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## ***OVERARCHING AGRAMMATISM***

Yosef Grodzinsky  
Department of Psychology  
Tel Aviv University  
Tel Aviv 69978, ISRAEL  
and  
Department of Neurology  
Boston University School of Medicine

If there is a single neuropsychological term that is most closely associated with Edgar Zurif (in terms of both content and style), it is “OverArching Agrammatism”. Zurif was the first to document the comprehension deficit in Broca’s aphasia systematically (with several colleagues - Caramazza, Myerson, Galvin and others (cf. Zurif, Caramazza, & Myerson, 1972; Zurif, Caramazza, Myerson, & Galvin, 1974; Zurif, & Caramazza, 1976), and show that this deficit has a syntactic character. These pioneering studies launched a new era in the neuropsychology of language, as they shifted the focus of research both to syntax, and to comprehension - two areas that are intensely investigated until today, with non-negligible success, one might add. Indeed, a significant body of valuable data, as well as a corresponding mass of theoretical work, was initiated by these early discoveries made by Zurif and his colleagues.

Conceiving of agrammatism as an “overarching” deficit was the next step. The discovery of syntactic deficits in Broca’s aphasia led to the (then unconventional) belief that the deficit in Broca’s aphasia was not linked just to speech production, but rather, was generalized, spanning

all communicative activities or channels. Moreover, the new findings indicated that the correct descriptive vocabulary for the deficit was linguistic. Thus, if previous accounts of Broca's aphasia viewed it as a channel-specific disturbance (cf. Goodglass and Kaplan, 1973; Geschwind and Goodglass, 1976; Goodglass, 1976), the emerging position was that this syndrome manifests as a severe loss of syntax that cuts across all linguistic activities. This claim has an important consequence: it suggests that the neural tissue implicated in the deficit - Broca's area and its vicinity, were the neural substrate for human syntactic capacity. The underlying reasoning was not unsound: some had already believed that speech production in Broca's aphasia was syntactically impaired; now a syntactic impairment was discovered in comprehension as well. It thus followed, apparently, that the right unit of analysis for neuropsychologists of language was linguistic. On this view (argued for vigorously in Zurif, 1978 and Zurif, 1980), one must "redefine" the cerebral language centers, reject the activity-based account of the 19<sup>th</sup> century, according to which Broca's area subtends speech production; instead, a linguistic account is proposed, in which Broca's area is the home of syntactic resources, recruited both for production and comprehension. The linguistic deficiency in Broca's aphasia was, from now on, OverArching Agrammatism (henceforth OAA).

OAA was an innovative and interesting idea. Its appeal, moreover, was in its simplicity. New data from structured experiments that began coming in at the time (mostly from the work of Zurif and his colleagues), indicated that the modality-based account was not entirely true, and that receptive aspects of language were also implicated in Broca's aphasia. These data flew in the face of the traditional account, as they demonstrated that the functional deficits subsequent to damage to Broca's area is not restricted to productive aspects of language. A modality-

based theory of the language centers had to give way to another, which was a proposal to view language as neurally represented, rather, according to linguistic levels. Syntax, on this view, was anterior, whereas the semantics was taken to be in and around Wernicke's area. A move towards "redefining" the cerebral language centers had begun (Zurif, 1980).

Yet there were problems with the new OAA account. First, apparent counterexamples were soon presented. Certain cases were reported, in which patients' disruptions did not span all modalities. There were studies in which Broca's patients scored "poorly" on production tests, yet thrived when their receptive skills were examined (Miceli, Mazzucchi, Menn & Goodglass, 1983; Kolk, van Grunsven & Keyser, 1985). And though at least some of these were later discredited (Zurif, 1995), they seemed (at least initially) to indicate that the OAA could not cover all cases. Further, they served as a basis for those who later attacked the concept of syndrome-complex in neuropsychology, and argued that the patient category Broca's aphasia is incoherent (e.g., Caramazza, 1986), partially because of these apparent inconsistencies in the data.

