The paper provides evidence that Grammar and Parser have access to the same computational tools. The empirical array consists of the so-called Garden Path sentences, which the human parser manages to analyze only after perceptible breakdown and conscious reanalysis (e.g., 'After Susan drank the water evaporated'). The paper examines garden path sentences of various patterns and in a variety of languages (English, Hebrew, Hungarian and Japanese). It is first argued that grammar and parser build structure based on the same principles. Differences in the structure building mechanism follow from the fact that the former builds structure based on internal intentions while the latter is fed with an external string. Licit reanalysis during processing is argued to be movement. Hence, whenever the target of relocation does not c-command the source, movement fails and breakdown is sensed. The distinctions between reanalysis-movement and syntactic movement concern copies (traces) and locality constraints. They result from the distinct task movement serves in each case. If the proposal is on the right track, we have independent evidence in favour of the operation Move, assumed by derivational theories.

1 Introduction

What is the relationship between grammar (grammatical knowledge) and processing (parsing)? Since both parser (processor) and grammar have similar tasks – roughly, associating a structural analysis with a set of terminal nodes – the simplest hypothesis seems to be that the same computational system handles both Generation of structures and their processing. Generation is used here to refer to structure building based on internal intentions. A less strong version is that the same computational tools are accessible for both tasks. Despite that, mostly, the processor is taken to be a system distinct from the system of grammatical knowledge. Most work by theoretical linguists does not take processing studies
into consideration and vice versa. Thus, processing needs usually do not play a role in evaluation of theories of grammar, nor is the relevance of tools of the computational system tested against processing phenomena.

Various reasons have led to the split between grammar and parser. First, experimental work in the sixties (Milner and Chomsky 1963) seemed to provide no evidence that the level of complexity of syntactic structures is reflected in processing in terms of processing time, accuracy, etc. This led scholars to hypothesize that processing is handled by algorithms distinct from grammatical mechanisms. Further, it did not seem possible to define a parser based on models of grammar (see Fodor, Bever and Garrett 1974, Matthews 1962). And at the same time, processing specific phenomena seemed to require devices not needed by the grammar, such as ambiguity resolution. Processing phenomena have been set aside by linguists as facts from the realm of performance irrelevant for the study of linguistic competence.

Indeed, Chomsky's (1965) distinction between competence and performance paved the way for theoretical linguists not to devote attention to processing. However, the distinction competence versus performance is by no means parallel to that between grammar and processing. Arbitrary, sporadic performance problems may occur in both generation and processing. Moreover, it is by now clear that human processing is systematic, as shown, for instance, by the fact that human processors systematically take certain wrong processing paths. Processing is thus an additional important empirical array that can shed light on the computational tools used by humans to perform linguistic tasks.

Discussing the developments that brought about the split into two disciplines – study of grammar and study of processing1 – Phillips (1996) argues that the outcomes of empirical work did not, in fact, warrant the split into grammar versus parser. He advocates the strongest possible hypothesis "parser is grammar", motivating on syntactic grounds modifications of principles of grammar to allow the grammar to handle parsing.

I share Phillips' doubts as to the inevitability of the split, but take a distinct path here. I examine the relevance of known computational devices for processing. See also Pritchett (1992), Mulders (2005), Reinhart (2006) for the claim that devices of the computational system are accessible to the parser. In the spirit of Pritchett (1992), I assume that the structure building operations for processing are cast in the same mould as those for generation. Furthermore, I suggest exploring the hypothesis that movement (Internal Merger in Chomsky's 2001 terms) plays an important role in sentence processing. Garden Path phenomena (to be presented in section 2) serve as the empirical array of the paper. As will become clear by the end of the paper, if tools of grammatical knowledge are relevant for processing, then processing phenomena can also throw light on the workings of the mental grammar and should not be doomed as performance data irrelevant for the grammar.

After presenting the garden path phenomenon, section 2 discusses the structure building operations I assume for generation and processing (parsing). Section 3 presents the puzzle raised by garden path sentences: What is it about the structural misanalysis and reanalysis that garden path sentences involve that brings about a conscious breakdown, unlike other cases of misanalysis and reanalysis that parsers overcome automatically without perceptible effort? Section 4 offers a solution to the mystery: Alongside the structure building mechanisms, movement, I propose, is a tool allowing automatic reanalysis. If movement is impossible, a conscious breakdown is sensed. Section 5 enriches the empirical array, and section 6 evaluates the proposal in light of what we know about movement, its status, and the locality constraints it obeys. The paper does not offer a survey of alternative proposals discussed in the psycholinguistic literature on garden path, as these proposals mostly use

1 For further discussion of the split, see Fillenbaum (1971), Fodor, Bever and Garrett (1974), Pritchett (1992), and references therein.
mechanisms specific to processing, while here the attempt is to content with grammatical tools.2

2 Setting the Stage

2.1 Garden Path

It is well known that certain sentences prove very difficult for humans to process. Humans manage to analyze them only after perceptible breakdown and conscious reanalysis. Such sentences are called garden path sentences, as in the course of their processing humans are led down the garden path, and have to recover by conscious reanalysis. (1) exemplifies the phenomenon. The conscious effect that such sentences cause is somewhat comparable to the effect of ungrammaticality, but transient: it disappears once the sentence is successfully analyzed, and does not reoccur once the processor is acquainted with the sentence. Following Pritchett's (1992) notation, I mark garden path sentences here with ¿.

