Against Modularity

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The fundamental claim of the modularity hypothesis (Fodor 1983) is that
the process of language—mapping from the speech signal onto a message-
level interpretation—is not a single, unitary process but involves at least
two different kinds of process¹: A modular, highly constrained, automa-
tized “input system” operates blindly on its bottom-up input to deliver, as
rapidly as neurally possible, a shallow linguistic representation to a second
kind of process, labeled by Fodor a “central process.” This relates the
output of the modular input system to the listener’s knowledge of the
world, of the discourse content, and so on. In particular, these central
processes are responsible for the fixation of perceptual belief.

To justify this dichotomy between kinds of mental process, Fodor
marshals a list of properties that input systems have and that central
processes do not have. These include domain specificity, mandatoriness,
speed, informational encapsulation, and a number of less critical properties.
We do not dispute that there are some “central processes” that do not
share these properties. Our argument here, nonetheless, is that those pro-
cesses that map onto discourse representations and that also participate in
the fixation of perceptual belief in fact share many of the special properties
that Fodor treats as diagnostic of modular input systems.

We will argue on this basis that the modularity hypothesis gives the
wrong kind of account of the organization of the language-processing
system. This system does have fixed properties, and it does seem to be
domain specific, mandatory, and fast in its operations. It is also, in a
restricted sense, informationally encapsulated, because top-down influences
do not control its normal first-pass operations. But its boundaries do not
neatly coincide, as Fodor and others would have us believe, with the
boundaries conventionally drawn between the subject matter of linguistic
theory (construed as formal syntax) and the subject matter of disciplines
such as pragmatics and discourse analysis.

In other words, we will argue, Fodor has misidentified the basic phe-
nomenon that needs to be explained. Our comprehension of language, as
he repeatedly stresses, is of the same order of immediacy as our perception,
say, of the visual world. The modularity hypothesis tries to explain this by
arguing that the primary processes of language analysis must operate with the blindness and the immunity to conscious control of the traditional reflex. Only in this way can we buy the brute speed with which the system seems to work.

But what is compelling about our real-time comprehension of language is not so much the immediacy with which linguistic form becomes available as the immediacy with which interpreted meaning becomes available. It is this that is the target of the core processes of language comprehension, of the processes that map from sound onto meaning.

In the next section we will discuss the diagnostic properties assigned to input systems. We will then go on to present some experimental evidence for the encroachment of "modular" properties into processing territories reserved for central processes. This will be followed by a discussion of the implications of this failure of the diagnostic features to isolate a discontinuity in the system at the point where Fodor and others want to place it.

We do not claim that there are no differences between input systems and central processes; but, the differences that do exist are not distributed in the way that the modularity hypothesis requires.

Diagnostic Features

Table 1 lists the principal diagnostic features that, according to Fodor, discriminate input systems from central processes.\(^2\) We will go through these six features in order, showing how each one fails to support a qualitative discontinuity at the fracture point indicated by Fodor and by most other modularity theorists, e.g., Forster (1979 and this volume), Garrett (1978), and Frazier et al. (1983b). In each case the question is the same: Does the feature distinguish between a mapping process that terminates on a specifically linguistic, sentence-internal form of representation (labeled "logical form" in the table) and a process that terminates on some form of discourse representation or mental model?

<table>
<thead>
<tr>
<th>Diagnostic feature</th>
<th>Target of mapping process</th>
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<tbody>
<tr>
<td></td>
<td>Logical form</td>
</tr>
<tr>
<td>Domain specificity</td>
<td>Yes</td>
</tr>
<tr>
<td>Mandatory</td>
<td>Yes</td>
</tr>
<tr>
<td>Limited access to intermediate representations</td>
<td>Yes</td>
</tr>
<tr>
<td>Speed</td>
<td>Yes</td>
</tr>
<tr>
<td>Informational encapsulation</td>
<td>No</td>
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<tr>
<td>Shallow output</td>
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Domain Specificity
The argument here is that when one is dealing with a specialized domain—that is, a domain that has its own idiosyncratic computations to perform—one would expect to find a specialized processor. However, as Fodor himself points out (1983, p. 52), the inference from domain idiosyncracy to modular processor is not by itself a strong one. Furthermore, he presents neither evidence nor arguments that the process of mapping linguistic representations onto discourse models is any less domain specific (i.e., less idiosyncratic or specialized) than the processes required to map onto "shallow" linguistic representations.