Still, problems with OAA actually seemed to run deeper. To see that, we need to consider what it takes to be convinced of the validity of such an idea. Recall that by "OverArching Agrammatism" one meant a specific disruption in language processing, that did not just span all modalities; the pattern of selectivity in the disruption was expected to exhibit cross-modal uniformity. OAA, then, was taken to be roughly the following:

**(1) OverArching Agrammatism (OAA)**

The language disruption in agrammatism (a) spans all modalities, (b) the selective pattern of impairment and sparing is identical cross-modally.

Such a version of OAA underlay the psycholinguistic account of agrammatism of Bradley, Garrett and Zurif (1980). They proposed a comprehension/production parallelism, in that the deficit to both modalities involved Closed- vs. Open Class vocabulary items. Their account promoted a particular view of the mental lexicon, whose disruption manifests in OAA. Although this proposal was later abandoned for various reasons, it did meet the requirements posited by the OAA hypothesis: it purported to provide uniform cross-modal evidence regarding the selectivity of the aphasic deficit.

Bradley, Garrett and Zurif's account was based on meager empirical evidence: all they had available were spontaneous speech data in English, and one set of results from RT experiments that they ran with normal and aphasic subjects. Further, the linguistic basis of their account was rather shaky. Linguistic analyses of agrammatism that were proposed later, taken in conjunction with the massive body of experimental data that has since accumulated, enable us to evaluate the OAA account more seriously than ever before. Yet the type of data they considered underscored the existence of a receptive deficit in Broca's aphasia, and thus from that moment on, OAA was to be true or false not depending on a comprehension deficit *per se*, but rather, on the degree of similarity between it and the deficit in production. Based on the current state of the evidence, I propose to do such an evaluation below. My examination will consist of several steps: first, I will go over the current state of the art in studies of agrammatic speech production. Second, I will summarize the situation in the comprehension domain. Next, differences and similarities between the two will be examined, to evaluate the current validity of the OAA. Finally, I will try to look at points of connection.

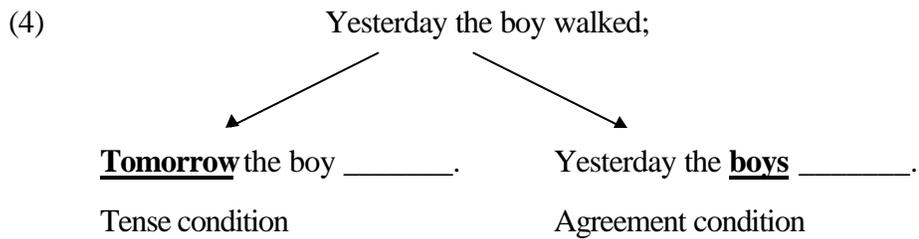
## 2. PRODUCTION: a Tree-Pruning Hypothesis

Consider the structural properties of the agrammatic speech production deficit: Recent investigations indicate that, contrary to traditional views, inflectional categories are not all equally impaired. Rather, it turns out that inflectional elements are impaired or preserved depending on their structural position on the syntactic tree. The first piece of evidence for this claim came about through a Hebrew speaking patient studied by Friedmann (1994), who was selectively impaired in the production of inflection: she had problems with tense, but not agreement. This finding runs contrary to common belief, according to which agrammatic aphasics have equal problems with all functional categories. Friedmann also showed, through a retrospective literature review, that cross-linguistic evidence goes in the same direction: a significant group of patients reported in the literature also showed impairment in tense but not agreement (Nespoulous et al. 1988, Miceli *et al.*, 1989, Saffran, Schwartz and Marin, 1980) yet the opposite (impaired agreement but not tense) is never found:

- (2) *Speaking English*: The kiss...the lady kissed...the lady is...the lady and the man and the lady...kissing.
- (3) *Reading French aloud*:  
target: Bonjour, grand-mere, je **vous ai apporte'**  
good morning, grandma, I to-you have bring (pres.-perf.)  
read: Bonjour, grand-mere, je **portrai** euh je /pu/ /zeda/ a-aporte'  
bring (future)

Seeking to obtain a detailed error analysis, Friedmann then created a set of tests to track the exact nature of the impairment in tense versus agreement in speech production. The distinction made by the patients was especially important in light of recent developments in linguistic theory: the split inflection hypothesis (Pollock, 1989) proposes structural differences

between tense and agreement, and argues that they each form a distinct functional category. This hypothesis not only provides a powerful and precise descriptive tool, but also presents a host of related issues to be examined. So, the tests were first conducted on one patient (Friedmann, 1994; Friedmann & Grodzinsky, 1997) and then extended to a larger group of Hebrew and Arabic speaking patients (Friedmann, 1998, Friedmann & Grodzinsky, 1999):



