

Levels of Representation and Units of Access Relevant to Agrammatism

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The paper differentiates argument structure from other levels of representation and uses linguistic analysis of aphasic narrative production to support an enriched lexical entry for verbs that includes the d-structure representation of the configuration of the verb, its arguments, and any other lexically selected material. A single narrative production study and portions of two follow-up studies are presented. The argument structure distributions for two agrammatics (with varying degrees of fluency) and a nongrammatical conduction aphasic with anomia are compared and contrasted with both matched controls and each other. © 1995 Academic Press, Inc.

This paper makes the case for using linguistic analysis of aphasic narrative production as evidence for an enriched lexical entry for verbs that includes the d-structure representation of the configuration of the verb, its arguments, and any other lexically selected material.

This narrative production research is complemented by on-line processing studies currently being conducted by Caroline Carrithers in the Psychology Department at Rutgers University. The data for two of the agrammatic speakers studied were provided to us by Myrna Schwartz whose own research has greatly inspired and influenced our own. We are grateful to her for her generous contributions of data, the foundations of a system for analyzing narrative production, as well as theoretical insights, thoughtful feedback, and helpful suggestions. Mary Jack in the Psychology Department at Rutgers has been involved in much of the subject testing, as well as the coding and analysis of data. We are indebted to her for both her help and her insights into the data. We thank the Kessler Institute for Rehabilitation, Inc. for sponsoring our research and providing us with subjects. Above all we are grateful to the aphasic and control subjects who graciously gave of their time and conscientiously participated in these studies. The research reported here and the road to its explication has benefited from discussions with Kathleen Baynes, Rita Sloan Berndt, Branch Coslett, Ruth Fink, Renee Kaufmann, Beth Macauley, Lorraine Obler, Howard Poizner, Leslie Gonzalez Rothi, Elinor Saffran, Myrna Schwartz, and Sarah Wayland. This research was supported by NIH Grant DC01656 to Rutgers University. Address reprint requests to Judy Kegl, Center for Molecular and Behavioral Neuroscience, Rutgers University, 197 University Avenue, Newark, NJ 07102. E-mail: kegl@andromeda.rutgers.edu.

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Linguistic Background

The linguistic component of this research makes use of a typology of argument structures for syntactic constructions in English. This typology is a finite set of patterns reflecting structural arrangements possible for those nouns or sentential complements serving as the d-structure subject (external argument), d-structure direct object (direct argument), and d-structure indirect object (indirect argument) of verbs. Verbs lexically select certain argument structure patterns or sets of patterns. This is a property of distinct semantic classes of verbs (see Levin, 1993). The typology presented here serves as a resource for organizing research questions, as a guide in the analysis and coding of aphasia data, and in the development of psycholinguistic stimuli.

Lexical Conceptual Structure

Word knowledge, in this model, concerns the recognition of verb classes represented cross-linguistically, such as verbs of change of state, verbs of creation, verbs of perception, verbs of contact, etc. (see Levin, 1993). These classes are associated with a core meaning shared by all their members and a particular set of argument structure patterns they instantiate. The meaning of these verb classes involves the mapping of a lexical conceptual representation of the verb and its participant roles (agent, theme, source, etc.) onto some specific argument structure pattern or set of patterns. The Lexical Conceptual Structure (LCS—Hale & Laugren, 1983; Jackendoff, 1987; Jackendoff, 1990) decomposes the meaning of a verb into semantic concepts like Go, Be, Stay, Move, etc. The LCS also includes elements bearing certain semantic/thematic roles like Event, State, Goal, Source, Theme, Place, etc. with respect to verbs. Figure 1 presents an LCS from Jackendoff (1990) for the verb *drink*.

The LCS is a subset of the world knowledge associated with the event labeled by *drink*, but it is a superset of the semantic information that is encoded in the lexical representation of the verb *drink* (see Kegl, 1989). Because of regularities in the mapping of components of the LCS to argument structure within verb classes, links between thematic relations and specific argument types might seem systematic. However, the linking of participant roles in an LCS to argument positions in a verb's lexical entry are idiosyncratic and nonisomorphic. As a result, generalizations across the lexicon concerning the thematic roles held by the external, direct or indirect arguments of verbs are spurious. For this reason, syntactic rules under the analysis offered here do not make reference to thematic roles, but rather refer to structurally defined argument positions. Furthermore, a given argument structure pattern may appear in a variety of unrelated semantic classes of verbs. Problems exhibited by agrammatics apply across the board to all constructions of a given argument struc-

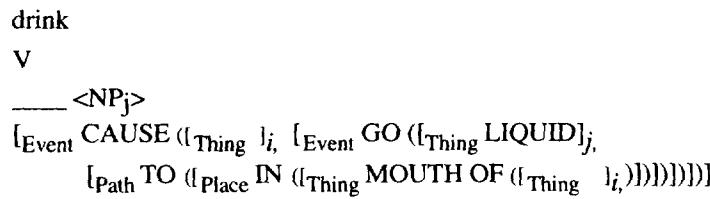


FIG. 1. Example of a Lexical Conceptual Structure (LCS). Reprinted by permission, from Jackendoff (1990).

ture type and do not break down according to semantic verb classification, further supporting the claim that agrammatism involves a syntactic rather than semantic deficit.

Argument Structure

Argument structure patterns are defined structurally in terms of the d-structure subject (external argument), d-structure direct object (direct argument), or d-structure indirect object (indirect argument) positions the verb selects for. The syntax sees and manipulates only these structurally configured noun phrases without reference to any association they may have to participant roles. An agrammatic speaker is assumed to retain control over the lexical entry up to and including its realization as the d-structure representation of the verb phrase yet to lack access to that portion of the syntax which forces movement rules that shift noun phrases to different argument positions. Phrase structure abilities are intact, but analysis always follows the d-structure canonical arrangement of arguments, yielding the set of processing heuristics based on basic S-V-O (subject–verb–object) order that is frequently attested in the literature.

Argument. For a sentence to be well-formed, the verb in that sentence characteristically requires some number of elements to be present. These required elements are referred to as *Arguments*. For example, the transitive verb *bite* requires two arguments, the biter and the thing bitten (*The dog bit the boy*), while the intransitive verb *sleep* requires one argument, the sleeper (*The baby slept*). The choice of verb determines not only how many, but what type of, arguments a verb requires. It is a property of *bite* that the arguments it requires are both noun phrases. In contrast, the verb *claim*, which also takes two arguments, requires that one be realized as a noun phrase and the other as a sentence, specifically a sentence with the complementizer *that* (*The accountant claimed that the bill had been paid*). The particular realization of an argument of a verb as a noun phrase (NP) or a sentence (S) is not due to any characteristic property of that argument but rather follows from properties of the verb. In addition, the choice of verb influences the syntactic realization of these elements, so that the three arguments of *put* are realized as noun phrases

bearing the relations of subject, direct object and object of a preposition (*The teacher put the books on the desk*) and not, for example, as subject, direct object, and indirect object (**The teacher put the desk the books*).

Argument structure. When used in a sentence, a verb requires certain arguments which may be realized as particular lexical categories and bear particular grammatical relations to the verb. These properties are specific to the verb and, therefore, must be signaled in its lexical entry. The verb entry contains an abstract representation of its argument-taking properties, referred to as its Argument Structure. A verb's argument structure must indicate the number of arguments that a verb requires; this information is often encoded in the argument structure by using variables to serve as placeholders for arguments (Rappaport & Levin, 1988; Rappaport, Levin, & Laughren, 1988). The argument structure includes one variable for each argument of the verb. For example, two distinct variables, *x* and *y*, in the argument structure for *bite* signal that this verb takes two arguments: *bite: x <y>*.

Types of arguments. It is necessary to establish correspondences between the NPs and Ss that syntactically realize the arguments of a verb and the appropriate variables (*x*, *y*, or *z*) representing these arguments in the verb's argument structure. Arguments are distinguished in the argument structure of a verb by introducing the notions of External and Internal Arguments, and by then further subdividing internal arguments into Direct and Indirect arguments. NPs or Ss are identified as arguments of a verb by virtue of being licensed by the presence of particular other elements in the sentence such as the verb or a preposition. This process is referred to as Argument Identification (Levin & Rappaport, 1986; Rappaport & Levin, 1988).

The argument identified directly by the verb is called the Direct Argument. It is typically adjacent to and c-commanded by the verb. Assuming that a verb may identify no more than one argument (Marantz, 1984), some NP arguments of a verb are identified not by the verb but by some other element. An NP that is an argument of a verb but needs to be identified indirectly through the use of an element other than the verb (for example, a preposition) is an Indirect Argument.¹ Finally, one argument may be identified by the verb phrase itself via a special relation called predication. This argument is referred to as the External Argument (Williams, 1981).

Unaccusative Constructions

The last bit of terminology we need to make reference to is Unaccusative. An unaccusative argument structure is any argument structure that

¹ Sometimes the direct argument is itself licensed by a preposition as in *John loaded the truck with hay*. In such cases, the direct argument need not be adjacent to the verb at s-structure.

lacks an external argument. It may have a full complement of internal arguments. This generally means that the surface subject of the sentence is actually the d-structure object or direct argument. Since this is the type of construction that is particularly problematic for agrammatics, we will be referring to it frequently. Unaccusatives are sometimes referred to in the linguistics literature as "ergatives," following Burzio (1981). This terminology will not be used here.

*The Structural Relations Different Types of Arguments Hold
at D-structure*

The syntactic configurations in which each argument type occurs at d-structure appears in Fig. 2.

Argument structure and argument types. Kegl and Levin (1989) address what information a Government-Binding account (GB; Chomsky (1981) and subsequent work) of English verbs needs to encode in their lexical entries. Drawing upon that study and more recent extensions of that work, the typology of argument structures presented in Fig. 3 is proposed. The first column lists the argument structure associated with each construction. Only verbs whose lexical entry indicates this argument structure will appear in the associated construction type. The second column lists the name most frequently given to the type of construction associated with this argument structure pattern. And column three gives example sentences of each construction with noun phrases subindexed with x, y, or z to indicate the argument type they correspond to: x = external argument, y = direct argument, z = indirect argument. The list of construction types is not exhaustive.

More than one construction type can be associated with a given argument structure pattern. For example, the unaccusative pattern ($<y>$) is instantiated by not only the unaccusative intransitive (or inchoative), but also the passive and the *seems*-type subject raising constructions. Figure 4 presents a variety of representations that characterize any given construction while illustrating how the single $<y>$ argument structure pattern is instantiated by three very distinct types of constructions. The levels of representation are: argument structure (indicating the number and type of arguments the verb requires), d-structure (before syntactic movement rules apply), s-structure (after movement rules apply where traces (t_i) indicate the original position of an argument and NP_i indicates the position to which it has moved), and the subcategorization frame (indicating the noun phrases/sentential complements that appear in the surface realization of the sentence). Only the complements within the verb phrase are indicated in the subcategorization frame because, in English, every sentence must have a surface subject. Lexical Conceptual Structure representations are omitted for lack of space.

Differences in the three constructions follow from properties of the

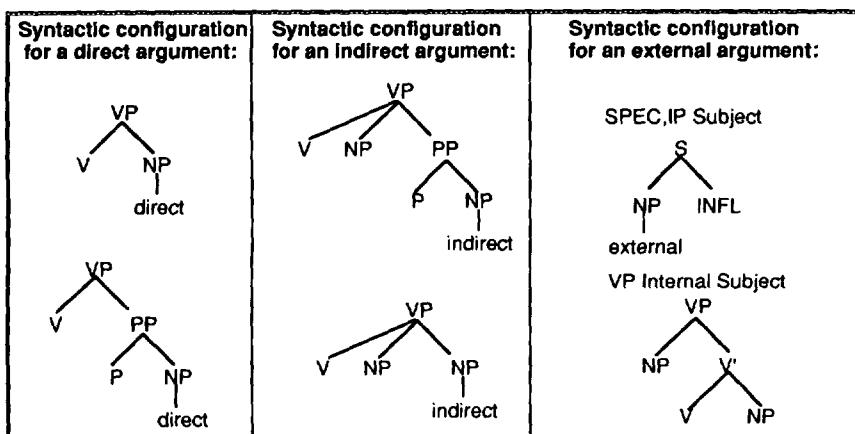


FIG. 2. Syntactic configurations for direct, indirect, and external arguments. The bottom row illustrates a prepositionally licensed direct argument, a nonprepositionally licensed indirect argument, and the structure of a VP-Internal Subject. Only the analysis involving the external argument base-generated in SPEC,IP is offered here; however, VP-Internal Subjects are compatible with this analysis as well, but not an issue addressed in this paper. Their allowability despite movement is parallel to the analysis we propose here for the processing of copular constructions.

verbs. Passives under this analysis are treated as distinct lexical items from their active counterparts, but are related. Their lexical entries specify that they take passive morphology. Similarly, it is a property of the lexical entry of the verb *seem* that its direct argument is a sentential complement rather than a noun phrase complement.

The same argument structures are found both with verbs that take only NP complements and with verbs that take sentential complements. In fact, sentential complements are invariably the direct argument and therefore sentential complement-taking verbs use only a subset of the argument structures used by verbs that take NP complements. The Appendix provides a comprehensive typology of argument structures for English. The typology in the Appendix is in the form of a branching tree, illustrated with example sentences and organized on the basis of the presence (Ia) or absence (Ib) of an external argument and then the presence or absence of a direct argument. All sentential complements are direct arguments. This portion of the hierarchy splits on the basis of finite versus infinitive clauses, and the infinitive category divides on the basis of control properties (subject versus object control). Finally, the presence or absence of an indirect argument is indicated.

