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LEVELS OF LINGUISTIC REPRESENTATION IN BROCA'S

APHASIA:

IMPLICITNESS AND REFERENTIALITY OF ARGUMENTS¹

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ABSTRACT

We investigated the interaction between different levels of linguistic representation and the syntactic deficit in Broca's aphasia. We varied a semantic property of arguments - referentiality, and a phonetic property - implicitness, and crossed them with the constructions that expose the syntactic deficit in agrammatic Broca's aphasia. Our results show that referentiality and implicitness of arguments interact with θ -role assignment in agrammatic comprehension of passive constructions. Using a truth value judgment paradigm, differential performance was documented: we observed above chance performance in the comprehension of passives with quantified subjects; and at chance performance on short passives (without a *by*-phrase), in conjunction with the standard finding of above-chance performance on actives, and at-chance on agentive passives. We conclude that (1) knowledge of information on referentiality is not only accessible to the agrammatic patients, but also interacts with their deficit in a surprising manner; (2) information about implicit arguments (semantically existent, yet phonetically unrealized elements) is represented for them; (3) these new findings lend further support to the Trace-Based Account (TBA) - the recent reformulation of the Trace-Deletion Hypothesis.

0. INTRODUCTION

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This study investigated agrammatic representation of two properties - one semantic and one phonetic, and the way these interact with the patients' comprehension abilities of passive constructions. We investigated two elements which we varied systematically: (1) referential properties of moved NPs in subject positions, and (2) implicit (i.e., phonetically realized) and overt *by*-phrases in passive. We obtained results indicating that both elements significantly affect performance, yet in different ways. We also tested Wernicke's aphasics, to see whether damage in different brain regions would yield different results in this type of test.

1. BACKGROUND

The Trace Deletion Hypothesis (henceforth TDH, Grodzinsky, 1986, 1990) was designed to handle the agrammatic deficit in receptive language (comprehension, grammaticality judgment, and real-time processing, cf. Grodzinsky, 1998 for review). Specifically, the deficit to syntactically moved elements is at its center. Yet the complexity of the ever-increasing body of data has changed the standard pattern of loss and sparing, and given certain novel theoretical considerations, a reformulation was forced. The result is a more restrictive, precise theory - the Trace-Based Account (TBA, Grodzinsky, 1995b). We examined two aspects of language to see which of them, if any, influences comprehension patterns typically observed in agentive passives. The properties of interest here are *referentiality* and *implicitness* of arguments. They were chosen for a reason - referentiality is a semantic property of NPs, whereas implicitness regards phonetic realization. We wanted to investigate the interaction between processes involving different levels of linguistic representation subsequent to brain damage. Specifically, we wanted to see how a purely syntactic

deficit interacts with a semantic and a phonetic levels. We thus varied our stimuli systematically along semantic and phonetic dimensions, seeking to chart out the interaction between these properties, and the movement-related properties of the passive construction.

1.1. A semantic property - referential vs. non-referential arguments

As experiments become more sophisticated, charting ever more precisely the intricate performance patterns revealed in aphasia, it is becoming increasingly clear that referential properties of at least some arguments play an important role in the comprehension deficit in agrammatic aphasia. The first relevant finding is due to Hickok and Avrutin (1994) who tested agrammatic comprehension on four types of questions, along two dimensions: questions pertaining to subject (1a,c) vs. object (1b,d) position, and those expressed by *which* (1a,b) vs. *who* (1c,d). The findings they obtained are in parentheses:

- | | | |
|-----|---|-----------------------|
| (1) | a. Which boy pushed the girl ² ? | (above chance) |
| | b. Which boy did the girl push <i>t</i> ? | (chance) |
| | c. Who pushed the girl? | (above chance) |
| | d. Who did the girl push <i>t</i>? | (above chance) |

Previous experiments have documented subject/object asymmetries in constructions with movement - subject extractions yield normal performance, whereas object extractions are performed at chance (cf. Grodzinsky, 1990 for a review). Yet here there was a surprise: on the structure in (1d), namely on the *who* object question, the patients were, unexpectedly, above chance, in apparent violation of the TDH.

²Traces in subject position were not annotated here, because their presence or absence from the representation has no empirical consequences in the present cases. Cf. Grodzinsky (1990, 170).

Why would such an asymmetry be observed? There are differences between the two types of questions, motivating this experiment in the first place: first, *Which*-questions (but not *who*-questions) are 'Discourse-linked', requiring reference to previous discourse (cf. Pesetsky, 1987). The question in (1a), for instance, presupposes the existence of a set of boys, already been mentioned in the discourse, from which one boy will be picked. It is pragmatically odd (although syntactically well-formed) to ask questions (1a-b) if there are no boys around. Thus, the interpretation of *which*-questions requires both syntactic and contextual information. By contrast, no such requirements exist for *who*-questions. Questions (1c-d) can be asked without presupposition, and the answer does not pick an element from a previously established set. Their interpretation is based only on intrasentential (syntactic and lexical) information.

