Title
Acquiring Grammars with Complex Heads: A Model Using Have as a Complex Verb

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Acquiring Grammars with Complex Heads: A Model Using *Have* as a Complex Verb

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Abstract

A thorough account of how grammar is acquired must handle the problem of how learners deal with covert grammatical elements. In particular, there is cross-linguistic evidence that languages contain verbs that are formed by incorporating a silent grammatical element (a head, in GB terms). Assuming this to be a possibility in natural grammar, this paper investigates what type of input would enable a learner to identify a verb with covert head incorporation, and thus to identify a grammar that contains such a verb. I show that such a grammar cannot be learned from input that does not give the locations of empty heads in sentential structure.

Introduction

The Poverty of the Stimulus

If children were given fully labeled structures as input, with all categorial information provided explicitly, language learning would be trivial. But this is not the case in natural language acquisition. Language learning always involves learning from partial input: category labels are not explicit in speech (people do not explicitly identify nouns, verbs and empty categories as they speak), and furthermore, learners have only finite (indeed, limited) exposure to a grammar that generates an infinite set of expressions.

Given these conditions on natural language learning, it is important to investigate exactly what type of input is needed to identify a natural grammar, and whether this type of input is reasonably available to learners.

Have is a Complex Verb (*be*+P)

In languages that do not contain a verb equivalent to English *have*, possession is often expressed by the copular verb *be*, and a preposition or grammatical case marker marking the possessor. For example, possession in Hindi is expressed in the following way:

(1) Siitaa-kii do bɛ hne hɛ̃
Sita-gen two sisters be-pres-pl
"Sita has two sisters" (Mahajan, 1997)

A pattern of alternation between *have*, and *be* plus a grammatical marker across languages has led a number of linguists to suggest that the verb *have* is actually a composite form of *be* plus a silent incorporated preposition (P). Furthermore, there is evidence from languages such as Classical Armenian and Iranian that the verb *have* is the same lexical item in more than one (perhaps all) of its syntactic occurrences. That is, the verb *have* in possessive constructions (e.g. *John has a book*), is not distinct from the verb *have* that appears in past participle constructions (e.g. *John has left*). Thus, both (or all) types of the verb *have* should be complex.

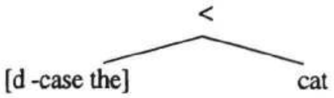
In languages like English, there is no overt evidence for the complex makeup of *have*. If exposed to a language of this type, how could a learner figure out that *have* is complex, unlike other main verbs?

Using a Minimalist Grammar

In order to identify the type and amount of grammatical input necessary for a learner to identify *have* as a complex verb (*be*+P), I use a minimalist framework as developed in Stabler (1996, 1998). The idea behind this framework is that the grammar is represented within the lexicon, so that each lexical item is a composite of the item's category, selectional features, pronunciation and meaning. Lexical items are combined through the operations of *merge* (two items are merged to satisfy selectional requirements) and *move* (an item moves to satisfy grammatical case requirements).

For example, a Determiner Phrase (DP) is formed by merging a determiner (which selects a noun) and a noun, as illustrated in (2).

(2) merge [n= d -case the] and [n cat]



In the application of the rule merge, exactly two features cancel: the feature that is selected by the head (in this case the feature n, selected by the head d), and the category of the item that is selected (in this case, n). The word itself given at the end of the entry represents both pronounced and interpreted featrures. A node labeled '0' does not contain any phonetic material. The '<' symbol indicates that the projecting head is on the left branch in the structure; a '>' symbol would indicate a head on the right branch. Abstract grammatical case is assigned to DPs by verbs and the Tense head. The need for case (a property of arguments, i.e. DPs) is indicated by [-case]. The ability to assign case weakly, inducing only covert movement of features, is indicated by [+case], and the ability to assign case strongly, inducing overt movement of the case assignee, is indicated by [+CASE].

In order to use this framework to build constructions containing the verb *have*, we must allow a head to strongly select another head. In other words, we will represent head incorporation by having one head strongly select another head, thereby inducing movement of all features in the selected head into the position of the selecting head. We will indicate head incorporation by X=, where X is the category that incorporates into the head that selects it. Thus in our case, we will need a verb, v, that strongly selects a preposition (P=).

