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The Use of Linguistic Theory as a Framework for Treatment Studies in Aphasia

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This paper outlines the theoretical underpinnings of a linguistic-specific treatment program for aphasia. It opens with some introductory comments about why we think linguistic theory should be taken seriously as a possible framework for investigations of normal and disordered language. Then, it presents an overview of some current linguistic theory and briefly shows how linguistic constructs borrowed from such a theory appear to affect both lexical and sentence processing in normal and brain-damaged adults. Finally, it reviews some recent treatment literature and shows how linguistic theory can be used to devise treatment programs. Given the uniqueness of our treatment approach, however, we must initially offer only promissory notes and await some considerable data before our program can be fully evaluated. We have begun this data-gathering process (see Thompson, Shapiro, & Roberts, 1993; Thompson & Shapiro, 1992), and our initial results look promising.

Effective language research, including work in psycholinguistics, neurolinguistics, and language treatment studies, requires knowing as much as possible about the object of inquiry—language. The most proper characterization of language comes from formal linguistic theory. As a point of logic, if one discovers that certain constructs from linguistic theory have "processing reality"—that is, affect lexical and sentence processing in normal subjects—and assumes that a brain-damaged language system reflects an impaired version of the normal system, then one needs to control and manipulate in treatment those aspects of language that affect the normal system. The beauty of formal linguistic theory lies in its explicitness; it offers language scientists a way to understand the nature of the material used in their experimental manipulations.

This approach should be considered regardless of any concomitant theory of the language disorder in aphasia. For example, if you support

the notion that an attentional impairment underlies the language disorder, you should probably manipulate those linguistic structures in your research that you hypothesize might tax sustained attention. Relatedly, if you support the notion that there is an underlying memory deficit in some language disorders, it appears necessary to understand how linguistic structures and parsing routines might affect *sentence memory.* This is the only way in which to understand the underlying memory requirements of the sentence processor (see, for example, Shapiro, McNamara, Zurif, Lanzoni, & Cermak, 1992). If you support the notion that agrammatic Broca's aphasia involves a parsing disorder, you must manipulate those structures relevant to your hypotheses (see, for example, Zurif & Swinney, in press). Finally, if you support a computational complexity deficit in Broca's aphasia (see, for example, Frazier & Friederici, 1991), then you need a theory of what it means for language to be computationally complex. The point is that if linguistic theory is not exploited in the work of language scientists undertaking treatment research, then explictness will give way to vague intuitions about language, and greater generalizations may be missed.

A BRIEF REVIEW OF SOME LINGUISTIC THEORY

Lexical Properties

Our approach borrows from the government-binding framework (Chomsky, 1986), but with some modifications, several other linguistic theories might be equally useful.[1] Critical to our approach are the *mental lexicon* and the kinds of information in a lexical entry that must be represented with the phonological form of a lexical item. For example, our grammatical intuitions tell us that the verb *hit* allows a direct object noun phrase (NP) to follow it; the verb *give,* if followed by a direct object NP, also requires a prepositional phrase (PP); and the verb *sleep* does not require a direct object NP. That is, when we acquire these labels (*hit, give,* and *sleep*) and what these labels refer to in the real world, we also acquire the knowledge that they

1. Government-binding theory contains several subtheories and modules, including x-bar theory (concerned with phrasal geometry); the theory of move-alpha (transformations); binding theory (antecedent-referent relations); bounding theory (constraints on movement); control theory (concerned with the controller of certain "empty categories"); case theory (abstract case); theta theory (the assignment of thematic roles); and the theory of empty categories (governing traces, etc.) In this paper we will summarize only those aspects of GB theory that are relevant to our present approach. For further information we refer the reader to Liliane Haegeman's (1991) *Introduction to Government and Binding Theory.*

can—and sometimes must—occur in particular structures. This phrasal (and clausal) information is known formally as *strict subcategorization.*

Part of this subcategorization information is predictable from the real world contingencies of language use. For example, when you learn the label for the concept of *hit,* you also learn that the object of *hit* is *affected* by the "hitting"; when you learn the label for the concept of *give,* you learn that you have to give something to someone and that the action of giving something to someone entails a *path* along which the object metaphorically travels. This type of information is reflected in *lexical conceptual structure* (roughly, "semantics"). By some accounts (Jackendoff, 1990), the theory of lexical conceptual structure encompasses the notions of *thematic roles* (e.g., Agent-of-action, Theme-of-action, Goal-of-action, Experiencer, etc.) and *argument structure* (either a set of indices that relate the semantic/thematic roles to the syntax or an indication of the number of *logical arguments* or participants—usually described by NPs—entailed by a predicate). On other accounts, argument structure forms a level of representation separate from that of conceptual structure (Grimshaw, 1990). For our present purposes, we will use the term *argument structure* generically to describe the semantic/thematic information about a predicate.