The argument structure typology is complemented by Levin's (1993) book on verb classes in English, which identifies a large majority of se-

Construction Types in English

$x < y >$	transitive	The dog x bit the boy y . The accountant x claimed [that the bill had been paid] y .
$x < >$ $< y >$	unergative unaccusative	The woman x slept. The package y arrived.
	passive middle	It seems [that she has forgotten her hat] y . The window y was broken by Bill.
$x < y, Pz >$	transitive+PP	The door y opened easily. The man x donated the book y to the library z . Sue x loaded hay y onto the truck z .
$x < Py, z >$ $< y, Pz >$	transitive+ind. unaccusative+PP	The man x motioned to P Bill z [that he should leave] y . Sue x loaded the truck z with P hay y .
$x < y, z >$	double object	The ivy y clung to P the wall z . It occurred to P Alice z [that she should write a book] y .
$< y, z >$	psych-verb	The man x gave the woman z the book y . Ann x warned Carol z [that she should leave] y .
$x < Pz >$	unergative+PP	The play y amused the children z . It relaxes Bill z [to read a good book] y .
$x < z >$	unerg.+ind. obj.	John x proposed to Mary z .
$< >$	weather verb	John x paid Mary z . It rained.
$< y > w$	copular measure verb	Mary y is a doctor w . The chicken y weighs three lbs. w .

x =external argument; y =direct argument; z =indirect argument; w =obligatory adjunct

FIG. 3. Construction types in English. First column presents argument structure schemata; second column gives traditional labels associated with the constructions exemplified; third column gives an example sentence for each construction with arguments indicated.

Example:	<i>A man was robbed.</i>	<i>A cup broke.</i>	<i>Pam seems to be sad.</i>
Type:	Passive	Inchoative	Subject-to-Subject Raising
Arg. Structure:	$< y >$	$< y >$	$< y >$
D-structure:	$e V NP$	$e V NP$	$e V S$
S-structure:	$NP_1 V + \text{pass} t_1$	$NP_1 V t_1$	$NP_1 V t_1 \text{ to } VP$
Subcat. Frame	<i>rob</i> +passive:	<i>break</i> :	<i>seem</i> :
	+ [$__ NP$]	+ [$__ NP$]	+ [$__ S$]

FIG. 4. Levels of representation for three construction types that all have the simple unaccusative argument structure pattern $< y >$.

mantic classes of verbs in English and the argument structures and argument structure alternations (diathesis relations) characteristic of each of these classes. Using the argument structure typology, it is possible to identify all the constructions in English that involve "moved arguments" and are predicted to be the class that cause problems for agrammatics. This typology of argument structures informs coding schemes for analyzing production data as well as the choice of stimuli in on-line processing experiments currently underway (Carritthers, Jack, & Kegl, 1995; Kegl & Carritthers, 1994).

Lexically Selected Nonarguments

Working under the assumption that agrammatic aphasics have access to the lexical representation of the verb (a prestructured VP) entails assuming access to not only the verb and its arguments, but also to any other lexically selected material such as verb particles, idiom remnants, and other adjuncts such as the measure phrases selected by the class of measure verbs and the predicate adjectives and predicate nominatives selected in copular constructions. This material is referred to as an Obligatory Adjunct. Our analysis of obligatory adjuncts is based upon an analysis presented in Kegl and Fellbaum (1988, 1989) and assumes the following structure for obligatory adjuncts (Fig. 5).

Kegl and Fellbaum's primary focus is on a class of constructions called measure constructions such as *The chicken weighs three pounds*, *The book costs ten dollars*, *The movie lasted four hours*, and *The rug measured 39 feet*. The underlined material is the obligatory adjunct. Notice that all four sentences are ungrammatical if the adjunct is missing. The phrases that occur in the obligatory adjunct position do not behave like the noun phrase arguments we discussed previously. Evidence that the obligatory adjunct does not function as an argument includes the inability of measure constructions to alternate with a passive form, the ability of the adjunct to serve as an adjective modifying the direct argument (a three-pound chicken), selectional restrictions between the direct argument and the obligatory adjunct, etc. Since obligatory adjuncts never move to argument positions, they should never cause the "moved argu-

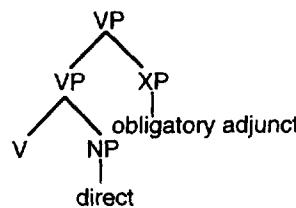


FIG. 5. Structural configuration for the obligatory adjunct.

ment problem" for agrammatics. However, Kegl and Fellbaum argue that the other noun phrase in these measure constructions is actually a moved argument—namely, that these are members of the class of unaccusative constructions. Notice that the semantics of *the chicken* appear to be similar in the following two sentences, providing some evidence that *the chicken* is the d-structure object/direct argument in the second sentence as well as the first. These sentences are not derivationally related, however.

The butcher weighed <u>the chicken</u> .	[The butcher weighed the chicken]
<u>The chicken</u> weighed three pounds.	[⟨e⟩ weighed the chicken three pounds]

A parallel set of constructions to the measure constructions are called copular constructions: *Mary is a doctor*, *The book is ten dollars*, *The cup was unbroken*, etc. Again, the underlined material is the obligatory adjunct and the subject noun phrase is a d-structure object. However, there is a difference.

In these sentences, *to be* is not a verb, but rather an auxiliary. Arguments for forms of *to be* as auxiliaries include the following: (1) Verbs do not undergo subject Aux inversion in questions, auxiliaries do. Compare **Ran John home with Is Mary a doctor*. (2) Verbs do not occur in Tags; auxiliaries do. Compare **John kissed Mary, kissn't he?* and *Mary is a genius, isn't she?* (3) Verbs do not contract with Neg, auxiliaries do. Compare **Sue broken't the cup* and *John isn't the murderer*. It seems that copular sentences have a nonphonologically realized or "zero" verb. We see a similar phenomena in embedded sentences in which the auxiliary is optional, such as the underlined material in *I consider John a fool*. Copular sentences provide an interesting test case for the procedural mapping hypothesis of sentence processing in agrammatics since, even though a moved argument is involved, it is not really displaced in the surface form of the sentence. Only the auxiliary (*is*) which is a function word, appears displaced between d-structure and s-structure, and function words are typically omitted by agrammatics.

The inventory of obligatory adjuncts is large, also including the verb particle in constructions like *Alice looked the address up*, the resultative phrase in *James hammered the metal flat* or *The lake froze solid*, and the idiom remnant in *Joe kicked the bucket*. In all cases, an agrammatic's access to lexically specified information contained in the verb entry should predict that if the verb shows up, there is a high likelihood that its obligatory adjunct will show up as well, even when discontinuous.

Obligatory adjunct constructions might well provide alternative argument structure realizations for certain problematic syntactic constructions. For example, the adjectival passive as in *The cup was unbroken* is a copular construction involving an obligatory adjunct. It promises to be easily processable by agrammatics. The passive, a problematic construc-

tion for agrammatics to produce, is superficially indistinguishable: *The cup was broken (by John)*. In fact, in many instances adjectival passives and real passives are indistinguishable, except for subtle aspects of their interpretations. This superficial similarity provides a prime test case for facilitating the use of a problematic set of sentence forms by bootstrapping them with an alternate argument structure.

In some of the mapping therapy studies currently being conducted by Schwartz, Saffran and their colleagues, patients have shown some success in being trained to produce more passives. It is possible that the similarity to adjectival passives facilitates this process. Additional argument structure patterns might be substituted for problematic "moved argument" constructions and thereby facilitate their use. For example, an adjectival passive (no permutation of the lexically specified arrangement) pattern might facilitate the production of true passives (involving moved arguments), or an agentive pattern (*He frightened the children* (intentionally, as in by jumping out from behind a door)) might facilitate production of nonagentive psychological constructions (*The story frightened the children*.). See Tinker, Beckwith, and Dougherty (1990) for acquisitional evidence suggesting that this might be a possibility.

Agrammatism as a Focusing Tool

Agrammatism has received much attention and has posed great problems for providing a coherent linguistic and psycholinguistic account of sentence processing deficits in aphasia. The controversy among researchers concerning the validity of using clinical categories such as "agrammatism" in cognitive linguistic and neuropsychological research (see Badecker & Caramazza, 1985, 1986; Caplan, 1986) is tangential to the focus here. The clinical classification of "agrammatism" serves simply as a large grain filter to help focus in on a set of theoretically interesting patients who, studied in detail as individual case studies, promise to offer insights into the role lexical information regarding argument structure plays in sentence production and comprehension.

Individual patients with access to lexical information, but incapable of unraveling the surface structure representation of a sentence that reflects the application of movement rules triggered by syntactic constraints on well-formed sentences, are expected to exhibit a predictable pattern of sparing and loss with respect to their ability to both produce and process specific types of constructions. We expect this deficit in the context of production, comprehension, and grammaticality judgment tasks to manifest itself in quite different ways and in vastly differing degrees of severity. A breakdown in production will not necessarily be mirrored by a comparable breakdown in comprehension in all instances. Other factors can conceivably come into play to further hinder or to compensate for

difficulties caused by argument placement mismatches. A primary aim is to identify a linguistic basis that links these individual cases.

Argument Displacement Hinders Processing

The pattern of sparing and loss mentioned above follows from a cross-linguistically relevant theory of argument structure patterns and is correlated primarily with the presence versus absence of an external argument (a d-structure subject) in any given verb's associated argument structure representation(s). Verbs whose argument structure pattern contains an external argument are more stable and processible by agrammatic aphasic subjects because the presence of an external argument precludes in most cases the need for movement rules that displace arguments from their lexically specified positions. The processing of displaced arguments requires specific syntactic knowledge. It is not the presence of an external argument, but the syntactic role it plays in maintaining an orderly arrangement of surface noun phrases conforming to the arrangement specified in the lexicon that makes it a key player in the agrammatism profile.

A subset of argument structure patterns lacking an external argument but still maintaining the lexically specified arrangement of arguments is also identified. These patterns involve the presence of an obligatory adjunct and a copula—sentences like *Vicki is a strict timekeeper*. Because copular constructions, as we argue elsewhere (Kegl & Fellbaum, 1988, 1989), involve a zero verb, the displacement of the direct argument to surface subject position involves vacuous movement of the direct argument and therefore is still compatible with the d-structure template lexically available to the agrammatic subjects.

To be more precise, any displacement of arguments from their d-structure positions that results in a tangible permutation of the arguments relative to the verb and to each other is predicted to prove problematic. In addition to passives, middles, *amuse*-type psych verb constructions, *seems*-type raising constructions, locative inversion constructions and other unaccusatives; we also predict that double object dative constructions such as *John gave Mary a book* and spray/load constructions such as *John loaded the truck with hay* should prove troublesome. This paper, however, focuses on just those constructions lacking an external argument.

Summary of Characteristics of Agrammatism

Agrammatics show a production² deficit evidenced by a proliferation of content words and a scarcity of function words and inflectional affixes,

² See Kean (1977); Saffran, Schwartz, and Marin (1980); and Schwartz (1987), among others.

a limited set of syntactic constructions, and the rare occurrence of complex sentences with embedded clauses. They also show, to varying degrees, a comprehension³ deficit, particularly in constructions in which word order strays from the canonical d-structure order consistent with the mapping of semantic roles and grammatical morphemes that must be used in order to assign the proper semantic interpretation to a sentence. Yet, despite production and comprehension deficits that appear to be syntactic in nature, many agrammatics demonstrate, via their ability to make grammaticality judgments,⁴ a surprising sensitivity to the abstract structural organization of sentences (phrase structure), the syntactic information signaled by function words, and a keen sense of strict subcategorization and selectional restrictions. The discrepancy between omissions in production and sensitivity to the same items in off-line grammaticality judgment tasks resolves to a certain extent when we admit syntactically enriched lexical entries for verbs.

Previous Accounts of the Phenomena

Caplan and Hildebrandt (1988) as well as Grodzinsky (1990) present comprehensive literature reviews that compare, contrast, and critique processing models and linguistic analyses proposed to account for the previously mentioned constellation of deficits and spared abilities exhibited by agrammatics. I will not reiterate their overviews here.

Mapping Deficit Hypotheses

The account offered here falls roughly within a family of explanations that assume the deficit underlying agrammatism to involve problems with mapping thematic roles (semantic roles—agent, theme, source, goal experiencer, etc.—played by the noun phrases a verb cooccurs with) onto the subject, direct object, and indirect object noun phrases in the surface representation of a sentence (Linebarger, Schwartz, & Saffran, 1983; Saffran, Schwartz, & Marin, 1980; Schwartz, Saffran, & Marin, 1980, etc.). The correct mapping of thematic roles to noun phrases in subject, object and indirect object position in a sentence is necessary in order to assign a meaning to a sentence. Problems associating thematic roles to appropriate noun phrases are not uniform across all sentence types. Some sentences present more difficulties than others.

³ See Heilman and Scholes (1976); Caramazza and Zurif (1976); Caplan and Hildebrandt (1988); Grodzinsky (1990); Schwartz, Saffran, and Marin (1980); Schwartz, Linebarger, Saffran, and Pate (1987); and Hickok, Zurif, and Canseco-Gonzalez (1993), among others.

⁴ See Linebarger, Schwartz, and Saffran (1983); Berndt, Salasoo, Mitchum, and Blumstein (1988); Lukatela, Crain, and Shankweiler (1988); Berndt and Caramazza (1980); and Shankweiler, Crain, Gorrell, and Tuller (1989); see also Kolk, van Gunsten, and Keyser (1985).