Second, certain intricate tests on multiple questions reveal fine differences between the two: Superiority (Chomsky, 1973) can be violated by *Which*-questions under certain conditions, but not by *Who*-questions. The Superiority Condition requires that, in multiple questions, a moved wh-element cannot cross another:

- (2) a. *Who_i* did you persuade *t_i* to read *what*?
b. ??*What_i* did you persuade *who(m)* to read *t_i*?

These cases constitute part of a generalized Superiority Condition - Rizzi's (1990) Relativized Minimality (RM). Specifically, Rizzi proposes that a moved element can never cross a like element, a proposal which account for a variety of syntactic phenomena across movement types (cf. Grodzinsky & Finkel, 1998 for a study of Relativized Minimality in aphasia). Yet, as Pesetsky (1987) observes, Superiority can be violated under certain circumstances, for instance, where *which*-questions are

involved. (3) is the *which* analog of (2), yet the contrast observed in the latter disappears (compare (2b) to (3b)):

- (3) a. *Which man_i* did you persuade *t_i* to read *which book*?
 b. *Which book_i* did you persuade *which man* to read *t_i*?

This difference, noted by Pesetsky, had led Cinque (1990) to propose a refinement to Rizzi's RM, and argue in favor of the existence of two types of movement relations, or chains: Binding (1a-b) chains, and Government chains (covering (1c-d) in the present context) where only the former are D-linked. This distinction helps Hickok and Avrutin to claim that in agrammatism only the Binding chains is disrupted, which presumably explains the asymmetry in the agrammatical data. Left unexplained, though, is the normal performance of the agrammatics on (1a). Moreover, this claim does not generalize to the problem agrammatics have in passive (cf. Grodzinsky, 1995 for a critique of this claim).

Let us consider the matter in some more detail. Following his observations, Pesetsky (1987) attempts to exploit the distinction between D(iscourse)-linked and non-D(iscourse)-linked questions, as well as the Superiority-related syntactic differences between the two question types, to propose the following:

- (4) a. Non-D-linked phrases are quantifiers and adjoin to S'
 b. D-linked wh-phrases are not quantifiers

This conclusion means that non-D-linked phrases (*who*) are not referential (since quantifiers never are), whereas D-linked phrases (*which NP*) are referential.

Pesetsky's ideas have been used by a reformulated account of agrammatism, the TBA (Grodzinsky, 1995). Following the distinction between D-linked and non-D-linked moved phrases, the TBA claims that cognitive strategies (and specifically, the

Default Strategy of the TDH) apply to referential elements only³, leading to a reformulation of the default strategy used in agrammatism. Specifically, quantifier-like, non-referential wh-expressions are outside the scope of the strategy and therefore, non-referential NPs are exempt from it:

(5) R(eferential)-Strategy (Grodzinsky, 1995a)

Assign a referential NP a role by its linear position iff it has no ϑ -role.

The interaction between the TBA and the R-strategy gives precisely the desired results. (1a-b) are accounted for as before. In (1b) the strategy-assigned role on the NP [which boy] conflicts with that assigned to the subject NP [the girl], yielding chance performance. (1a) is a subject question, thus if there is movement, then it is correctly compensated for by the R-strategy. But consider (1c-d) now. Since *who* is a non-referential expression, it is exempt from the R-strategy. Thus in both cases, no role is assigned strategically to the wh-word. As a result, only one role is assigned (to the subject in (1c) and to the object in (1d)), and, given the intactness of lexical knowledge in agrammatism, the correct semantic role of the thematically-dangling NP can be easily inferred⁴. Hence above-chance performance is predicted, fitting the data - old and new - precisely⁵.

³Referentiality is used here in the manner common in linguistics, namely, in a sense that does not require reference in the world, but rather, in the universe of discourse. An element is thus used referentially when it refers to a member of a set that has been preestablished in discourse. Cf. Chomsky (1981), Pesetsky (1987), Rizzi (1990), Cinque (1990).

⁴As Na'ama Friedmann correctly points out, an additional assumption is necessary here: the language processing device must be capable of carrying out this inference in a way that has access to all the data structures that are required, namely the syntax as well as the argument structure. This is a non-trivial, yet a rather plausible assumption.