(1) ¿After Susan drank the water evaporated. (Pritchett 1992)

Of course, the effect in (1) (as well as in other garden path sentences) does not arise if the sentence is punctuated (comma following drank) or pronounced with proper intonation (by and large, garden path effects do not occur in natural speech). Deprivation of punctuation and intonation, however, generates a valuable empirical array, which allows testing the processing procedure. It is clear by now that the absence of punctuation and intonation in certain configurations systematically leads humans to garden path effects. As the phenomenon is systematic, it must be the result of the way processing works. Deprivation of punctuation and intonation, thus, is a technique to shed light on the workings of the 'machine'.3

Garden path sentences are often said to involve transient ambiguity at a certain stage of their processing. Thus, in (1) at the point when the water is encountered, it can ultimately head the complement of drank (After Susan drank the water) or the subject of the subsequent clause (owing to lack of punctuation (intonation), as just explained). Attachment infirmness per se, however, cannot be the reason for breakdown. As is well known, ambiguous sentences, which avail themselves of two (or more) attachment options do not involve a processing breakdown. This is illustrated in (2), where the PP with the binoculars can be attached as modifying either the noun suspect or the verb saw.

(2) Max saw the suspect with the binoculars yesterday.

But unlike ambiguous sentences, where both options lead to a grammatical sentence, in garden path sentences, one of the choices leads to a processing failure (to transitory ungrammaticality). Crucially, this choice is the one made by humans uniformly in a variety of garden path sentences of diverse structural patterns. So, in fact, despite the transient ambiguity, there is no optionality. In (1), humans systematically first associate the water with the internal role of drank. Upon the arrival of evaporated, they realize that this was an erroneous parse, as the water must head the subject of evaporated; drank is object-less in the final parse (which is possible for certain transitive verbs, as is well known). This path of processing is compulsory. Thus, human processing is systematic: it is guided by universal

2 Pritchett's (1992) seminal work on grammatical processing is an exception: it suggests that the structural relation of Government is relevant during processing (specifically, for sentence reanalysis). Beyond the fact that the adequacy of government has been doubted in the past two decades, the proposal is not satisfactory empirically (see note 15).

3 This is comparable to insertion of islands in sentences in order to test subjects' reactions.
principles to be explored in what follows. Moreover, processing waits neither until the end of the sentence nor until disambiguation. It builds structure as soon as possible, that is, as soon as an attachment option is available. If attachment involved a minimal "look-ahead", no garden path effect would arise in e.g., (1), as upon arrival of evaporated, the correct parse becomes the only option. The next section discusses the structure building devices operative in generation and processing, and clarifies what guides attachment, that is, what makes it possible and mandatory.

2.2 Structure Building Operations

It is commonly assumed that the structure building operation – Merge in Chomsky's (1995, 2001) terms – applies first and foremost on the basis of predicate-argument relations (θ-relations) accompanied by the relevant functional structure, and modification relations. This is summarized in (3).4

(3) Merge is triggered by
   a. θ-relations
   b. the relevant functional material
   c. adjuncts

A priori, there is no reason to assume a different structure building mechanism for processing as the task is similar. In the spirit of Pritchet (1992), I assume the mechanism is basically the same. Thus, roughly, the guideline in (3) underlies processing as well. However, given that processing assigns structure to strings provided by an external source (not built according to internal intentions), the question arises: What determines the processing steps? We have already seen in the previous section that human processing lingers neither until the end of the sentence nor until disambiguation. Let us make this observation more precise, focusing on each of the factors relevant for merging (3a-c) one by one.

Let us start with (3a). θ-relations are satisfied as soon as possible. As observed by Pritchett (1992), predicates "want" to assign their role asap, and potential arguments "want' to be associated with a role asap. Garden path sentences show that. Were the human processor not "anxious" to implement the θ-relation between drank and the water in (1), no processing failure would occur. The processor would hold on and upon the arrival of evaporated would "realize" that it is the latter that must assign its role to the water. But the human parser assigns 0-roles as soon as possible, and therefore experiences breakdown in (1). Of course, the processor takes into account formal/grammatical features of lexical items, and assigns θ-roles accordingly. Thus, in languages where case marking distinguishes between objects and subjects, the water would not be attached as the object of drank in (1), as the formal features of the water would mark it as subject incompatible with the object position.

To make things concrete, let us consider the stages of processing that (4) undergoes. Upon the arrival of Dan, no merger takes place as there are no θ-relations to implement, owing to the lack of θ-assigner (there is no θ-assigner available yet). Dan is kept in the working memory, labeled store in what follows (4b). Next, ran is identified as a verb with one θ-role to assign. Dan is retrieved from the store and the relevant structure is built (4c).

4 In Chomsky's (2001) terms, θ-relations and functional structure are merged by set-merge and adjuncts by pair-merge. This is not directly relevant for our purposes.
Next, consider functional material (3b), such as auxiliaries or complementizers (extended projections in Grimshaw's (1991) sense). I assume functional material is kept in the store until the arrival of the relevant predicate. This is a working hypothesis; it has no bearing on the claims advocated here. Nonetheless, to understand the rational underlying the hypothesis, consider the examples in (5).

(5) a. Without her contributions would cease.                        (adapted form Pritchett 1992)
b. Without her contributions would it be impossible?