The Procedural Mapping Hypothesis

The account favored by Schwartz, Linebarger, Saffran and Pate (1987) claims that the problems agrammatics (in fact, an even wider range of aphasic patients) have with passives, embedded relatives, and several other constructions stems from the indirectness or lack of transparency by which they express thematic roles. Their analysis requires that in addition to the surface structure (s-structure) arrangement of the verb and its selected noun phrases, we recognize a second level of syntactic representation known as d-structure. D-structure is an abstract level of sentence representation where the position of noun phrases relative to the verb is consistent with the thematic roles those noun phrases will bear in the interpretation of the sentence. For example, even though the noun phrase *the baseball* appears in two distinct grammatical positions (subject vs. direct object) in the surface representations of an active versus passive construction, it bears the same thematic relation to the verb in both sentences. In both sentences *the baseball* has the thematic role "theme," which roughly characterizes the element that moves, is located, or is directly affected by the action of the verb.

S-Structure Level of Representation

The pitcher threw the baseball. (active)
direct object | The baseball was thrown (by the pitcher). (passive)
subject

At d-structure, all noun phrases that bear the same thematic relation to the same verb would occupy the same syntactic positions. In the case of the active and passive sentences above, *the baseball* would occupy the d-structure direct object position in the d-structure representation of both sentences. This d-structure direct object position is the "theta position" to which the thematic role theme is assigned. (The "[e]" in the d-structure passive indicates that the subject position of the passive verb is empty at the d-structure level. Consequently, in contrast with the active form, there is no assignment of an agent role to a noun phrase associated with this position.)

D-Structure Level of Representation (with Respect to Arguments Not Inflectional Elements)

The pitcher threw the baseball. (active) | [e] was thrown⁵ the baseball by the pitcher. (passive)
d-strux direct object d-strux direct object

⁵ Actually, it would be more correct to represent the d-structure representation of the verb as *throw* + *passive*. The surface inflection is a simplification for purposes of more transparent exposition.

Schwartz et al. (1987) claim that in a construction like the passive, in which the noun phrase receiving a thematic role such as theme, occupies a different position at s-structure than it did at d-structure, the mapping between the surface syntactic position and the theta position (the d-structure position at which the thematic role is assigned), necessary for semantic interpretation, is not transparent and causes difficulties for agrammatics. Assuming that these same agrammatic subjects do have access to the Lexical Conceptual Structure of the verbs used in production, one would not expect the nontransparency problem ever to arise in production. The agrammatic speaker already knows the assignment of roles to given arguments. Yet, the agrammatic still fails to produce precisely those constructions in which a mismatch between d-structure and s-structure occurs. It is at this point that our analysis diverges from the Mapping Deficit Hypothesis.

Problems Co-indexing Traces of Movement

Grodzinsky (1986) characterized the same problem as "an inability to co-index traces in comprehension tasks." In transformational grammar the displacement of *the baseball* from d-structure direct object position to s-structure subject position is accomplished by a movement⁶ rule that leaves behind a trace (t_i) that is coreferential (co-indexed) with the moved noun phrase: *The baseball, was thrown t_i by the pitcher*. The movement from object to subject position in a passive is required for theory internal reasons. In the Government and Binding framework (Chomsky, 1981), passives are intransitive constructions whose verbs cannot support a direct object. So even though *the baseball* occupies direct object position at d-structure, it cannot remain there at s-structure. According to Grodzinsky, agrammatics have problems recovering the coreference relation between a moved noun phrase and its trace. This link is necessary to transmit the thematic role associated to a particular position at d-structure to the noun phrase moved from that position. Grodzinsky's account also fails to address the production data.

Case Theory and the Extended Projection Principle

Failure to produce the s-structures involving argument position mismatches points to a failure to respond via the application of move alpha to a variety of s-structure well-formedness constraints and has no relation to thematic roles or their mapping. Instead, it indicates a problem with engaging syntactic movement rules to satisfy the Case Filter and the Extended Projection Principle.

⁶ Perturbations between the d-structure and s-structure will be referred to as movements, but this is purely metaphorical and used for purposes of exposition.

Case Theory

In addition to being identified in some way, all argument NPs in a sentence must be assigned Case in order for that sentence to be well-formed; this requirement is the Case Filter of Chomsky (1981). Case is assigned at s-structure under government by Case-assigning elements: verbs and prepositions assign accusative Case to their objects. In addition, the subject of a verb in a tensed sentence is assigned nominative Case by the Inflectional element (INFL).

Mapping from d-structure to s-structure for the unergative construction (*The woman slept*, $x < >$), the transitive construction (*The dog bit the boy*, $x < y >$) and transitive + PP construction (*The man donated a book to the library*, $x < y$, $P z >$) is trivial because these constructions include Case assigners for each of the NP arguments. The external argument in each receives Case from Inflection. Since the unergative construction has only a single external argument that needs to receive Case, it automatically satisfies the Case Filter. The direct argument in a transitive construction is already governed by the verb at d-structure and s-structure—this is precisely the configuration necessary for Case assignment. However, there is the added requirement that the verb that assigns Case to this argument position also take an external argument. This interdependency between the presence of an external argument and the ability of a verb to assign accusative Case is called Burzio's Generalization (Burzio, 1981, 1986). By definition, all transitive constructions have external arguments; therefore, they all assign accusative Case. The extra argument in the transitive + PP construction receives Case by virtue of being governed by a preposition.

Unaccusative Constructions

Simple unaccusative constructions (*The package arrived*, $< y >$) and unaccusative + PP constructions (*The ivy clung to the wall*, $< y, P z >$) lack an external argument. The passive form of a transitive verb also lacks an external argument, taking the argument structure $< y >$, and is subject to the same process of mapping between d-structure and s-structure representations as the unaccusative constructions (Baker, Johnson, & Roberts, 1989; Chomsky, 1981; Jaeggli, 1986; among others). Verbs in these constructions select for a direct but not an external argument, having d-structures such as *e arrive NP*.

Following Burzio's Generalization, verbs in these constructions cannot assign accusative Case to the NP in direct object position, the position adjacent to and governed by the verb. Since this NP argument must receive Case in order for the Case Filter to be satisfied, and it cannot be assigned Case by the verb, it must move to a position in which it can receive Case. Since there is no external argument, subject position is

available. There the NP can be assigned nominative Case by Inflection. The d-structure object becomes the s-structure subject through the application of the rule Move alpha. It then receives nominative Case from Inflection and the Case Filter is satisfied. The Extended Projection Principle is also now satisfied. Thus unaccusative constructions usually display a consistent discrepancy between the configuration of arguments at d-structure and at s-structure.

Amuse Type Psychological-Verb Construction

Amuse-type psych-verb constructions (*The play amused the children, <y, z>*) pose not one, but two problems for Case assignment. First, like other unaccusative constructions, the verb, lacks an external argument and, therefore, cannot assign accusative Case. In addition, the indirect argument, lacking a prepositional identifier, lacks a Case assigner as well. The absence of a preposition that can license the indirect argument is a problem also shared by double object constructions ($x <y, z>$, *Sarah gave Martha the book*). Numerous analyses have been proposed to handle these two constructions, and most recent accounts have recognized the fact that these two constructions, differing only in the presence versus absence of an external argument deserve a unified account. Stowell (1981) and Baker (1988) propose analyses only of the double object constructions. More recent analyses, starting with Belletti and Rizzi (1988), have attempted to provide a unified account of both psych-constructions and double object constructions. However, all the accounts have been forced to rely upon fairly complicated and abstract solutions involving very marked d-structure arrangements of arguments, abstract rules of incorporation of arguments (Stowell, 1981; Kegl & Fellbaum, 1988), abstract prepositional licensers that are incorporated into the verb (Baker, 1988), lexical rather than structural Case assignment (Belletti & Rizzi, 1988), and the radical restructuring of d-structure via passivization within the VP (Larson, 1988). Despite the fact that many would perhaps agree that a simple and straightforward account of these constructions remains to be found, it is clear that the absence of a prepositional licenser in the argument structure of verbs with two internal arguments, whether or not they take an external argument, is related to the problem.

Remaining Gaps in Theoretical and Empirical Accounts

Only a subset of construction types involving moved arguments have been identified and tested. A comprehensive inventory of the construction types expected to cause problems is needed to inform detailed and systematic experimentation. Providing such an inventory is one of our primary goals.

The Central Question

How can agrammatics exhibit substantial deficits in syntactic production and comprehension and yet demonstrate the ability to make rather sophisticated grammaticality judgments that demonstrate a sensitivity to phrase structure information, strict subcategorization, and function word vocabulary? Or, more simply, how can agrammatic aphasics have so much syntax?

Hypothesis

Instead of attributing more syntactic abilities to agrammatics, perhaps more syntactic content should be attributed to the lexicon to which they are presumed to have maintained access. Consider the hypothesis that verb entries in the lexicon come fully specified for the noun phrase arguments they require and the syntactic configuration of those arguments to the verb at d-structure.

Predictions

Such a hypothesis predicts that sentence processing for agrammatics should break down in production when there occurs a discrepancy between the position of noun phrase arguments at d-structure (the level of representation specified by the verb and unaffected by movement rules) and s-structure (the level of representation at which noun phrases may appear displaced from their lexically specified positions to other argument positions). However, the same constructions that are avoided or problematic in production will not necessarily cause similar or equally severe problems for comprehension. No prediction is made here concerning other sorts of movements such as WH-movement for questions or topicalization which would displace arguments, but not to new argument positions. Such movements would not necessarily have the same effect. Hickok and Avrutin (in press) have addressed this issue. Their results suggest a parallel problem in the comprehension of what might be labeled movements from A' to A' position, but not in movement from an A position to an A' position as we see in Wh-movement of arguments. This formulation of the problem is not considered in their analysis, however.

Predictions Concerning Grammaticality Judgments

Despite production and comprehension difficulties, using a grammaticality judgment task, Linebarger, et al. (1983) found that agrammatics are surprisingly sensitive to syntactic structural information in sentences. (1) Agrammatics show an awareness of the number and type of noun phrases required by a verb to be present in the surface realization of a sentence (strict subcategorization frames). (2) Agrammatics are sensitive

to function word vocabulary and cooccurrence restrictions on pairs like *did + ed*, or *was + ing*. (3) Sensitivity to the presence of function words as would be required to distinguish between *The starving man was hungry for food* and **The starving man was hungry food* also demonstrates ability to compute hierarchical syntactic structure. (4) Agrammatics are able to handle discontinuous syntactic dependencies such as the one that holds between a verb and its particle; where, for example, the particle which is part of the lexical item we call a verb occurs separated from it. All of these abilities can be supported by access to the enriched verb entry assumed here.

The ability of agrammatics to contrast the ungrammaticality of a preposition occurring after its noun phrase (as in the first sentence pair below) and the acceptability of a floated verb particle (as in the second pair below) is argued by Linebarger et al. to show a sensitivity to syntactic properties associated with specific lexical items.

*She went the stairs up in a hurry. She rolled the carpet up in a hurry.
 She went up the stairs in a hurry. She rolled up the carpet in a hurry.

Notice that the floated verb particle is associated only with transitives {roll up, call up, work out, find out, eat up, etc.} and not intransitives {*went the stairs up, *slept the bed on}. The verb particle construction occurs with verbs that have both an external and direct argument at d-structure. Under our analysis, the verb particle is a piece of the lexical material of the verb able to appear either with the verb or in an obligatory adjunct position occupied by lexically incorporated material. By virtue of its status as a part of the verb rather than a licenser of a NP argument, the verb particle is allowed more freedom in its ordering, but notably, being lexically selected material, it does typically surface when its verb is produced. We see this ordering freedom in production as well, as the following excerpt from agrammatic subject ELW's recounting of a Movie clip from *Moonstruck*. ELW's profile was presented in Kegl and Jack (1995).

Ronnie fake	"Ronnie said, "It's fake."
cut	cut . . .
roast beef and <u>cut</u> her all <u>off</u> fingers	"He was cutting roast beef and <u>cut off</u> all his fingers." <small>[bread]</small>

On the other hand, the lexical representation of the verb *go* (intransitive + PP) allows the ungrammaticality of **She went the stairs up in a hurry* to be determined because it requires a prepositional licenser for the NP (the stairs). It's position within VP is recoverable from the verb's lexical entry alone. Such an account might further predict that agrammatics would fail to be sensitive to certain ordering violations in verb particle constructions.

As in comprehension, a one-to-one correspondence between constructions hard to produce and constructions that pose problems for grammaticality judgments is not proposed. The distinguishing information in many of the “doable” grammaticality judgment tasks is recoverable from a syntactically enriched lexical entry of verbs independent of whether the syntactic mechanisms needed to produce or comprehend a well-formed s-structure representation are available. We need to focus in on those grammaticality judgment tasks that cannot be made. These can hopefully guide us to those constraints and processes that uniquely come into play after the d-structure representation is established. This rules out violations of the Projection Principle, possibly lexically registered cooccurrence restrictions on pairs of lexical items like *did+ing*, and violations of the Theta-criterion, and points to more subtle phenomena like sensitivity to function word orderings and inflections that pose a mismatch between a d-structure and s-structure realization. Instead of sensitivity to agreement mismatches, it may be more promising to look for insensitivity to inflected versus uninflected forms; insensitivity to ordering violations in verb particle constructions rather than constructions with a prepositionally licensed argument, problems in scope interpretation at LF, etc. These are directions the field is already moving toward.

Problematic Constructions

The Syntactically Enriched Verb Entry Hypothesis explicitly predicts the class of constructions in which agrammatics should exhibit the most problems in production—any constructions that would require movement of a noun phrase from one argument position to another between d-structure and s-structure such that the lexically specified arrangement of arguments would be permuted. The problem cases involve any verbs whose lexical entry does not require an external argument (d-structure subject): passives, unaccusative intransitives involving verbs like *bloom* and *appear*, *amuse*-type psychological verbs, and subject raising verbs like *seems*. Such constructions cause problems because the subject position, unfilled at d-structure, has consequences for the grammar. For example, lack of a d-structure subject means that the verb is unable to take a surface direct object, triggering movement of the d-structure object. Since another grammatical requirement for English is that all surface sentences must have subjects, the obvious place for a displaced d-structure object to move would be to subject position. Below are example sentences illustrating these types of constructions followed by their d-structure representations. The noun phrases that move between d-structure and s-structure, and thereby cause processing problems for agrammatics, are underlined. The material in parentheses is actually

tense marking and auxiliary verbs that are not part of the d-structure representation, as are the articles.