Mandatory Processing
Mandatory processing is what we have called obligatory processing (Marslen-Wilson and Tyler 1980a, 1981), and what others have called automatic (as opposed to controlled) processing (e.g., Posner and Snyder 1975; Shiffrin and Schneider 1977). The claim here is that modular processes apply mandatorily and that central processes do not. Fodor's arguments for this are entirely phenomenological. If we hear an utterance in a language we know, we are are forced to perceive it as a meaningful, interpretable string, and not as a sequence of meaningless noises.

But there is no reason to suppose that this mandatory projection onto higher-level representations stops short at logical form. Indeed, one's phenomenological experience says quite distinctly otherwise. Consider the following pair of utterances, uttered in normal conversation after a lecture: "Jerry gave the first talk today. He was his usual ebullient self." Hearing this, it seems just as cognitively mandatory to map the pronoun He at the beginning of the second sentence onto the discourse representation of Jerry, set up in the course of the first sentence as it does, for example, to hear All Gaul is divided into three parts as a sentence and not as an acoustic object (see Fodor 1983, p. 55).*

In other words, in what we call normal first-pass processing the projection onto an interpretation in the discourse model can be just as mandatory as the projection onto "shallower" levels of linguistic analysis. And if there is a distinction here between mapping onto logical form and mapping onto a discourse model, it probably isn't going to be picked up by this kind of introspective analysis.

Limited Central Access to Intermediate Representations
The underlying assumption here is that the perceptual process proceeds through the assignment of a number of intermediate levels of representation, culminating in the final output of the system. Fodor claims that these "interlevels" are relatively less accessible to central processes than the output representation. There are two points we can make here.
First, there is nothing in Fodor’s discussion of this (1983, pp. 55–60) that specifically implicates a shallow linguistic level as the level of representation that is more accessible to central processes. Second, if one is dealing with a series of automatized processes, tracking obligatorily through the processing sequence, then one is surely going to get a form of overwriting of the perceptual representations at each level intermediate to the final one. This will make the interlevels less accessible to the perceiver, but without the need to assign a special status to this final level—other than that, because it is the final level, it will not be overwritten by subsequent levels.

At this point one is returned to the phenomenological issues raised in the preceding section: What is the level of perceptual representation onto which the process obligatorily maps, and is this the form of representation that is most readily accessible to other processes?

**Speed**

The speed of language processing is central to Fodor’s argument. The projection from signal onto message seems to be carried out as rapidly as is either neurally or informationally possible. Close shadowers, as he points out, with repetition delays of around 250 msec, seem to be operating at the limit of the ability of the speech signal to deliver information. In fact (as we argue in Marslen-Wilson 1985), close shadowers are outrunning even the abilities of their processing system to deliver its products to conscious awareness; they start to initiate their repetition of what they hear before they are fully aware of what they are saying.

But why does this speed matter? How does it help to diagnose an input system with its boundaries somewhere in the region of logical form?

Fodor’s argument is simply that speech processing can only be this fast if it is domain specific, mandatory, and informationally encapsulated—if, in other words, it is like a reflex. And for a process to be reflexive it cannot also be reflective—or, as Fodor puts it, “sicklied o’er with the pale cast of thought” (p. 64). This means, in particular, that this primary rapid analysis process must be restricted to properties of utterances that can largely be computed from the bottom up and without reference to background knowledge, problem-solving mechanisms, and the like. These properties, Fodor believes, are the grammatical and logical structure of an utterance: the abstract representation of utterance form.

Fodor’s argument fails on two counts: because the available evidence shows that mapping onto a discourse model can be at least as fast as any putative mapping onto logical form, and because discourse mapping is not necessarily slowed down even when it does involve pragmatic inference (which is just the kind of open-ended process that Fodor argues must be excluded from rapid first-pass processing).
Informational Encapsulation

Informational encapsulation is the claim that input systems are informationally isolated from central processes, in the sense that information derived from these central processes cannot directly affect processing within the input system. This claim lies at the empirical core of Fodor's thesis.

Informational encapsulation is not a diagnostic feature that functions in the same way as the previous four we have discussed. Although it is a property that modular language processes are assumed to have and that central processes do not, it is definable as such only in terms of the relationship between the two of them. To defeat Fodor's argument, we do not need to show whether or not central and modular processes share the property of encapsulation, but simply that they are not isolated from each other in the ways the modularity hypothesis requires. Exactly what degree of isolation does the hypothesis require?