The results were remarkable: While agreement was normal, tense was severely impaired, even though the patient’s perception of time, as well as comprehension of temporal adverbs, was shown to be intact. Tense errors were mostly substitutions of inflection (with no preferred “unmarked” form), observed in repetition (25), and in completion (26) tasks. In (27) a numerical representation of error rates is presented:

(5)      Target: ha’anashim **yixtevu**                      mixtav la-bank  
                  the-people write-**future**-3-m-pl letter to-the-bank  
             Repeated: ha-anashim **katvu**                      mixtav la-bank  
                  the-people write-**past**-3-m-pl letter to-the-bank

(6)      Target: axshav ata holex.                      etmol ‘ata \_\_\_\_\_ (expected: halaxta)  
                  now you go-pres-2-m-sg yesterday you \_\_\_\_ (go-**past**-2-m-sg)  
             completed: axshav ata holex.                      etmol ata telex  
                  now you go-pres-2-m-sg. yesterday you go-**future**-2-m-sg.

(7)

Agreement Errors		Tense Errors	
3.9%	(5/127)	42.4%	(62/146)

This dissociation suggests a deficit that implicates tense, but not agreement features. This, in itself, is new, for agrammatic aphasia has always been thought to implicate all functional elements equally, and the striking asymmetries we observe appears to have been overlooked.

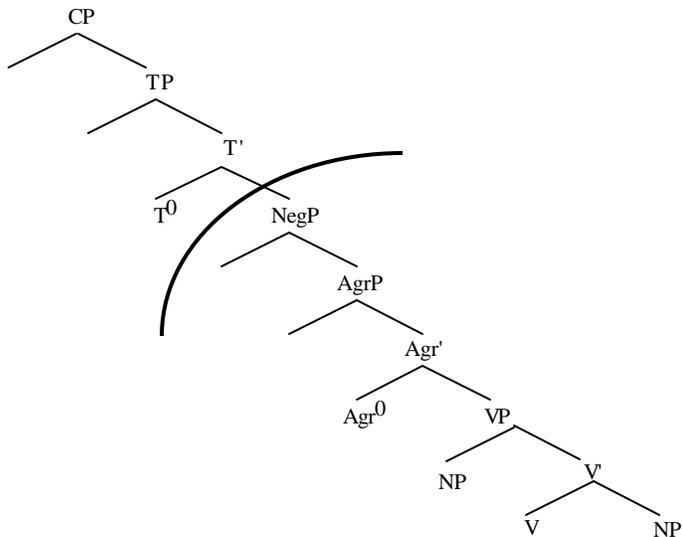
Further, the impairment touches on a cluster of syntactic properties related to the Tense node (according the split-inflection hypothesis), which are also disrupted: Observed are subject omissions, difficulties with copulas, and specific word order problems that pertain to nodes in the syntactic tree that are beyond the Tense node, but nothing below this node is impaired. Moreover, the impairment is associated with problems in yet higher parts of the tree (CP). As a result, questions and embedded clauses are nonexistent or completely ill formed.

By contrast, other properties that are related to Agreement, and lower parts of the tree, are left intact. The distinction that linguists have posited receives direct neurological support. Moreover, the disruption affects the tree from the Tense node and above, and leaves whatever is below it intact.

This rather rich cluster of cross-linguistic facts has led to a description of agrammatic speech production that is stated over trees, not elements. That is, unlike every previous statement, which looked at functional elements regardless of their position in the sentence, the currently available data lead to the view that agrammatic aphasic patients produce trees that are intact up to the Tense node and “pruned” from this node and up (Friedmann, 1994; Friedmann & Grodzinsky, 1997):

(8) Tree-Pruning Hypothesis (TPH, Friedmann & Grodzinsky, 1997 *simplified*):

Broca’s aphasics cannot represent T; higher branches of the tree are pruned.



