Lexical Expectations in Parsing Complement-Verb Sentences

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Using the single-word self-paced reading task, three experiments investigated parsing of temporarily ambiguous sentences containing complement verbs. The verbs differed in the likelihood with which they are typically followed by a direct object (NP-bias verbs) or a clausal complement (clausal-bias verbs). When the potential direct object was short, readers were “garden-pathed” after NP-bias verbs, but not after clausal-bias verbs. The pragmatic plausibility of the potential direct object also only influenced responses in sentences containing NP-bias verbs. The results suggest that lexical expectations may determine the initial structural assignment made by the reader in these sentences. It was argued that models of parsing should incorporate a role for lexical expectations at an early stage of syntactic decision-making.

The purpose of the arbitrary symbols that constitute a printed text is to attempt to communicate a message to some actual or potential audience. The meaning of the message is of course crucially dependent on the meanings of the individual words making up each sentence. It is for this reason that considerable interest has centered on the question of how readers recognize words and gain access to their meanings. However, any general theory of the reading process must also have something to say about how structural relations between words are established during reading. If readers did not appreciate how to group words into phrases and clauses, they would be able to understand only a limited number of exceptionally simple sentences.

It is possible that the presence of supra-segmental cues in the acoustic signal assists listeners to make such syntactic parsing decisions. Readers, however, have no analogous clues available in the visual stimulus beyond those minimally provided by punctuation. Thus, the task of identifying structural relations may well be more demanding in reading than in listening. Admittedly, whether or not this is the case remains to be demonstrated conclusively. Nevertheless, it is clear that a better understanding of how skilled reading proceeds will be gained if we can specify how readers decide on phrasal structure. The present paper reports an investigation into sources of information that influence this decision-making process.

It has long been recognized that in English the verb provides critical information about a sentence’s structure. Since in English the verb often occurs early in a clause, it is plausible that the reader may use knowledge of the potential syntactic contexts of a verb to project hypotheses about the structural relations following it. An early conjecture based on this assumption was that, where a verb could appear in more than one structural context, people...
might temporarily entertain all hypotheses about the subsequent structure (Fodor, Garrett, & Bever, 1968). One presumed consequence of this multiple computation view was that such verbs might complicate processing compared with verbs which could appear in fewer structural contexts. Some evidence consistent with this expectation has been obtained. Compared with simple verbs, verbs that could potentially occur in more than one construction caused processing complexity in a rapid reading task (Holmes & Forster, 1972). As far as auditory processing is concerned, early evidence was negative (Hakes, 1971); however, an effect has recently been obtained with a different task by Shapiro, Zurif, and Grimshaw (1987).

The importance of the verb in controlling syntactic decision-making has also been emphasized in an alternative perspective on the parsing process. It has been proposed that, for verbs which can appear in a number of structural configurations, the syntactic possibilities are ranked in terms of their likelihood and tested out in that order (Fodor, 1978; Ford, Bresnan, & Kaplan, 1982; Holmes, 1984). This lexical expectation hypothesis has received support from experiments on verb transitivity. For example, Cliffton, Frazier, and Connine (1984) have found that readers experienced difficulty processing sentences in which optionally transitive verbs were used in a context which turned out to conflict with their preferred (dominant) usage.

More specific information than transitivity may also form the basis for structural predictions based on the verb. A particular class of transitive verbs formed the focus of interest in the present study. These verbs may either be followed by a simple noun phrase as direct object, as in (1), or have as complement an entire clause, as in (2). For ease of exposition, these complex verbs may be termed complement verbs. If the lexical expectation hypothesis is correct, then the lexical entries of such verbs should contain the alternative analyses ranked according to their usage, and this ranking should determine the order in which the structural options are tested.

(1) I suspected the boy.
(2) I suspected that the boy was wrong.

Some evidence relevant to this question has been presented by Mitchell and Holmes (1985). They constructed a small number of pairs of sentences such as (3) and (4). Owing to the absence of the optional complementizer that, these sentences are temporarily ambiguous at the noun phrase with respect to the direct-object and clausal reading. Verbs like suspect were assumed to be biased towards a clausal continuation, whereas verbs like read were assumed to be biased toward a simple direct-object (or NP) continuation.

(3) The historian suspected the manuscript of his book had been lost.
(4) The historian read the manuscript of his book had been lost.

In a phrase-by-phrase reading task, sentences like (4) were read for much longer at the beginning of the verb phrase (the disambiguation point) than sentences like (3). When the same sentences were presented in another experiment with the word that included, the complexity difference was not obtained. These findings can be interpreted in line with the lexical expectation hypothesis: the initial analysis assigned to these clausal-complement sentences was correct for the clausal-bias verbs, but turned out to be incorrect for the NP-bias verbs, causing a re-analysis of the input.

Both of the preceding views assume a distinctive role for the verb in determining parsing decisions during reading. They can be contrasted with other models which do not see the verb as having any special significance in the reader's syntactic decision-making. One such model is that of Frazier and Fodor (1978) and Fodor and Frazier (1980), who have proposed several independent parsing principles governing a reader's initial analysis in particular struc-
tural environments. Of relevance to the sentences under discussion here is the principle of minimal attachment, according to which a word is incorporated into the existing structure "with the fewest number of nonterminal nodes linking it with the nodes already present." This principle predicts that the direct-object assignment is always the first structural analysis postulated by the reader in sentences such as (3) and (4), regardless of possible verb preferences. Empirical support for the validity of this strategy comes from an experiment by Frazier and Rayner (1982), in which eye-movement patterns were compared in sentences like (5) and (6).

(5) I wonder if Tom heard the latest gossip about the new neighbours.
(6) Tom heard the latest gossip about the new neighbours was false.

For the clausal-complement constructions such as (6), more time per character was spent in the disambiguating region (was false) than earlier regions, and these sentences evoked more regressive fixations during the ambiguous noun phrase than the direct-object sentences exemplified by (5). While these results are consistent with the notion that the reader has been "led up the garden path" in sentences such as (6), other possible interpretations cannot be ruled out. One is that reading rate in the different regions of the clausal-complement sentences might have differed because they differed completely in lexical content. Another is that these sentences may have required more inspection and reinspection of the disambiguating and earlier regions simply because the initial analysis itself necessitated more computation. In other words, sentences such as (6) may be more difficult to read than sentences such as (5), not because the reader has to revise an incorrect analysis, but because incorporating a new clause into an existing structure may involve more processing than continuing an analysis within the same clause (cf. Holmes, Kennedy, & Murray, 1987).