A Grammar Containing *Have* as *Be*+P

Since I am interested in testing the learnability of a grammar containing a verb formed by covert head incorporation, I include in my grammar a verb (v) which strongly selects a preposition (p), pronounced /ha/, yielding a lexical element pronounced /have/. In (3) I give my grammar, where 't' indicates a Tense node (corresponding to present/past tense features), and 'c' indicates a Complementizer node, the root of each clause.

(3) Grammar

[t= c]	[T= c]	
[v= +CASE t]	[V= +CASE t]	
[n= -case d]	[n]	
[c= +case d= v]	[C= +case d= v]	
[c= +CASE d= v]	[C= +CASE d= v]	
[d= +case d= v]	[d= v]	[P= v]
[v= p ha]	[d= +case d= p ha]	
[p= d= p ha]	[t= d= p ha]	

Notice that my grammar contains four distinct p entries, each pronounced /ha/. Inclusion of these four items, each of which has different selectional properties, enables the grammar to generate different types of *have* constructions (e.g. possessive: *John has a book*; past participle: *John has left*; causative or experiential: *John had Mary leave*; locative: *The table has a book on it*).

For clarity, I will illustrate how the lexical items in (3) can be put together with the operations merge and move, to build the sentence *Maria has a book* (see also Becker, 1997 for a more detailed description).

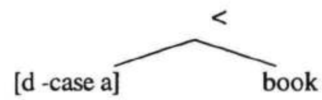


Figure 1: merge: [n= d -case a], [n book]

Notice that exactly two features cancel: the n feature selected by the determiner *a*, and the n category of *book*.

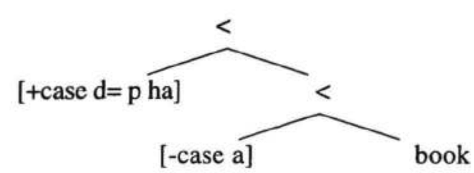


Figure 2: merge: [d= +case d= p ha], [d -case a book]

The DP [a book] must move to get case, assigned weakly by the p [ha].

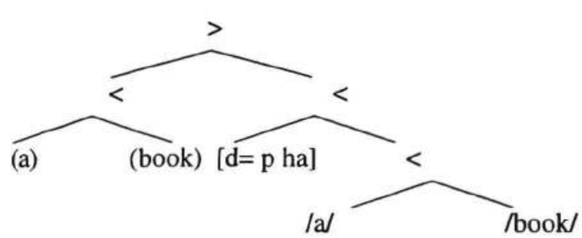


Figure 3: move [a book] for case

Since case was assigned weakly, movement is covert: the pronounced features of the DP [a book] remain in their original posiiton, and only the interpreted features move. The preposition [ha] still wants to select another DP, so we merge the subject:

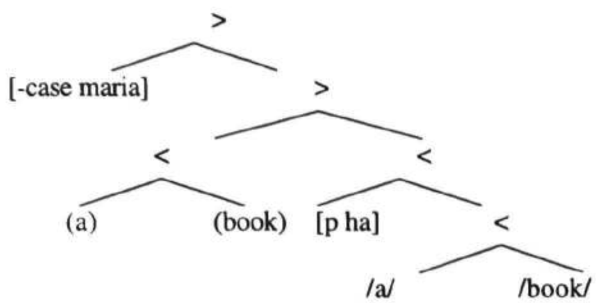


Figure 4: merge: [d -case maria], [d= p ha]

We need to merge an item that will select the p, so we merge the v that (strongly) selects p:

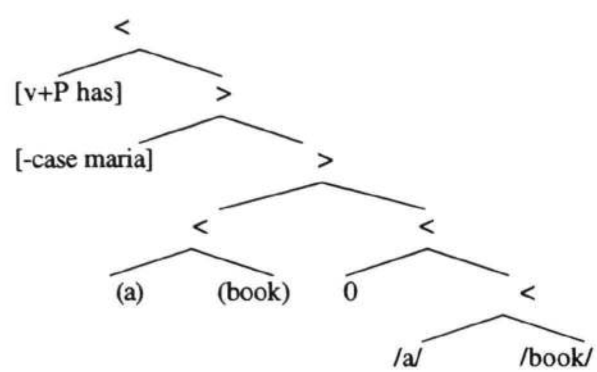


Figure 5: merge: [P= v], [p ha]

Since P is strongly selected, all of its features raise into the head that selected it, namely v, leaving its original node empty (represented by '0'). The verb now needs to be selected, so we merge a tense head, which will select the verb.