⁵ One issue still needs to be addressed: When a nonreferential NP is left without a theta role, the strategy is not applied and agrammatics must infer which ϑ -role the moved constituent receives in these cases. But why shouldn't they be able to make the same inference for all other passive constructions? The answer is that there is an order among the steps applied to a representation. The agrammatic interpretive system first identifies an argument without a ϑ -role and uses the default strategy to assign one to that constituent. If the NP is non-referential, the strategy is withheld. Only after this step has

This claim can be generalized in the following way: in movement-derived structures, with agentive predicates, one would expect chance performance if the moved constituent is extracted from object position, and is referential (6a). Yet, when the antecedent of the trace is non-referential (6b), performance should go up to normal levels, even though it contains an agentive predicate and a trace in object position, as we saw in (1d). This is so because the strategy (whose interaction with the rest of the thematic representation brought about guessing) is now absent, and hence the patient can infer the correct thematic representation from the available information.

- (6) a. The man is pushed *t* by the boy.
 b. Every man is pushed *t* by a boy.

While counterintuitive, this prediction has received some initial empirical support from a preliminary study by Saddy (1994), who found a difference in the performance of a Broca's patient on regular passive sentences (6a), and passives in which the subject is a quantified expression (6b). Specifically, performance in the latter was better, even though it is ostensibly more "complex". We decided to try and obtain this finding for a group of aphasics in a broader experiment, and we thus presented the test materials in conjunction with the other structures we intended to test.

The reason for this pattern of sparing and loss is a deletion of traces which interferes with thematic transmission to moved constituents which, in turn, are not assigned a ϑ -role. These are traces in ϑ -positions, the deletion of which is postulated by the TBA⁶. These constituent NPs are then subject to a default strategy, which

taken place can the agrammatic begin extracting meaning from the syntactic structure. It is at this point that the patient chooses which agent bears the correct theta role for agentive passives, or if need be, ameks an inference regarding the correct ϑ -role to a moved nonreferential constituent.

⁶ The TBA explicitly excludes traces of head-movement from its scope. These appear to be intact in agrammatism (cf., Grodzinsky 1995b; Lonzi & Luzzatti, 1993; Grodzinsky & Finkel, 1996 for empirical arguments to that effect).

assigns them a default role according to their linear position in the string, assigning 'agent' to the clause initial NP, regardless of other grammatical considerations. In the case of passive, even though the NP in the *by*-phrase has already been assigned the agent role grammatically, the strategy applies. The resulting representation, maintaining two agents, forces the agrammatic aphasic to guess and perform at chance.

It is important to emphasize that, since the passive construction is not fully understood in linguistics (cf., for instance, Jaeggli, 1986; Baker, Johnson & Roberts, 1989; Grimshaw, 1990; Pesetsky, 1994; Fox & Grodzinsky, 1998), and as many details of its analysis remain highly controversial, the debate on agrammatism should not take it as the centerpiece of the deficit (indeed, it has not, at least as far as the TBA has been concerned). Results involving the passive are valuable only if (a) they are taken in conjunction with other structures (as has been the case with the TBA), or (b) they are used to obtain contrastive results, through interaction with other (grammatical or non-grammatical) factors. This latter approach has been taken in the present study. Specifically, we used the passive as part of an effort to discover what information remains intact in the agrammatic's syntactic representation.

1.2 A phonetic property - implicit vs. overt arguments

A related question that focuses on the representation of arguments and their corresponding ϑ -roles involves short passives, namely, what happens when there is no *by*-phrase? For a short passive in which the *by*-phrase is truncated, such as "the man is hit," the only argument present is the derived subject. For agrammatics, this argument will have no thematic label since it has been moved and has left a trace behind which is ultimately deleted. The prediction the TBA has crucially depends on

the type of theory it is coupled with regarding the representation of the deleted *by*-phrase, in particular, the status of implicit arguments. The issue, in brief, revolves around the syntactic function and representation of the missing *by*-phrase. A hallmark of linguistic theory is the requirement that a predicate cannot appear at any syntactic level of representation with more or less arguments than those listed in the lexicon for that predicate. The short passive is a clear counterexample of this requirement, as it manifests with and without the external argument of its predicate:

- (7) a. John is hit by Bill.
 b. John is hit.

