  $\alpha_{i-1}$

(iii) for  $i > 1$  (a)  $\alpha_i$  is a non-pronominal empty category

or

(b)  $\alpha_i$  is A-free

(iv)  $C$  is maximal, i.e., is not a proper subsequence of a chain meeting (i)–(iii).

Given this definition, we can now explicate the condition on agrammatism as a violation of (ii), for example. This, however, is not relevant in the present context.

hence nothing is unspecified. Thus, the data for both active and passive constructions are accurately predicted.

There is a problem here, however. If it is assumed that the properties of passive are intact, then it follows that the subject position is not a thematic one, and thus, by hypothesis, neither (9)a nor (9)b can apply. Arguably, since (9)a applies for the NP in the *by* phrase, and assigns the role of AGENT definitively, then no confusion should arise, because we now have two NPs, one without a theta role, and one with a theta role. If it is assumed that all the information about the verb is intact, it would then follow, that the theta role of the NP in subject position can be inferred from the combination of two known facts: (i) the argument structure of the verb, and (ii) the fact that one of the arguments has a theta role, and only one "free" theta role remains to be assigned.

This is a problem. We need to find a principle that would "put pressure" on the subject position for it to be assigned the role of AGENT, so that a contradictory situation would again arise, that will explain the random performance of the agrammatical patients.

The way out is to say that positions are associated with theta roles regardless of properties of assigners, and in case that no role is assigned, they would have a default value.<sup>9</sup> This can be stated as the following, to be added to the principles of theta-role assignment in (9):

- (9) c. Default Principle: A NP which has not been assigned a thematic role by (9)a or (9)b should be assigned a theta role according to a *list* which universally associates default values to positions.

The clause-initial position in a language like English, would on this account, have the role of agent as its default value.

Note that in principle (9)c, thematic roles are not defined as relations between assigners and assignees, as is normally the case. Rather, thematic roles are assigned to positions. It is easy to see the reasons for this difference: while principles (9)a–b account for the assignment of thematic roles as motivated by the theory of syntax, principle (9)c accounts for the assignment of roles which is driven by nonlinguistic considerations. Taken together, all three principles in (9)—those stemming from the patient's impaired grammatical capacity, and the nonlinguistic one invoked to compensate for the impairment—*interact* and result in the observed agrammatical behavior.

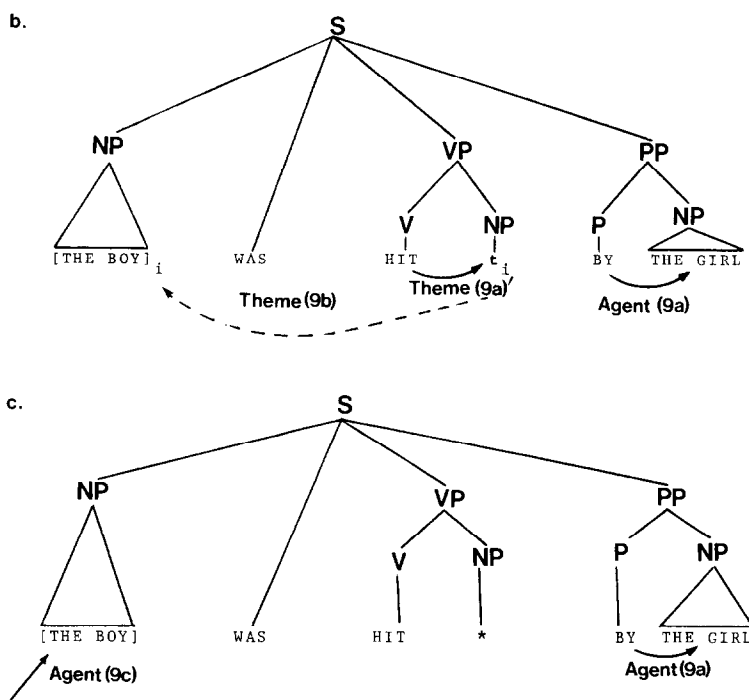
In summary, what the principles in (9) say, is that sometimes thematic roles are assigned in agrammatism according to syntactic principles, and sometimes they are not, yet the instances where each principle is operative are precisely specified. It seems a plausible assumption in light of many claims concerning perceptual strategies, namely, that in normal language

<sup>9</sup> As suggested to me by Jane Grimshaw.

use, the speaker relies on a variety of heuristics (see Bever, 1970). It would then be reasonable to assume, that for want of any cue for interpretation, the agrammatic subject would employ such strategies, and in this particular case, not to his benefit.