The verb *hit,* for example, requires two participants, each occupying an *argument position* in the sentence. One of these arguments is assigned the role of Agent, and the other argument is assigned the role of Theme:

1. [$\text{Joelle}_{\text{Agent}}$] hit [the $\text{ball}_{\text{Theme}}$];

the verb *give* requires three arguments, the final argument having the role of Goal:

2. [$\text{Joelle}_{\text{Agent}}$] gave [the $\text{ball}_{\text{Theme}}$] to [$\text{Zack}_{\text{Goal}}$];

and the verb *sleep* requires only one argument, the subject:

3. [$\text{Joelle}_{\text{Experiencer}}$] slept.

With this argument structure information, the lexical representation for *hit,* for example, looks something like that in Example 4:

4. *hit* V: lexical category
/HIT/: phonology
[____ NP]: strict subcategorization
(Agent/Theme): argument structure

The entry in Example 4 expresses both the syntactic and general semantic character of a sentence in which the lexical item is contained.

Let us now briefly consider how these lexical properties are reflected in the syntax. Again, the verb *hit* requires one and only one direct object NP. This lexical property is reflected in the sentences of Example 5:

5a. Joelle hit the ball.
b. Joelle hit Zack.
c. *Joelle hit.
d. *Joelle hit the ball Zack.

Sentences 5a and 5b are acceptable and well formed because the verb *hit* is followed in both cases by one NP. Sentence 5c is unacceptable and ill formed because there is no NP following the verb. And Sentence 5d is unacceptable because there are two NPs following the verb. To be more specific, any adequate grammatical theory should be able not only to describe why any given sentence is grammatical in a language but also formally to rule out ungrammatical sentences. Much of this work is done by the interaction of the lexicon and the sentence via the *Projection Principle:* Lexical properties are observed at all levels of syntax.

Consider again the sentences in Example 5. The lexical entry in Example 4 reflects what we know about the verb *hit,* that it entails a direct object NP position to which the role of Theme can be assigned. The projection principle requires that this lexical property be syntactically represented. The verb *theta-marks* its arguments; that is, it assigns its thematic roles the argument positions in the sentence. Skipping the details, *hit* (and the VP it heads) has two thematic roles to assign—Agent to the subject argument and Theme to the object argument. Thus, Sentences 5a and 5b are well formed because there are two argument positions represented in the syntax. On the other hand, Sentence 5c is ill formed and rendered ungrammatical by the projection principle because the lexical properties for *hit* are not satisfied in the sentence; there is no direct object position in the sentence to which the role of Theme can be assigned. Sentence 5d also violates the Projection Principle because there are two NPs following the verb; the lexical properties of *hit* require only one. In this way, lexical information and the Projection Principle largely determine the syntactic structure of a sentence. We will show later that these linguistic properties indeed have processing and treatment significance.

Syntactic Properties

Consider now some wh-questions containing the verb *hit:*

6a. What did Joelle hit?
b. Whom did Joelle hit?

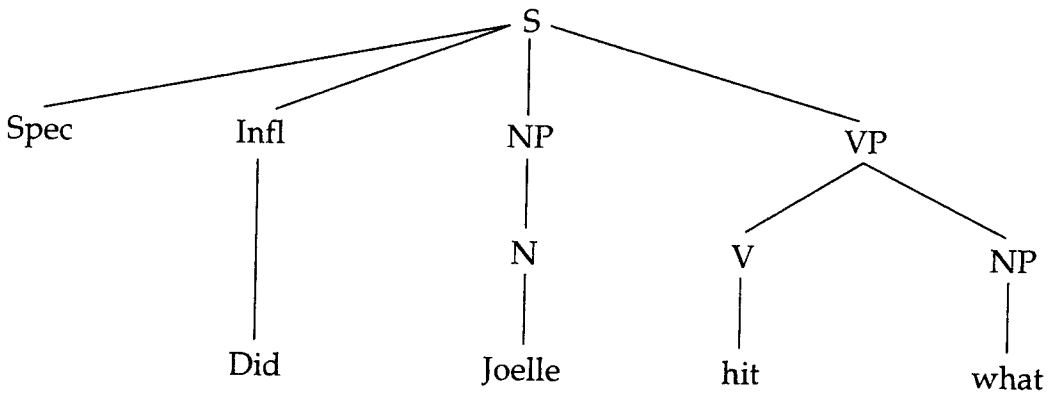
c. *What did Joelle hit Zack?
d. *Who did Joelle hit the ball?