One way of getting around this dilemma is to argue that the missing argument is syntactically active and represented, even though it is silent and invisible (i.e., implicit). To see how it works, consider first an independent proposal aimed at solving other problems posed by the passive. This proposal states that the ϑ -role of the external argument is “absorbed” in the passive morphology during the process of passivization (e.g., Borer, 1980; Jaeggli, 1986, and many others). The *by*-phrase, if present, on this account, receives its ϑ -role from the passive morphology through some process (whose precise nature is highly controversial, cf., Jaeggli, 1986; Baker et al., 1989; Grimshaw, 1990; Fox & Grodzinsky, 1998). If the *by*-phrase is deleted, as in short passive, that ϑ -role remains in the passive morphology, and, importantly, it is syntactically active, as can be seen in the following contrasts (cf., Manzini, 1983; Roeper, 1983)⁷:

- (8) a. The captain sank the ship to collect insurance money
 b. The ship was sunk by the captain to collect insurance money
 c. The ship was sunk to collect insurance money

⁷⁷ See also Jackendoff 1972 for other arguments to the same effect, e.g., *the price was decreased willingly* vs. **the price decreased willingly*.

d. *The ship sank to collect insurance money

The question is what is the subject of the infinitival purpose clause *to collect insurance money* (or, in technical terms, what controls the PRO subject of the infinitive). Clearly, in (8a) it is *the captain*. Similarly in (8b) it is *the captain* again, controlling the PRO from inside the *by*-phrase, perhaps. Yet in (8c) we discover, surprisingly, that the meaning of the sentence remains unchanged, namely, that there is someone out there who sank the ship to collect insurance money, even though this someone is not represented by an overt NP. This gives us an indication that there is some argument, implicitly represented, which functions as the subject of the infinitive. Importantly, this argument must be present in the active construction, as seen from (8d). In this example, the verb *sink* has one less argument for reasons that are lexical, not syntactic. In this structure, nothing can control the PRO and hence the sentence is ungrammatical. The conclusion is that there is an implicitly represented argument in the short passive. When coupled with the idea that the external ϑ -role is absorbed in the passive morphology, one possible solution to the dilemma regarding short passives is that the implicit argument is represented in the passive morphology.

Returning now to agrammatic aphasia, we are left with an open question: does the implicit argument in the short passive interact with the default strategy and affect performance? There are several possibilities to consider: 1) The implicit argument does not manifest itself in the patient's representation, and does not interact with the strategically assigned agent ϑ -role. In this case, the patient would perform below chance because the only ϑ -role they would have in their representation is agent, assigned to the subject NP (which should be theme according to normal grammar); since there is no other ϑ -role around to compete with the subject for agency, the

agrammatic would assume that the subject is the one performing the action and would reverse the correct interpretation systematically. 2) The implicit argument is represented, and is pitted against the strategically assigned agent in the subject position of the short passive. If this is the case, then comprehension would be at the same level as the agentive passives, because the argument in the *by*-phrase - whether overt or implicit - would appear in the thematic representation. On this account, the subjects would be guessing because they have two agents, even though there is only one overt argument. Chance performance will thus help us make a case for the existence of a phonetically unrealized, implicit agent. 3) Finally, the patients could perform above chance, a result which would indicate a 'fill-in-the-blank' strategy. On this (remotely possible) account, there is no implicit ϑ -role, and no strategy as the one assumed by the TBA. The patient uses the information available, namely that there is one ϑ -role which needs to be assigned to one NP. Since there is only one option, the patient makes the correct choice.

All these considerations led us to test short passives in conjunction to the other experimental conditions we constructed.

2. METHODS

2.1 Subjects

Twelve subjects participated in the study: four neurologically intact control subjects, four agrammatic Broca's aphasic patients and four Wernicke's aphasic patients.

All normal control subjects were right-handed, native speakers of English, who had never experienced any head injury and whose eyesight and hearing were

corrected to normal. Ages ranged from 69 to 72 with an average education of 13.5 years.

All agrammatic Broca's aphasic patients were medically stable, with at least two years since the date of stroke. All were right-handed native speakers of English whose eyesight and hearing were corrected to normal. The ages ranged from 59 to 79 with an average education of 13.5 years.

Patient	Onset	Lesion Site	Speech
FA	1992	CT Scan 1992 Left CVA - CT scan is unremarkable.	Nonfluent Paraphasisas Agrammatic Telegraphic Verbal and Oral apraxia
FC	1973	MRI 10/24/94 Very large left dorsolateral frontal lobe lesion involving almost all of the inferior and middle frontal gyri. Lesion includes all of Broca's area and the white matter deep to Broca's area. The lesion continues superiorly and includes the lower 2/3 of the pre-motor, motor and sensory cortex and the white matter and periventricular white matter deep to these areas. There is no lesion in the temporal and parietal lobules.	Nonfluent Dyspraxia Agrammatism
RD	1976 & 1977	CT Scan 1978 Two left frontal lesions - Broca's area with deep extension across to left frontal horn - lower motor cortex. (face and lips) left temporal lobe sparing more than 1/2 of Wernicke's area.	Nonfluent Telegraphic
WF	1994	CT Scan 5/21/94 A large lateral frontal lesion, a large lesion in the frontal operculum, and two small lesions, one in the motor cortex and the other in the caudate putamen ALIC (anterior limb of the internal capsule).	Nonfluent Agrammatic Impaired articulation Long latencies in speech

All agrammatic Wernicke's aphasic patients were medically stable, with at least five years post onset. All were right-handed, native speakers of English whose eyesight and hearing were corrected to normal. The ages ranged from 59 to 71 with an average education of 11.25 years.