Although the evidence for minimal attachment is not unequivocal, it is a strategy that readers might feasibly adopt. If so, then there are implications for the interpretation of Mitchell and Holmes' (1985) findings. It could be argued that a direct-object construction was postulated by readers for all the sentences in that experiment no matter what the verb was. For the putatively clausal-bias verbs, such as that in (3), however, there was always a pragmatic/semantic clue that this analysis would be inappropriate, since attempting to integrate the ambiguous noun phrase as a direct object would produce, if not semantic anomaly, at least severe pragmatic implausibility. This means that a direct-object assignment could be blocked immediately on detection of the odd meaning. By contrast, for the sentences containing NP-bias verbs, such as (4), the noun phrase could serve as a pragmatically plausible object, and so cancellation of a direct-object attachment would have to wait until the verb phrase was processed. Thus, while the results of this experiment indicate that different verbs appearing in the same sentential context have different processing consequences, whether this difference can be attributed to the verbs themselves triggering different structural hypotheses is not certain. Hence, it would seem that the evidence for the lexical expectation hypothesis is itself problematic.

There is a further possible option that a reader might pursue in trying to determine phrasal structure. When the input is structurally ambiguous, the reader might detect and note the presence of the ambiguity, but might then delay making a structural commitment, waiting until enough evidence became available to make an appropriate choice. Marcus (1980) has put forward such a delay or decision-lag hypothesis. Results compatible with this view have been presented by Holmes et al. (1987). In a single-word self-paced reading task, they compared sentences like (6) with sentences that were identical apart from the inclusion of
the complementizer *that*. A set of direct-object sentences containing a phrase after the direct object was also presented. These conditions are exemplified in that order in (7), (8), and (9).

(7) The attendant indicated the main exit of the building had been blocked.
(8) The attendant indicated that the main exit of the building had been blocked.
(9) The attendant indicated the main exit of the building to the tourists.

Holmes et al. found that words in the disambiguating region of sentences like (7) were read for no longer than the same words in the unambiguous versions like (8), although this region in both constructions was read for longer than the corresponding phrase at the end of the direct-object sentences like (9). On the basis of these results, Holmes et al. argued that their subjects were not reading in a predictive way, but were delaying making structural assignments until they were able to do so with reasonable certainty. They explained the increased reading time required by both unambiguous and ambiguous clausal-complement sentences in terms of extra processing required to incorporate an additional set of clausal relations. Evidence contradictory to this has, however, been presented in a recent experiment by Rayner and Frazier (1988). Using sentences based on those of Holmes et al. in an eye-movement procedure, they found more reprocessing in the disambiguating region of the reduced complement sentences such as (7) than in the corresponding regions of both unambiguous sentence types exemplified in (8) and (9). These authors reaffirmed the validity of minimal attachment, and suggested that the cumulative presentation mode used by Holmes et al. may not have been sensitive enough to allow the detection of garden-pathing effects.

The picture is even further complicated by the results of an analysis conducted by Holmes (1987). Bias estimates of the verbs used in Holmes et al.'s (1987) experiment were obtained, and sentences containing NP-bias verbs were distinguished from those containing clausal-bias verbs. Post-hoc tests indicated that reduced complements did take longer to read than *that* complements in the disambiguating region, but only for the sentences with NP-bias verbs, a result which is entirely consistent with the lexical expectation hypothesis.

Of the four models that have been discussed, none has a body of evidence in its support which is entirely convincing. However, most experiments have simply not considered the possible role of lexical expectations, and even when effects appeared to be representative of items used in an experiment, it is in fact possible that only some of the items were responsible for a given effect. In other words, garden-pathing effects which seem to be general may actually be primarily resulting from sentences containing NP-bias verbs. Thus, we felt that a more direct test of the lexical expectation hypothesis was warranted. It was hoped to gain some clarification of what parsing strategies readers actually do apply when trying to understand English sentences.

**Verb Pretest**

The first phase was to pretest a set of complement verbs to determine any biases in the way in which people use the verbs. Forty-eight complement verbs were presented as the second verb in sentence fragments beginning with a pronoun, for example, *She believed, They admitted, He noticed*. The complement verbs were interspersed among 69 other verbs which do not take clausal complements, and the items were typed on the left-hand side of a page. Each fragment was followed by four underlined spaces to indicate potential word positions, and there was generous spacing between items to allow for extra words.

Thirty-nine University of Melbourne undergraduates volunteered to complete the questionnaire. They were told to add several words to make each fragment into a
complete meaningful sentence, using at least four words. They were to write whatever came into their heads first, and to go through the items as quickly as possible. Subjects took about 40 min to complete the items. They were paid a small sum for their participation.

Completions for the test items were classified according to whether the verb was followed by a noun-phrase complement (with or without that), by a noun phrase as direct object, for example, as in read the book to the child, or by some other phrase type, for example, a prepositional phrase, as in explain about. Verbs were selected so that there was an imbalance of at least 15% between the noun phrase and the clause reading. The sixteen NP-bias verbs chosen elicited 70% NP continuations and 13% clause continuations, on average; while the 16 clausal-bias verbs elicited 55% clause continuations and 14% NP continuations, on average. The biases of the individual verbs can be found in Appendix 1.

For one NP-bias verb (expect) and three clausal-bias verbs (argue, decide, and forget), there was actually a preponderance of constructions other than direct objects or that complements given as responses, for example, expect to, argue with, decide to, forget to. This might mean that for both reduced and that complements neither a direct object nor a clausal complement would initially be expected after the verb. However, it was felt that this would not alter the priority for the testing of these hypotheses once the noun phrase had been processed. The clausal-bias verbs evoked more alternative structures than the NP-bias verbs. Whether this is a general feature of clausal-bias verbs, or an accident of the verbs we happened to test, is not known.

**Experiment 1**

Each verb from the two classes was placed in two syntactic contexts. The verb was followed by a clausal complement with the complementizer that either present (that complement) or absent (reduced complement). The reduced complements are temporarily ambiguous throughout the noun phrase following the verb, whereas the presence of the word that as a complementizer removes the ambiguity. The lexical expectation hypothesis predicts additional processing for reduced complements relative to that complements at the beginning of the verb phrase, but only for sentences containing NP-bias verbs and not for those containing clausal-bias verbs. By contrast, minimal attachment predicts greater complexity at this point for all reduced-complement sentences, independently of verb type. Verb type should also be irrelevant according to both the multiple-computation and delay strategies, neither of which expects a difference between reduced and that complements at any stage during processing.

The experiment also included a test of the idea that lexical biases guide decisions before pragmatic factors are taken into account. The noun phrase either completed a plausible proposition if taken as the direct object, as in (10), or created an implausible proposition, as in (11). For simplicity we shall call these plausible and implausible objects, respectively.

(10) The reporter saw her friend was not succeeding.
(11) The reporter saw her method was not succeeding.

Tanenhaus, Stowe, and Carlson (1985) have reported results suggesting that transitivitiy preferences appear to operate prior to the use of pragmatic information, in that the plausibility of a potential object influenced on-line processing only in sentences containing transitive-expectation verbs. Sentences with intransitive-expectation verbs were not affected by differences in object plausibility. In contrast to this, however, Clifton et al. (1984) found that verb transitivitiy preferences did not determine structural choices when there was prior pragmatic information from a lexical item suggesting the appropriate interpretation. They concluded that "pragmatic informa-
tion can override information about preferred verb frames."