The baseball was thrown by the pitcher.	[e was thrown the baseball by the pitcher]
A flower bloomed on the rosebush.	[e bloom(ed) a flower on the rosebush]
The story amused the children.	[e amus(ed) the story the children]
John seems to be unhappy.	[e seem(s) [John (to be) unhappy]S (infinitival)]

Verb types lacking external arguments at d-structure might not be expected to pose problems. These would include weather verbs like *rain*, *snow*, *sleet*, etc., which don't force any arguments to move since they don't require any arguments at all. At s-structure a dummy word *it* is inserted to satisfy the requirement that there be a surface subject. Notice that *it* has no semantic content.

It rained. [e rained)]

There are also (zero verb) copular sentences such as the following in which, although an argument is moved, there is no explicit verb present. Superficially, then, the arrangement still conforms to the d-structure representation. The *is* in these sentences behaves as an auxiliary and is therefore a function word (see Kegl & Fellbaum, 1988, 1989).

Mary is a doctor. [e (is) Mary a doctor]
The pole is 3 feet long. [e (is) the pole 3 feet long]

There are other cases of moved arguments that might be expected to cause problems. For example, there are two types of dative constructions in English as exemplified below:

Mary gave the book to John. [Mary gave the book to John]
Mary gave John the book. [Mary gave the book John]
(no prepositional licenser)

The NP to NP dative has all the noun phrases in their canonical order at both d-structure and s-structure. However, the double object dative exhibits an inversion of the order of its arguments. Knowing that the thematic roles of these noun phrases are the same in both sentences, it is reasonable to surmise that their positions at d-structure are the same. Since it involves a moved argument, the double object dative should cause processing problems for agrammatics and have consequences for production as well. The following examples (from Schwartz, 1987) elicited from 10 aphasics via a picture description task exemplify persistence of the canonical ordering of noun phrases (girl > flowers > teacher), even in the absence of the preposition *to*.

Picture shows a young girl handing a bouquet of flowers to her teacher:

(PT.1) "The young . . . the girl . . . the little girl is . . . the flower."
(PT.2) "The girl is the flower the woman."
(PT.3) "Girl is . . . going to flowers."

- (PT.4) "The girl is . . . is roses. The girl is rosing (/rozin/). The woman and the little girl was rosed."
- (PT.5) "The girl is giving . . . giving the teacher . . . giving it teacher."
- (PT.6) "The girl is flowering."
- (PT.7) "The teacher is . . . the girl . . . giving the girl and the flowers."
- (PT.8) "Girl is handing flowers to teacher."
- (PT.9) "The flowers . . . the girl bringing the teacher."
- (PT.10) "The girl is flowers . . . teachers."

Although this paper presents a refinement rather than a refutation of preexisting accounts, its contribution is still substantial. Working within a specific theory offers the chance to be very precise about our predictions. This precision, in turn, allows the generation of more testable predictions and an exhaustive typology of the argument structures to be examined. An exhaustive typology of argument structure patterns makes it possible to "scale up" to a more comprehensive treatment of the database as a whole.

Production Studies

The remainder of this paper presents a single production study and portions of two follow-up studies. The goal is to demonstrate breakdown compatibility between the deficit exhibited by agrammatics and the linguistic theory of argument structure espoused here. This particular study focuses on the distribution of argument structure patterns in a posterior aphasic subject (FOK) versus a gender, dialect area, and roughly age matched control (SC). FOK shows a significant absence of noncopular unaccusative constructions, but preserved production of copulars which are a subtype of unaccusatives. This result conforms with our prediction which says that copulars, by virtue of having zero verbs, would not pose problems for agrammatics because the lack of a verb leaves the s-structure superficially indistinguishable from the d-structure arrangement of arguments and verbs. However, the resilient presence of "is" in FOKs preserved copular constructions poses a problem, since it should signal the displacement of the direct argument to SPEC, IP.

The Loss of Noncopular Unaccusatives in Agrammatic FOK

Hypotheses. Agrammatic aphasics have access to the lexicon, and in the case of verbs, to a prestructured d-structure representation of the configuration of verbs and their selected arguments and obligatory adjuncts, but not to the syntactic constraints triggering movement operations that disrupt the d-structure arrangement of the verb and its selected material. In clauses lacking external arguments (unaccusatives), the Case Filter and the Extended Projection Principle are more likely to require NP

movement in order to satisfy constraints on s-structure representations. Therefore, constructions lacking an external argument (unaccusatives) will prove problematic for these aphasics. Furthermore, copular constructions, although unaccusative (Perlmutter, 1978; Kegl & Fellbaum, 1988; Kegl & Fellbaum, 1989), should not be problematic by virtue of the fact that the linear d-structure arrangement of the zero verb and its arguments remains undetectable.

METHODS

Case history. FOK, a 54-year-old, white male suffered a nonhemorrhagic infarct in the left middle and posterior cerebral arteries in 1986. The lesion, at the junction of the left posterior parietal and occipital lobes, resulted in mild hemiplegia and aphasia, with comprehension relatively unimpaired. The data were elicited in 1989 when FOK was 57 years old. SC, also a white male Philadelphian, was chosen as a control for FOK. SC is neurologically intact and his data were elicited at age 73. Both subjects are well educated and of upper middle class socioeconomic status.

Data elicitation. Data were elicited by having the subject and his control recount in detail each of six 15- to 20-min movie excerpts (presented on videotape). These data were elicited over several sessions, each of which consisted of viewing a tape and then recounting the story to a tester, who systematically avoided interjecting comments or leading questions except when necessary to facilitate continued production. Sentences responding to or mirroring the experimenters' prodding were systematically eliminated from the analysis. In this study, the six movie clips included one clip from *Moonstruck*, one from *The Natural*, two from *On the Waterfront*, and two from *Witness*. These clips contained both action and dialogue shots. Movie clips were used to control the content of the narratives elicited. In this way, the intent of the speaker was recoverable from the context even when the actual sentences produced were ambiguous, incomplete, or ungrammatical. Furthermore, like stimuli allow closer comparison with controls in terms of word choice, quantity of output, and events recounted or avoided. FOK was tested on the set of six movies twice (FOK-early and FOK-late) with an intervening period of 6 months during which he received syntactic mapping therapy under a protocol offered as part of a research project run by Myrna Schwartz and Elinor Saffran. The narrative data used in this analysis were collected as a part of that study and we are grateful to them for allowing us to further analyze it.

Coding. The subjects' speech was recorded, transcribed, and segmented into utterances following the coding system in Saffran, Berndt, and Schwartz (1989). Subsequent to coding in this manner, each verb-containing clause was then coded according to its argument structure, making careful note of the presence of the verb and its external, direct and indirect arguments as well as any obligatory adjuncts. These data were then entered into an Excel program for further sorting and analysis. For this study, focus was placed upon the quantity of sentences produced per movie and across movies as well as the percentage of argument structure types produced in each of the following categories: (1) verbs with external arguments (including transitives, ditransitives, and unergative intransitives), and (2) verbs lacking an external argument: (2a) copular constructions (zero verb constructions with a form of the auxiliary *to be*, and (2b) noncopular unaccusatives (including amuse-type psychological verb constructions and unaccusative intransitives); and (3) uncodable verbs, broken down into three categories: (3a) "uncodable *is*"—including sentences with *is* but clearly lacking a main verb (e.g., *Loretta is [. . .] dinner salad*); "fragment *is*"—including fragments of NP followed by *is* with no following material (e.g., *Loretta is . . .*), and "uncodable non-*is*"—including all other uncodable utterances.

RESULTS

Although the number of utterances varied from movie to movie, typically SC (the control) produced at least 50% more utterances per movie than FOK (the left posterior-lesioned aphasic). Only *The Natural*, whose excerpts included more action depictions, elicited a more comparable amount of output from FOK; see Fig. 6.

Yet, despite a more prolific output by the control, the distribution of argument structures from movie to movie was comparable across FOK and his control. Figure 7 presents the argument structure distribution for SC-control across all six movies. Notice the almost equal split between SC's use of constructions with and without external arguments—with a slight favoring of constructions using external arguments, as well as an equal division between copular and noncopular unaccusatives. Figure 8 presents the argument structure distribution average across three controls coded to date, suggesting that the balanced patterning of argument structures seen in SC may well serve as a template against which the argument structure profiles of all of our aphasic subjects can be compared.

Figures 9 and 10 present the argument structure distributions produced by left-lesioned, agrammatic FOK while recounting the same six movies upon two separate testings 6 months apart. The data labeled FOK-early were collected at the beginning of a protocol of thematic mapping therapy that FOK was offered as part of a research project run by Myrna Schwartz at Moss Rehabilitation Hospital. FOK-late was collected approximately 6 months into the mapping therapy.

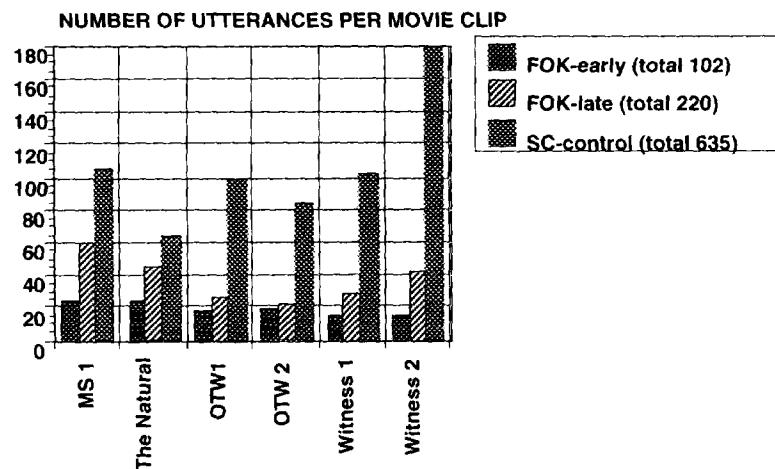


FIG. 6. Number of utterances produced by FOK-early and -late (6 months later) and his control SC broken down by movie.

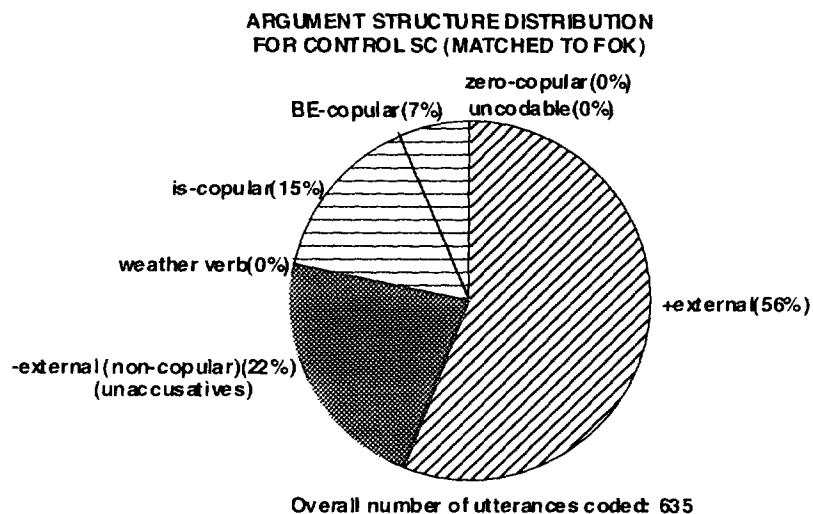


FIG. 7. Argument structure distribution produced by FOK's control is evenly balanced between sentences with and without an external argument and within the unaccusative set between copulars and other unaccusatives.

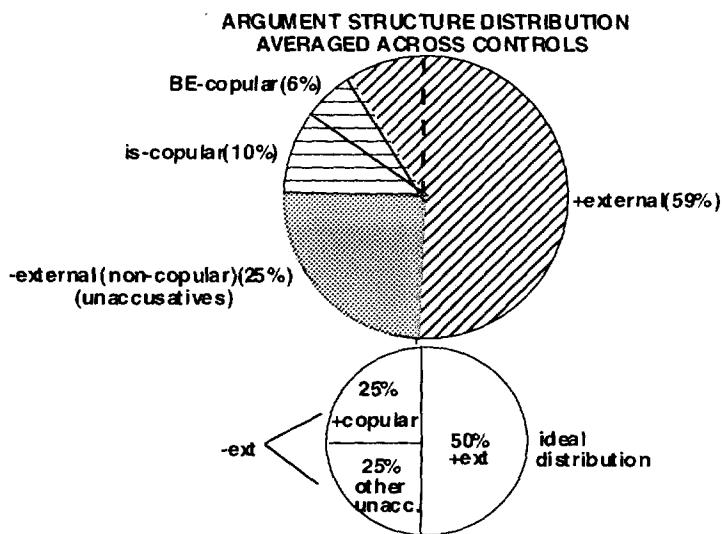


FIG. 8. Argument structure distribution averaged across controls reveals a consistent distribution that may serve as a benchmark for production studies.