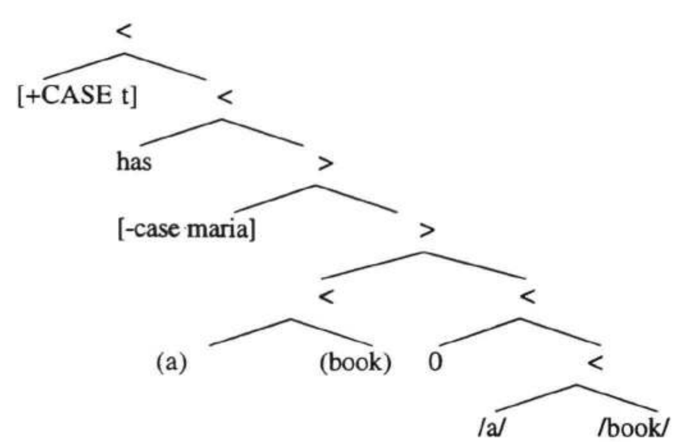


Figure 6: merge: [v= +CASE t], [v+P has]

The subject, *Maria*, still needs case, and t will assign it case strongly, inducing overt movement.

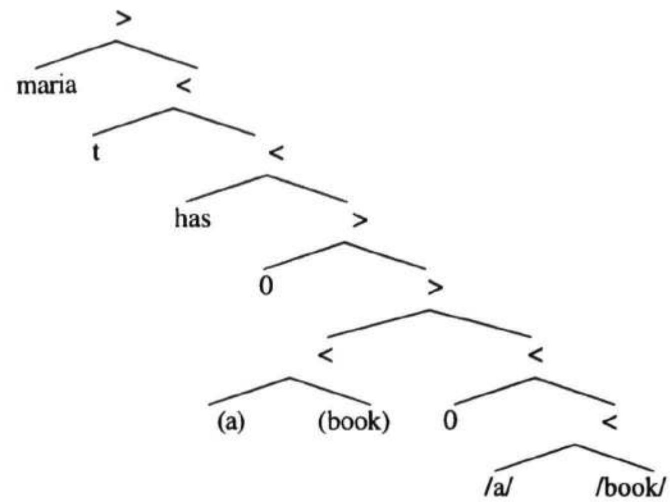


Figure 7: move [maria] for case

Finally, we merge a node that will select t, namely c. Once we do this and remove the interpreted features, we have a bare tree structure, with unlabeled nodes, for the construction *Maria has a book.*

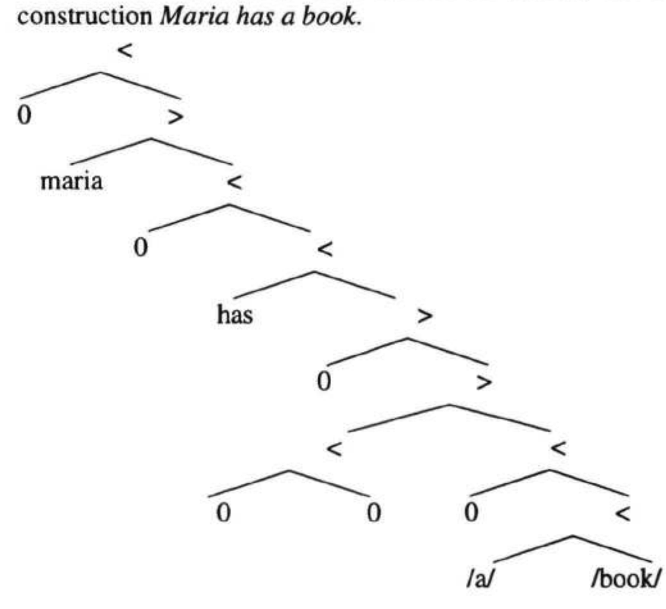


Figure 8: merge: [t= c], [t]

The representation in Figure 8 provides no categorial information (we know by assumption that the root node is category c), but it still gives the locations of empty nodes, information that is not plausibly available to children in the auditory input.

We formally represented the categorial options and used a prolog implementation to identify all the possible classifications of lexical items consistent with the unlabeled structures, finding that in every case, the classification is unique. That is, our grammar allows these structures to be derived in only one way. Given the structure in Figure 8 as input, the prolog program identifies the category of each node unambiguously, i.e. it generates the lexicon in (3).