The results of Tanenhaus et al. predict that any effects of object plausibility in the present sentences would occur only within reduced complements containing NP-bias verbs. For reduced complements containing clausal-bias verbs, for example, (12) and (13), if the first structural hypothesis entertained is that the noun phrase is the subject of a clause, then the fact that there would be a difference in plausibility if the noun phrase were taken as the object of the verb should not matter. If pragmatic information, however, influences initial structural choices, then effects of object plausibility might also be observed in these sentences.

(12) The inspector realized the mistake had already been detected.
(13) The inspector realized the vehicle had already been detected.

It should be noted that the proponents of minimal attachment have taken the view that this principle is not influenced by considerations of pragmatic plausibility. Rayner, Carlson, and Frazier (1983) investigated sentences in which the minimal attachment of a prepositional phrase was directly to the main verb rather than as part of an intervening noun phrase. When the meaning of the sentence was compatible with the minimal-attachment interpretation, reading rate was more rapid than when the sentence meaning corresponded to the interpretation requiring the more complex attachment. This was seen as indicating that the minimal attachment is always made first, but it may have to undergo revision if the resultant clausal meaning seems implausible. According to this view, the fact that a noun phrase seems implausible as the object of the complement verb should not prevent minimal attachment always being the first structural hypothesis tested. Thus, garden-pathing should still occur in reduced complements even after implausible objects, and this would be true for both verb types. However, perhaps the implausibility of the object might make the garden-pathing less severe.

The reading task used in this experiment was a self-paced single-word procedure requiring a grammaticality judgment. An abbreviated description of the experiment has already been given by Holmes (1987).

**Method**

Each of the 16 verbs in the two bias categories was used in a set of four related sentences corresponding to the basic conditions, as shown in Table 1. The lexical content was always the same for the reduced and *that* versions within each plausi-
bility condition, apart from the word that. In order to vary the pragmatic plausibility of the potential direct object, different nouns were used following a given verb. For each sentence these nouns were identical in length and matched closely on frequency of occurrence as determined by Kucera and Francis (1967). The 32 sentence sets are listed in Appendix 2.

To check that our intuitions about the pragmatic plausibility of the objects were accurate, simple propositions were formed using the noun phrases as actual direct objects, as in (14) and (15). Two lists containing one sentence from each of the 32 pairs were constructed, each containing half of the plausible items and half of the implausible items. The same 39 fillers, various intransitive constructions, were included on each list. Each list was rated for plausibility by a different set of 28 subjects, who were undergraduate students at Monash University. A five-point scale was used in which five represented high plausibility and one represented low plausibility.

(14) The tenant remembered the reply.  
(15) The tenant remembered the smoke.

Every item except one produced a lower average rating for the implausible than the plausible objects. For NP-bias verbs, sentences containing plausible objects received an average rating of 4.5, while those containing implausible objects received an average rating of 2.2. For clausal-bias verbs, the values were 4.3 and 2.0, respectively. Thus, there was a clear separation of plausibility in the two conditions. Four lists of the 32 test sentences were prepared, so that one of the four versions of a sentence appeared on each list, and so that the list contained four sentences from each condition. Each subject saw only one of the four lists. The test sentences were divided into blocks containing one example from each of the eight conditions. The sentences were interspersed among 38 filler sentences, which were constructed to be as natural as possible. They used a variety of structures, such as relatives and adverbials, and did not contain complement verbs. Also presented were 57 sequences which contained a grammatical violation or were grammatically incomplete. They were never merely semantically anomalous. Examples of ungrammatical items are shown in (16), (17), and (18).

(16) This formula is the unsuitable for  
(17) The lieutenant attacked the aeroplane had  
(18) The counsellor urged that the contrast should be given they

Data analyses were performed on both subject and item means, and minimum $F'$ was calculated (Clark, 1973). In the analyses of the time scores, the effects of exceptionally short or long values were minimized by calculating cutoffs set at two standard deviations from the average across a given subject's scores, and setting any outlying values equal to the cutoff.

Procedure

Items were presented on an 80-character-wide screen controlled by an LSI 11/23 micro-processor system. Words were presented across the screen starting from the left-hand side, with each word staying on the screen in a cumulative fashion. Subjects had to decide whether the sentence could continue grammatically. They pressed a yes button until they detected an ungrammaticality, in which case the no button was pressed. Time between button presses was recorded by the computer to the nearest millisecond, and erroneous responses were noted. Times of erroneous responses and response times to words following an error were not included in the analyses.

Subjects

Forty-eight students at the University of Melbourne participated as subjects in the experiment. All had normal vision, corrected or uncorrected, and were native
speakers of English. They were given a small remuneration for their services.

**Results**

The critical words of interest are the determiner and noun of the second noun phrase of the sentence, and the two subsequent words at the start of the disambiguating verb phrase. To avoid confusion, the word introducing the verb phrase will be termed the auxiliary, even though it was sometimes an auxiliary and sometimes a part of the verb to be used with a predicate. The average results for these positions in the sentence are shown in Fig. 1. Owing to the large number of factors involved, separate analyses of variance were performed for each verb type at each position. The results for NP-bias verbs will be described first. There were no differences between conditions at the determiner. At the following noun, there was a 71-ms advantage of plausible over implausible objects, which was significant, with \( \text{min } F'(1,31) = 4.32 \). However, there was no sign of an interaction of this effect with complement type, with \( \text{min } F' < 1 \). No further effects of object plausibility were observed in the reading times of these sentences. Processing of the auxiliary introducing the verb phrase indicated a clear difference between the two structural types: reduced complements were read for 403 ms longer than that complements! This effect was significant, with \( \text{min } F'(1,24) = 30.58 \). There were no significant carryover effects by the next word of the verb phrase.

The results for the clausal-bias verbs were very different. There was already a small (61-ms) effect at the determiner, such that reduced complements took longer to read than that complements. The difference was significant, with \( \text{min } F'(1,42) = 5.55 \). Reduced complements took 56 ms longer to read at the noun, a difference which did not achieve significance, with \( \text{min } F'(1,40) = 2.59 \). This difference increased to 110 ms, at the auxiliary, and was significant, with \( \text{min } F'(1,17) = 4.84 \). As a check that the magnitude of the difference at the auxiliary was significantly smaller than the 403-ms effect found for the NP-bias verbs, an analysis was performed at this position including verb type as a factor. The interaction of verb type and complement type was indeed significant, with \( \text{min } F'(1,46) = 15.16 \). No significant effects were obtained at the next word. Object plausibility had no significant effect in any of the analyses performed for each position. Nevertheless, there was the suggestion of an interaction between plausibility and position across the noun and the auxiliary for the reduced complement sentences alone. A test of this possibility showed the interaction to be nonsignificant, with \( \text{min } F'(1,69) = 1.69 \).