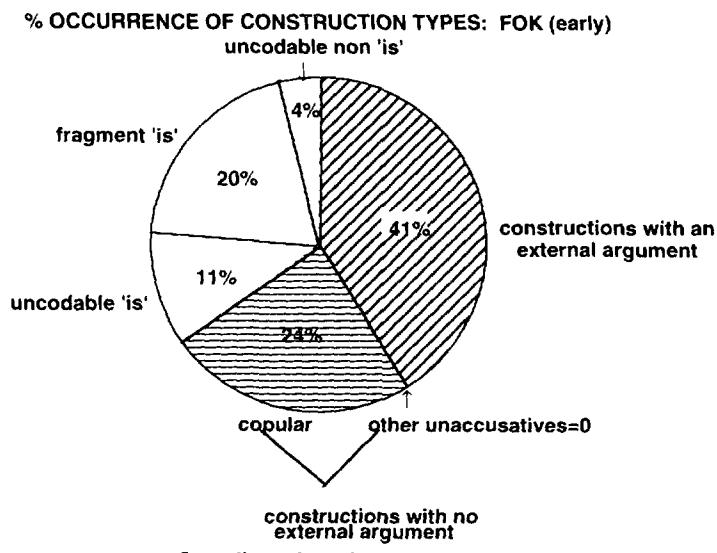


FIG. 9. Percentage of occurrence of construction types for FOK-early literally zeros out noncopular unaccusatives.

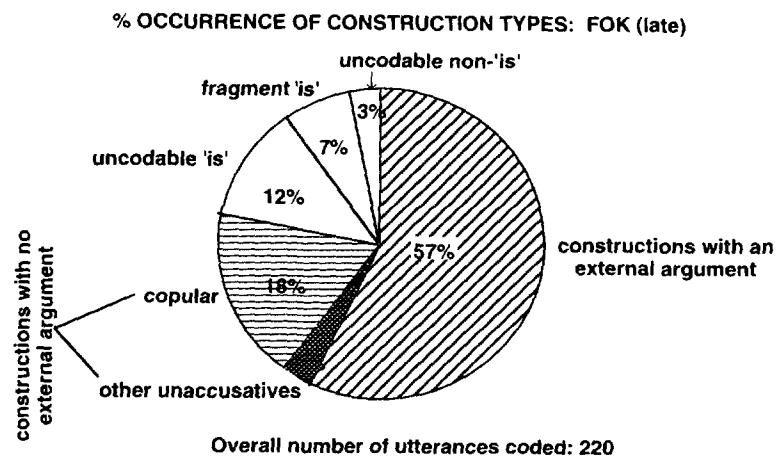


FIG. 10. Percentage of occurrence of construction types for FOK-late differs only minimally from his earlier distribution.

Notice that, as predicted, FOK-early's argument structure distribution profile shows a significant lack of noncopular unaccusatives. He produces none. After 6 months of syntactic mapping therapy designed to increase such structures, particularly passives, his percentage increases to only 3%, most of which are ambiguous between a true passive (unaccusative) and an adjectival passive interpretation (copular). We code against ourselves in such cases. Over the 6 intervening months, the percentage of uncodable utterances which had composed fully 35% of FOK's utterances decreased by 13%, all of which is reflected in an increase in the use of constructions taking an external argument. FOK-late, as a result, has an almost identical percentage of constructions lacking an external argument. His percentage of copular constructions is comparable as well. Copular constructions make up 18% of FOK's utterances and 22% of control SC's utterances.

We had predicted that, despite the fact that copular constructions are unaccusative (lack an external argument at d-structure), they might remain in the repertoires of agrammatics because they have zero verbs, and given their omission of function words, there would be no overt verb to signal the displacement of the direct argument to SPEC,IP. However, there is a problem. FOK did not seem to omit the function word. FOK produces an *is* in each of the copular constructions coded. In fact, since we only coded utterances with a verb present, all copulars contained a form of the verb *to be*. Notably, however, except for one item, the only form of the verb *to be* to surface was *is*.

The Peculiar Distribution of Is

Looking closer at the occurrence of *is* in FOK's narratives revealed that *is* is the only form of the verb *to be* to surface in FOK's sentences. Furthermore, it not only occurs; it occurs with a vengeance. Notice in FOK's argument structure profiles that 91% of the uncodable utterances produced in FOK-early and 93% of the utterances in FOK-late contained *is*, either in sentence fragments like *Loretta is . . .* or in sentences lacking a verb like *Loretta is [??] dinner salad*. In fact, most sentences begin with "NP is . . ." We counted the frequency of occurrence of *is* in all of FOK's utterances—codable and uncodable, with and without external arguments and we found that regardless of argument structure type, *is* occurred in 71–72% of FOK's utterances as compared with a 21% occurrence for SC; see Fig. 11.

The proliferation of *is* is accompanied in FOK's narratives by an overuse of progressive -ing. Although the linguistic literature rarely notes the exceptional persistence of the function word *is* in the speech of agrammatics, its presence in a reasonable subset of agrammatics was confirmed by every speech and language pathologist consulted.

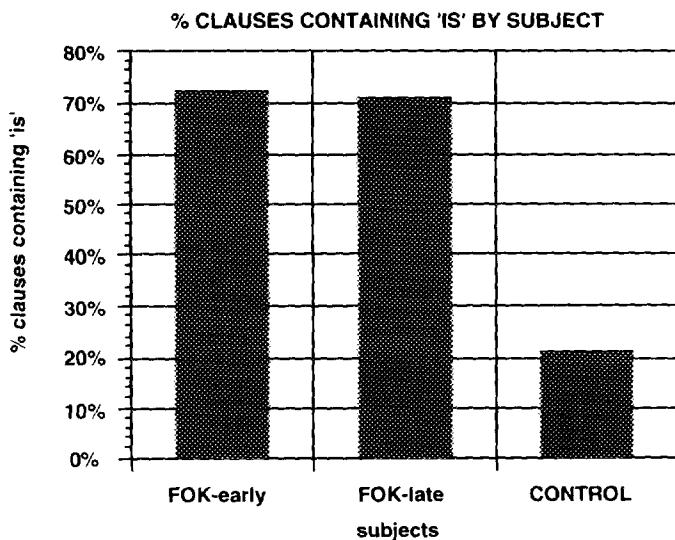


FIG. 11. FOK's use of "NP is" as a sentence facilitator is strongly suggested by his overproliferation of *is* across all argument structure patterns.

FOK's actual inventory of verbs at the early and late testing appears below with their frequency of occurrence. Notice that FOK has access to a varied range of verb types specific to his needs. He shows little evidence of anomia.

DISCUSSION

Unaccusative Drop Out

Agrammatic FOK does indeed have a blind spot specifically with respect to his production of unaccusatives. This was demonstrated by establishing a control profile for the distribution of argument structure patterns in a narrative and finding that, independent of the eliciting stimulus material, speakers of English seem to balance their use of varied argument structure patterns between those constructions that have an external argument and those that do not, and, within the set of unaccusative constructions (those not having an external argument), there is a 50/50 split between noncopular unaccusatives that overtly reflect a displacement of the direct argument at s-structure and the copulars that do not. The argument structure profile of FOK was then compared and contrasted with this control profile. Agrammatic FOK, despite significant omission of all function words except *is*, successfully, and with the correct canonical ordering and percentage occurrence, produced the same range of constructions as his control in all remaining argument structure

TABLE 1
FOK-Early: Verbs with External Argument

Verb	Frequency	Verb	Frequency	Verb	Frequency	Verb	Frequency
bet	1	give	2	moan	1	strike	1
break	1	go	2	pitch	2	strike out	3
cry	1	have	1	plead	1	throw	3
draw	1	kill	2	propose	2	tote	1
drink	1	lie	1	scare	1	write	1
drive	1	light	1	shoot	2		
fight	2	love	1	sneer	1		

TABLE 2
FOK-Early: Verbs without External Argument

Verb	Frequency
be	24

TABLE 3
FOK-Late: Verbs with External Argument

Verb	Frequency	Verb	Frequency	Verb	Frequency	Verb	Frequency
bake	2	fix	3	marry	1	serve	1
bat	2	give	1	murder	1	shoot	6
bet	4	go	4	offer	1	show	1
bring	1	harp	1	pitch	6	speak	2
carry	1	have	1	plan	1	stab	1
clean	1	hear	1	play	2	sweep	1
come	1	invite	3	plead	8	tell	3
die	1	jump	1	point	1	thank	1
discuss	1	kill	2	propose	2	throw	3
draw	1	kneel	1	provide	1	toss	1
dress	1	latch	1	pull	1	transfer	1
drip	1	lick	1	punch	1	type	1
drive	6	light	1	push	2	use	2
eavesdrop	2	live	2	read	1	want	1
excuse	1	load	1	realize	2	wash	3
finish	1	make	1	say	1	work	1

TABLE 4
FOK-Late: Verbs without External Argument

Verb	Frequency	Verb	Frequency	Verb	Frequency	Verb	Frequency
be (is)	39	fall	1	play	1	strike	1
be (are)	1	fly	2	propose	1		

types. He showed in his sentence production a sensitivity to the number and configuration of arguments required by specific verbs to be present in the sentence in order for it to be well-formed.

The Paradox

What accounts for the presence of *is* in FOK's copular construction? If it is a main verb, then copulars should behave exactly like noncopular unaccusatives and such constructions should drop out of the repertoire of agrammatics. Of course, we know on the basis of linguistic tests involving subject-aux inversion, occurrence in Tag constructions, and ability to contract with Neg that *is* in the speech of controls behaves like an auxiliary and not as a verb. If *is* does function as an auxiliary, then, like other function words, it should be omitted in agrammatic production, but it is not. Still, despite the fact that it appears in over 70% of all utterances, its presence does not serve to signal a perturbation of the arrangement of the direct argument, even though it intervenes between the s-structure subject and its d-structure direct argument position.

The Solution

The word *is*, for a subset of agrammatic speakers such as FOK, serves neither as a verb nor as an auxiliary, but rather as a sentence facilitator. This postulation is supported by the fact that FOK starts over 70% of his sentences with "NP *is*." This phrase gets the sentence rolling even before he had selected the verb to use. In over a quarter of the utterances, he fails to fill in the verb, producing either a sentence fragment (NP *is* . . .) or a verbless sentence. In the instances in which FOK does successfully fill in the verb, he has, by virtue of his use of this sentence facilitator, committed himself to using a progressive form of the verb—frequently in contexts in which the progressive is stylistically awkward. Notice that FOK's consistent use of the progressive form, even when it is strained, is the production equivalent of the grammaticality judgment task that showed the sensitivity of agrammatics to violations in the cooccurrence of function word in sentences like **Was John enjoy the movie* or **Did John enjoying the movie?* We have to surmise that, being a sentence starter, the *is* is invisible for purposes of signaling the arrangement of a verb and its arguments.

Relevance to Linguistic Theory

Identifying a specific syntactic deficit involving an avoidance or failure to produce only unaccusatives serves as a breakdown compatibility argument in support of the abstract lexical representation for this set of verbs that has been proposed within the Government and Binding framework as

well as its more recent incarnations. In particular, the mismatch between d-structure (the lexical representation of the verb and its arguments) and s-structure is motivated, and a solely semantic account of unaccusativity is soundly challenged to account for the pervasive avoidance of a structurally defined class of constructions that defies categorization in terms of its aspectual or thematic properties. Furthermore, given the intact lexical semantic knowledge exhibited by agrammatics which allows them to circumvent their syntactic deficit in the majority of grammaticality judgment tasks, to posit a semantic deficit to account for the agrammatic profile would seem fruitless. Preservation of d-structure information in the absence of access to the syntactic constraints that condition successful s-structure representations also points to an enriched lexical representation of verbs that hands off a prestructured VP to the syntax, further motivating the modular nature of linguistic organization. Finally, the preserved sensitivity to the need for a progressive form of the verb to follow the "facilitatory" is, and the successful execution of the "is + ing" form in production, promises to shed light upon the representation of functional categories both in the lexicon and at d-structure. We intend to take a closer look at the successful production of functional elements by agrammatics by developing a new set of grammaticality judgment tasks that can distinguish between the d-structure representation of functional categories and their s-structure positioning in the architecture of functional categories above VP.

Relevance to Psycholinguistic Experimentation

This research has identified a metric for syntactic complexity that is decoupled from possible non-linguistic memory constraints. Many test batteries, the Rhode Island Test of Linguistic Structure (RITLS; Engen & Engen, 1983) for one, and numerous sentence processing studies use memory demanding, multiclausal sentences with embedded clauses. Tasks with attention and memory demands prove problematic for more than the subset of aphasics with a syntactic deficit. Such tasks lead to the lumping together of a wide variety of older, nonlinguistically neurologically compromised subjects (Parkinsonian, depressed, schizophrenic speakers), as well as a diverse range of aphasic subjects under the umbrella of subjects with a syntactic parsing deficit. Although the surface manifestation of the deficit may occur in the processing of sentences, the underlying cause of the problem may not be linguistic at all. FOK, for example, produced at most one sentential complement-taking clause per narrative. Although this may well reflect a deficit in processing multiclausal utterances, there is no easy way to establish that the basis for the deficit can be traced to linguistic rather than memory factors.

The metric provided by recognizing a complexity difference between

clauses with and without external arguments can be applied within monoclausal sentences, the type of sentences most frequently produced by agrammatics. In fact, this metric can distinguish in complexity between what seem like the simplest of intransitives such as *John slept* (unergative), which is easy, and *John arrived* (unaccusative), which is hard, or seemingly parallel constructions with two NPs such as *Sue kissed Bill* (transitive), which is easy, and *Sue astonished Bill* (double object unaccusative), which is hard. It can distinguish between semantically similar constructions such as *John broke the bottle* (causative transitive) versus *The bottle broke easily* (middle), *The bottle broke* (inchoative), or *The bottle was broken (by John)* (passive). Comparison of the simplicity of the causative and the complexity of the inchoative makes it clear that a complexity metric based upon sentence length cannot be useful. The transitive proves easy to produce, while all three unaccusative intransitives prove problematic.