Patient	Onset	Lesion Site	Speech
CC	1984	C.T. Scan 7/17/84 Left hemisphere lesion involving portion of posterior temporal lobe with superior extension into supramarginal and angular gyrus areas (surface and deep) and large occipital lobe lesion.	Fluent Anomic
WD	1991	CT Scan Left hemisphere lesion in the posterior part of the inferior section of MCA; one fourth of Wernicke's area deep to supramarginal gyrus.	Fluent Anomic
NL	1987	CT Scan 10/13/95 Decreased density in the left posterior parietal area. Although it is adjacent to the posterior body of the left lateral ventricle, it does not appear to distort the ventricle. Low attenuation region in the left posterior temporo-parietal region.	Fluent Naming difficulty Paraphasias Neologisms
JM	1986	CT Scan 1/22/86 Vague patchy lesion involving the temporal isthmus and the posterior/superior portion of putamen and insular area. Patchy , superior lesion extension in the posterior supramarginal and angular gyrus areas with deep extension across to the border of the body of the left lateral ventricle-interrupting pathways of the arcuate fasciculus.	Fluent Anomic Paraphasic

2.2. Materials

Stimulus items consisted of twenty token sentences for each of the four different sentence types: actives, agentive passives, short passives, and quantified passives. A

verb appearing in an active structure, such as 'pay', was also represented in an agentive passive, short passive and quantified passive. The following is an example of each sentence type:

1. The man pays the woman. (active)
2. The man is paid by the woman. (agentive passive)
3. The man is paid. (short passive)
4. Every man is paid by the woman. (quantified passive)

80 short stories were created, one for each sentence, in order to create an appropriate discourse context, against which the truth-value judgment task can be properly performed⁸. Each story involved several visual aids, including figurines which represented the characters, and in some cases an additional prop that pertained to the context of the story such as a canoe or currency. The sentences were combined with 40 sentences from another study (Balogh & Grodzinsky, in preparation). See Appendix 1 for instructions and example stimuli.

2.3 Design

A truth-value judgment task (Crain & McKee, 1985) was used to assess patients' comprehension of the sentences. This experimental design ensured that an appropriate licensing context for the scenario depicted in the sentence was created for the subject, thus avoiding any computational overload involved in generating a discourse context.

Half of the sentences required a 'yes' response and half required a 'no' response, with rotations among the verbs for each sentence type so that each agentive verb was in two 'yes' and two 'no' contexts, making all items counterbalanced.

All stories involved two figurines except for those which were followed by quantified passive sentences. These stories used six characters instead of two so that one type of character (e.g. one of the three dog figurines) could perform an action on each of the three characters of the other type (e.g. on each of the three pig figurines). We included three of each type of character so that the subject could not use the number of characters (one versus three) as part of a strategy to deduce which character type was fulfilling a certain theta role in the sentence.

Sentences and their respective stories were presented in a random order.

2.4 Procedure

The experiment was conducted in four sessions, with a break during each session, so that only 15 sentences and stories were presented at a given time. This was done to avoid overtaxing the patients.

Patients were given explicit instructions about what would take place during the session and what they were expected to do. An example was presented so that subjects could observe a demonstration of what they would be asked to do. Then subjects were given a short practice session in which they responded as they would during the actual experiment, but feedback was given and reasons for correct responses were explained.

First, each of the figurines for a given story was identified to the patient and given a name, for example, "This is the girl." This was done to establish a discourse context for the characters who later appeared in the sentences. Then the subject heard a short story while the experimenter acted out the scenario using the figurines. After

⁸ With one exception (Hickok & Avrutin, 1996), no study of agrammatic comprehension has ever had an appropriate discourse context. This point should not be overlooked by critics of results of experiments

the story, a sentence was read, and the subject was to decide whether the sentence matched or did not match the story.

To circumvent severe speech production impediments, the patient was asked to respond by pointing to a picture. The patient made a 'yes' response by pointing to a colored smiling face with the word 'yes' printed underneath or a 'no' response by pointing to a frowning face with the word 'no.'

To ensure that the patient understood the story and sentences to the fullest, each sentence was repeated twice. The patients were also encouraged to ask the experimenter to have either the sentence or story or both be repeated as many times as the patient wished.

After the patient made a response by pointing, the response and number of repeats were recorded.