The sentences in Example 6 appear to present a problem. Note that our generalization about the sentences in Example 5 makes exactly the wrong predictions about the sentences in Example 6. That is, our knowledge of English has told us that a sentence containing the verb *hit* must have a direct object NP coming directly after the verb for that sentence to be grammatical, as in Sentences 5a and 5b. Sentences 6a and 6b do not seem to have direct object NPs after the verb, yet they seem well formed by any native English speaker's grammatical intuitions. Perhaps even worse, Sentences 6c and 6d do seem to have the required direct object NP position, yet they are ill formed. The theory is either wrong or needs to be extended to explain these grammatical facts.

One possibility is that our generalization about *hit*—that it must take a direct object—was simply wrong, but this possibility conflicts with what we know about *hit*, that there is always some affected object of the action. So let us assume that there is indeed a direct object position in Sentences 6a and 6b and that the wh-word originated in that position and moved to sentence-initial position by a *transformation*. The structure that exists before the wh-word is moved is called the *underlying* or *D(eep)-structure*, and that which exists after the wh-word is moved is called the *S(urface)-structure*.

A first approximation of the underlying structure in Sentence 6a is shown in Example 7:[2]

7.

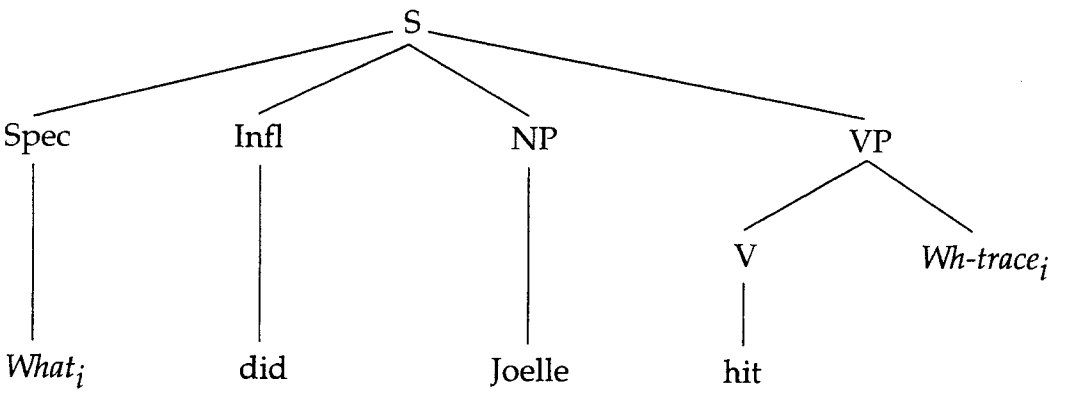


Note that this underlying structure is consistent with our generalization that the verb *hit* requires one and only one direct object NP position (occupied in the underlying structure by *what*). On most accounts, the-

2. The phrasal geometry shown in Examples 7 and 8 are simplifications; they have a flatter structure and contain node labels that are quite different from that proposed by more current theory. For present purposes we can ignore these differences.

matic role assignment takes place at D-structure, so that, again, the role of Theme is assigned to the direct object position and Agent is assigned to the subject NP. The *wh-movement* rule—a transformation—applies to the underlying structure in Example 7 and transforms it to the S-structure in Example 8:

8.