After running the program on six different tree structures containing various *have* constructions as input, the result was that the nodes in all six trees were correctly labeled (*all* nodes were labeled: even the empty ones). That is, the program was able to determine that the verb in Figure 8 is of category V+P, not just category V.

Crucially, this means that the program distinguishes between the verb in Figure 8 and the one in Figure 9, which is of category V.

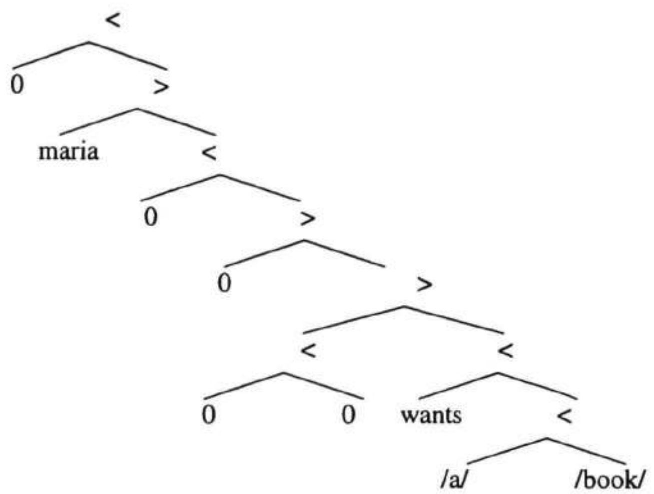


Figure 9: The structural difference between *has* and *wants*

Note that the learning program I use here does not involve learning the meanings of these verbs. That is, the learner identifies *have* as V+P and *want* as V, but does not learn that *have* in Figure 8 means something like 'possess', while the *have* in *John had Mary leave* means something like 'cause'. The problem of how children learn the meanings of words, and of verbs in particular, remains unsolved. Very interesting proposals have been put forth, for example by Gleitman (1990), but I will not address this issue here.

A Grammar With Less Syntactic Information

Having established that the grammar containing V+P can be learned from bare structures, we should ask whether the grammar can be learned from input that provides less structural information. For instance, if we reduce the input to bracketed strings, we can no longer see where the empty nodes are. This type of input is given in (4):

(4) a. [[Maria [has [a book]]]
b. [[Maria [wants [a book]]]

The grammar in (3) is not learnable from the type of input in (4), because items that are V+P are now indistinguishable from items that are simply V. Furthermore, without knowing where the Tense node is, the learner cannot determine whether the subject, *Maria*, is in a projection of the verb, or a projection of Tense.

The type of input in (4), however, is a closer approximation of the type of input children receive when learning language. Given that children have no difficulty acquiring the verb *have*, we are left with at least two possibilities: 1) the complex analysis of *have* (as *be*+P) is simply implausible, and 2) children project additional structure that is unavailable in the auditory input.

I reject the first option because as we saw in (4), it is impossible to determine whether the subject is in the projection of V or T. Thus, even if *have* were simply of category V, the grammar would still not be learnable from the type of input in (4). Exploring the second option, then, let us ask what information in the auditory input children might actually exploit in order to acquire a grammar containing *have* as a complex verb.

Acquisition in Children

Since children acquiring English monolingually are not exposed to possessive constructions formed without *have* (e.g. in Hindi, as in (1)), it is worth investigating what overt information in the input of English children could use to figure out that *have* is *be*+P.

The verb *have* in English is quite an unusual verb in terms of its syntactic distribution. It occurs in a wider variety of syntactic contexts than any other single verb. A partial list of *have* constructions is given in (5).

(5) example (type)
(a) I have been to Paris. (auxiliary)
(b) I have to finish this project tonight. (semi-modal)
(c) I have brown eyes. (inalienable possession (animate))
(d) The chair has a high back. (inalienable possession (inanimate))
(e) I have a sister. (alienable possession (animate))
(f) I have too many linguistics books. (alienable possession (inanimate))
(g) I had cereal this morning. (light verb)
(h) John had me turn in my homework early. (causative-eventive)
(i) John had me turning in six abstracts per week. (causative-stative)
(j) The ice had the car sliding around (on it). (causative-locative) (from Belvin, 1993)

(k) I had a bee sting me yesterday. (experiential) (from Déchaine, Hoekstra & Rooryck, 1994)
(l) I have a pen on me / I have a hat on. (locative)