To illustrate the operation of (9)a–c with an example, we have the passive sentence in (10)a, with its S-structure representation (10)b, where thematic roles are assigned by a verb and a preposition according to (9)a–b, as indicated by the arrows. In (10)c, however, one thematic role is assigned positionally to the subject by (9)c, since a trace is missing from the thematic position from which the subject was supposed to inherit its role; the other thematic position in (10)c is assigned its role in a normal fashion by the preposition according to principle (9)a.

(10)a. The boy was hit by the girl



So, the subject position has been assigned the theta-role of AGENT by (9)c on this story, and the other NP (the one in the *by* phrase) is AGENT, too. Thus, the representation contains conflicting information regarding thematic roles, and the chance performance of the patients is correctly predicted.

We will see below that this assumption of default value for each position actually does more work for us in other cases.

no assumption is made that "traces" are, in any physical sense, disrupted in the patient's head. Rather, this is supposed to be an abstract, yet precise, representation of the impairment. In addition, the considerations I specified above are by no means conscious, but reflect indeterminacy which may result in chance performance.<sup>10</sup>

### 3. FURTHER SUPPORT

At first blush, this whole story looks suspicious. Why would one invoke bizarre constructs such as trace theory in the characterization of aphasic deficits? There are two reasons: the first stems from the belief that linguistically significant generalizations are at least compatible with the representation of language in the brain. But even without such an assumption, it is clear that formal models may serve as adequate descriptive devices for the analysis of language deficits. Now, a question arises concerning this particular proposal: what other evidence can be invoked to support such an analysis, to salvage it from its so far ad hoc standing?

3.1. To begin, let me discuss the issue of prepositions. It is usually assumed that these are omitted in agrammatic production (Goodglass, Gleason, Bernholtz, & Hyde, 1972), and also, that in tasks which require comprehension, they are not well detected (e.g., Zurif & Caramazza, 1976). The present account of passive, on the other hand, crucially assumes the intactness of *by* in the representation as a theta-role assigner; so, some empirical support needs to be entered at this point.

Evidence abounds showing that agrammatics do not treat prepositions in a unified way. That they can fully represent those which are heads of PPs directly attached to the S node, as in *John is hit by Bill*, and cannot represent others as in *John looked for Bill*. This has been shown by several investigators (Friederici, 1982, 1983; Friederici, Schönle, & Garrett, 1982). These authors have tested the performance of agrammatic patients in several tasks (picture matching, sentence completion) in relation to the contrast just discussed. The results have supported the claim that agrammatic performance distinguishes among prepositions on the basis of syntactic configuration. In particular, the distinction seems to be between prepositions which are governed by the verb (i.e., which are inside the VP), and those which are not (i.e., are outside the VP, in adjunction to S). So, the assumption that the *by* phrase is available for the patient seems empirically sound<sup>11</sup> (see Grodzinsky, 1984a for a detailed discussion of this issue).

<sup>10</sup> For an interesting discussion of the "reality" of traces, see Chomsky (1980b, Chapt. 4).

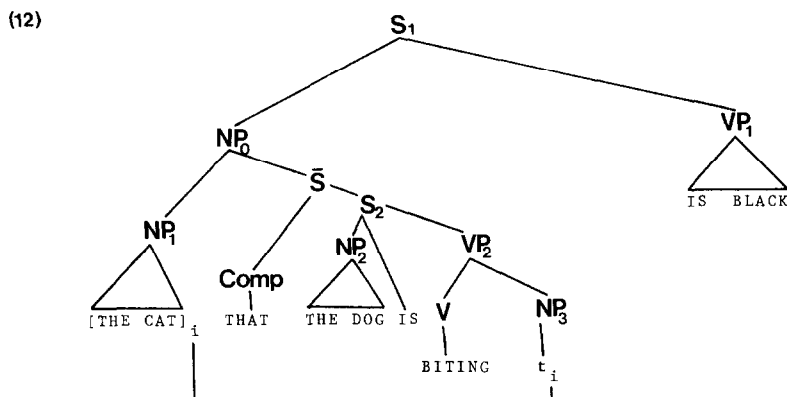
<sup>11</sup> Luigi Rizzi (1985) suggests that the distinction between the prepositions retained and those impaired is not configurational, but according to which of them assigns theta-role and which does not. Though it is hard to find data to distinguish the two alternatives at this point, they are both compatible with the suggestion that the *by* in the passive is intact, because it is both a theta assigner, and in the position which is assumed to guarantee the intactness of prepositions, that is in [PP.S].