(5a) involves a garden path effect. On the initial processing path, *contributions* heads the complement of the preposition *without*. The grammatical analysis of the sentence, after breakdown, merges *contributions* as the subject of *would cease*. My working hypothesis here is that reanalysis in such cases takes place upon the arrival of *cease*, as auxiliaries and functional material in general do not merge independently of and prior to the merger of the lexical head that they are associated with (the lexical head they are the extended projection of), the verb in (5). The grammaticality of (5b) may be taken to be an argument supporting this claim. If breakdown and reanalysis occurred upon the arrival of the auxiliary *would*, we would expect a processing difficulty in (5b), too, contrary to facts, as the string until *would* is identical in both (5a) and (5b). In contrast, if the auxiliary, as an extended projection of the verb, is merged only following the merger of the latter, we predict no processing difficulty in (5b), because the merger of *contributions* within the PP is adequate there.5

Finally, let us turn to adjuncts. As will become clear directly, adjuncts on a par with arguments are attached to the structure as soon as possible. Consider the Hebrew garden path sentence in (6), resulting from the ambiguity of *mištatfim* between a participle, 'participating', and a noun, 'participants'. Its initial processing path introduces a participial relative into the structure, after *ha-ovdim* 'the-workers' has been merged as the internal argument of *mefateret* 'fires'. The participial relative *ha-mištatfim ba-mexa'a* 'participating in the protest' is introduced, as usual in Hebrew, by the prefix *ha-*, which is also the definite article (see Siloni (1995) for discussion of participial relatives). With the arrival of the matrix verb *za'am* 'were.furious', it becomes evident that it lacks a subject, a processing breakdown is sensed, and *ha-mištatfim ba-mexa'a* is consciously reanalyzed as 'the participants in the protest', the "missing" subject of *za'am* 'were.furious'. Had the parser waited, no breakdown would have occurred. This means that adjuncts (a participial relative clause, in this case) are also merged as soon as possible.6

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5 Pritchett (1992) suggests an alternative analysis of (5b), which casts doubt on the argument I advance here. According to Pritchett, reanalysis is "so hard" ("impossible" in his words) that the parser continues its automatic operation. In (5b) a subject is encountered (ii), and hence no processing difficulty is sensed. In (5a), in contrast, the situation continues to deteriorate. Presumably, when the sentence ends, conscious reanalysis is performed. I leave this issue for future research, as nothing hinges on it here.

6 For Hebrew speakers to be able to read (6) naturally and feel the effect, I add the example in Hebrew script:

(i) ימיון השחטוולת היא מסדרת נבדים והם מתנהלים בשתייה עתירה.
Thus, θ-relations and modification relations give rise to syntactic structure as soon as possible. Most reasonably, this is so because the input string is external and has to be handled with limited resources (the human working memory). Discharging semantic information such as θ-relations and modification relations lightens the load. Functional material, I assume for concreteness, is dependent on the relevant lexical head and hence projected as a consequence of the merger of the latter. This is summarized in (7).

(7) Processing: Merge
   a. to optimize satisfaction of θ-relations as soon as possible
   b. functional material following the relevant lexical head
   c. adjuncts as soon as possible

In order to make (7a) more explicit, let us consider a couple of examples, starting with the famous garden path sentence in (8). The initial processing of (8) takes floated to be an intransitive verb heading a matrix clause whose subject is the boat. θ-relations are thus optimally satisfied: no θ-role is left unassigned and no potential argument remains unattached. Next, the PP down the river is added within VP. Upon the appearance of sank in the string, the processing path is revealed to be incorrect. The DP the boat turns out to be the subject of sank, and floated down the river is analyzed as the participial relative (alias reduced relative) modifying boat.

(8) ¿The boat floated down the river sank. (Bever 1970)

(9) seems to have the same structure as (8). However, informal findings based on preliminary questionnaires reveal that sentences of the type in (9) are not pure garden path sentences. The occurrence of a garden path effect in such sentences qualifies as chance distribution: some people experience the effect while others do not (the parentheses surrounding ¿ mark that).

(9) (¿)The bear recently found disappeared

The crucial distinction between (8) and (9) is that found does not have an intransitive realization, which would allow and require a temporary satisfaction of all θ-relations. The transient ambiguity therefore involves either analyzing the bear found as a matrix clause containing the transitive verb found or as a noun phrase with the passive participle found heading a participial relative modifying bear. On the former parse, found remains with its internal θ-role unassigned. On the latter parse, found has satisfied its θ-requirements (since it is in the passive voice, its external role is implicit and the internal one assigned). However, the whole noun phrase the bear recently found remains role-less. If the two options – (i) an

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7 For our purposes it suffices to realize that found has discharged its θ-roles on the parse involving the participial relative. The exact analysis one attributes to passives and participial relatives is less important here. Specifically, I believe that: (i) in the passive voice, the external role is assigned to a variable existentially bound at the semantic representation; (ii) on the parse involving the participial relative (the correct parse of (8-9)), the internal role of floated and found is assigned to an A'-chain forming the relative clause. For more on the structure of participial relatives, see 4.1 and Siloni (1995).
unassigned 0-role and (ii) a noun phrase with no role – are equal as far as instruction (7a) is concerned, then both processing routes just mentioned (the matrix clause parse and the noun phrase parse) are equal and can be freely selected during processing. If the former route is selected, it is revealed to be incorrect, resulting in a breakdown. If the latter route is taken, the sentence is correctly analyzed as involving a participial relative from the outset. This can explain the chance distribution of the garden path effect that sentences such as (9) seem to manifest. I hence assume an unassigned role and a noun phrase with no role are equal as far as (7a) is concerned.

As processing proceeds left-to-right (top-bottom), structure building during processing must be able to perform some restructuring without cost (difficulty). Specifically, left-to-right incremental structure building, with no "look-ahead", must be able to (i) branch an existing node; (ii) insert a node within the structure. To see that, consider the processing of (10). Upon the arrival of Mary, the existing VP must branch in order to add Mary into the structure, as illustrated in the tree diagram in (10b). Similarly, when encountering the PP on Thursday, the processor must form an additional intermediate projection (T’) in order to insert the adjunct (10c). (Clearly, left-to-right structure building cannot be constrained by the extension (no tampering) condition (Chomsky 1995, 2005) to merge only at the edge (root).)

(10)  a. John saw Mary on Thursday.
     b. 
     c. 