3. RESULTS

3.1. Neurologically Intact Elderly Control Data

The data for the control subjects were broken down into sentence type and compared to chance using a two-tailed t-test. For each sentence construction, $n=20$ with a hypothesized mean of 10 ($p = .50$) when at chance, given that in all cases there was a binary choice. Table 1 presents the p-value for each condition:

TABLE 1 ELDERLY CONTROL DATA

Each Sentence Type Compared to Chance Performance

sentence type	mean	p-value
ABOVE CHANCE		

on agrammatic comprehension.

active	18.75	<.0001
agentive passive	18.75	.0004
short passive	19.25	.0003
quantifier passive	19.75	<.0001

All sentence types are significantly above chance. A pairwise comparison of means showed that there were no significant effects for any sentence types and that there was no significant difference between overall 'yes' versus 'no' responses.

3.2. Aphasic Patient Data

3.2.1. Broca's Aphasics

The data for the Broca's aphasics were broken down into sentence type and compared to chance using a two-tailed t-test. For each sentence construction, n=20 with a hypothesized mean of 10 (p = .50) when at chance. Table 2 presents the p-value for each condition:

TABLE 2 BROCA'S APHASIC DATA

Each Sentence Type Compared to Chance Performance

sentence type	mean	p-value
<i>ABOVE CHANCE</i>		
active	17.75	.0125
quantifier passive	17.00	.0046
<i>AT CHANCE</i>		
agentive passive	14.50	.0979
short passive	14.50	.1970

Actives and quantifier passives are significantly above chance, whereas performance on agentive passives and short passives is at chance.

Pairwise comparisons of means showed that there was a significant effect for actives vs. agentive passives [$F(1,15) = 4.768, p = .0453, MSe = 4.431$], actives vs. short passives [$F(1,15) = 4.768, p = .0453, MSe = 4.431$].

TABLE 3

Pairwise Comparison of Means for Broca's Aphasics

	Active	Passive	Short	Quantified
Active		+	+	
Passive	+			
Short	+			
Quantified				

3.2.2. Wernicke's Aphasics

The data for the Wernicke's aphasics were also broken down into sentence type and compared to chance using a two-tailed t-test. For each sentence construction, $n=20$ with a hypothesized mean of 10 when at chance. Table 3 presents the p-value for each condition for these patients:

TABLE 4 WERNICKE'S APHASIC DATA

Each Sentence Type Compared to Chance Performance

sentence type	mean	p-value
<i>ABOVE CHANCE</i>		
active	19.25	<.0001
quantifier passive	17.50	.0109
<i>AT CHANCE</i>		
agentive passive	13.75	.0650
short passive	14.25	.2238

Actives and quantifier passives are significantly above chance, whereas performance on agentive passives and short passives is at chance.

A pairwise comparison of means showed that there was a significant effect for actives vs. agentive passives [$F(1,15) = 9.233$, $p = .0083$, $MSe = 6.553$], actives vs. short passives [$F(1,15) = 7.630$, $p = .0145$, $MSe = 6.553$].

TABLE 5

Pairwise Comparison of Means for Wernicke's Aphasics

	Active	Passive	Short	Quantified
Active		+	+	
Passive	+			
Short	+			
Quantified				

A comparison of the performances of the two clinical groups using an ANOVA revealed no significant effects across the groups for any given condition.

A comparison of 'yes' and 'no' responses revealed that, for Broca's aphasic patients, there was no significant difference between the responses for each condition, and therefore showed no overall response bias in either direction. A comparison of Wernicke's aphasic patients did not present any significant difference between 'yes'

and 'no' responses for any sentence type. There was also no significant effect for 'yes' and 'no' responses across the two clinical groups.

An item analysis revealed no clustering of errors. An analysis of word frequency (Francis and Kucera, 1982) for the verbs in this sentence type revealed that there is no correlation between word frequency and errors.

4. DISCUSSION

4.1. Summary of results

Of the complex array of findings in Tables 3 and 5, here are what we consider to be the 2 types of main results of this experiment:

A. Differential performance of agrammatic (and Wernicke's) aphasics:

1. Agentive passives with quantified (i.e., non-referential) subjects are above chance.
2. Short, truncated passives are comprehended at chance, and significantly different from their agentive active counterparts.

B. No group differences.

4.2. A complex performance array

4.2.3. Referentiality

With regard to referentiality, our results replicate Saddy's (1995) experiment — that is, the patients' comprehension of the passive construction improves when the moved constituent includes a non-referential quantifier. This finding lends further support to the R-strategy.