Interestingly, this claim receives empirical support from yet another direction: there is a salient cross-linguistic difference in the production of verbs by Broca's aphasics. In English, the speech output of Broca's aphasics contains verbs that are bare stems, yet these are in their proper position in the sentence - always after the subject. In verb-second (V2) languages (e.g., Dutch, German), however, where inflected verbs undergo movement, the situation is different. In these languages verbs start out in sentence-final position (see Koster, 1975; den Besten, 1983, but see Zwart, 1993 for a different analysis), and must raise to pick up its tense features, and the result is SVO order. A non-finite verb in a main clause (for instance, in a clause that contains an inflected auxiliary), will remain in final position, and its finite counterpart will be in second position. In a patient whose syntactic tree is pruned, verbs will fail to raise, and the result will be as is observed in Dutch: in aphasic speech verbs in main clauses not only appear uninflected, but also, are in sentence final position, resulting in ungrammatical strings (Kolk & Heeschen, 1992; Bastiaanse & Van Zonnenfeld, 1998; Friedmann, 1998). Dutch agrammatics make no errors on infinitives in subordinate clauses, but have major difficulties with inflecting main verbs, which they mostly produce not only as infinitives, but, critically, in final position.

So, in sum, the deficit in speech production in Broca's aphasia is strongly linked to structural factors: they fail to represent parts of the syntactic tree from a certain node up, and given that these underspecified nodes usually house inflectional categories, it was believed, until recently, that all inflections are impaired; the current cross-linguistic evidence, however, suggest a partial deficit as described above. Next, we will examine comprehension patterns in Broca's aphasia, and see whether these parallel those in production. As we have seen, for the OAA to be true, such a parallelism is a must.

### **3. RECEPTIVE ABILITIES: A RESTRICTIVE TDH**

A syntactic deficit to receptive abilities on Broca's aphasia has been shown time and again over the past three decades. That there is selectivity within the syntax is a more recent claim. Thus Caramazza & Zurif's (1976) attempted to ascribe "asyntactic comprehension" to these patients, which implied a total loss of syntax. This suggestion, which gave rise to OAA, was clearly too strong. It was only later experimentation that indicated that the impairment was not as widespread: certain syntactic structures gave rise to normal comprehension, whereas others were impaired. The issue has been the stability of these pattern, and their precise description. As matters currently stand, the comprehension patterns of Broca's aphasics appear stable; moreover, it may very well be that cases whose comprehension had previously been thought to be deviant (like the apparent counterexamples to OAA that are mentioned above) in fact conform to the pattern, in that they fall within the allowable variation (cf. Grodzinsky, Pinango, Zurif & Draï, in press). As this pattern is currently described, the deficit mainly affects syntactic

movement. That is, patients mostly fail (a) to comprehend movement-derived structures (Grodzinsky, 1986; 1990; 1995); (b) to detect violations of grammaticality when movement rules are involved (Grodzinsky & Finkel, 1998); and (c) to properly process movement derived structures on-line (Zurif, Swinney, Prather, Solomon & Bushell, 1993 Swinney & Zurif, 1995). In (9), some examples of the comprehension performance of these patients are presented, according to level of performance for the group (cf. Grodzinsky, Pinango, Zurif & Drai, 1999, for discussion of this issue):

	<u>Construction type</u>	<u>Performance level</u>
(9)	a. The girl pushed the boy	<i>above chance</i>
	b. The girl who pushed the boy was tall	<i>above chance</i>
	c. Show me the girl who pushed the boy	<i>above chance</i>
	d. It is the girl who pushed the boy	<i>above chance</i>
	e. The boy was interested in the girl	<i>above chance</i>
	f. The woman was uninspired by the man	<i>above chance</i>
(10)	a. The boy was pushed by the girl	<i>chance</i>
	b. The Boy who the girl pushed was tall	<i>chance</i>
	c. Show me the boy who the girl pushed	<i>chance</i>
	d. It is the boy who the girl pushed	<i>chance</i>
	e. The woman was unmasked by the man	<i>chance</i>

These experimental results (pooled from a large body of studies) speak against the “asyntactic comprehension” account. They suggest, rather, that while a syntactic deficit exists, it is partial. For details, see Grodzinsky (1995). Here, just a summary statement will be presented: given that the constructions in (10) are derived by a movement rule, the following account has been proposed (a revision of the Trace-Deletion Hypothesis - TDH, Grodzinsky, 1986, 1990):

(11) Trace Based Account (TBA, Grodzinsky, 1995):

- a. **Trace Deletion:** Traces in *J*-positions are deleted from agrammatic representation
- b. **R(eferential)-strategy:** Assign a referential NP a role by its linear position iff it has no *J*-role.