In both (10b) and (10c) an input is merged to a node dominating the rightmost terminal node in the structure. This is not surprising since processing is incremental and must respect the dictated linear order of the input string. It follows that it can only merge to a node dominating the rightmost material (under standard assumptions regarding phrase markers). I propose the operation Expand (11), as an additional structure building mechanism essential for left-to-right structure building.

(11)   Expand
       Merge input (by (7)) to a node dominating the rightmost terminal node.

I believe expand is indifferent as to which of the merging nodes project: the node that is already part of the tree (as in (10) above) or the one that is added to the tree (as in (13c) to be discussed shortly). Structural changes falling under expand evidently do not cause a processing breakdown. As will become clear in the next section, expand is not the sole

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8 It has been proposed that generation of structure also operates right-to-left (Philips 1996, Bianchi and Chesi 2005, among others). An expand type operation would then be relevant for generation, too. I will not discuss that any further here.
structural amendment allowed in processing. Reanalysis involving relocation of an element from its original position to another position is also sometimes allowed, not always. The next section discusses that.

3 Reanalysis: The Problem

Let us consider again example (6a) repeated in (12a). Recall that the fact that it is a garden path sentence shows that contributions must first expand the DP her, independently of one's analysis. (12b) confirms that this step causes no processing difficulty.

(12) a. Without her contributions would cease.
   b. Without her contributions the program would fail to survive.

The processing steps of (12a) leading to a processing breakdown are schematized in (13). The input string starts with the preposition without, which is stored (13a), as there is no constituent to which it can assign its role. The arrival of her requires the formation of the PP without her by (7a), as illustrated in (13b). With the arrival of contributions, the DP her is expanded by (11), as schematized in (13c) (striped frame). The auxiliary would is then identified (13d) and stored by (7b). The next input is cease (13e): the analysis is revealed to be incorrect as the subject position of cease needs to be filled. Contributions must be relocated from within the complement of without to the subject position of the forthcoming clause. This causes a breakdown and a garden path effect is sensed.

(13) a. Input: without Store: without
   b. Input: her Output: by merge (7a):

   c. Input: contributions Output: by expand (11)

   d. Input: would Store: would
   e. Input: cease

But relocation does not always cause a breakdown. Consider (14a), which raises no processing difficulties. Let us skip its initial processing steps forming the tree fragment John gave her as they are trivial. Note nonetheless that upon merger (expand) of her, there is uncertainty as to the actual content of its θ-role: As the object of gave it could be either a Goal as in (14b) or a Theme/Patient as in (14c). As observed by Pritchett (1992), given the well-formedeness of both (14b) and (14c), it is obvious that such uncertainty does not cause any processing difficulty.
(14)  a. John gave her books to Sara
    b. John gave her books.
    c. John gave her to the witches.

The next processing step of both (14a) and (14b) is identical: Books must merge as the second object of gave, as in (15), because this way the verb assigns its two internal θ-roles, optimizing satisfaction of θ-relations (7a). Had books expanded the DP her, gave would have remained with an unassigned θ-role in violation of (7a). (I assume a VP-shell structure à la Larson (1998) and subsequent work).

(15)

```
V'  
  V   VP
     gave
     DP
       V
       her
       t
       books
```

Upon the arrival of the constituent to Sara (its internal makeup is not directly relevant here), books has to be relocated to expand her, in order to void the complement position for the new input. No processing breakdown is sensed.

The question is what the difference is between relocation in (12a) and (14a) that can explain the fact that the former involves a breakdown but the latter does not. Let us examine an additional case of relocation before turning to the proposal.

The processing of (16a) is performed to construct the tree fragment in (16b). The CP that he stopped is merged as the sentential complement of told for θ-relations to be optimally satisfied as soon as possible (7a).

(16)  a. ¿John told the policeman that he stopped to leave.

    b. Initial processing:

```
TP
  DP  VP
    John  VP
      V  VP
          told
          DP
            V
            the policeman
            t
            that he stopped
```

Upon the arrival of the CP to leave, the CP that he stopped has to be relocated from the complement position in (16b) to expand the policeman as a relative clause modifying policeman, thereby voiding the complement position for the infinitival to leave. This causes a processing failure and a garden path effect is sensed.

The next section suggests an answer to the question: Why is relocation difficulty-free in (14a), but causes a breakdown in (12a) and (16a)? In other words, when is relocation licit?
4 Licit Reanalysis

The initial intuition behind my proposal has been that in (14a) reanalysis raises the relocated element in the syntactic structure, while in the garden path cases ((e.g., (12a) and (16a)), the relocated element is lowered. In other words, licit relocation seems to be sensitive to structural hierarchy. This has led me to think that licit relocation may be movement (internal merger in Chomsky's (2001) terms) and consequently sensitive to c-command. Let us see how this can be made more concrete.

4.1 Movement

Reanalysis takes place in configurations of transient ambiguity, where theoretically there is more than one merging options, one of which is forced by the need to optimize satisfaction of θ-relations etc., as stated in (7). When the initial processing path is revealed to be erroneous, the alternative merging option is retrieved. Homing in on the alternative, the system tries relocating. Suppose the target of relocation (to be defined soon) should attract the node to be relocated. It is standardly assumed that the attract operation is constrained to be operative only in the c-command domain of the attractor (Chomsky 1995). Indeed, my proposal is that the target of relocation can "see" and attract a node only if it is in its c-command domain. This is why relocation is possible only "upwards". The proposal is formulated in (17) and explained directly.

(17) a. Licit relocation is movement. For movement to be possible, the Target must c-command the Source.
   b. The Source (α) is the node to be relocated.
   c. The Target is the maximal projection of α in its new merger.