4.2.2 Implicit arguments

Next when considering the role of implicit arguments on comprehension patterns, we see that the absence of an argument does not improve comprehension for passives with transitive verbs. As with the passive construction, patients performed at chance on the short passives. This result leads us to the conclusion that a second ϑ -role, even if not realized at Phonetic Form, is represented in the syntax, and is part of the thematic representation. A conflict with the strategically assigned agent ϑ -role on subject thus arises, forcing the patient resort to guessing. A conclusion along these lines strongly suggests that the patients have access to information about covert arguments in their representation and that the ϑ -roles mapped onto covert arguments play a crucial role in the patient's interpretation.

4.3. Group differences (or lack thereof)

We found no difference between the groups. We expected such differences, but failed to find them. Opponents of clinical groupings in aphasia might take this result as a decisive argument against clinical groupings in aphasia. This conclusion is clearly unwarranted. There is no reason to expect no overlap in the comprehension performances of agrammatic Broca's and Wernicke's aphasics. The deficits the two groups suffer need not, and in fact could hardly be imagined to be completely distinct. There is, as of yet, little understanding of the underlying deficit in Wernicke's aphasia, but the known differences among these two patient types (most prominently in speech production, but also, in many receptive tasks as well) suffice to establish the validity of the clinical groupings. Only adherence to the traditional clinical schema, and further experimentation, will reveal the true picture. Indeed, as experiments on receptive abilities in aphasia are becoming more and more subtle, a syntactic

disturbance of some sort is gradually being revealed in Wernicke's aphasia (cf., Grodzinsky & Finkel, 1996 for another study documenting a systematic syntactic deficit in this syndrome). The currently available experimental results present a very mixed picture, still quite difficult to understand. The array of findings does include a host of receptive tasks on which Wernicke's aphasics are quite different from Agrammatics (cf., for instance, Shapiro et al., 1993; Zurif et al., 1995). Thus, while certain involvement of temporo-parietal areas in syntactic processing is beginning to emerge, it is not very likely to be a consequence of the same disruption evidenced in agrammatism.

REFERENCES

- Ansell, B. and C. Flowers. 1982. Aphasic adults' use of heuristic and structural linguistic cues for analysis. *Brain and Language*, **16**, 61-72.
- Baker, M., K. Johnson, and I. Roberts. 1989. Passive Arguments Raised. *Linguistic Inquiry*. **20:2**, 219-251.
- Belletti, A. and L. Rizzi. 1988. Psych-verbs and J-theory. *Natural Language and Linguistic Theory*, **6**, 291-352.
- Caplan, D. and C. Futter. 1986. Assignment of Thematic Roles to Nouns in Sentence Comprehension by an Agrammatic Patient. *Brain and Language* **27**, 117-134.
- Caramazza, A. and E. Zurif. 1976. Dissociation of algorithmic and heuristic processes in sentence comprehension: Evidence from Aphasia. *Brain and Language* **3**, 572-582.
- Cinque, G. 1990. *Types of A'-dependencies*. Cambridge, MA: MIT Press.
- Crain, S., & C. McKee. 1985. Acquisition of structural restrictions on anaphora. *Proceedings of the Sixteenth Annual Meeting, NELS, GLSA, University of Massachusetts at Amherst*.
- Druks, J. & J. Marshall 1995. When passives are easier than actives: Two case studies of aphasic comprehension. *Cognition*. **58**, 271-279.
- Fox, D. & Y. Grodzinsky. 1996. Children's passive: a view from the by-phrase. *Linguistic Inquiry*, **28**, 111-133.
- Francis, W. and H. Kucera. 1982. *Frequency Analysis of English Usage: Lexicon and Grammar*. Boston: Houghton Mifflin.
- Goodglass, H. & E Kaplan. 1972. *The assessment of aphasia and related disorder*. Philadelphia: LEA & Febiger.
- Grodzinsky, Y. 1986. Language Deficits and the Theory of Syntax. *Brain and Language* **27**, 135-159.
- Grodzinsky, Y. 1990. *Theoretical perspectives on language deficits*. Cambridge, MA: MIT Press.
- Grodzinsky, Y. 1991. There is an entity called agrammatism. *Brain and Language*,
- Grodzinsky, Y. 1995a. Trace-deletion, theta-roles, and cognitive strategies. *Brain and Language*, **51**, 469-497.
- Grodzinsky, Y. 1995b. A restrictive theory of agrammatic comprehension. *Brain and Language*.
- Hickok, G., E. Zurif & E. Canseco-Gonzalez. 1993. Structural description of agrammatic comprehension. *Brain and Language*, **45:3**, 371-395.
- Hickok, G. and S. Avrutin. 1996. Comprehension of Wh-questions by two agrammatic Broca's aphasics. *Brain and Language*, **52**, 314-327.
- Jaeggli, O. 1986. Passive. *Linguistic Inquiry*, **17**, 587-622.