On less than 1% of trials, subjects erro-
neously classified test sentences as ungrammatical. The average percentages of errors made for each condition are shown in Table 2. It can be seen that for clausal-bias verbs, no errors were made on the ambiguous that complements at any position, and reduced complements also caused practically no errors. However, for NP-bias verbs, while no errors were again made in classifying that complements, some errors did occur for the reduced complements. The only errors of any magnitude occurred at the auxiliary. At the auxiliary there was an almost significant main effect of object plausibility, and an almost significant interaction of plausibility and complement type, both with min F'(1,25) = 4.01. The main effect is accounted for completely by the higher error rate for plausible rather than implausible objects for the reduced-complement sentences.

Discussion

Not only do the results pose problems for the multiple-computation hypothesis, they are not readily explained by a delay model which assumes that no cost is associated with noting the presence of a temporary ambiguity. Both models would need to invoke additional assumptions to explain why a particular class of reduced complements was more difficult to process than corresponding that complements. An unelaborated version of minimal attachment is also unable to provide a complete account of the results. Nevertheless, it is evident that minimal attachment does explain the very large difference between the reduced and that complement sentences containing NP-bias verbs. The effect can be attributed to reprocessing caused in the reduced complements by discovering that the noun phrase has been assigned incorrectly as the direct object of the preceding verb. But garden-pathing after NP-bias verbs is also predicted by the lexical expectation hypothesis.

It is the results for clausal-bias verbs which provide direct evidence for the role of lexical expectations. While reduced complements containing these verbs were more difficult to process than that complements at the point of disambiguation, this effect was only one quarter the size of the corresponding difference obtained for NP-bias verbs. It might be objected that finding any complexity at this position for clausal-bias verbs offers support for minimal attachment. However, the results obtained at other positions in these sentences are not easily explained by this principle (cf. Holmes, 1987). Importantly, the reduced complements took longer to read than the that complements as soon as the deter-

| TABLE 2 |
| MEAN PERCENTAGE OF GRAMMATICALITY CLASSIFICATION ERRORS FOR SENTENCES IN EXPERIMENT 1 |

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miner was encountered. The effect implies that subjects may not have been anticipating a noun phrase at that stage. While they may sometimes have been expecting another part of speech altogether, they may often have been expecting the complementizer *that*. In other words, the initial structural hypothesis may be the nonminimal clausal one. If this is so, then the fact that this complexity effect was rather small would presumably be due to the fact that the absence of a complementizer is far from definite disproof of a clausal hypothesis, as the complementizer is an optional element in these constructions. On this account, the subsequent greater complexity of reduced complements at the verb would arise because subjects sometimes had to reestablish the clausal analysis after temporarily abandoning it.

Regarding the possible influence of pragmatic plausibility on processing, it was found that the pattern of results again depended on verb type. For sentences with clausal-bias verbs, there were no significant effects of object plausibility, neither in response times nor in error rates. For sentences with NP-bias verbs, however, effects were observed for both measures. In the reading times of these sentences, although object plausibility did not influence the time spent at the disambiguation point, it did produce a significant difference at the noun itself. However, the effect was true, not only for reduced complements, but also for the supposedly unambiguous *that* complements, where the object assignment is ruled out by the presence of the complementizer.

This result is somewhat surprising. It may mean that the expectation of a direct object is so strong after NP-bias verbs that people simply fail to pay attention to the presence of the word *that*. That is, even in sentences with an overt complementizer, subjects may temporarily make a direct-object assignment if the noun appears to be a plausible object for the verb. To see whether this really was the case, one would have to compare reading times of *that* complements and matched unambiguous direct-object constructions at the point where the mistake is revealed. Thus, longer times should be found for the auxiliary of *that* complements than for a corresponding word of direct-object sentences. Such an explanation for the present result might seem somewhat unlikely; however, other plausible accounts do not immediately reveal themselves. One alternative possibility is that the effect may reflect some kind of inhibition operating at a lexical level. Since the nouns forming potentially implausible objects were more likely to have come from entirely different semantic domains from the verb than were the nouns forming potentially plausible objects, this may have made the implausible nouns less readily assimilable as lexical partners of the verbs, regardless of the syntactic relationship holding between them. Of course, if this is true then it is not evident why such an effect failed to emerge also in the sentence containing clausal-bias verbs.

In contrast to the above result, the effect of object plausibility on erroneous responses was quite predictable. Sentences containing clausal-bias verbs produced virtually no errors of classification. Similarly, no misclassifications were made for *that* complements containing NP-bias verbs. However, in classifying reduced complements containing NP-bias verbs, readers made errors at the disambiguation point, and these errors occurred almost exclusively after plausible objects. This effect suggests that, when the noun phrase is a plausible direct object for the verb, on some occasions readers are unable to revise a direct-object analysis at all and see the auxiliary as an unacceptable continuation of the sentence. Thus, even though in this experiment object plausibility did not influence the time taken to reprocess erroneous syntactic analyses, it is clear that it did influence the conviction with which the initial structural choice was made. Apparently, in a task where a grammaticality decision has
to be made as each word is read, if a preferred analysis produces a proposition of high pragmatic plausibility, a less preferred analysis may never even be considered.

**Experiment 2**

One possible criticism of the conclusions presented above is that the effects may be limited to the particular task conditions that we employed. It might be argued that forcing the subject to make a decision about the well-formedness of the sequence at every word is inadvisable. Under the pressure for an immediate decision, subjects may make structural assignments on the basis of less evidence than they would otherwise. Alternatively, they might make use of information to which they would normally pay no attention. To meet this objection, Experiment 2 used the same sentences as the previous one, but eliminated the requirement to make a decision as each word was read. Subjects still read words one at a time at their own rate. However, this time they were asked to remember the sentence, so that they could reproduce it if required. It was assumed that the simplest way to remember the sentence was to understand it; that is, to apply a syntactic and semantic analysis to the word string.

**Method and Procedure**

The test items for this experiment were the same as those used in Experiment 1. They were scattered among 90 filler sentences of different complex structures similar to those used in Experiment 1. Subjects were told to press a button to make the words appear on the screen individually. They were to read and understand the sentence and to be prepared to say it out loud as soon as the last word vanished from the screen. They were told that if they could not repeat the sentence verbatim, they were to reproduce the sentence meaning as accurately as possible. A request to do this was made randomly every four trials on average. Subjects' repetitions were not analysed, as observation by the experimenter indicated that all subjects reproduced the sentences with reasonable accuracy.

**Subjects**

Subjects were 40 University of Melbourne undergraduates who were paid a small sum for their participation. They were native speakers of English.