(18) C-command (Reinhart 1976)
\[ \alpha \text{ c-commands } \beta \text{ iff } \]
(i) \( \alpha \) does not dominate \( \beta \) and \( \beta \) does not dominate \( \alpha \) and
(ii) the first branching node dominating \( \alpha \) also dominates \( \beta \)

The target is defined in (17c) in terms of maximal projection. I chose to define it this way, because I believe this definition detects the position that attracts the relocated material in order for the latter to re-project it anew. This is the position "suggesting" itself for (re-)construction (as a result of the failure of the previous parse). I thus propose that maximal projections can attract during reanalysis (in syntactic theory, features of heads are assumed to attract (Chomsky 1995 and subsequent work)). Importantly, in what follows we will see that the various structural patterns that garden path sentences involve can indeed all be captured under this proposal (alternative executions based on different definitions of target can be envisioned).

Turning first to the examples discussed in section 4, let us start with (16), which is repeated in (19a) for convenience. As mentioned, breakdown here is caused by the arrival of the CP to leave, which has to be inserted in the position occupied by the CP that he stopped. The latter CP has to be relocated to remerge as the relative clause of policeman. This is depicted in (19b). The target and source positions are framed; a bolded frame is used for the target. Since the target as defined by (17c) does not c-command the source as defined by (17b), it cannot attract it; automatic reanalysis fails to apply and a garden path effect is sensed.
(19) a. John told the policeman that he stopped to leave.

b.

In contrast, in (14a) (repeated as (20a)), reanalysis upon the arrival of the PP to Sara is automatic because movement is possible. Books projects a DP by expanding her (thus substituting the DP her) in order to void the complement position for the new input. The maximal projection (DP) is thus the target (and attractor). Since the target (bolded frame) c-commands the source, as shown in (20b), movement can take place. Reanalysis is therefore free of conscious difficulty (recall that changes in θ-role labels do not play a role in reanalysis, as discussed in section 3).

(20) a. John gave her books to Sara

b.

Notice that in (19) the target does not exist in the first (erroneous) parse, while in (20) it does. I believe this distinction is irrelevant. In both cases, this is the position that upon reanalysis suggests itself for merger and searches in its c-command domain for material to attract. If this proposal is on the right track, it means that during reanalysis structural positions can search and attract independently of whether or not they existed in the failing parse. As reanalysis is triggered by thematic (semantic) needs, I think that projection of a new branch to be filled after reanalysis (as in (19)) is not unreasonable, because the "machine" (parser) homes in on the alternative parse for the input. In section 5 (example (40)), it will become clear that positions absent in the erroneous parse can attract.

Turning now to (12a) repeated in (21a), recall that contributions must be relocated from within the complement of without to the subject position of the forthcoming clause. The target position (bolded frame) does not c-command the source, as is clear from the tree diagram in (21b). Therefore, movement is impossible and reanalysis upon the arrival of cease involves a breakdown.

(21) a. Without her contributions would cease.
Before concluding this section, let us examine the garden path pattern involving a participial relative, which was discussed in section 3 with regard to example (8) repeated below in (22).

(22) ¿The boat floated down the river sank.

As already mentioned in section 3, the initial processing of such sentences interprets *floated* as an intransitive verb heading a matrix clause whose subject is *the boat*, as in (23a). θ-relations are thus optimally satisfied: no θ-role is left unassigned and no potential argument is unattached. Next, the PP *down the river* is added within VP. Upon the appearance of *sank*, the processing path is revealed to be incorrect, as *sank* requires a subject. Reanalysis has to relocate *the boat* from the subject position of *floated* to the subject position of *sank*, as depicted in (23b). The target position dominates the source and hence does not c-command it (by (18)); a processing difficulty is sensed.

(23) a. Initial processing as matrix clause:

b. Reanalysis upon the arrival of *sank*:
Three notes are in order here. First, the clause built upon the first parse becomes (after reanalysis) a participial relative (alias reduced relative) (which I believe to be a DP involving A’ movement of a null operator, as depicted in (23b). For more discussion, see Siloni (1995); nothing hinges on this specific analysis). More importantly, up to now, I have assumed implicitly that reanalysis preserves predicate structure and relocates arguments. Regarding (23), this means that reanalysis relocates the boat, not the clausal constituent floated down the river. I would like to make this assumption explicit now. The logic behind this decision is that structure is built based on predicates (\(\theta\)-assigners); hence, predicates constitute the skeleton of the structure, which is retained and around which arguments are relocated during reanalysis, either consciously after breakdown or by movement, automatically, without difficulty.

Finally, recall that we have seen that when the verbal form in the participial relative does not have an intransitive realization, as in (9) repeated in (24a), the sentence exhibits a chance distribution of the garden path effect. Pritchett (1992) observes that sentences such as (24b), which seems very similar to (24a), do not provoke a garden path effect at all, unlike (24a). Let us see why.

(24) a. (¿)The bear recently found disappeared.
b. The bear found in the cave disappeared.

As discussed regarding (9), found does not have an intransitive instantiation, which would allow and require a temporary satisfaction of all \(\theta\)-relations via the construction of a matrix clause. The transient ambiguity therefore in both sentences of (24) involves either analyzing the bear recently found as a matrix clause containing the transitive verb found or as a noun phrase with the passive participle found heading a participial relative clause modifying bear. The two processing options are equal as on the former parse, found remains with its internal \(\theta\)-role unassigned, and on the latter, the whole noun phrase remains role-less (found having satisfied its \(\theta\)-requirements within the participial relative). If the latter route is taken, the sentence is correctly analyzed as including a participial relative from the outset. But what happens if the former route is selected? In (24a), it leads to a processing difficulty, when the parse is revealed to be incorrect (since movement is impossible as the target does not c-command the source, just like in (22), as depicted in (23b)). So what happens in (24b)? Why does it never result in a breakdown?