The structure in Example 8 shows that the NP *(what)* has moved from the postverb direct object position in the underlying structure to the sentence-initial position in S-structure. The moved constituent leaves behind a *trace* of its movement, which is *coindexed* with its *antecedent*, the wh-word. The trace serves as the direct object argument position, one that, again, is required by the lexical properties of *hit*. The trace and its antecedent form a *theta-chain* such that the moved constituent (in this case, *What*) inherits its thematic role (the Theme) from its trace. Now we can explain the grammaticality of Sentences 6a and 6b by claiming that both the underlying- and surface-structure representations of the sentences contain the direct object positions required by the lexical properties of *hit* and the Projection Principle.

Passive sentences in the government-binding framework undergo similar grammatical mechanics:

9. Zack was hit by Joelle.

Example 9, like the wh-questions in Example 6, does not have a phonologically filled direct object NP position occurring after the verb. Additionally, a general property of all sentences is that they must have subjects, regardless of the argument structure of the verb. This property, along with the stipulation that lexical information must be represented at all levels of syntax, is termed the *Extended Projection Principle (EPP)*. Given this principle and the lexical properties of *hit*, consider the D- and S-structures for Example 9, shown in Examples 10 and 11:

10. *e* was hit Zack by Joelle (D-structure)
11. $Zack_i$ was hit *NP trace*$_i$ by Joelle (S-structure)

The *empty category (e)* in the underlying structure of Example 10 is required by the EPP. Skipping many details, the direct object NP *(Zack)* is forced to move into the empty category position (because of the lack of structural Case, which has been "absorbed" by the passive morphology), leaving behind an *NP trace.*

Thus, there are two kinds of movement subsumed under the general rule *move-alpha,* wh-, and NP-movement. Again, NP-movement occurs in the derivation of the passive (and in so-called NP-raising structures). NP-movement moves an NP from an argument position (in the passive, the direct object position) to another argument position (the subject position), leaving behind an NP-trace. In effect, both the site from which the constituent moves and its "landing site" are positions projected from the verb's lexical representation. Wh-movement derives wh-questions, relative clauses (e.g., "The man$_i$ that the bully hit *trace*$_i$ was tall"), and relative clefts (e.g., "It was Popeye$_i$ that$_i$ Bluto hit *trace*$_i$"). Unlike NP-movement, wh-movement involves displacement of wh-phrases from argument positions (e.g., direct object) to *nonargument positions* (e.g., Specifier of COMP), leaving behind a wh-trace. Thus, unlike NP-movement, wh-movement involves a landing site that falls outside those positions projected by the verb's entry. Finally, another difference between NP-movement (specifically, the passive only) and wh-movement involves the distance between the trace and its antecedent. Consider the simplified structures in Examples 12 and 13:

12. $[_S\ [_{NP}$ the boy$]_i$ was hit $[_{NP}$ *trace*$]_i$ by $[_{NP}$ the girl$]]$
13. It was $[_{NP}$ the boy$]_i$ $[_{S'}$[who]$_i$ $[_S\ [_{NP}$ the girl] hit $[_{NP}$ *trace*$]_i]]$

Note Example 12 shows that only one S node intervenes between the trace and its antecedent in the passive, yet in the object cleft (Example 13) both a more dominant S-bar node and an embedded S node intervene. We will show that this distinction between wh- and NP-movement derived structures has processing and treatment implications.

Arguments and Adjuncts

Related to the notion that verbs project their lexical properties onto syntax is the distinction between an argument of the verb and an *adjunct.* Again, an argument of the verb is entailed by the verb's meaning or conceptual structure; it is idiosyncratic to the verb and is thus represented with the verb's phonological form in the lexical entry. The argument position is assigned a thematic role by the verb or its VP. An adjunct,

however, is not selected by the verb; it can appear with any verb in the language and thus need not be specified as part of the verb's lexical entry. Subsequently, the adjunct is not theta-marked by the verb. Consider, for example, the prepositional phrases in Examples 14 and 15:

14. Mitzi sent the car *to the garage.*
15. Mitzi fixed the car *in the garage.*

In Example 14, the verb *send* allows three arguments: Agent is assigned to the subject NP *Mizi,* Theme is assigned to the direct object NP *the car,* and Goal is assigned to the indirect object NP *the garage* that forms part of the PP. That is, you have to "send something to *someone* or *somewhere,*" and thus the Goal is implied—and supplied—directly by the verb. In Example 15, however, the PP *(in the garage)* is considered a locative adjunct; it's meaning is not inherent in the verb's representation. Though you indeed have to "fix something somewhere," that fact cannot be inferred from the verb but instead is supplied by additional material in the sentence—the adjunct PP. Thus, an adjunct is always optional, whereas an argument can be either obligatory (e.g., "John gave the ball *to Mary,*" where "*John gave the ball" is ungrammatical if the third argument is omitted) or optional (e.g., "Mitzi sent the letter," where, though the third argument is omitted, it is still implied). Finally, an adjunct can be ambiguous, whereas an argument rarely is. In Example 15, for example, *in the garage* is structurally ambiguous; it can either modify the direct object NP *the car* (as in "it was the car in the garage [and not the car outside the garage] that Mitzi fixed"), or it can modify the VP *fixed the car* (as in "it was in the garage [and not in the driveway] where Mitzi fixed the car"). There are no interpretive or attachment ambiguities involving the PP *to the garage* in Example 14; it is the Goal of where the car was sent.

SENTENCE PROCESSING

Recent psycholinguistic and neurolinguistic work has shown that virtually all these theoretical constructs have lexical- and sentence-processing implications. For example, in a series of psycholinguistic studies, Shapiro and colleagues (Shapiro, Brookins, Gordon, & Nagel, 1991; Shapiro, Zurif, & Grimshaw, 1987, 1989) found that a verb's lexical properties (e.g., thematic representations/lexical conceptual structure) directly affect sentence processing. That is, as the verb becomes more complex in terms of number of different argument structure arrangements, processing load increases in the immediate temporal vicinity of the verb. For example, the verb *fix* allows only one two-place argument structure (Agent/Theme, as in "Rico

fixed the toilet"), whereas the verb *send* allows both a two-place (Agent/Theme, as in "Phil sent the message") and a three-place structure (Agent/Theme/Goal, as in "Phil sent the message to Pepe"). When embedded in simple NP-V-NP structures, *send* yields a greater processing load than *fix*. In effect, all possible argument structures associated with a verb are momentarily and exhaustively activated when the verb is accessed.

In a more recent effort, Shapiro, Nagel, and Levine (in press) found that, given a verb with multiple argument structure possibilities, a subject's preferences for one of these possibilities might then be used to determine the initial course the parser takes after encountering the verb. In this study we also found some indications that adjuncts are more computationally expensive than arguments of the verb; that is, processing load increased in the immediate temporal vicinity of a preposition heading an adjunct PP (as in, for example "The old man sent the toy *in the box*") relative to a preposition heading a PP that contains an argument (as in "The old man sent the toy *to the girl*").

Agrammatic Broca's aphasic patients normally activate a verb's multiple argument structure possibilities in the immediate vicinity of the verb (Shapiro & Levine, 1990). This result implies that verb properties need to be controlled in language experiments, including treatment research, because these properties are projected from the lexicon to the syntax and indeed have direct consequences on online performance. Importantly, Broca's aphasic patients also seem able to use this lexical information as a way "into" the sentence production system (Canseco-Gonzalez, Shapiro, Zurif, & Baker, 1991). However, such patients appear to have difficulty with sentences where arguments have been moved out of their canonical positions (Grodzinsky, 1990; Schwartz, Linebarger, Saffron, & Pate, 1987), as in, for example, passives, wh-questions, and relative clause constructions.

There is also a large body of evidence suggesting that the antecedent to a trace (the moved NP, for example) is normally reactivated in the immediate vicinity of the trace, well after the moved constituent has appeared in the sentence (see, for example, Frazier, 1987, for a review). Again, however, in sentences with moved arguments, agrammatic Broca's patients may not reactivate the antecedent to a trace at the right time for normal thematic role assignment to occur (Zurif & Swinney, 1992). Finally, it also appears that wh- and NP-movement may each have its own processing routines: More "work" must be done to attach an antecedent to a wh-trace (i.e., in wh-questions or relative clauses) than to an NP trace (i.e., in a passive sentence) because a wh-trace and its antecedent are separated by clausal boundaries (see, e.g., Berwick and Weinberg, 1984). Indeed, such a distinction between the movement types shows up in aphasic performance (Caplan and Hildebrandt, 1988) and in the sentence production performance of amnesic patients and their controls (Shapiro et al., 1992). Better performance is observed on sentences derived from NP-movement relative to wh-movement.