If children assume that different occurrences of a verb are in fact occurrences of the same verb (not homonymous, different verbs), then experiencing the verb *have* in the wide variety of constructions in (5) could indicate to a learner that *have* is a special verb, perhaps even that it is not simply of category V. Secondly, its distribution is similar to that of the verb *be* in many respects: *be* also occurs with a wide variety of complements (e.g. VP, DP, PP, CP), a set which overlaps with the set of complements that *have* can take (VP, DP, PP). The fact that *have* and *be* take a similarly wide range of complement types could tell the learner that these verbs are derivationally related. Additionally, the fact that these verbs are able to take such a wide range of complement types is consistent with the idea that these verbs contain little, if any, semantic content (and thus are copular verbs).

Beyond recognizing the special status of *have* and *be* and the derivational relation between them, how would a child figure out that *have* is specifically *be*+P? In fact, English does display a *have-be* alternation pattern in certain constructions. Some examples are given in (6-7).

(6) a. A book is on the table.
b. The table has a book on it.
(7) a. My knees are bent.
b. I have my knees bent.

The alternations in (6-7) are somewhat weak, since the overt P in (6a) remains overt in (6b), so it cannot be the incorporated element. In (7a), there is no overt P that could incorporate into *be* to form the *have* in (7b). However there are some more transparent cases, as in (8-9).

(8) a. *Sleep* <u>is of</u> category V.
b. *Sleep* <u>has</u> category V.
(9) a. Y <u>is</u> a property <u>of</u> X.
b. X <u>has</u> the property Y.

In these cases it is easy to see that the verb *have* in the (b) examples corresponds exactly to the *be+of* combination in the (a) examples.

Interestingly, we find some examples of apparent *have-be* substitutions in child language. In the following example from Bowerman (1982), the child (age 2;1) produces what appears to be either a correct *be* construction but fails to raise the subject out of the small clause, or she produces *be* instead of *have*:

(10) Mother: Close your eyes.
Child: No! I want be my eyes open.

The adult version of the child's utterance is either (11a) or (11b):

(11) a. I want my eyes to be open.
b. I want to have my eyes open.

A careful study of children's productions of *have* and their errors involving *have* is needed to determine how *have* develops in natural language acquisition, and whether alternations with *be* play a large or small role.

Summary and Future Directions

The employment of the prolog learning algorithm shows that a grammar containing a complex verb (i.e., one involving covert head incorporation) is learnable given input that provides information about the location of empty heads in the structure, but not from input without this information (from bracketed strings). This result requires the learner to draw on information that is not available in the auditory linguistic input, thus suggesting that the syntactic information in the input is insufficient for acquiring the grammar. In solving the learning problem for complex *have*, the learner must rely on syntactic structural information, both information that is available in the input (e.g. *have-be* alternations) and information that is not (e.g. the locations of empty heads). While we know that non-overt structural information is necessary, it remains to be determined whether a learner could identify the grammar based on input whose syntactic richness lay somewhere between unlabeled structures and bracketed strings. That is, we cannot immediately conclude that the moderately rich structures like the ones in Figures 8 and 9 are available to children innately.

Importantly, my prolog learner was not required (or even allowed) to make any assumptions as to whether the category of a given lexical item remains constant across different occurrences. That is, if the learner figures out that *have* is *be*+P when it occurs in a possessive construction, it cannot assume a priori that causative *have* is likewise *be*+P: rather, the prolog learner must arrive at this conclusion based on syntactic evidence in the causative *have* construction. What I suggest, however, is that children do make this a priori assumption. In particular, they must reason across utterances (e.g. those in (5a-l)) in order to figure out that *have* is complex, and in doing so, they must assume categorial consistency across occurrences of *have*.

A number of issues are raised here that remain unresolved. I have tried to show that while regularities in the input, such as *have-be* alternations, are likely to be exploited by language learners, syntactic information about empty heads is an essential key to learning the grammar. This information cannot be retrieved from patterns in the auditory input.

The implementation described here is a step toward a better understanding of how natural grammar can be acquired. It takes a different direction than most recent learnability work, in that it assumes initially very little innate syntactic structure on the part of the learner. Furthermore, it tests the plausibility of the claim that natural language could contain covertly complex verbs, by examining whether children could come to analyze such a verb correctly as containing a silent, incorporated grammatical element.

Acknowledgments

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