**3.2.** What about traces in chains? Are there other findings that support the analysis? A study by Caramazza and Zurif (1976) found that semantically reversible relatives are also treated at chance level by agrammatic patients. A look at the syntactic structure of these sentences reveals that here, too, a theory of unspecified traces would predict chance performance by agrammatic aphasics. Let us look at the analysis given to relative clauses by GB theory, and then examine the consequences it may have for agrammatism, when coupled with the unspecified trace hypothesis.

**3.2.1.** Consider the sentence

(11) the cat that the dog is biting is black

Its S-structure representation is the following (the numbers are for expository purposes only):



The transformational derivation here would consist, more or less, of movement from a thematic position into a nonthematic one. The trace in NP<sub>3</sub> will function as a variable, bound by an operator in COMP (an abstract Wh-trace binder at S-structure), and coindexed with NP<sub>1</sub>. In terms of theta-roles, the issue here is somewhat different from the one in the NP-movement case. Restricting ourselves to aspects relevant to agrammatism, the issue here centers around the thematic structure of NP<sub>0</sub>, namely, how theta-roles are assigned to NP<sub>1</sub> and NP<sub>2</sub> by the verb in VP<sub>2</sub>. This seems to be the crucial case, because interpretation of “reversible” relatives will hinge on it, as we will soon see.

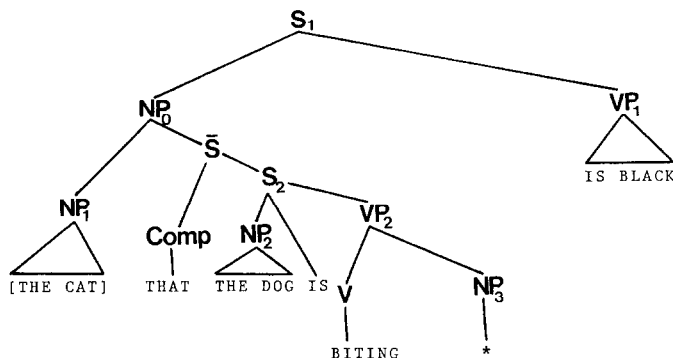
NP<sub>1</sub> is a part of the thematic structure of both the main clause and the relative. In the main clause, it is assigned a theta-role by VP<sub>1</sub>, hence by principle (9)a above; in the relative, it is assigned a theta-role even though it does not occupy a position there, that is, it receives a role by virtue of its being the head of a chain, one of whose other members is assigned a theta-role in the relative, namely, by principle (9)b.

In other words, NP<sub>1</sub> is thematically represented in the main clause because it is a part of the structure of that clause, and in the relative,

because it inherited the theta-role of its trace (in NP<sub>3</sub>) in that relative. NP<sub>2</sub>, on the other hand, is the subject of the embedded clause, hence it is assigned the theta-role of AGENT [by (9)a].

**3.2.2.** What may happen in agrammatism, according to the proposed account? Recall that the assumption is that trace is deleted, hence no chain can be formed, that links the operator in COMP to NP<sub>3</sub>:

(13)



Consequently, NP<sub>1</sub> will now have no theta-role in the relative, because neither (9)a nor (9)b can apply, to assign the operator in COMP the role which NP<sub>1</sub> will inherit. NP<sub>2</sub> will remain AGENT, since the deletion of the trace does not affect it.

Now, if we make the same considerations as in the passive case, then the Default Principle must apply, and so NP<sub>1</sub> should be assigned a thematic role positionally by (9)c, and it thus becomes AGENT. So, the thematic structure of the (agrammatic) sentence consists now of two AGENTS, and the chance performance is predicted.

**3.3.** An analogous analysis holds also for cases involving (object) clefts, such as (14):

(14) It was the frog that the monkey chased.