Pritchett (1992) suggests that the necessity of restructuring is revealed in (24b) as soon as the PP in the cave is encountered. This is so since English imposes an adjacency requirement between the verb and its accusative complement (hence, the ungrammaticality of *The bear found in the cave a puppy). As the verb is immediately followed by in the cave, the parser "concludes" that the sentence does not include a direct object and therefore reanalyzes the string the bear found as a noun phrase involving a participial relative headed by found. The bear is removed from the subject position of found but cannot be attached in its new position because the matrix verb disappeared has not yet arrived. The PP then serves as a trigger for reanalysis (attaching found in the cave as the participial relative of bear), but the whole noun phrase the bear found in the cave cannot be relocated as its \(\theta\)-assigner has not yet appeared. Thus, reanalysis is enforced but relocation is impossible and the noun phrase must wait in the store until the arrival of its \(\theta\)-assigner. Such reanalysis does not fail to perform movement and does not need to perform conscious relocation. As the processing of the sentence is difficulty-free, it follows that "Parking" in the store is licit when enforced. Importantly, parking in the store is not a device that the parser can freely use to avoid breakdown since the parser merges constituents as soon as possible (see (7)). Parking in the store is unavoidable and therefore allowed, only if the target position is not yet available, as is
Before turning to the examination of more data, let us summarize our claims and results thus far.

### 4.2 Interim Conclusion

Processing proceeds left to right, building structure according to (7) and (11) repeated below for convenience. (25) summarizes the points explaining how optimal satisfaction of θ-relations is understood here.

(7) **Processing: Merge**
   a. to optimize satisfaction of θ-relations as soon as possible
   b. functional material following the relevant lexical head
   c. adjuncts as soon as possible

(25) **Optimal satisfaction of θ-relations:**
   a. For θ-relations to be optimally satisfied
      (i) a predicate needs to assign its role(s), and
      (ii) a potential argument needs to be assigned a role.
   b. an unassigned role "equals" an unattached argument

(11) **Expand**
    Merge input (by (7)) to a node dominating the rightmost terminal node.

Reanalysis maximizes preservation of predicate structure, relocating arguments accordingly. Licit relocation is movement as summarized in (17) repeated below. If upon reanalysis, a constituent cannot be attached to the tree since the target position cannot yet be projected (as in (24b)), the constituent is stored. Such reanalysis is licit, as stated in (26).

(17) a. Licit relocation is movement. For movement to be possible, the target must c-command the source.
   b. The source (α) is the node to be relocated.
   c. The target is the maximal projection of α in its new merger.

(26) Parking of β in the store is licit iff its target position cannot yet be attached.

Up to now, we have seen three garden path patterns. The next section examines the movement hypothesis (16) against additional patterns. Prior to that, I summarize the patterns we have already seen, adding more examples instantiating them. As the new examples exhibit patterns already depicted above, I do not provide tree diagrams for them.

**Pattern I:** The second object of a ditransitive verb is relocated to merge as an adjunct within the other object as in (19) above. Additional sentences of the same pattern are given in (27). In (27a), *in the jar*, first parsed as second internal argument of *puts*, becomes the modifier of

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9 As is well known, intervention between the verb and its accusative argument is allowed when the latter is phonetically heavy (in the so-called *Heavy NP-Shift constructions*), as in (i).

(i) The bear found in the cave a puppy that was left there a few hours earlier.

In (i) (and parallel contexts), upon the arrival of *the puppy*, "retraction" to the main clause parse is unproblematic, as *the bear* is retrieved from the store; it is not part of the tree, and therefore free for construal just as is any unattached element.
candy after reanalysis. In (27b), the dog, first analyzed as the second object of gave, forms a relative clause (modifying the boy) together with bit. Relocated nodes are bracketed.

(27) a. ¿John puts the candy [PP in the jar] into his mouth.
    b. ¿John gave the boy [DP the dog] bit the bandage.

**Pattern II**: A constituent embedded in an adjunct has to be relocated into the subject position of the matrix clause, as in (21) above. Additional sentences involving the same pattern are (1) repeated in (28), and the Hebrew garden path sentences (3) repeated in (29), and (30).\(^\text{10}\) In (30), dam 'blood' is first merged as the argument of the head noun torem 'donor' (forming together the well-known Semitic construct state construction), meaning 'a donor of blood'. Reanalysis has to relocate 'blood' to the subject position of 'difficult to obtain'.

(28) ¿After Susan drank [the water] evaporated.

(29) ¿keyvan še-ha-hanhala mefateret ovdim ha-mištatfim ba-mexa'a because that-the-management fires workers the-participating in.the-protest za'amu.
    were.furious
    'Since the management fires workers, the participants in the protest were furious'

(30) ¿lelo torem [DP dam] kaše le-hasaga.
    Without donor blood hard to-obtaining
    'Without a donor blood is hard to obtain.' (Hebrew)

**Pattern III**: A constituent is relocated from the subject position of a clause (to become a relative in the right parse) to the subject of the matrix, as in (23) above. Additional sentences of this pattern are given in (31). In (31a), the first parse takes Was the cheese just eaten by Fred to be the matrix clause. Upon the arrival of the verb bought, the cheese has to be relocated to the subject position of bought (the newly formed matrix clause), just like in (23).\(^{11}\) In (31b) the first parse forms the matrix clause the cotton clothing is made of. Upon the arrival of the verb grows, the first parse is revealed to be incorrect and the cotton has to be relocated from the subject position of is made to the subject position of grows, again just like in (23).