**Results and Discussion**

Figure 2 shows the average inspection times for words in the critical positions in the sentence. As before, the NP-bias and clusal-bias items were analyzed separately. The results were straightforward. For sentences containing NP-bias verbs, there was a 50-ms increase in inspection time for reduced complements compared with that complements at the auxiliary, although the difference was not significant.
with $min F'(1,34) = 1.37$. However, the difference of 92 ms at the next word was significant, with $min F'(1,45) = 5.08$. No analogous effects were obtained for the sentences containing clausal-bias verbs. An analysis across both verb types at the next word after the auxiliary showed that the interaction of complement type and verb type was significant, with $min F'(1,59) = 4.95$. There was no influence of pragmatic factors on the reading times: for neither verb type were there main effects or interactions involving object plausibility which at all approached significance.

The results of this experiment are compatible with those of Experiment 1 and also support the lexical expectation hypothesis. When reading reduced-complement sentences, subjects were garden-pathed only after NP-bias verbs and not after clausal-bias verbs, suggesting that it is only NP-bias verbs which lead the reader to make an immediate direct-object analysis. After processing clausal-bias verbs, readers do not make this false assignment. The major difference between the results of this experiment and those of Experiment 1 was that the critical complexity effects were obtained at different positions in the sentence structure. This would seem to be a consequence of the different task demands of each experiment. In Experiment 1, when a decision about the role of each word in the sentence structure had to be completed before the next word was processed, the processing differences were manifested immediately any disambiguating information was available. However, in the present experiment, the garden-pathing effect was obtained one word further along. Apparently, the removal of the decision requirement permitted a strategy whereby readers lagged behind the input slightly in their structural assignments.

**Experiment 3**

The previous two experiments obtained garden-pathing for sentences whose potential objects were quite short, consisting of only two words. In the present experiment we wished to examine the effect of lengthening the critical noun phrase. We felt that this manipulation might change the pattern of results for sentences with clausal-bias verbs. If the first analysis readers hypothesize for these sentences it is a clausal one, perhaps they would begin to question this as they continued to find no evidence of a new clause, and they might then assume a direct-object analysis.

The sentences used by Holmes et al. (1987) contained long noun phrases and, according to Holmes' (1987) re-analysis of those data, garden-pathing was obtained after NP-bias verbs but not after clausal bias verbs. This might lead one to expect that garden-pathing would not be evidenced for clausal-bias verbs with long potential objects. On the other hand, Rayner and Frazier's (1988) eye-monitoring experiment obtained overall garden-pathing for very similar sentences. Similarly, Frazier and Rayner (1982) found that although short objects produced no garden-pathing at all, long objects did. While the eye-movement experiments suggest that garden-pathing should be obtained with long objects, it has not been shown unequivocally that these complexity effects really did occur with clausal-bias as well as NP-bias verbs.

The present experiment compared reduced and that complements with NP-bias and clausal-bias verbs as before. Sentences with either long or short noun phrases were now included. The task used in this experiment was self-paced word-by-word reading, again without the requirement of a decision while the sentence itself was being processed. To make the task even closer than before to normal reading, subjects were not required to repeat the sentence, but were asked to answer a simple question presented immediately after the last word had been processed. A further change from the preceding experiments was to use sequential presentation of the input, according to which each word disappears from the screen before the subsequent one is intro-
duced. Results of Holmes and Kennedy (1983), as well as other unpublished data from our laboratory, have shown that this method is preferable to cumulative presentation with the question-answering procedure. When performance across presentation modes is compared for the same subjects, words are processed more rapidly when they are presented cumulatively than when they are presented sequentially, apart from the last word, which is then left on the screen for a substantially longer time in the cumulative mode. In addition, while word length correlates with inspection time to the same extent in both modes, word frequency correlates significantly with inspection time only in the sequential mode. These data suggest that, in the cumulative mode, subjects may not even be completing word identification before the next word is displayed, let alone keeping up with syntactic processing.

Method and Procedure

Sentences were constructed based on those of the preceding experiments which had contained plausible objects. The same 32 verbs were used, but the wording of some sentences was altered to accommodate both a long and a short plausible object. There were thus four versions for a given verb, as exemplified in (19) to (22), each of which was assigned to a different list. Each of the 32 test sentences was presented one word at a time using sequential presentation, followed by a yes/no question, as in (23). The items are listed in Appendix 3. They were preceded by several practice items, and were interspersed among 78 filler items. These again exemplified a variety of different superficial structures, using intransitive and noncomplement transitive verbs.

(19) The lawyer heard the story was not really true.
(20) The lawyer heard that the story was not really true.
(21) The lawyer heard the story about the accident was not really true.
(22) The lawyer heard that the story about the accident was not really true.
(23) Was the lawyer informed that the story was correct?

Subjects

Forty-eight University of Melbourne undergraduates participated in the experiment for a small remuneration. A further seven subjects were run, but their data were rejected owing to their extremely slow response times. Replacement of these subjects made more comparable the average times of each material list.

Results and Discussion

Subjects answered the postsentence questions incorrectly on 12.0% of trials. For neither verb type were the subsequent questions answered at a significantly different rate depending on complement type or noun-phrase length. Mean reading times on correct trials for the first two words of the noun phrase and the first two words of the disambiguating material of the test sentences are shown in Fig. 3. Note that the additional three words of the long noun phrases are not included in this figure. Analyses were again conducted separately for NP-bias and clausal-bias verbs. For sentences containing NP-bias verbs, there were no significant differences between conditions during the noun phrase. However, at the auxiliary, reduced complements took 60 ms longer to read than that complements, a difference which was significant, with \( \min F'(1,25) = 5.31 \). The 37-ms effect apparent at the next word did not quite achieve significance, with \( \min F'(1,34) = 3.76 \). The difference at the auxiliary appeared to be larger for sentences containing short rather than long noun phrases; however, the interaction of noun-phrase length and complement type was not significant, with \( \min F'(1,26) = 1.41 \).

The results for sentences containing clausal-bias verbs were quite different. Here there were also no differences at the noun phrase. At the auxiliary, complement
type was not significant, with \( \min F'(1,32) = 1.31 \). However, there was a significant main effect of noun-phrase length, with \( \min F'(1,32) = 5.04 \). More processing was needed after long than after short noun phrases. It is clear that this length effect was only true for reduced complements and not for that complements, even though the interaction of length and complement type was not significant, with \( \min F'(1,51) = 3.05 \). It was more informative for our purposes to consider whether there was an effect of complement type for either the long or the short versions. To do this, the sums of squares for the interaction and the main effect of complement type were combined and this component was divided into two contrasts. For the sentences with short noun phrases, the 5-ms difference between the two complement types was not significant, with \( \min F'< 1 \), whereas for the sentences with long noun phrases, the 47-ms longer inspection time for reduced complements than for that complements was significant, with \( \min F'(1,51) = 4.96 \).