An abbreviated S-structure representation for this sentence is given in (15):

(15) [it was [the frog]<sub>i</sub> that the monkey [chased [t<sub>i</sub>]]]

Indeed, as Futter and Caplan (1983) have found, their patient performed randomly on such constructions.

On the other hand, upon being presented with subject clefts like (16):

(16) [it was [the frog]<sub>i</sub>] that [t<sub>i</sub>] chased the monkey]

the patient had no problem.<sup>12</sup>

<sup>12</sup> As for the rest of the structures in the Caplan and Futter study, I find them very hard to evaluate, as they involve two verbs and three nouns, hence a vast number of possible error types.

The contrast between (15) and (16) should now be obvious: while the former involves movement from object position, the latter involves movement from subject position. Consequently, the Default Principle (9)c will apply in both cases, because they both involve movement which leaves a trace behind, hence according to the proposed analysis, (9)c will be invoked. The crucial difference between the two is that in (15), the Default Principle will *change* the thematic role assignment of the moved NP (= *the frog*) from THEME to AGENT, but in (16), the thematic role of *the frog* will remain unchanged. It moved from subject position, where it was supposed to be assigned a thematic role of AGENT anyway. So, the application of (9)c will correctly compensate for the representational loss.

The upshot of the theory proposed here is, in effect, that constructions containing elements that underwent movement from subject position are not expected to cause any problems for the agrammatic patient in comprehension, whereas those which involve movement from object position are expected to be problematic, and the patients are predicted to perform at chance level.

It is thus possible to account for a range of results, and to have a precise prediction: sentences with movement from subject (subject relatives and clefts) are apparently intact;<sup>13</sup> sentences with movement from object (object relatives and clefts, passives) are impaired. I will return to actual tests of these predictions with respect to other constructions beyond those discussed here, that have these properties, in Section 5.<sup>14</sup>

Before we continue, there are several important properties of this account that should be emphasized. First, the analysis is crucially based on the following observation: comprehension performance on the syntactic constructions at issue can be normal or abnormal. The former case is straightforward: the level of correct responses would be above chance. In the latter case, however, we have two possible outcomes: chance level and below chance. Each of these calls for a different interpretation. This is best demonstrated by the contrast between the present proposal and the previous account. So, a precise characterization must consider the type of performance, which manifests itself through error level.

A second point concerns the heuristic strategy (9)c. This strategy is an ad hoc device in the account, in that it does not follow from grammatical principles. But this is precisely what a heuristic is: a nongrammatical

<sup>13</sup> Apparently, because the actual deficit in these constructions will be compensated for correctly by the strategy of Principle (9)c.

<sup>14</sup> Note that the proposed account generalizes over any trace. Surely, there are many distinctions that can be made between a NP-trace and a Wh-trace; but as the data stand at this point, there is no motivation for such a distinction in the context of agrammatism. However, if it turns out to be necessary, then the theory is capable of doing so.



consideration, which is formed for specific cases, and is arrived at by induction over experience. Nevertheless, note that the agrammatic case is not the only instance where the particular strategy included here, first NP = AGENT, is assumed. It is central in Bever's (1970) account of nongrammatical (what he calls "cognitive") sources of linguistic performance.

3.4. It now remains to clarify the precise nature of the "impairment" of chains. For the analysis to be maintained, it would suffice to claim, somewhat vaguely, that chain formation is disrupted, without saying how. However, there are several imaginable ways to do that. One could say, for example, that chain formation is blocked altogether, that is, any relation among members of a chain can no longer hold in the disrupted system. This is strong to an unnecessary extent, however. The same result could be achieved by a weaker claim, namely, that traces are invisible for chain formation. Though these possibilities may be adequate, there is a third possible solution, which makes the whole analysis much more general.

In a previous paper (Grodzinsky, 1984a) I have claimed that an adequate structural account of agrammatic production patterns must assume that *nonlexical terminals* are unspecified. This is motivated by agrammatic speech patterns from several languages. Returning now to the syntactic analysis, we observe that *trace* is also a nonlexical terminal (see, for example, Lasnik & Kupin, 1977), thus by the same analysis it is deleted from the representation, and so it is invisible to chain formation mechanisms.

The obvious conclusion is that the above analysis follows from the analysis of speech patterns in agrammatism, which has been constructed independently. This clearly adds generality, hence provides strong support for the present proposal.