(31) a. ¿[Was] [the cheese] just eaten by Fred bought here? (Omer Preminger p.c.)
    b. ¿[The cotton] clothing is made of grows in the Mississippi. (Marcus 1980)

Finally recall relocation of the second object of a ditransitive verb to expand the first object, as in (20) above, does not trigger a garden path effect, because the target c-commands the source and movement is allowed. In Hungarian we find the same reanalysis pattern in examples such as (32). Here, first, fiának 'son' is merged as the dative argument of the verb Elküldtem 'sent away', resulting in the parse: "I have sent Mari's son the picture". Upon the arrival of an additional dative DP Pistának 'Pista', the DP a képét 'the picture' has to free the second internal argument position for 'Pista' to occupy it, and consequently moves upwards to

\(^{10}\) (24) is repeated below in Hebrew script:

(i) להשגה קושה דם תורם ללא.

\(^{11}\) In addition, was is relocated from its original position under the first parse to C of the matrix. Its maximal projection, CP of the matrix, dominates the source position (C of the relative clause), and therefore does not c-command it.
head the first object position, the specifier of VP, just like 'books' in (20). As movement is possible, reanalysis is difficulty-free.

(32) Elküldtem Mari fiának [DP a képét]  
Away+sent.1SG.DEF.OBJ Mari.NOM son.POSS.3SG.DAT the picture. POSS.3SG.ACC  
már tegnap Pistának.  
already yesterday Pista.DAT  
'I have sent Mary's son's picture to Pista already yesterday.'  
(Hungarian: Julia Horvath p.c)

5 Further Evidence: Additional Patterns

Pritchett (1992) discusses minimal pairs of the type in (33). At first glance, the sentences seem structurally identical. Nonetheless, while (33a) is processed without conscious difficulty, (33b) involves a breakdown. Pritchett attributes this distinction to the different $\theta$-grid (argument structure) know and tell are associated with: while knows is associated with one internal role, tell specifies two internal roles. Let us see the effect it has on their processing, in light of the analysis advanced here. The initial processing steps of both sentences are identical, as schematized in (34a-b).

(33) a. John knows her friends could be unreliable.  
   b. ¿John told her friends could be unreliable.  
      (Pritchett 1992)

(34) Initial processing of (33a-b):
   a.  
      \[ \begin{array}{c}
      \text{TP} \\
      \text{DP} \quad \text{VP} \\
      \text{John} \quad \text{V} \quad \text{DP} \\
      \text{knows/told} \quad \text{her} \\
      \end{array} \]
   b. Input: friends  
      Output: by expand  
      \[ \begin{array}{c}
      \text{TP} \\
      \text{DP} \quad \text{VP} \\
      \text{John} \quad \text{V} \quad [\text{DP} \quad \text{DP} \quad \text{D'}] \\
      \text{knows/told} \quad \text{DP} \quad \text{her} \quad \text{friends} \\
      \end{array} \]

Upon the arrival of unreliable in (33a) (recall auxiliaries are stored until the arrival of the lexical verb they are associated with), the DP complement of V (knows) is expanded as depicted in (35).
As the structural change in (33a) is the result of expand, no processing difficulty is expected, as is indeed the case. In (33b), in contrast, upon the arrival of *unreliable*, *friends* has to be relocated to merge within the second argument of *told*. Movement is impossible, as the target does not c-command the source, as shown in (36). A processing breakdown is sensed.

(36) Reanalysis upon the arrival of *unreliable*:

This reanalysis pattern is distinct from the ones we saw in section 4. It involves relocation from within the first object position of a ditransitive verb (SpecVP) to the subject position of its sentential complement. This is a garden path pattern as the target does not c-command the source.\(^{12}\)

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\(^{12}\) The same conscious reanalysis as in (36) takes place in (i), but the original object position in SpecVP is cancelled after reanalysis, as the entire DP (*Bill*) has to be relocated. Note that I assume that a DP object of a ditransitive verb is necessarily mapped first to SpecVP, anticipating a VP-shell. In case the ditransitive ends up with one internal argument, the shell is restructured without difficulty (unless the sentence involves illicit relocation as in (i)).

(i) ¿John warned Bill could be unreliable.
(37) is a severe garden path sentence.\(^{13}\) The string is first analyzed as a 'subject verb prepositional phrase' structure, as in (37i), despite its implausible interpretation. Most probably, (37i) is the first parse owing to the fact that 'subject verb' order is more frequent in Hebrew. Alternatively, one can propose that \textit{xulca} is more frequent as a noun than as a verb (I leave this issue for future research). Reanalysis here involves categorial change of \textit{xulca} from N to V, and \textit{metayelet} from V to N (37ii).

(37) \textit{xulca metayelet ba-vadi.} \hspace{1cm} (Naama Friedmann p.c)

i. shirt travels in.the-wadi

ii. was.rescued hiker in.the-wadi

Meaning: ‘A hiker (in the-wadi) was rescued (in the wadi).’

But categorial change in itself does not cause a breakdown. In (38) category specification can be altered without processing difficulty (Pritchett 1992): \textit{duck} can be analyzed as N or V and neither analysis is problematic.

(38) a. I saw her duck into the alley.
     b. I saw her duck fly away.

The initial analysis of (37) is depicted in (39). Reanalysis relocates \textit{xulca} from SpecTP to head the VP. The target does not c-command the source, as depicted in (39b) and movement is impossible. In addition, \textit{metayelet} moves from V to head the DP complement of V; this movement is licit, as DP (target) c-commands V (source)).\(^{14}\)

(39) a. Initial analysis:

\begin{center}
\[ \text{ TP }
\quad \text{DP}
\quad \text{T}
\text{xulca}
\text{metayelet}
\quad \text{VP}
\text{V}
\quad \text{TP}
\]
\end{center}

b. Reanalysis:

\begin{center}
\[ \text{ TP }
\quad \text{DP}
\quad \text{pro}
\quad \text{T}
\text{xulca}
\text{metayelet}
\quad \text{VP}
\text{V}
\quad \text{TP}
\]
\end{center}

\(^{13}\) (37) is given below in Hebrew script:

(i) בוואדי מטיילת חולצה.