At the word after the auxiliary, for sentences with long noun phrases, inspection time for reduced complements was still longer by 35 ms than that for that complements; and there was a 21-ms difference for the sentence with short noun phrases. Accordingly, not only was length significant, with \( \min F'(1,27) = 8.66 \), but so was complement type, with \( \min F'(1,24) = 4.89 \), and there was no significant interaction between the two factors, with \( \min F' < 1 \). The appearance of an effect for clausal-bias sentences containing short noun phrases deserves comment. The extra processing required for the reduced complements at this stage may be analogous to the result observed within the verb phrase in Experiment 1. That difference was argued to reflect increased computation necessary to reestablish the clausal hypothesis after it had been briefly discarded. However, there are differences between the two sets of results which may lessen the appropriateness of the comparison. The effect observed in Experiment 1 was obtained at the auxiliary, and was preceded by a difference at the determiner, whereas the result in the present experiment was obtained one word further along and was not preceded by detectable complexity at the determiner. If the same explanation does not hold for the present result, it is not clear exactly what might have caused a difference between the two structural types to emerge at this point. At the least it is clear that this increase in processing time for the reduced complements cannot derive from the same immediate reaction to the disambiguating information obtained for sentences containing NP-bias verbs.

In sum, the results were again consistent with the lexical expectation hypothesis. For sentences with NP-bias verbs, the noun phrase coming after the complement verb...
seems to have been attached as the direct object of the verb, causing reanalysis at the disambiguating auxiliary. This strategy was applied in the case of both long and short potential objects. This garden-pathing did not occur for sentences containing clausal-bias verbs when the noun phrase was short. This finding with short noun phrases is consistent with the results of Experiments 1 and 2. However, garden-pathing did occur for these sentences when they contained a long noun phrase. Since the lexical content of the short noun phrases was identical to the first part of the long noun phrases, there is no way the subject could have known in advance whether the noun phrase was going to be long or short. Hence, the fact that garden-pathing ultimately occurred after long noun phrases indicates that the subject must have changed structural hypotheses while processing the additional words of these phrases. Thus, it seems that when the noun phrase continues for too long, the hypothesis that it is the subject of a new clause is replaced by the direct-object hypothesis.

**General Discussion**

The results of the experiments reported here have indicated that the way in which readers process a temporary structural ambiguity following the main verb of a sentence is determined by the verb’s preferred subcategorization frame. The most straightforward explanation of these results seems to us to be the following. After a verb which is typically followed by a direct object, the reader performs a structural analysis that assumes this direct-object assignment. If subsequent lexical items indicate that the less preferred clausal structure is actually appropriate, the reader is garden-pathed, resulting in increased processing at this point in the sentence. On the other hand, after a verb which is typically followed by a direct object, it is this structural hypothesis that is initially postulated by the reader. All is well if the disambiguating material confirms the hypothesis, and no garden-pathing results. Only if the noun phrase continues beyond two or three words does the reader suspect that the clausal hypothesis may have been wrong and institute a direct-object analysis. Such incorrect rejection of the clausal structure also results in increased processing when the disambiguating information becomes available.

The different pattern of results observed for sentences containing NP-bias verbs compared with those containing clausal-bias verbs would not be obtained unless readers were taking into account more than just form-class information about lexical items. Evidently, readers’ processing strategy is based on knowledge of the preferred structural environment for individual verbs.

This finding has implications for models of the parsing process during reading. Without further assumptions, a principle of minimal attachment cannot account for the fact that differential garden-pathing occurs depending on the verb’s subcategorization bias. It predicts that garden-pathing should occur for both verb types. A delay strategy of the kind discussed earlier, if it assumes that verb subcategorization information is ignored, is by contrast too conservative, as it does not expect any garden-pathing to occur at all. The multiple-computation model fares somewhat better, as it does presume that the reader pays attention to verb subcategorization information. However, while recognizing the importance of the verb, it does not appear to have a mechanism for ordering the competing structural analyses.

The model which seems to us to explain the results the most simply is the lexical expectation hypothesis, proposed in various forms by Fodor (1978), Ford et al. (1982), Holmes (1984), and Clifton et al. (1984). The strongest version of this model assumes that the reader uses verb subcategorization information predictively to make immediate structural assignments of lexical items that follow the verb. Recently, Frazer (1987) has argued that an alternative account of selective garden-pathing is possible. She has proposed that minimal at-
tachment is always the preferred analysis and that revision of this analysis is performed much more quickly after clausal-bias verbs than after NP-bias verbs. On this view, lexical preferences act as filters confirming or disconfirming analyses based on minimal attachment. At present, there is no evidence directly distinguishing the lexical filter hypothesis from the lexical guidance hypothesis that we have proposed here.

Whichever theoretical account turns out to be correct, it is clear that lexical expectations play a part at an early stage of the reading process. Our results suggest that a critical factor in determining the processing consequences of lexical expectations is the length of the ambiguous noun phrase. It is interesting that in Experiments 1 and 2 we obtained garden-pathing after NP-bias verbs in sentences containing short ambiguous noun phrases. This result appears to disagree with Frazier and Rayner's (1982) failure to find overall garden-pathing after short noun phrases. However, perhaps if lexical biases had been explicitly varied in that experiment an effect might have been detected.

With the short noun phrases used in Experiments 1 and 2, garden-pathing after clausal-bias verbs was not obtained. In Experiment 3, however, although garden-pathing after clausal-bias verbs was again not obtained for short noun phrases, it did occur after long noun phrases. This means that the present results for long noun phrases are quite compatible empirically with those of Frazier and Rayner (1982) and Rayner and Frazier (1988), as their garden-pathing occurred with long noun phrases. A discrepancy remains, however, between these results and those of Holmes et al. (1987), who found no garden-pathing after clausal-bias verbs in sentences with long noun phrases.

We can only reiterate the remarks made above, that the question-answering procedure used in the earlier experiment, as well as in Experiment 3, differs from conditions where the surface form of the sentence has to be checked for well-formedness or committed to memory. Even with a presentation mode where words are presented centrally on top of each other on the screen, Aaronson and Scarborough (1976) have shown that word reading times reflect superficial structure less strongly under a requirement to answer a question about the sentence than to recall it. In conjunction with question-answering, the cumulative presentation mode used by Holmes et al. (1987), may permit much processing to be delayed to the end of the sentence. In addition, Holmes et al. asked subjects to pace through the words as quickly as possible consistent with understanding the sentence. This instruction, which was not included in the present experiments, may well have further encouraged a less immediate strategy. In these conditions, it may be that the continuation of a noun phrase beyond two or three words does not cause readers to revise a clausal-hypothesis after clausal-bias verbs. A direct comparison of the different procedures would be able to clarify whether readers’ strategies do change as a function of task requirements in the way that we have suggested.