Sentence processing studies developed to date have on occasion failed to control for unaccusativity, namely a difference in the d-structure representation of the sentence that may be obscured at s-structure. They may wash out major processing effects by pooling together constructions of both types. Experiments such as those presented in Carrithers (1986, 1989) show that when carefully controlled, word-by-word reading paradigms are sensitive to differences at the level of argument structure representations. Unaccusatives (such as *amuse*-type psych verbs, in which the direct argument occurs before the verb at s-structure) actually speed up reading time after the verb is encountered, indicating that a mismatch between d-structure and s-structure has already been detected and the s-structure has already been parsed accordingly. The same facilitating effect would not be expected for agrammatics, who would not be expected to be able to recruit the syntactic mechanisms needed to parse the noncanonical string. We are currently replicating the Carrithers studies with new stimuli in preparation for applying the same paradigm to on-line processing studies with agrammatics.

Relevance to Research on Agrammatism

The narrative production results presented here are compatible with prior research that attributes to agrammatics problems recovering traces of movement or in recovery of thematic roles in sentences whose s-structure involves a permutation of the d-structure arrangement of arguments. However, the fact that production mirrors comprehension in certain respects calls for a more general account of the syntactic deficit exhibited by agrammatic aphasics. Such an analysis needs to go beyond focusing upon a parsing deficit to include a detailed description of the content of the lexical entries of verbs, a model of the lexical information

that is spared and the extent to which it can or cannot continue to support syntactic processing in on-line production and comprehension as well as in off-line tasks (informed by information available in the lexicon) that allow one to make a range of grammaticality judgments that indicate sensitivity to interdependencies among functional elements that do not always surface in production.

Possible Implications for Therapy

Providing an exhaustive list of those constructions that are expected to be problematic for agrammatics and those that are expected to be preserved has obvious implications for therapy. For chronic aphasics, it allows for an alternative to teaching to the deficit. It can map out those areas of grammar that may well persistently resist remediation and point to those areas of preserved abilities that can be maximized in compensating for syntactic deficits elsewhere. The resilience of copular constructions in FOK's narratives supports the analysis of these constructions as involving zero verbs, and as such, despite being unaccusative, as continuing to serve as a usable argument structure pattern in this repertoire. This is significant since the copular construction can easily cover for verbs associated with noncopular unaccusative constructions. For example, measure verbs such as *weigh*, *measure*, *register*, *total*, etc. are noncopular unaccusatives—problematic for agrammatics. However, they are paraphrasable as a transitive followed by a copular construction or even in most cases by the copular construction alone. The triplets below illustrate the ability of the copular to substitute for an unaccusative measure phrase which because it contains a verb is problematic for agrammatics.

The butcher_x weighs the chicken_y.
 The chicken_y weighs three lbs_w.
 The chicken_y is three lbs_w.

The seismologist measured the quake.
 The quake registers 7.2 on the Richter Scale.
 The quake is 7.2 on the Richter Scale.

The seamstress measures the material.
 The material measures 4 ft.
 The material is 4 ft.

The waiter totals the bill.
 The bill totals \$25.
 The bill is \$25.

These triplets also offer a nicely controlled set of stimuli we intend to use in future production and comprehension studies to tease apart the differences between the production and comprehension of noncopular versus copular unaccusatives.

As was mentioned earlier, the copular—in the form of an adjectival passive—also provides a potential substitute for passives.

Bill broke the cup.	(transitive/causative)
The cup was broken (by Bill).	(passive)
The cup was broken/unbroken.	(adjectival passive/copular)

In this case, some semantic retuning or fiddling is involved since the semantics of adjectival passives are distinct from the semantics of the passive. However, they are close enough so that if we were to be able to nudge "passives" into the copular argument structure pattern we might be able to partially fool the Turing machine and allow the processing and production of certain structures otherwise lost to the agrammatic. If the agrammatic were led to "trade up" from a problematic noncopular unaccusative pattern for passives to the copular construction, the semantic shift incurred should be detectable on picture matching tasks which would favor the adjectival rather than verbal reading, but may well go undetected by the interlocutor. Similar trading up options were mentioned earlier with respect to nudging *amuse*-type psych verb constructions into the transitive pattern. Similarly, we would predict that the semantics of the "traded up" form would give a slightly skewed or overly agentive/causative interpretation to the s-structure subject. Given an option between two pictures, one with a monster jumping out from behind a door and frightening some children and the other with a monster doing nothing but a frightened expression on the children's faces, we would predict the agrammatic whose lexicon had been rearranged to favor the former rather than the latter picture as an interpretation of the sentence, but to be able to be trained to use the construction for both.

FOK's ability to recruit the word *is* in a novel role, functioning neither as verb nor auxiliary but as a sentence facilitator (as dummy material that gets the sentence rolling along) is encouraging. He has altered the function of *is* and only *is* such that it can be overtly realized, but still fails to signal the displacement of the direct argument. Although his representation for *is* is vastly different from its representation in the grammars of his interlocutors, he has "traded up" and has succeeded in producing a homophonous, but structurally more accessible, sentence that for him serves the same purpose as the vastly more complex construction his interlocutor assumes he has produced.

Just the First Step

Although the results in the production study on FOK are robust and suggestive of a great deal, we are looking at only a single case study. The next step is (1) to replicate this study with many more cases like FOK, (2) to see how comparable the results are for more telegraphic agrammatics with frontal lesions, and (3) to show that aphasics with non-syntactic, but rather lexical accessing deficits (such as anomics) have differing profiles more comparable with controls. We are currently testing additional agrammatics and plotting their argument structure profiles. We have already reported preliminary results concerning the latter two issues in Kegl and Jack (1995) and Jack and Kegl (1992).

Comparison with Telegraphic ELW

Since FOK's prolific use of *is* in the copular construction as well as throughout the other utterance types was attributed to an idiosyncratic sentence starting strategy (NP *is* . . .) that proved facilitatory, we should expect to find other agrammatics without this strategy who nevertheless produce copular constructions. Kegl and Jack (in press) compared FOK with another agrammatic, ELW, whose speech is much more telegraphic and whose omission of function words was pervasive, including *is* along with all other forms of the verb *to be*. ELW is a well-educated (M.A. in education; former teacher), 65-year-old white female Philadelphian of middle-class socioeconomic status. ELW's corpora of data consisted of the recounting of 20 movie clips,⁷ yielding 260 utterances—a sample comparable to FOK's 414 utterances elicited during two periods of testing on seven clips. As can be seen in Fig. 12, while both produce a percentage of copular constructions comparable with controls, FOK favors the inclusion of the copula, while ELW favors its omission. Their patterns are almost exactly opposite.

Except for one example, FOK favors *is* to the exclusion of other forms of the verb *to be*, while ELW, despite production of fewer auxiliaries overall, seems to draw from a wider range of possible forms (see Fig. 13). Like her control (MB), ELW has a 50/50 split between *is* and other forms of *to be*.

FOK and ELW, both independently classified as "agrammatic" following the criteria of another research lab, have very different lesion sites. FOK's lesion is posterior (at the juncture between the parietal and occipital lobes), and ELW's lesion is frontal (in Broca's area). To compare FOK and ELW (who systematically omitted all function words) we coded not only utterances with verbs or a form of *to be*, but included Topic-Comment utterances. Topic-Comment utterances potentially fall into 3 categories: (1) passives, which are one instantiation of noncopular unaccusatives (e.g., *Book shot* (ELW—*Witness*)); (2) copulars, in those cases in which the sentence could be construed as a copular with the insertion of some form of the verb *to be* (e.g., *Melanie pregnant* (ELW—*Gone with the Wind*)); and (3) uncodables, where a copular was improbable, but a missing verb was plausible from the context (e.g., *David wedding* (ELW—*Bringing up Baby*)). Figures 14 and 15 present argument structure profiles for FOK before and after including Topic-Comment utterances in the coding.

⁷ The movie clips presented to ELW included *The Wizard of Oz*, *On the Waterfront* (two clips), *The Natural*, *Moonstruck* (two clips), *Overboard*, *The Princess Bride*, *Kramer vs. Kramer*, *Gone with the Wind* (four clips), *Terms of Endearment*, *Witness* (three clips), *Bringing up Baby* (two clips), and *African Queen* (two clips), each eliciting roughly 12–15 utterances.

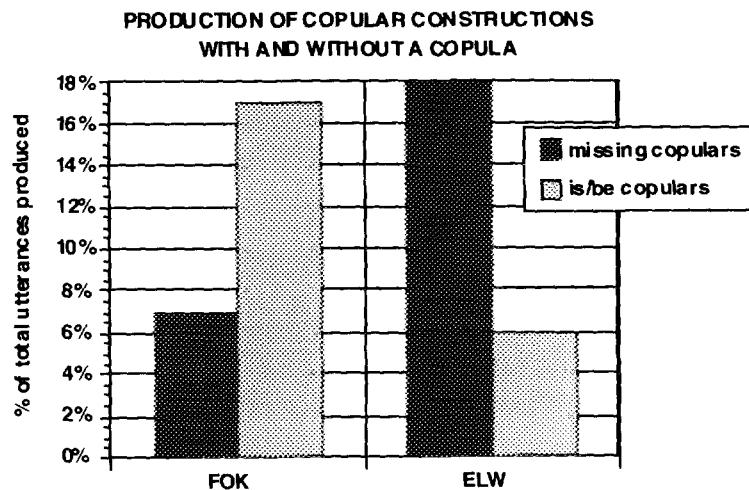


FIG. 12. FOK and ELW have almost opposite production patterns with respect to their omission versus overuse of copulars. FOK favors use of an overcopula and ELW favors omission.

We also added an extra movie clip. Recoding FOK's data to include Topic-Comment utterances did not dramatically alter his argument structure distribution profile. The increase in noncopular unaccusatives results from Topic-Comment constructions in which passive participle morphology on what could well be an adjective could also be construed as a passive. Still, despite a coding system that is overgenerous in identifying

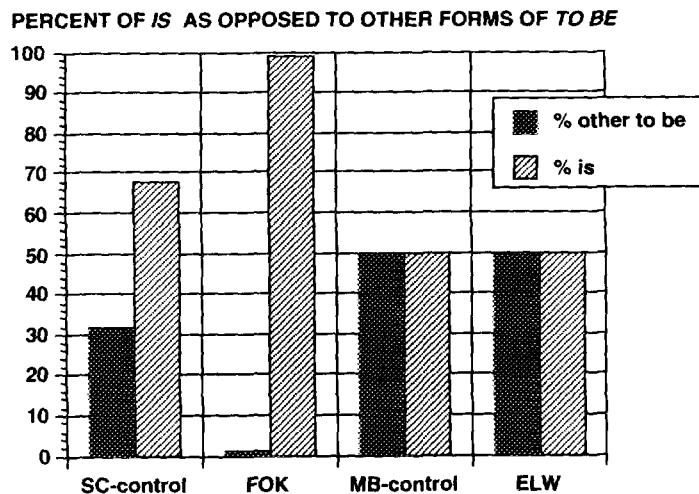


FIG. 13. FOK's use of "*NP is*" as a sentence facilitator is supported by the fact that *is* is the only copula he produces, whereas other subjects present a balanced sampling.

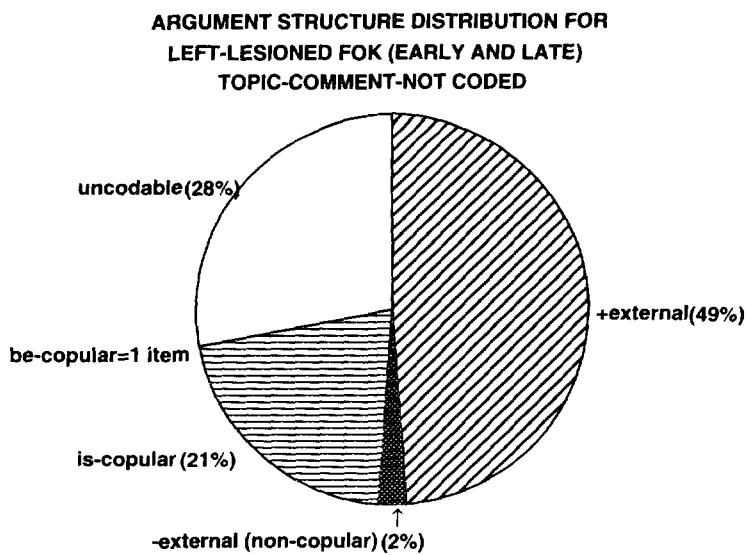


FIG. 14. FOK's early and late argument structure distributions combined prior to adding in Topic-Comment coding as well.

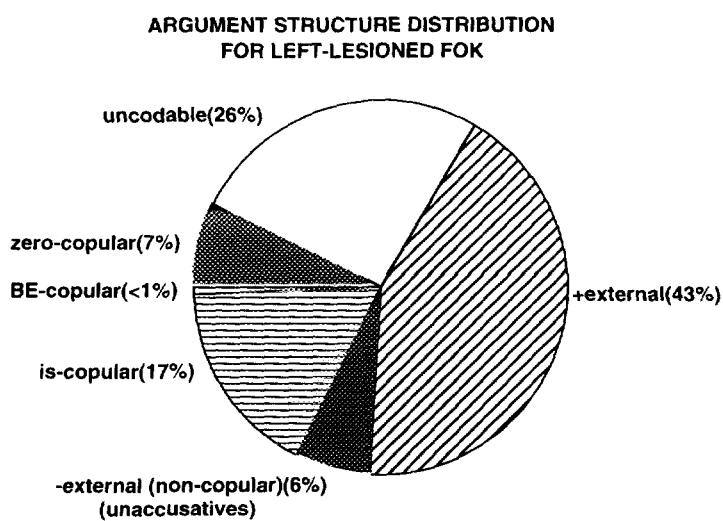


FIG. 15. To compare FOK with ELW, it was necessary to add Topic-Comment constructions (lacking any verb or form of *to be*) to his utterance inventory. His distribution was not significantly changed.

noncopular unaccusatives, this class of argument structure patterns remains grossly underrepresented.