This proposal is corroborated by several types of results. Consider, first, comparisons with scores obtained from Broca's aphasics in a language with a different phrasal geometry. If the account would hold there, its generality would be significantly greater. Japanese is one such test case, as it has a different basic word-order when compared to English (SOV vs. SVO). Further, its interaction with transformational movement is orthogonal to the active/passive distinction: it has two types of active sentences and two types of passives - each with a movement-derived version (non-scrambled for active (12a), direct for passive(13a)), and a version that is not (scrambled (12b) for active and indirect (13b) for passive). Hagiwara has documented the comprehension skills of these patients systematically, and showed that movement is the decisive factor determining their comprehension (cf. Grodzinsky, 1998 for analysis). The Japanese data are in (12)-(13):

(12) Japanese Active:

a. *Non-scrambled (basic):*

Taro-ga Hanako-ni nagutta *above chance*  
 -NOM -ACC hit

Taro hit Hanako

b. *Scrambled (movement-derived):*

**Hanako<sub>i</sub>-o** Taro -ga *t<sub>i</sub>* nagutta *chance*

(13) Japanese Passive:

a. *Direct (movement-derived):*

**Taro<sub>i</sub>-ga** Hanako-ni *t<sub>i</sub>* nagu-rare-ta *chance*  
 -NOM -ACC hit-PASS-PAST

Taro was hit by Hanako

b. *Indirect (not derived):*

Okaasan-ga musuku-ni kaze-o hik-are-ta *above chance*  
 mother-NOM a son-by a cold-ACC catch-PASS-PAST

Mother had (her) son catch a cold on her

These results provide an important cross-linguistic angle to the account, and strengthen it significantly. Next, our cross-linguistic account is further fortified with evidence that shows its inter-task generality: in Grodzinsky & Finkel (1998) we tested some predictions of the TBA to grammaticality judgment. The leading idea of this study was that, if traces of movement are deleted from syntactic representations, then any task that critically relies on these constructs will reveal the deficit. Thus, we presented the patients with judgments such as those in (14)-(15). In order to be able to see that the strings in (14) are ungrammatical, a subject must know that the relationship between the (bolded) antecedent and the trace (*t*) is illicit. But for that, the trace must be represented. Our patients failed at this task. By contrast, they were successful in detecting ungrammaticality in other, analogous cases, in which traces were not involved, such as those in (15).

- (14) a. \***John** seems that it is likely *t* to win  
b. \***Which woman** did David think that *t* saw John?  
c. \*I don't know **what** who saw *t*
- (15) a. \*Who did John see Joe?  
b. \*Who John saw Joe?  
c. \*The children sang the football over the fence  
d. \*The children threw

These results provide an important angle on the TBA, corroborating the claim that trace-deletion is a proper characterization of Broca's receptive skills through a study of grammaticality judgment. Next, a real-time perspective is in order. It is by now well established that normal language users demonstrate trace-antecedent relations in real-time tasks (e.g., Stowe, 1986; Swinney *et al.*, 1988; Bever & McElree, 1988; McDonald, 1989; Swinney and

Zurif, 1995). The typical experiment exploits priming effects to uncover antecedent reactivation. The leading idea is that the link between a trace and its antecedent causes antecedent reactivation at the trace in the course of comprehension. Thus in (16), *the drink* will be active when heard (namely, at point 1), will then decay (2), but will get reactivated following the verb (3), due to its link to the trace.

(16) The priest enjoyed **the drink**<sup>1</sup> that the caterer was<sup>2</sup> serving *t*<sup>3</sup> to the guests

This is precisely what on-line experiments on normal language users have discovered. Experiments typically take *the drink* as prime, and while the sentence unfolds auditorily, a target is flashed on a screen at points (1)-(3). The expected finding, then, is that if a target word, say, *juice*, is presented visually to subjects at points (1), (2) and (3) when they are listening to the sentence, and the subjects have to make a lexical decision on it, priming effects would be documented at (1) and (3), but not at (2). This is found: priming effects are obtained only in (1) and (3).