We have argued that the garden-pathing found in sentences containing clausal-bias verbs and long noun phrases results from the reader switching from a clausal to a direct-object hypothesis. What might cause the reader to make this change is not certain. It may be that whenever noun phrases remain unattached to preceding material for too long, they create memory storage problems, causing the reader to question the current structural hypothesis. In this case, the reader would find an acceptable alternative by re-assessing the rankings contained in the verb’s lexical entry. If the switch is triggered by some kind of simple memory overload, then it might not matter what the structure of the ambiguous phrase is. Thus, phrases lengthened by preceding qualifiers, for example, the extremely useful local newspaper should cause hypothesis-switching just as much as the phrases
we used in Experiment 3, which consisted of a noun phrase followed by a qualifying phrase, as in the outcome of the election or the teacher who walked past. On the other hand, perhaps the reader would be more likely to doubt the clausal hypothesis in the latter cases, since a noun phrase which could form a potential attachment had already been completed.

Another possibility is that readers may not expect subjects of clauses to be long, regardless of their structure. English is a predominantly right-branching language, with "heavier" constituents usually occurring at the ends of clauses. One example of this is the tendency for many complements in subject position to be postposed by means of a dummy it construction. For example, a sentence such as (24) is found more commonly than a sentence such as (25); even when (25) is made more natural by beginning it with something like The fact. Supporting this observation, Holmes and Forster (1972) found that sentences with complements in subject position were more difficult to process than sentences with complements in object position. Thus, perhaps it is an expectation that subjects of embedded clauses normally do not last beyond two or three words that decides the reader to reject the clausal hypothesis in the ambiguous sentences used in the present study. It would be quite feasible to try to discriminate empirically between these possible accounts of the hypothesis-switching that we observed.

(24) It is lucky that you remembered your umbrella.
(25) That you remembered your umbrella is lucky.

Our results indicate further that the particular lexical expectations that we investigated were not influenced by semantic/pragmatic factors. In the first two experiments we manipulated how plausibly the noun phrase fitted as a potential object of the complement verb. There was no evidence from these experiments that readers altered their structural assignments as a function of object plausibility. Object plausibility did not influence processing in sentences containing clausal-bias verbs. However, in Experiment 1, object plausibility did affect responses to sentences containing NP-bias verbs. Implausible objects seemed to be harder to assimilate even when the disambiguating complementizer was present. Moreover, although incorrect direct-object assignments were not revised any more quickly after implausible than plausible objects, these erroneous analyses were sometimes so firmly entrenched that disambiguating material was not perceived as a grammatical continuation of the sentence. The finding that plausibility effects were found only with NP-bias verbs is compatible with Tanenhaus et al.'s (1985) result that object plausibility influenced processing of sentences containing transitive-expectation verbs, but not those containing intransitive-expectation verbs.

In contrast to these results, Clifton et al. (1984) found that pragmatic information did affect choices made by readers about whether a verb was taken to be transitive or intransitive. Perhaps a resolution of this conflict may be found in methodological considerations. It is possible to question the sensitivity of their response measure to immediate syntactic decisions. Although their experiment used single-word presentation of the input, the grammaticality judgment that subjects had to make was timed only from the end of presentation of the sentence. These times did not reveal an effect of incongruity of verb bias and actual structure with pragmatic cues were present. However, failure to detect an effect in postsentence judgment times does not necessarily mean that extra computation may not have been involved during the initial processing of the sentence.

Our own study and that of Tanenhaus et al. (1985) find no evidence that semantic/pragmatic information within the sentence itself modifies analyses based on lexical expectations. For this reason, we have sug-
gested that the structural hypotheses tested by the reader derive from fixed syntactic rankings contained in the lexical entry of each verb. However, our research does not provide an explanation for why certain verbs might have a bias to one structure rather than another, nor why the strengths of the biases should vary. Why should some complement verbs seem more naturally followed by entire propositions and others by objects or entities? Since syntactic conventions exist in order to convey meanings, it might be supposed that the biases should be based on semantic characteristics of the verbs. Examination of the verbs we used does not suggest any simple meaning correlate that distinguishes the two types. Several NP-bias verbs were verbs of perception, for example, see, read, hear, whereas several clausal-bias verbs could be said to represent “higher-level” cognitive acts, for example, know, realize, prove. However, many other verbs in each of the groups could not be described in these terms. Clearly, specification of the exact basis for the verb biases would be an important step in understanding how semantic and syntactic information interrelate to determine lexical biases.

While we have shown that lexical expectations are independent of subsequent context, our study has not dealt with the possible effects of prior context. Hence, it could be argued that the structural preferences we have demonstrated do not stem from inherent lexical biases but are essentially pragmatically based. For example, Crain and Steedman (1985) have proposed that what appear to be structural preferences may simply be default options that the reader uses when sentences are isolated from context. In reality, the initial structural hypothesis tested for any given ambiguous segment may depend completely on information provided by prior context. Crain and Steedman’s own evidence, based as it was on changes in percentages of grammaticality judgments, can hardly be said to be definitive. There is even some evidence suggesting that readers do not use information contained in a prior context sentence to select nonpreferred structural analyses for ambiguous sentences (Holmes, 1984). Nevertheless, it is evident that an important question for future research is to examine whether the strategies we have observed do remain constant in the face of different types of prior context. If they do not, then it will be necessary to try to determine exactly how such contextual control over structural choices operates. None of the models of parsing during reading that we have discussed has yet confronted the problem of how readers might take prior context into account when making structural assignments.

Finally, a word should be said in defense of the single-word self-paced reading task. It might be argued that this task is totally unnatural and has nothing to do with “normal” reading. On the other hand, controlling the presentation of single words across a screen may not be so very different from programming one’s eyes to move to each word of a text. Moreover, even in so-called normal reading, people read for different purposes and with different degrees of attention to the words they are scanning. It is true that readers rarely have to give such detailed scrutiny to a text that they have to decide whether it remains grammatical as each word is processed, but they do sometimes have to commit sentences they are reading to memory. Performance under these conditions presumably represents what people do when they have to try construct a superficially accurate representation of a sentence. The third procedure that we used, where readers had to remember enough of the sentence to answer a simple question about it, perhaps resembles most closely a common reading situation. It is notable that, with these less constrained conditions, the basic results of the experiment were the same as those obtained with the other two procedures.
In sum, the results of the present study have shown that readers process sentences very differently depending on the main verb’s preferred subcategorization frame. While previous research has indicated that readers derive lexical expectations about transitivity, we have shown further that more specific expectations can be formed about different kinds of transitive continuation. We have suggested that such lexical expectations operate at an initial stage of processing during reading. However, it remains to be determined whether or not they actually guide initial parsing decisions or merely act as a filter after the application of more general parsing strategies. What is clear is that models of syntactic processing during reading will have to incorporate mechanisms that accommodate such lexical biases in some way if they are to provide adequate explanations of the parsing process.