These facts argue for using a principled account of grammatical representations when investigating normal and disordered sentence processing and, subsequently, when devising treatment programs. For example, fully specified lexical entries seem to be available at D-structure for some, if not all, Broca's aphasic patients; the problem for some of these patients lies either in the derivation of the S-structure representations (e.g., traces; see Grodzinsky, 1990) or in the sentence-processing routines computing these representations (see, for example, Prather, Shapiro, Zurif, & Swinney, 1991; Schwartz et al., 1987; Zurif & Swinney, in press). We exploit this obvious strength and purported weakness in our treatment experiments. We also consider the representational similarities and differences underlying the surface realizations of sentences used in our treatment program—similarities and differences that can be explained only by reference to linguistic theory (Thompson et al., 1993; Thompson and Shapiro, 1994).

With our linguistic and psycholinguistic perspective in mind, consider now a brief review of some recent treatment literature.

TREATMENT RESEARCH

Recent studies concerned with treatment of sentence-level disorders have begun to consider both the nature of aphasic language deficits and what is known about normal sentence processing (Byng, 1988; Jones, 1986; Loverso, Prescott, & Selinger, 1986, 1992; Mitchum, in press; Saffran, Schwartz, Fink, Meyers, & Martin, in press; Thompson, in press). For example, Byng (1988), Jones (1986), and Saffran et al. (in press) developed treatments for aphasia based on the "mapping hypothesis," which holds that agrammatic performance reflects an impaired mapping between grammatical constituents (e.g., subject, object) and thematic roles (e.g., Agent/Theme) (Schwartz et al., 1987). In these studies treatment was provided largely for chronic, long-term Broca's aphasic patients who were claimed to have a "mapping" deficit. Using color-coded materials corresponding to sentence constituents, patients were trained to recognize the thematic roles of noun phrases set around the verbs in sentences in both canonical (active NP-V-NP sentences) and noncanonical sentences by responding to questions of the form "Who did what to whom." Generalization both within and across sentence types was claimed for some subjects.

Though we fully agree with the intent of these studies, the experimental designs used fall short of those required in a controlled treatment study. That is, internal validity was not demonstrated. For example, Byng (1988) presented case studies for two subjects, reporting only pre- and posttreatment data, without control subjects or a controlled single-subject design. Saffron et al. (in press) attempted to incorporate a single-subject

research design, but experimental control was lost when shifts in baseline performance were noted on untrained sentence types. In addition, subjects in both studies exhibited high performance rates prior to treatment, allowing little opportunity for changes to occur on the dependent measures; the lack of repeated measurement precluded examination of the variability within and across phases of the experiments; and, importantly, changes in the independent variables and in the manner by which the dependent measures were tested were made throughout the course of the experiments.

Further, in Saffron et al., a pretraining phase was instituted whereby patients were trained to understand wh-questions necessary for the subsequent training phase. As noted by the investigators, however, wh-questions are problematic for these patients. Indeed, according to the "mapping" hypothesis, the same deficit contributes to the problems these patients have in understanding both wh-questions and the sentences that were targets for treatment; that is, both sentence types are derived from noncanonical thematic role assignment. Nonetheless, to reap the benefits of the treatment the patients had to understand the wh-questions in the pretraining phase.

These design issues aside, none of the treatment studies of which we are aware has considered recent findings from the psycholinguistic literature. For example, though both Byng and Mitchum use Garrett's (1982) sentence production model as a base for treatment programs, the representations and processes underlying "functional" and "positional" frames in the model were never clearly specified. As we have claimed in this paper, the psycholinguistic literature is now rife with examples that such issues as lexical properties and their access and integration into the syntax, arguments versus adjuncts, phrasal density, inferential chains consisting of traces and their antecedents, and so on all affect normal and aphasic sentence processing to some degree. Such linguistic constructs have not been used to fill in the gaps of Garrett's model, nor have they been controlled or manipulated in treatment studies.