ELW showed a comparable percentage of external argument-taking constructions (50%) and copulars (25%), but fewer unaccusative constructions (14%) in comparison to controls. Still, ELW produced more noncopular unaccusative argument structures than FOK (see Fig. 16).

It should be noted, however, that half of ELW's noncopular unaccusatives lack an overt realization of the direct argument, many consisting of just a stand alone verb (e.g., *Grows up* (ELW—*The Natural*); *Going out* (ELW—*Kramer vs. Kramer*); *Escaped the from the fire escape* (ELW—*On the Waterfront*)). We also find instances of an inverted ordering in which the s-structure subject follows rather than precedes the verb (e.g., *Slip and fell David* (ELW—*Bringing up Baby*)).

Freer Ordering in ELW's Utterances

As in the example above from *Bringing up Baby*, ELW exhibits a much freer word order in her utterances than does FOK. Several examples and their interpretations appear below:

Slip and fell David	“David slipped and fell.”	(<i>Bringing up Baby</i>)
Bicycle and sit Miss Mulch.	“Miss Mulch sat on the bicycle.”	(<i>Wizard of Oz</i>)
Toto lie paper.	“The paper lied about Toto.”	(<i>Wizard of Oz</i>)

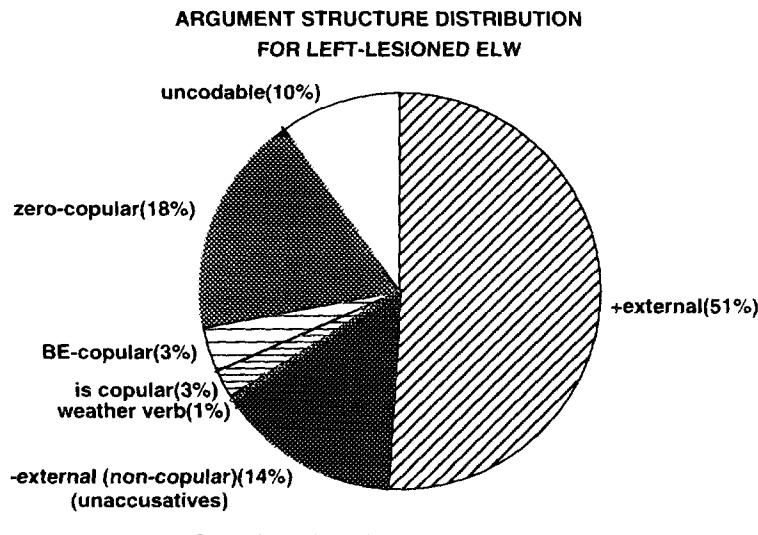


FIG. 16. The argument structure profile for ELW has fewer noncopular unaccusatives than controls, but still reflects a much higher percentage of these unaccusatives than seen for FOK.

Roy and Whammy pitched . . .	"Roy pitched to Whammy . . ."	(<i>The Natural</i>)
. . . and cut her all off fingers	"And, (he) cut off all his fingers."	(<i>Moonstruck</i>)
Got married Flap and Emma	"Flap and Emma got married."	(<i>Terms of Endearment</i>)
Sees Samuel one cop and shot man	"Samuel saw one cop shoot a man."	(<i>Witness</i>)

FOK produces few verb-argument ordering errors. The one's that do occur such as *Tree is lightening strikes* (FOK, *The Natural*) may even be attempts to recover from an utterance started by his "NP is" strategy that is then salvageable only by producing an unaccusative argument structure. For example, in the sentence above, where the logical continuation after *tree is* would be *struck by lightening*, FOK shifts to an active rather than a passive structure, seemingly producing a disordering of *Lightening strikes tree*. Other sentences produced by FOK seem to place functional material last: *Girl struck is* (FOK, *Moonstruck*); *Girl bride will be* (FOK, *Moonstruck*); *Hobbs pitching is* (FOK, *The Natural*).

Concatenation of Verb and Arguments

In contrast with FOK, whose utterance boundaries and verb argument configurations are self-evident, ELW tends to use *and* as a cohesion device to signal the combining of NPs and verb into a single utterance.

And basket and Toto basket.	"Toto was in the basket."	(<i>Wizard of Oz</i>)
Ball and Emily and heart attack	"She looked in the crystal ball and saw that her Aunt Emily was having a heart attack."	(<i>Wizard of Oz</i>)
And hand bible and sit down	"He put his hand on the bible (swore and oath) and sat down"	(<i>On the Waterfront</i>)
Roy and Whammy pitched and strike one	"Roy pitched Whammy a strike."	(<i>The Natural</i>)
Johnny and her no more	"She and Johnny broke up."	(<i>Moonstruck</i>)
Babysitter and wrapping up toilet paper	"The babysitter was wrapping something in toilet paper."	(<i>Overboard</i>)
Soldier and dying	"The soldier was dying."	(<i>Gone with the Wind</i>)
And rain and come in and sleep	"It was raining and they came in to sleep."	(<i>African Queen</i>)

Units of Access and Production

There are several differences between the individual utterances comprising the narratives produced by FOK and ELW. First, FOK simply produces more material per session than ELW. We were able to collect 414 codable clauses from FOK in his recounting of 7 movies (less than half the output we got from his control), whereas it took 20 movies to elicit half that much codable production data from ELW, one tenth the amount we were able to elicit from her control. Although both may be agrammatic, ELW exhibits the classic labored, telegraphic speech so characteristic of Broca's aphasics. She is, in fact, a most classic example

of an agrammatic, Broca's aphasic. For FOK sentence production is a struggle. For ELW, it is a battle—one that makes greater demands on her energies, thereby increasing the cognitive load in every component of the task. Therefore, it is possible that they share, by virtue damage to a shared neurologic system dedicated to the processing of specifically syntactic information, the same core syntactic deficit, yet the site of their lesions and differing impairment on other nonlinguistic systems may impinge upon their remaining linguistic abilities in differing ways, thereby constraining in different ways their ability to compensate for the same core syntactic deficit.

The Unit Accessed

One possible difference between FOK and ELW is that the unit of access for them is different. It is possible that for FOK the unit of access is the verb in the context of its argument structure, constituting, in essence, access to the d-structure representation of the sentence, the canonical order, the first pass parse, etc. It is possible that the unit of access for ELW is the verb alone—the word and its meaning—its lexical conceptual structure. This difference could account for the “grabbag” initial appearance of ELW's sentences—pieces of a lexical conceptual structure strung together by the conjunction “and.” This difference could explain the freedom in word order seen in ELW's sentences compared with the canonical d-structure ordering seen in FOK's sentences, as well as the smaller MLU and the failure of many selected arguments to surface, while more lexically tight components like verb particles and idiom remnants seem to survive. Finally, it might explain her apparent lack of reliance on configurational cues such as word order, agreement, tense, aspect, and gender matching, among others, in favor of what looks like a simple concatenation device—the stringing together of the relevant bits of an utterance that instantiates some lexical conceptual structure by a never ending supply of “ands.”

However, this purported difference falls short of accounting for the full range of facts. In particular, it cannot account for ELW's preserved ability to perform a range of grammaticality judgments that appear to be sensitive to syntactic information. It cannot explain why the verbs and arguments that do surface are typically those components encoded in the verb's argument structure representation rather than a more general selection from among the components of the LCS. It cannot account for the fact that although ELW omits a great deal, her intended argument structure patterns can generally be recognized, with a little help from the context, and furthermore, it cannot account for the fact that ELW's argument structure distribution is normal, except for the class of noncopular unaccusatives, which she fails to produce with the same success

and frequency as control subjects do. How could such an asymmetrical argument structure profile result from having access only to the verb itself? It cannot. In reviewing ELW's data, one gets the clear sense that her ability to produce more verbs from the unaccusative class does not reflect a better linguistic command over the use of verbs lacking an external argument at d-structure. It just reflects a greater tendency to get the verb out and to paint herself into a corner trying to produce a viable carrier sentence to house it. There is alternative explanation for the differences seen between FOK and ELW, and it goes back to the cognitive load and processing restrictions mentioned above.

The Production Unit

Let's focus for the moment on accounting for why ELW would produce more noncopular unaccusatives than FOK. Suppose that the domain that characterizes FOK's processing unit is the clause, or given his sentence starter strategy of using "NP is . . .," maybe just the VP. FOK can spew out the "NP is" component rather easily, but then he has to monitor in his head the VP that can successfully complement it and get across his intended message. On occasion, as in the sentence *Tree is lightening strikes* (FOK, *The Natural*), he backs himself into a corner by using a starter that can only serve as the subject of a sentence that is unaccusative and therefore nearly impossible for him to successfully produce and he proceeds to effect only a partial repair: *Gun is shoot him Charlie dead* (FOK, *On the Waterfront*), etc. Other times, up to a full 20% of the time, he aborts the process, leaving behind a sentence fragment: *Wonder boy is . . .* (FOK, *The Natural*); *Personnel is . . .* (FOK, *Witness*); *Bailing hook is . . .* (FOK, *On the Waterfront*); *Handgun is . . .* (FOK, *On the Waterfront*); *Carnival is . . .* (FOK, *The Natural*); *Retta is* (FOK, *Moonstruck*). Or he gets out another argument without being able to produce the verb: *Ronnie is {???*} bride-to-be (FOK, *Moonstruck*); *Retta is {???*} tickets and chewing gum paper (FOK, *Moonstruck*). FOK, by virtue of being able to monitor the potential outcome of the whole VP before committing to producing its verb can abort the process when he comes across an unaccusative construction.

Now, consider ELW and all the problems she is struggling with, even at the level of articulating the components of the sentence. Her production is labored and her output is slowed and often interrupted by numerous attempts to get out a single word. As a result, it is perfectly plausible that ELW might be unable to keep in mind the whole clause as she struggles to get her information conveyed. She may well produce an unaccusative verb before she recognizes that it is likely to give her a bad hit in terms of producing a viable sentence, at which point she has produced a fragment that we will end up coding as production of a noncopu-

lar unaccusative argument structure pattern. This could account for the fact that 50% of the noncopular unaccusatives she produced ended up being single-word utterances. Like FOK, she may even go on to get out the arguments she has accessed, yielding odd orderings. On occasion, she may well get out a good sentence. Thus, a smaller window to work in to monitor the utterance being produced could lead to a larger percentage of constructions with problematic argument structure patterns being produced or partially produced.

A Final Speculation and Justification for Our Focus

Let us assume for the moment that the same core syntactic deficit shared by ELW and FOK is the one we have been attempting to characterize here. Namely, they are limited in their engagement with syntactically organized material to only that information encoded in the lexical entry, and that information is sufficient to allow them to construct the d-structure representation of the VP. Furthermore, assume that it is the varying patterns of argument structures cross-linguistically available and instantiated in a variety of language specific pairings of transitivity alternations that characterize an also cross-linguistically near-homogeneous set of semantic verb classes such that no single argument structure has a one-to-one correspondence with a single semantic class, but rather the set of argument structure possibilities is put to multiple use in varying combinations, with varying patterns of nuances (added restrictions or freedoms with respect to argument taking and selectional properties) as one moves higher or lower within verb taxonomies—from the genus level to more and more specific subclasses of verbs. The presumption is that FOK and ELW have access to verb class information, lexical conceptual structure which allows the rudimentary identification of relevant semantic roles, as well as the argument structure, which determines (in a somewhat arbitrary, somewhat consistent fashion) what components of the lexical conceptual structure will contribute potential argument slots to the set of argument structure patterns a given sense of a given member of a given verb class will be associated with. Furthermore, they have access to the lexical entry which, crucially includes the verb and its associated argument structures, stated in terms of the number and configuration of noun phrases, sentential complements, and obligatory adjuncts the verb selects for. Once the verb has been selected, the syntax has access only to this last bit of information, information that predetermines its progression toward the production of a well-formed s-structure representation of the sentence. Now assume that the agrammatic has access to everything up to the point when the lexicon hands a prestructured VP over to the syntax, but not to any mechanisms of functional architecture, well-formedness constraints driving movement rules, or interdependencies

that play a role beyond that point. Argument structure demarcates the location of this bottleneck, which is why argument structure defines our research agenda.

Relevant Subject Populations

Although our focus is on subjects who fall within the clinical category labeled agrammatism, the scope of our studies extends beyond agrammatism to include a broader sampling of the aphasic population. Argument structure distribution provides a sensitive measuring stick for language impairment in general.

For example, the distribution of argument structure patterns in narratives produced by a Wernicke's aphasic (presumed to be incapable of adequately accessing the lexicon) should prove equally insightful. Wernicke's aphasics have been purported to have access to phrase structure, the "skeleton" upon which the sentence is hung (Lapointe, 1983), without having reliable access to specific lexical items—in particular the verb, its argument structure, and its semantic representation. Under our analysis, the verb and its argument structure (a virtually prestructured verb phrase) endow each sentence with its unique structural character. The functional architecture and the constraints on well-formedness are essentially uniform from sentence to sentence. It is the lexically variable d-structure instantiation of the verb and its arguments plugging into this functional superstructure of the sentence that determines the course of syntactic operations that must occur in order to yield a well-formed s-structure representation. So, what might the argument structure distribution profile be for a Wernicke's aphasic? The balanced variability in constructions produced by control subjects is maintained by successfully choosing among a diversity of transitivity alternations that are a feature of individual verb classes: causative versus inchoative in the change of state class; activity verb versus transitive in the creation class, etc. We might expect either a random syntactic patterning or a more stereotypic sentence frame that instantiates some default case, but that is another study.