### APPENDIX 1

**Verbs Used in the Experiments, with Percentage Biases to Direct Object (NP) Continuations and Clausal (That) Continuations Indicated**

<table>
<thead>
<tr>
<th>NP-bias verbs</th>
<th>Clausal-bias verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NP</strong></td>
<td><strong>That</strong></td>
</tr>
<tr>
<td>Urge</td>
<td>92</td>
</tr>
<tr>
<td>Teach</td>
<td>85</td>
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<tr>
<td>Warn</td>
<td>82</td>
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<td>Answer</td>
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<td>Judge</td>
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<td>Show</td>
<td>85</td>
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<td>Repeat</td>
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<td>Understand</td>
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<tr>
<td>Remember</td>
<td>46</td>
</tr>
<tr>
<td>Find</td>
<td>55</td>
</tr>
</tbody>
</table>

### APPENDIX 2

**Sentences Used in Experiments 1 and 2**

The plausible object is indicated first, then the implausible object.

#### NP-bias verbs

1. The reporter saw (that) her friend/method was not succeeding.
2. The secretary read (that) the article/fashion was already out of date.
3. The doctor found (that) the label/fever had disappeared completely.
4. The lawyer heard (that) the story/issue was about to be publicized.
5. The salesman wrote (that) the letter/market would be easy to locate.
6. The counsellor urged (that) the daughter/contrast should be given some attention.
7. The mechanic warned (that) the driver/engine was going to cause trouble.
8. The traveller judged (that) the contest/climate would be rather uninteresting.
9. The professor taught (that) the language/distance should be described carefully.
10. The scientist showed (that) the sample/travel was necessary for her project to succeed.
11. The dentist surprised (that) her visit/mouth was going to take a while.
12. The neighbor answered (that) her request/tragedy was already known to everyone.
13. The mayor recognized (that) the author/pocket was worn out.
14. The politician repeated (that) the comment/journal was not to be published.
15. The tutor understood (that) the concept/session was quite interesting.
16. The tenant remembered (that) the reply/smoke had surprised him.

#### Clausal-bias verbs

17. The lecturer said (that) the phrase/pencil was not particularly useful.
18. The constable knew (that) the teacher/traffic had already been busy.
19. The actress swore (that) the oath/exit was completely unplanned.
APPENDIX 2—Continued

20. The defence argued (that) the point/order was quite detrimental to their case.
21. The technician proved (that) the theorem/battery should be thrown out.
22. The observer forgot (that) the outcome/weekend would be so crucial.
23. The policeman denied (that) the charge/summer was going to be troublesome.
24. The editor claimed (that) the victory/library would be complete.
25. The candidate doubted (that) his sincerity/champagne would be appreciated.
26. The referee decided (that) the match/award was important to the player.
27. The critic learned (that) the truth/trial was being distorted in the press.
28. The inspector realized (that) the mistake/vehicle had already been detected.
29. The worker confessed (that) his faults/brakes had been ignored.
30. The solicitor believed (that) the witness/journey was not really worth bothering about.
31. The actor explained (that) the decision/audience had been disappointing.
32. The tourist discovered (that) the route/opera was extremely complicated.

APPENDIX 3

Test Sentences Used in Experiment 3

Sentences with short noun phrases did not contain the phrase in parentheses, whereas its inclusion produced the sentences with long noun phrases. Each item set is followed by the post-sentence question.

NP-bias verbs

1. The reporter saw (that) the woman (who had arrived) was not very calm.
   Did the journalist think the woman was calm?
2. The traveller judged (that) the contest (for the tourists) had been a flop.
   Was the contest successful according to the traveller?
3. The mayor recognized (that) the author (of the novel) deserved to be treated politely.
   Did the mayor plan to ignore the novelist?
4. The politician repeated (that) the comment (which he made) wasn’t meant to be rude.
   Did the politician explain how impolite the comment was?
5. The secretary found (that) the article (which needed typing) was on her desk.
   Was the secretary already aware of the article’s location?
6. The mechanic warned (that) the driver (of the utility) was likely to be late.
   Did the mechanic expect the driver to be on time?
7. The professor taught (that) the language (of the tribe) reveals what its speakers believe.
   Did the professor tell students that languages encode belief patterns?
8. The tenant remembered (that) the reply (which she received) had been quite unpleasant.
   Did the tenant remember anything about the reply?
9. The doctor read (that) the journal (which he ordered) was now in print.
   Did the doctor become aware of the journal’s availability?
10. The counsellor urged (that) the director (of the clinic) should be fired at once.
    Was it the counsellor’s opinion that the director should be dismissed?
11. The scientist showed (that) the pictures (which he took) supported his theory about neutrons.
    Was the scientist’s theory supported by the new evidence?
12. The tutor understood (that) the student (who was sick) was about to come back.
    Did the tutor expect the student to return?
13. The lawyer heard (that) the story (about the accident) was not really true.
    Was the lawyer informed that the story was correct?
14. The salesman wrote (that) the letter (about the prices) should be easy.
    Did the salesman include the information about where the letter was?
15. The neighbour answered (that) her request (for some help) required some more thought.
    Was the neighbour willing to help immediately?
16. The dentist expected (that) the patient (who had rung) would arrive quite soon.
    Had the patient called to cancel the appointment?
Clausal-bias verbs

17. The lecturer said (that) the phrase (in our textbooks) isn't actually used frequently. Was the phrase a common idiomatic one according to the instructor?

18. The passenger claimed (that) the luggage (which we took) should be given to him. Did the passenger expect us to take the luggage?

19. The student learned (that) the answer (which is taught) isn't the whole truth. Was the student satisfied as to the completeness of the answer?

20. The tourist discovered (that) the route (to the village) was quite hard to follow. Did the tourist consider the route difficult?

21. The principal knew (that) the teacher (who walked past) had already been working. Had the teacher started work earlier?

22. The observer forgot (that) the outcome (of the election) would be crucially important. Had the observer once been aware of the significance of the outcome?

23. The traitor swore (that) the oath (to the king) had been made under duress. Did the traitor claim that he had kept his oath faithfully?

24. The policeman denied (that) the rumor (which we heard) had any basis in reality. Did the policeman confirm the truth of the rumor?

25. The inspector realized (that) the mistake (which he'd made) had quickly been corrected. Did the inspector have evidence that the error had gone uncorrected?

26. The detective doubted (that) his story (about the murder) would be generally accepted. Did the detective consider the story incredible?

27. The actor explained (that) the decision (which annoyed them) was meant for the best. Did the decision seem wrong to the actor?

28. The worker confessed (that) his mistake (with the plans) had caused several delays. Was the worker unaware of the cause of the delay?

29. The barrister argued (that) the point (which he raised) was not really convincing. Did the lawyer try to convince others to ignore the point?

30. The instructor proved (that) the theory (of natural selection) isn't an adequate explanation. Didn't the theory prove to be adequate?

31. The referee decided (that) the outcome (of the match) should be published soon. Was it alright with the referee to publish the outcome?

32. The solicitor believed (that) the witness (who was lying) would not convince the jurors. Was it the lawyer's opinion that the witness would be disbelieved?

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