We thus have a precise characterization of the structural deficit in agrammatic comprehension, which follows from an account of production patterns they exhibit. This characterization can be stated as the following [(17) of the above-cited paper with a slight revision]:

- (17) If a terminal element at S-structure is not lexically specified, it will be deleted from the representation at this level.<sup>15</sup>

<sup>15</sup> Actually, the "trace" story follows from (17) only under certain conditions. Notice that (17) states that "lexically specified" elements will be the only ones to be present at S-structure, while those which are not, will be deleted. This formulation is ambiguous. It could mean "lexically filled," in which case the elements deleted from S-structure will be all the categories that have nonlexical terminals: INFL, DET, trace, PRO, etc. It could also mean "lexical categories," in which case all the categories which are not reducible to ( $\pm$ N,  $\pm$ V) will be deleted: INFL, DET, COMP, etc. At this point, it is not clear whether the ambiguity must be left, or whether we should take the first option.

#### 4. OBJECTIONS AND ALTERNATIVES

As things stand at this point, there is a number of reasonable objections and alternatives that can be raised in relation to the proposed account. I will deal with each of those in order.

**4.1.** One objection concerns the Default Principle (9)c. If the present account is a syntactic one, how could it explicitly invoke nonlinguistic considerations? The inclusion of such elements in a supposedly linguistic account, is ipso facto a violation of the principles that make the account linguistic. This, the objection runs, is a contradiction.

The truth is that there is no contradiction here at all. A deficit analysis of language can differ from the analysis of normal language in two respects: first, it may assume a deficient representation of structure (which is subsumed, in the present case, by the deletion of traces); second, it may reasonably assume that an impaired linguistic system seeks to overcome the impairment by the usage of any available cue, whether structural or not. This, of course, is not new, and has been pointed out by many investigators of aphasia (see Caramazza & Zurif, 1976).

So, just as it is almost a truism by now that agrammatic aphasics take advantage of semantic cues to overcome their limitation (what Caramazza & Zurif called "heuristic strategies," following Bever, 1970), so should it be with respect to nonsemantic cues. In particular, cues that come from the order of mention, what David Caplan has called "linear considerations."

If all that is correct, then the structural account should specify the precise nature of the limitation, and thereby indicate the conditions under which nonlinguistic considerations are invoked, as well as the nature of those latter considerations. The present account has all these properties. The result, as has already been said, is an *interaction* between structurally and heuristically motivated analyses of the input by the patient, which results in the impaired performance.

**4.2.** In Section 1, I considered and rejected two possible explanations of the agrammatic response to reversible passives. These, however, are not the only alternatives. Let me discuss another possible account for the passive.

In Section 2, I assumed that the passive morphology is intact, and it is the chain alone which is disrupted. Suppose that all these are intact, and only the preposition *by* is deleted. We would thus have a sentence like (18)a represented as (18)b:

- (18) a. The boy is pushed by the girl  
 b. [the boy]<sub>i</sub> is pushed *t<sub>i</sub>* \* the girl

where the symbol "\*" stands for the deleted preposition. This representation can now account for the random assignment of thematic roles in a different way. Namely, it is not the case that two NPs are assigned the role of AGENT; rather, *no* NP can now be AGENT. The subject,

namely *the boy*, is not in a thematic position, but it is in a chain with the trace in object position, which is assigned the role of THEME by the verb. The second NP, however, must be analyzed as second object, and thus cannot be AGENT. Thus, the chance performance is predicted.

In the active case, however, no problem should arise, on this account, because nothing is deleted from the representation. Both findings are thus predicted.

Though interesting, this alternative account could not be right. There are two reasons for that. The first, more obvious one is that it is based on a false assumption, namely that the preposition *by* is deleted. In Section 3.1 I discussed the issue of prepositions in agrammatism, and the conclusion there was that *by* in passives is unimpaired. But even if this assumption were true, turning now to the second objection to this proposal, then this account could not be generalized to the other cases, namely, to the relatives and clefts where the agrammatics perform at chance, too.

The conclusion is, then, that if one seeks generality, then this explanation cannot be maintained.