Comparison with Nongrammatic JMD

We have only speculated here on possible accounts for why ELW and FOK, although patterning alike in many respects, may diverge in how they compensate for one and the same syntactic deficit. Of course, we would hope to show that aphasics whose deficit affects some other component of the grammar, leaving the syntax intact, would exhibit a different profile. For anomics, who have a lexical accessing problem which seems to hinder their access to lexical items lower than a genus level in

the verb taxonomy,⁸ we would predict that the reduction in accessible forms would not necessarily yield a systematic blindspot with respect to the production of a particular set of construction types (such as the unaccusatives lacking an external argument), as long as the full typology of argument structure types was instantiated at the genus level of the verb lexicon. Our hypothesis is simple. Only a syntactic deficit should yield an unbalanced argument structure distribution in which the production of noncopular unaccusatives is greatly reduced. We predict that, with respect to argument structure distribution, nonagrammatic aphasic subjects should pattern like controls. Jack and Kegl (1992) report such a case.

Anomic Profile

In Jack and Kegl (1992), we produced an argument structure profile for JMD, an atypical conduction aphasic with an anomic component. JMD is a white male in his early thirties (a former computer programmer). He has a fronto-parietal lesion, resulting from an arterial venous malformation that was removed from his left central sylvian region. With respect to the crucial argument structure category, noncopular unaccusatives, JMD patterned completely in line with controls. However, he produced many more copular constructions than FOK, ELW, or the controls, yielding a distinct profile in this respect (see Fig. 17).

Forty percent of JMD's utterances were copular constructions. Notice also that, like controls, JMD's copular constructions used both *is* and other forms of the verb *to be*. Interestingly, JMD's over proliferation of copular constructions led to a reduction in the percentage of the easiest class of argument structure types for agrammatics like FOK and ELW to produce and spared the most problematic class of argument structure patterns, the noncopular unaccusatives.

JMD's 25% occurrence of noncopular unaccusative argument structure patterns is clearly preserved and very stable. On the basis of this alone we can conclude that argument structure coding is sensitive to picking up a syntactic deficit. But why should JMD's reduction occur in the class of verbs taking an external argument? The answer lies not in that class but in the copular construction and the fact that when we look at the nature of the verbs that are produced in all of JMD's utterances, regardless of argument structure type, we find that they are overwhelmingly light verbs. Semantically empty verbs like *is*, *have*, *get*, and *like*, generally require additional lexical material in an obligatory adjunct to con-

⁸ For a discussion of verb taxonomies and their interaction with verb class information and lexical memory, see Fellbaum and Kegl (1990) and Miller, Kegl, Fellbaum, and Miller (1988, 1991).

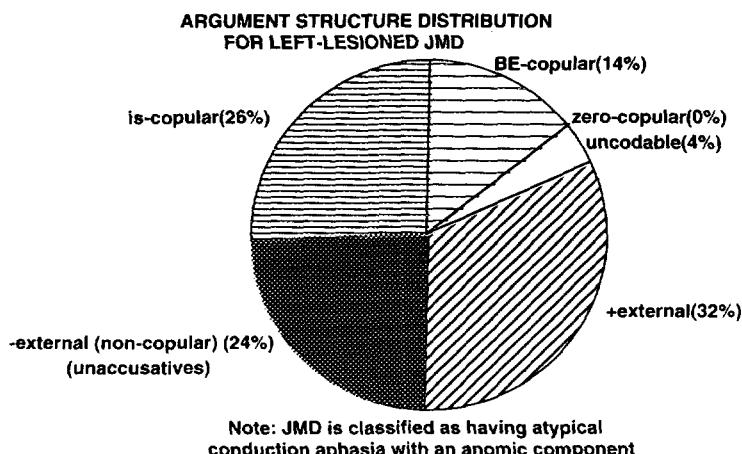


FIG. 17. JMD (atypical conduction with anomia) patterns much like controls except for a reduction in the category of constructions taking an external argument. This fits with his propensity for using light verbs, which, although occurring in all argument structure patterns, favor the unaccusative and copular constructions.

struct a specific verb sense. As an anomic, JMD has problems with the retrieval of semantically specific verbs and tends to use generic ones in their place. Although light verbs occur with different argument structure types, the prototypical light verb is the verb "to be." Since JMD is constantly using light verbs plus additional lexical material to make circumlocutions that can replace the words he cannot easily access, they predominate in his narratives. *Is*, as the prototypical and most semantically empty light verb, serves as the workhorse in circumlocutions; and, therefore, its increased frequency of occurrence makes sense.

So, we find in JMD another kind of aphasic—one with a lexical access deficit rather than a syntactic deficit and this distinction is highlighted by analyzing his argument structure distribution. Argument structure analysis reveals preservation of syntax in JMD. In fact, JMD needs to make productive use of syntactic processing to produce the many circumlocutions we find in each of his narratives. JMD's pattern suggests a characteristic argument structure profile expected in anomia who lack any syntactic deficit.

Conclusion

On the basis of the FOK study and the preliminary studies of ELW and JMD, presented in detail elsewhere, we conclude that

- Unaccusativity, a distinction not captured by subcategorization or the s-structure representations of sentences, is a valuable predictor of which constructions consistently will or will not pose problems for syntactic processing by agrammatics.

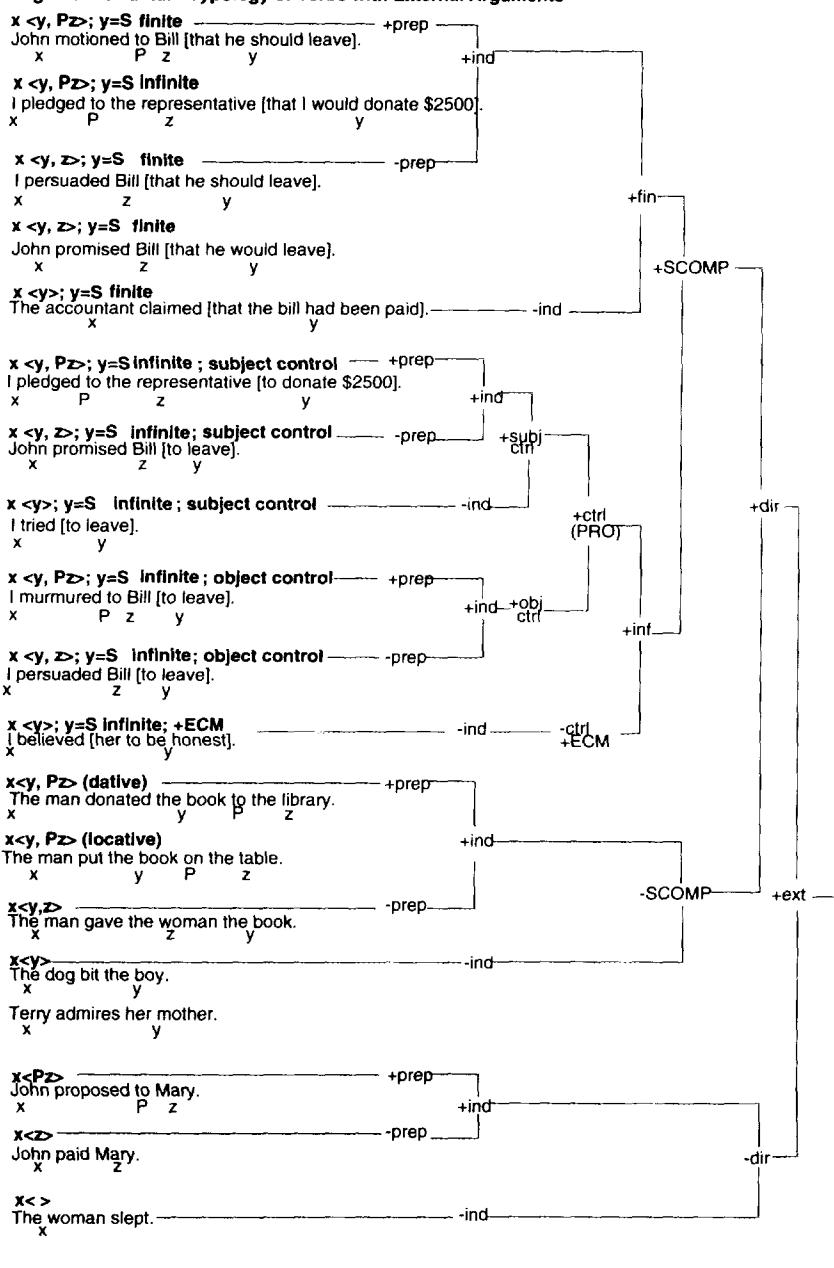
- Coding in terms of argument structure can provide useful profiles of sentence production that differentiate rather than collapse fine distinctions between aphasics with syntactic deficits and that distinguish between aphasics with and without a strictly syntactic deficit.
- Argument structure coding can differentiate between sentence complexity factors even within simple intransitive sentences such as *Susan slept* (unergative) versus *John arrived* (unaccusative), or *Sue kissed Bill* (transitive) versus *Bill surprised Sue* (unaccusative psych verb construction) and thereby decouples syntactic complexity from memory demands.

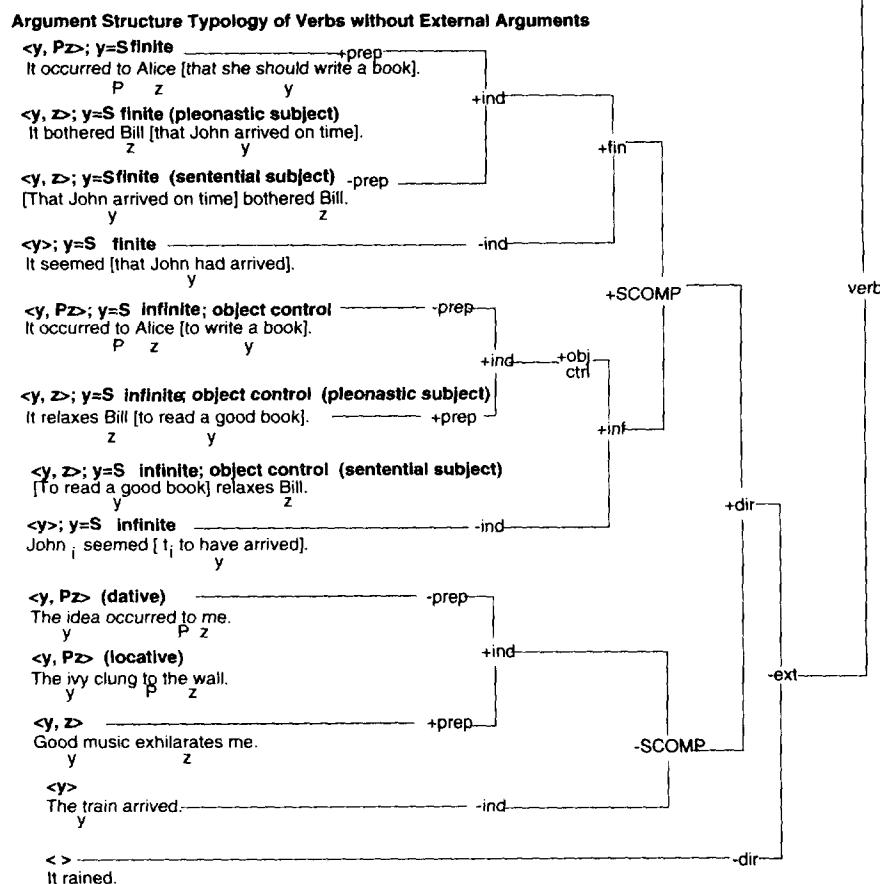
We hope to have made clear the benefits of narrative production studies using fine-grained analysis of the distribution of argument structures and to have established a means by which theoretically informed production studies can complement and serve to inform the design of studies of sentence comprehension across a variety of aphasic subjects.

It is important to recognize that a linguist looking at aphasia approaches the task with a different set of priorities, yet in many respects with the same ultimate goal as other researchers—a characterization of the representation of Language in the brain. In contrast with a psycholinguist who is looking to tap into the intricacies of how linguistic information is produced and comprehended—of how memory, cognitive load, or the time-course of parsing input or planning production interacts with the structural roles of the linguistic entity being grappled with, as a linguist, I am looking for a deficit or change in the system that points to a piece of mental representation that exists independently of other cognitive systems—a piece of linguistic competence. When the argument structure distribution in an anomic patterns with controls despite the use of a propensity of light (genus level) verbs (as reported in Jack and Kegl (1992)), but the class of unaccusative drops out in an agrammatic (as reported in Kegl and Jack (1992 and here)), we get excited because we are possibly seeing in the latter case, the reflex of a purely syntactic deficit that might be decoupled from other aspects of cognition. If unaccusativity distinguishes in complexity between the production of two sentences as simple as *John slept* (unergative) versus *John arrived* (unaccusative), we are encouraged because sheer memory for two-word concatenated strings in planning couldn't be the distinguishing factor. It points to a systematic structural difference that is linguistic. For the psycholinguist the process and the linguist representation are equally important. For the linguist, perturbations in the processing and production of language are simply a means to an end—the goal of characterizing what humans know and don't know when they have “knowledge of Language.” This comes down to focusing on how Language is represented in the brain rather than how the product of Language is processed by the brain, although both are equally important pieces of the same “elephant.”

APPENDIX

Argument Structure Typology of Verbs with External Arguments





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