Consider, now, the TBA and the expected real-time behavior of Broca's aphasics in such tasks. Deleted traces mean no reactivation at the trace. This means that only in point (1) would a priming effect be obtained. Decay would explain the lack of an effect in (2), and the correlate to trace-deletion would be a lack of priming in (3). Conducting such experiments is quite difficult, yet this is precisely the result of a series of carefully controlled studies of both subject and object relative clauses (Zurif *et al.*, 1993; Swinney & Zurif, 1995). Importantly, Broca's aphasics do prime, even if not in a fully normal fashion (e.g., Swinney, Zurif & Nicol, 1989; Shapiro and Levine, 1990; Shapiro *et al.*, 1993)). Yet, when faced with a task that involves

priming within a movement-derived construction, they are seriously impaired. Finally, this failure is not characteristic of all aphasics, nor is it necessarily related to general comprehension skills: Wernicke's aphasics with posterior perisylvian lesions perform normally on this task, even though their comprehension abilities are severely compromised.

In sum, then, the claim that Trace-Deletion characterizes the comprehension deficit in Broca's aphasia is reasonably corroborated by the empirical record. The next step in an assessment of OAA is to compare the linguistic accounts of receptive and productive skills in Broca's aphasia. If they are equivalent, the OAA will be supported; otherwise, its validity will, at the very least, be in serious doubt.

#### 4. OAA EXAMINED

We must now compare the two accounts, that are repeated below.

(17) PRODUCTION

Tree-Pruning Hypothesis (TPH, Friedmann & Grodzinsky, 1997, *simplified*):

Broca's aphasics cannot represent T; higher branches of the tree are pruned

(18) RECEPTION

Trace Based Account (TBA, Grodzinsky, 1995):

a. **Trace Deletion**: Traces in **J**-positions are deleted from agrammatic representation

b. **R(eferential)-strategy**: Assign a referential NP a role by its linear position iff it has no **J**-role.

The question is whether the TPH is derivable from the TBA, or vice versa, or, whether we can generalize over both. It is unclear how the pruning of subtrees can be made to follow from trace deletion; thus, (17) does not seem to follow from (18). The opposite, however, is not an impossibility. In fact, it has been proposed by Friedmann (1998), who seeks to derive the

receptive deficit from its productive counterpart. The intuition behind her proposal is that in all cases for which there are comprehension results, the moved antecedents of the deleted traces are in subject positions which, by the TPH, are pruned off. If this account will hold, then OAA is vindicated. Technical details aside, for the data above, this idea may work. Yet there are data that remain problematic for such an account, at least as stated. These are comprehension asymmetries, as well as direct contrasts between production and reception of language, mostly in the domain of verb movement.

If these problems are resolved, then OverArching Agrammatism will be vindicated. Zurif's original idea – that a supramodal account of the deficit is possible, and that as a consequence, Broca's area is home for certain syntactic abilities for all modalities – will, potentially, be correct, with the necessary refinements.

## **5. A TRIBUTE TO EDGAR ZURIF**

A good friend of mine, Gedon Medini, once told a story of Duke Ellington who, in a TV interview with him late in his life “was asked what he would like to say about the influences and events that shaped his starry life. He said something like this: ‘Ya know what it’s like runnin’ around life, like a maze, and ya comes to a corner and ya don’t know which was to go, and then some guy is standing there and ya asks him ‘which way?’ and he points and says, ‘That way,’ and ya run and run until you come to another fellow and ya asks him, and he points and says ‘that way’ - What I want to do today...is to thank all those guys who was standin’ on these corners at the right time and pointed me off in the right way.’” (Medini, 1988).

People's scientific world view is shaped by many factors. In my own case, I can testify to Edgar Zurif has been, for me, the guy around that corner. He was, after all, my doctoral thesis advisor. But Edgar hasn't been just a mentor of mine. His role in the international quest for understanding brain/language relations has been, in the past three decades, very central. Moreover, few scientists of his generation are still as active and creative. Happy birthday, Edgar.

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