Finally, one recent treatment program has used linguistic theory as a guide. Loverso and colleagues' "cueing verb treatment" (CVT) (Loverso et al., 1986, 1992) uses case grammar (Fillmore, 1968) as a basis for a treatment program for producing simple sentence structures. Case grammar, whose constructs have found their way into more modern approaches to lexical representation (see, for example, Jackendoff, 1990), considers the verb as the "motor" of the sentence's propositional structure. Loverso et al. have designed a treatment program that first trains the verb and then, in a series of graduated steps, attempts to expand the verb to include both its subject and, depending on the type of verb, either its object or a location, adverbial of time, instrument, etc. The sentence expansion is produced by clinician controlled use of wh-words (e.g., "who run" writ-

ten on index cards yields patient initiated "I run," "who run when" yields "I run yesterday," "who hit" yields "I hit," etc.). The investigators claimed generalization given increases in *Porch Index of Communicative Ability* (PICA) subtest scores. (So far as we are aware, however, generalization to untrained verb and verb-argument combinations was not assessed in their experimental design. Whether these subjects would show such generalization remains unanswered).

The generalization issue aside, from our present perspective Loverso and colleagues should be commended for devising perhaps the first treatment program that considered the influence of lexical properties on sentence generation. Their approach in its current status, however, is limited to the production of simple sentences, and, not unlike the Saffron et al. program, the use of *wh*-words to elicit the simple sentences may be problematic for some patients. Furthermore, though their materials were controlled for frequency of occurrence, imagery, and concreteness, the verbs themselves were not controlled for the number and types of arguments they entailed. These verbs included, for example, pure intransitives that do not allow direct object NPs, like *run* and *look;* "psychological" verbs like *think, feel,* and *like;* two-place transitive verbs like *hit* and *read;* datives like *write* and *buy;* and obligatory three-place verbs like *give.* Again, we know from the recent psycholinguistic literature that the lexical properties of verbs have direct consequences in sentence comprehension and production; thus it may be necessary to initially control for these properties when devising treatment programs.

To the best of our knowledge, the treatment literature thus contains few instances of studies that have seriously considered the linguistic and psycholinguistic underpinnings of sentence targets. In developing our present treatment approach, we considered, for example, the data derived by Wambaugh and Thompson (1989), who examined the effects of training *wh*-interrogative production in agrammatic patients. Questions like "What is he cooking?" (derived from "He is cooking *a steak,*" for example) and "Where is he sleeping?" (derived from "He is sleeping *in the park*") were trained because of their *surface* similarities. Results indicated that although generalization within *wh*-structures occurred (i.e., from trained *what* constructions to untrained *what* constructions), generalization across *wh*-structures (i.e., from *what* to untrained *where* constructions) was negligible.

Again, from our present perspective, generalization across wh-forms may not have occurred because the verbs *cook* and *sleep* have very different lexical properties. *Cook* is a transitive verb allowing a direct object NP argument to which the role of Theme is assigned (for example, you cook *the steak*); *sleep* is a pure intransitive verb not allowing a direct object NP. Indeed, the locative phrase *in the park* that is the focus of the *where* question is an adjunct of the verb, not an argument. Because these verbs differ in their underlying thematic properties, it follows that the sentence

structures in which these verbs are contained will also have different D- and *S*-structure representations. We suggest therefore that these differences in *what* and *where* interrogatives—distinctions having to do with the lexical properties of verbs—were reflected in the lack of generalization noted by Wambaugh and Thompson. If this postulate is correct, *wh*-interrogatives that use verbs with *similar* lexical properties would be better candidates for generalization. For example, we would predict generalization from *what* interrogatives to *who* because verbs that enter into both of these can take a direct object NP to which the role of Theme can be assigned. *Wh*-movement would then apply, yielding *wh*-interrogatives with similar *S*-structure and surface realizations as in, for example, "She is fixing *the car*" yielding "*What* is she fixing?" and "She is hitting *the boy*" yielding "*Who* is she hitting?"

We have recently begun a treatment program that controls for just these variables, and we think our program of research, takes the investigation of generalization a big step further. Again, consider that in our linguistic framework there are two types of constituent movement: *NP*- and *wh*-movement. We are not only examining generalization patterns across different kinds of *wh*-questions, but we are also examining whether generalization occurs across different sentence structures that rely on the same rule for their derivations, *even though the surface realizations of these sentences will be very different* (see Thompson et al., in press; Thompson and Shapiro, 1992).

We have outlined a theoretical approach to treatment that takes linguistic theory seriously as the proper description of language. We have attempted to show that the constructs born from the minds of theoretical linguists have consequences for the production and comprehension of sentences in both normal and brain-damaged populations. Finally, we have claimed that it is time for these facts to be considered in treatment research, and we offer one such program as our initial attempt in this enterprise.

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