**4.3.** Another general objection<sup>16</sup> has to do with the relation between accounts like this and linguistic theory. In particular, it is claimed that the imposition of formal conditions of the type proposed here results in violation of universal principles underlying the organization of grammar. To take an example, it could be said that the Theta-Criterion (Chomsky, 1981), which requires congruence between assigners and assignees of thematic roles, is violated by the proposed account. This violation is due to the fact that a theta-role assignee—a trace—is deleted from the representation. Thus, there is a role to be assigned (or a thematic position), but no argument to act as assignee. This is claimed to be a problem, because it goes against what is taken to be a central principle of the theory of syntax.<sup>17</sup>

This objection actually describes the situation correctly. However, no problem follows from this accurate description. That the grammar of aphasic sentences differs from normal has been our starting point. In fact, it is the difference between it and normal grammar that one seeks to characterize precisely. Hence, if it follows from the characterization that grammatical principles are violated in aphasia, it should come as no surprise; this is what one might expect.

To bring the general point home with an example, consider now the case of the Theta-Criterion and agrammatism. A generalization was sought over phenomena consisting of incorrect assignment of thematic roles (in passives and relatives). It is thus hardly surprising that a consequence

<sup>16</sup> Raised by David Caplan and an anonymous reviewer.

<sup>17</sup> A similar objection can be raised about the violation of Binding theory, as has been pointed out by an anonymous reviewer.

of the generalization is the violation of the Theta-Criterion. In fact, had it *not* been a consequence, it might have been a reason to question the plausibility of the entire account.

4.4. I turn now to three alternative explanations for the chance performance in the center-embedded relative clauses.

4.4.1. The first possibility is to assume that the agrammatic patient is unaware of the embedding. Since he hardly ever emits complementizers, we can assume that they are undetected in comprehension as well, and so, the sentence that the patient represents, contains two conjoined NPs in subject position, and no object. The chance performance is thus readily explained.

This alternative can also be rejected, for three reasons. First, the assumption here is not only that both NPs are daughters of the same NP, but also that none of them is in a chain with a trace in object position. This already makes the alternative more cumbersome than the proposal I have made, and it can be rejected on simplicity grounds. Second, just like the proposal considered in the previous section, it cannot be generalized to other cases. That is, this account cannot cover the passive cases. Third, we have some evidence to show that the patients are sensitive to embedding; in Linebarger, Schwartz, and Saffran (1983), it has been found that “gapless relatives” like (19) are easily detected as ungrammatical by agrammatical patients:

(19) the man that the boy is pushing the girl is tall

It is obvious that in order to be able to detect the ungrammaticality of this construction, the patient must represent an embedded structure. So, this account can be rejected, too.

4.4.2. The next two alternative explanations for the chance performance in the relative cases cast the limitation in processing terms only, and do not tie it at all to structure.

The first suggestion is that the performance is explained by assuming that the patients simply have a memory limitation. The argument runs as follows: it is reasonable to believe that there is a temporary store in the form of a push-down stack; if we limit its retrieval abilities to one item, then any task which demands storing more than one item would result in deficient performance. The center-embedded relative is one such case, and thus the performance is explained.

The problem is that the finding is *not* predicted by this account. If only one item can be stored, then it is probably the last item. So the patient is expected to perform perfectly on the object relatives, because the last NP he encountered and stored, according to this account, would be the subject of this relative, and he is thus predicted to make no errors. On the other hand, if it is assumed that the patient stored the *first* item, and could not store the second one, then it is predicted that the responses

would be consistently inverse. Either way, the chance performance is not predicted by this account, and it can be thus dismissed.

The second processing account is an argument from complexity. It is well known that normal subjects are incapable of processing sentences which are center embedded twice, such as (20):

(20) the boy the girl the man saw hit left

So, while one center embedding can normally be processed, though with some difficulty compared to right branching structures, there is a complete breakdown when the subject is presented with two embeddings (see Fodor et al., 1974). Now, suppose that what happens in agrammatism is simply an elevation of processing difficulty, such that the breakdown occurs in a structure which is the most complex, yet parsable, for normal subjects. The failure on the relatives is thus explained.

Unfortunately, this is at best a descriptive statement about the relation between normal complexity metrics and the agrammatic disruption. It does not specify disrupted mechanisms which underlie the impairment. Further, it cannot account for the failure in the reversible passive cases.