- Kolk, H., M. van Grunsven & A. Keyser. 1984. Parallelism in agrammatism. In M.-L. Kean Ed., *Agrammatism*. Orlando, FL: Academic Press.
- Marantz, A. 1984. *On the nature of grammatical relations*. Cambridge, MA: MIT Press.
- Maurer, G., V. Fromkin & T. Cornell. 1993. Comprehension and acceptability judgments in agrammatism: Disruption in the syntax of referential dependency. *Brain and Language*, **45.3**, 340-370.
- Miceli, G., A. Mazzucchi, L. Menn & H. Goodglass. 1983. Contrasting cases of Italian agrammatic aphasia without comprehension disorder. *Brain and Language*, **19**, 65-97.
- Pesetsky, D. 1987. *Wh-in situ: Movement and unselective binding*. In E. Reuland and A. ter Meulen (eds.), *The representation of (in)definiteness*. Cambridge, MA: MIT Press.
- Rizzi, L. 1990. *Relativized Minimality*. Cambridge, MA: MIT Press.
- Saddy, J. 1995. Variables and Events in the Syntax of Agrammatic Speech. *Brain and Language*. **50**, 135-150.
- Williams, E. 1995. Theta theory. In G. Webelhuth (ed.), *Government and Binding theory and the Minimalist Program*. Cambridge, MA: Blackwell.
- Zurif, E.B., D. Swinney, P. Prather, J. Solomon & C. Bushell. 1993. An on-line analysis of syntactic processing in Broca's and Wernicke's aphasia. *Brain and Language*, **45**, 448-464.
- Zurif, E.B., D. Swinney, P. Prather, A. Wingfield, and H. Brownell. 1995. The Allocation of Memory Resources During Sentence Comprehension: Evidence from the Elderly. *Journal of Psycholinguistic Research*, **24**, 165-182.

APPENDIX

Instructions for Passive Study

This experiment may seem silly at first because it uses children's toys. The reason we use toys is so that you can see action while listening to a story. We don't mean to be insulting and apologize if it seems offensive to you.

For this experiment you are going to hear a series of 30 short stories. The characters in each story will be introduced to you before you hear the story. While you are listening to the story, you will see the characters acting out what is happening.

After each story you will hear a sentence that will either match or not match the story. Here's an example:

This is a boy. This is an elephant.

Practice Story 1

The elephant doesn't like little boys. when the elephant sees the boy, he runs away. The boy chases after the elephant until they both run out of breath.

Practice Sentence 1

The boy chases the elephant. (repeat)

Does the sentence match what happened in the story? If you think it did, point to the smiling face. Now don't worry about whether the story could actually happen in real life. For many of the stories you will have to stretch your imagination. All we want you to do is to determine whether the sentence after the story matches or doesn't match what happened in the story. Here's another sentence:

Practice Sentence 2

The elephant chases the boy. (repeat)

Does this sentence match what happened in the story? (wait for response)
Right, the boy was the one who was doing the chasing, not the elephant. Since this sentence doesn't match the story, you would point to the frowning face.

Listen carefully to each story and the sentence that follows so that you can decide whether the sentence matches the story. Be sure to look at the characters while each story is being read.

This isn't a timed test, so you can take as long as you want to decide whether a sentence matches or doesn't match the story. You can have the sentence repeated as many times as you want. You may also ask that the entire story be repeated.

Make sure that you pay attention to who is doing what in the sentence. Decide on each sentence very carefully. If you think that the sentence matches what happened in the story, point to the smiling face. If you think that the sentence DOES NOT match what happened in the story, point to the frowning face.

Do you have any questions? Here are some more practice stories.

EXAMPLE STIMULUS ITEMS

Active

The characters are an Indian and a swimmer.

The story is *The Indian is having a coughing fit. The swimmer wants to help, so he hits the Indian on the back to help stop the coughing.*

The sentence is *The Indian hits the swimmer. (repeat)*

(Correct response is **NO**).

Agentive Passive

The characters are a muscle man and a boy

The story is *The muscle man is living in the boy's closet and pays rent every month. When the first of the month arrives, the muscle man gives the boy some money.*

The sentence is *The muscle man is paid by the boy. (repeat)*

(Correct response is **NO**)

Quantified Passive

The characters are three men and three mice

The story is *The mouse has just won some money from playing bingo. The mouse wants to pay off some of his debts. He gives some money to the first man, then the second man, and finally to the third man.*

The sentence is *Every mouse is paid by the man. (repeat)*

(Correct response is **NO**)

Short Passive

The characters are a robot and a horse

The story is *The horse has been painted for a special festival. Now the horse wants to wash the paint off, but he can't reach some of the spots. The robot takes a sponge and helps the horse get clean.*

The sentence is *the robot is washed. (repeat)*

(Correct response is **NO**)