\(^{14}\) If the verb is assumed to be inserted under T, then its maximal projection, TP (the target), dominates the subject position (the source) and therefore does not c-command it.
(37) is a severe garden path pattern from which speakers often do not recover without help or considerable effort. Plausibly, this is so because the first parse is only semantically anomalous but not ungrammatical. As reanalysis is not automatic here (movement cannot apply), the parser, in order to avoid breakdown, is liable to content with an anomalous sentence.

An additional support for the movement hypothesis (17) is found in Japanese. Owing to its verb-final order, Japanese offers an excellent testing field for our hypothesis. In case the sentence includes a relative clause or an adjunct, a constituent is likely to be merged first as argument of the embedded predicate, consequently being reanalyzed as argument of the matrix predicate (which is sentence final). (40), taken form Mazuka and Itoh (1995), shows that this rather 'long-distance' movement is unproblematic, as the target (subject position of the matrix predicate) c-commands the source (subject position of the embedded predicate).

The initial processing of (40) constructs the following parse: *when Nakamura bought a second hand computer*, as depicted in (41).

(40) Nakamura-ga tyuuko-no pasokon-o katta toki syuuri-site-kureta.
Nakamura-NOM second-hand computer-ACC bought when repair-did-for me
‘When I bought a second-hand computer Nakamura repaired it for me.’
(Mazuka and Itoh 1995)

(41) Initial processing:

Mazuka and Itoh (1995) note that upon the arrival of *syuuri-site-kureta* 'repaired for me', it becomes clear that *Nakamura* must be the subject of the matrix verb, and the speaker must be the subject of the embedded verb, as it must be the speaker who benefited from Nakamura's repair (the morpheme -*kureta* makes it clear that the repair was done for the speaker). Consequently, *Nakamura* must be relocated from the subject position of the adjunct to the subject position of the matrix. Movement is possible as the target c-commands the source, as shown in (42). Indeed no processing breakdown occurs.
Sentences of the type in (40) provide strong support in favor of our c-command requirement entailed by the movement hypothesis stated in (17). Moreover, since the subject position of matrix does not exist in the first parse, (40) reinforces the claim (advocated in section 4) that positions absent in the erroneous parse are able to project and attract.

Importantly, however, Nakamura in (42) is extracted out of an adjunct clause. In other words, its movement crosses an adjunct island. This seems, at least at first glance, to cast serious doubt on our movement hypothesis: If licit relocation is movement, how come it can cross islands in sharp contradiction with what we know about syntactic movement? Section 6 offers an explanation as to why "Reanalysis Movement" can cross islands. Before we turn to the explanation, let me summarize the garden path patterns discussed in this section.

**Pattern IV**: relocation from the first object position of a ditransitive verb to the subject position of the verb's sentential complement, as in (33b) depicted in (36).

**Pattern V**: relocation from Spec,TP to head the VP, as in (37) depicted in (39).

### 6 Reanalysis Movement and Locality

Reanalysis movement is a (difficulty-free) operation that moves a constituent to a position c-commanding the source, as defined in (17). Both syntactic movement (that is, movement during generation) and reanalysis movement are sensitive to c-command: the attractor in both cases must c-command the attractee. The trigger for movement is different in each case: syntactic movement is commonly assumed to be triggered by the need for feature checking (Chomsky 1995 and subsequent work), while reanalysis movement is triggered by thematic (semantic) requirements.

Naturally, reanalysis movement does not leave a copy because the source position is occupied by distinct material as in (20) and (40) above (or possibly cancelled, e.g., if one does not assume the subject position of the adjunct in (40) is structurally realized by an empty category). Syntactic movement does leave a copy (trace), creating a chain between the moved element and its copy.

Pritchett (1992) suggests that the target position must be governed or dominated by the source position for reanalysis to be possible. In (40) the source neither dominates nor governs the target, but the sentence does not cause a garden path effect. In (37), in contrast, the source of both metayelet and xulca governs its respective target, but the sentence involves a processing breakdown (see also note 2).
Further, syntactic movement obeys islands, as is widely assumed since Ross’ (1967) seminal work on the topic. In other words, the search domain of the attractor is limited by islands. Reanalysis movement, in contrast, can cross an island, an adjunct island in (40), for example. At first glance, this casts doubt on the adequacy of the movement hypothesis (17). However, an additional important distinction between reanalysis movement and syntactic movement suggests a solution to this problem, as explained below.

The additional crucial distinction between reanalysis movement and syntactic movement is that the latter can change word order, while the former is always string vacuous, because in processing word order is dictated by the input string and cannot be altered. It follows that the attractor must be linearly adjacent to the attractee because the attractee must have the same location in the linear string before and after movement. In other words, there is no real search in reanalysis. The attractor can "see" a constituent if the latter is in its c-command domain. Further, it can attract it if it is phonetically adjacent to it. It does not have to search for it. As there is no search, islands are not expected to be relevant, unlike in syntactic movement.16

Finally, it is important to note that if the present proposal is correct, we have independent evidence in favor of the operation move, assumed by derivational theories. It is well known that representational approaches suggest subsuming movement (Internal Merger) under External Merger, namely, merger of elements selected from the lexicon (Brody 1995, 2000 among others). The way this works is as follows: the constituent is not moved from the tail of the chain; rather, another copy of the same constituent is selected from the lexicon and directly inserted as the head of the chain by external merger. Clearly, external merger is not a candidate to replace reanalysis movement. This is so because the relocated element must be detached from its original position, as in the final parse it does not occupy it. If movement exists as a computational tool in processing, it is simpler to assume that it is available also as a device for generating utterances, rather than to limit its application to processing only.

7 References


16 I am grateful to Julia Horvath for pointing this out to me.