In sum, I have considered several objections and alternatives to the proposed account, and gave arguments against them. I believe these to be sufficient to show that the proposal in Section 2 is better for both empirical and methodological reasons. We can now turn to its consequences.

## 5. CONSEQUENCES

**5.1.** In the Introduction I argued that the two possible types of aphasic deficits, processing and structural, need not (should they be found) be reflections of the same functional disruption and could in principle stem from different sources. Damage to brain tissue is determined, after all, by factors which seem arbitrary as far as language mechanisms are concerned (such as the location of cerebral blood vessels), and as a consequence, one could imagine lesions that impair more than one functional system. I also commented that no evidence is currently available to bear on this issue.

But what could the relevant evidence be? That is, what could make us conclude that the deficit is to one functional system, or that it is rather a multiple deficit?

This question can be answered only if we obtain converging evidence from independently motivated accounts of the processing failure and the structural deficit. In this context, the structural characterization proposed here, locating the deficit at the level of S-structure is quite suggestive, for it bears an interesting relation to a variety of claims and speculations about this level: many recent authors have looked at S-structure as the possible point of connection between theories of language structure and

theories of language processing (Chomsky & Lasnik, 1977; Fodor et al., 1974). An independent processing account that could be compatible with the present proposal, is not available. Nevertheless, the fact that the present account is formulated in a fashion that does not *preclude* this connection is promising.

5.2. In order to further examine the empirical adequacy of this characterization, it is necessary to derive the consequences of the characterization in terms of the various structural configurations which are predicted to be correctly interpreted by the agrammatic patients, and the configurations that are not. A list of these configurations needs to be prepared, then tested on patients.

I have said before that one structural contrast between sentence types that are predicted to yield correct and random performance by agrammatic aphasic patients is that between movement from subject position (21)a and movement from object position (21)b:

- (21) a. The boy who  $t$  is pushing the girl is tall  
 b. The boy who(m) the girl is pushing  $t$  is tall

This contrast has been tested in Grodzinsky (1984b). The results were precisely as predicted: subject relatives yielded significantly better (and above chance) performance than object relatives, which were performed at chance by most patients (for details, see Grodzinsky, 1985).

At this point, I am aware of no data beyond those discussed (although some experiments are currently underway). Still, one can begin to think about the possible underlying processes that are disrupted, in case the conclusion will be arrived at, that indeed, the impairment stems completely from such disruption. In such a context, then, the terms used above—"incomplete representation," "availability," "visibility of traces," and the like—will get a very specific meaning: they will be descriptions of the output of a disrupted processor. It is very likely that some kind of memory (either dedicated to language processing or not), or perhaps some sort of temporary store, which relates positions in sentences during comprehension (i.e., is essential for the execution of the coindexing algorithm necessary for chain formation), is disrupted, and the result is the comprehension deficit in agrammatism (see Crain & Fodor, 1984, for a review of possible functional structures relating positions). One would like to get some more data from on-line, timed tasks, to bear on this issue. Also, it is possible that the temporary store is crucial for other tasks during sentence comprehension, namely, not only for relating positions, but also for a different type of linking, namely, agreement (which is achieved through a separate coindexing algorithm, cosuperscripting, in the Government and Binding theory). Evidence suggesting that, comes from the finding that agrammatic patients have serious problems with agreement (see Linebarger et al., 1983; Zurif & Grodzinsky, 1983). If

this is true, then we have a perfect example of how aphasia research can provide data which could not be obtained otherwise, and not only converging evidence.

In addition, it is now possible to relate the production and comprehension deficits. That is, patients are known to have production problems similar to the agreement problems they have in comprehension. It is thus possible to make the claim that the resource used in both activities is one and the same, and thus maintain the strong parallelism position between production and comprehension.

Again, if all this is true, or at least in the right direction, then the question of whether the deficit is syntactic, which has generated so much debate, is simply a nonissue. The analysis shows that structurally, the deficit is best represented at a syntactic level; but in terms of the functional architecture, the deficit involves a mechanism which may or may not be specialized for syntactic analysis, but plays a crucial role in it.

In sum, it is obvious how the analysis proposed here might be instrumental both in achieving a more precise formulation of the agrammatic structural deficit, and in discovering the underlying problem, be it a processing disruption, or impairment to systems of grammatical knowledge, or both. Still, the evidence at hand is no more than suggestive. One would like to know more.

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