The notion of informational encapsulation, as deployed by Fodor, is significantly weaker than the general notion of autonomous processing, argued for by Forster (1979) and others. This general notion states that the output of each processing component in the system is determined solely by its bottom-up input. Fodor, however, makes no claims for autonomous processing within the language module. Top-down communication between levels of linguistically specified representation does not violate the principle of informational encapsulation (Fodor 1983, pp. 76–77). The language module as a whole, however, is autonomous in the standard sense. No information that is not linguistically specified—at the linguistic levels up to and including logical form—can affect operations within the module. Fodor believes that the cost of fast, mandatory operation in the linguistic input system is isolation from everything else the perceiver knows.

As stated, this claim cannot be completely true. When listeners encounter syntactically ambiguous strings, where only pragmatic knowledge can resolve the ambiguity, they nonetheless seem to end up with the structural analysis that best fits the context. To cope with this, Fodor does allow a limited form of interaction at the syntactic interface between the language module and central processes. The central processes can give the syntactic parser feedback about the semantic and pragmatic acceptability of the structures it has computed (Fodor 1983, pp. 134–135). Thus, in cases of structural ambiguity, extramodular information does affect the outcome of linguistic analysis.

How is this limited form of interaction to be distinguished, empirically, from a fully interactive, unencapsulated system? Fodor's position is based on the exclusion of top-down predictive interaction: "What the context analyzer is prohibited from doing is telling the parser which line of analysis it ought to try next—i.e., semantic information can't be used predictively to
guide the parse" (Fodor 1983, p. 135; emphases in original). What this means, in practice, is that context will not be able to guide the normal first-pass processing of the material; it will come into play only when the first-pass output of the syntactic parser becomes available for semantic and pragmatic interpretation. This, in turn, means that the claim for informational encapsulation depends empirically on the precise timing of the contextual resolution of syntactic ambiguities—not whether context can have such effects, but when. Is there an exhaustive computation of all readings compatible with the bottom-up input, among which context later selects, or does context intervene early in the process, so that only a single reading needs to be computed? Fodor presents no evidence that bears directly on this issue. But let us consider the arguments he does present, bearing in mind that he does not regard these arguments as proving his case, but simply as making it more plausible.

The first type of argument is frankly rhetorical. It is based on an analogy between input systems and reflexes. If (as Fodor suggests on pages 71–72) input systems are computationally specified reflexes, then, like reflexes, they will be fully encapsulated. The language module will spit out its representation of logical form as blindly and as impenetrably as your knee will respond to the neurologist's rubber hammer. But this is not in itself evidence that the language input system actually is informationally encapsulated. It simply illustrates what input systems might be like if they really were a kind of cognitive reflex. By the same token, the apparent cognitive impenetrability of certain phenomena in visual perception is also no evidence per se for the impenetrability of the language module (Fodor, pp. 66–67).

Fodor's second line of argument is teleological in nature: If an organism knows what is good for it, then it will undoubtedly want to have its input systems encapsulated. The organism needs to see or hear what is actually there rather than what it expects should be there, and it needs its first-pass perceptual assignments to be made available as rapidly as possible. And the only way to guarantee this kind of fast, unprejudiced access to the state of the world is to encapsulate one's input systems.

It is certainly true that organisms would do well to ensure themselves fast, unprejudiced input. But this is not evidence that encapsulation is the optimal mechanism for achieving this, nor, specifically, is it evidence that the language input system has these properties—or even that it is subject to this kind of stringent teleological constraint.

The third line of argument is more germane to the issues at hand, since it deals directly with the conventional psycholinguistic evidence for interaction and autonomy in the language-processing system. But even here, Fodor has no evidence that the relationship between syntactic parsing and
central processes is restricted in the ways his analysis requires. What he
does instead is show that many of the results that are usually cited as
evidence for interaction need not be interpreted in this way—although, as
noted above, it is only by significantly diluting the concept of autonomy
that he can defend the modularity hypothesis against its major counter-
examples.

In any case, despite Fodor's caveats, the evidence we will report below
suggests that context does guide the parser on-line, and not solely in the
"after-the-event" manner Fodor predicts. Hence the entry in table 1. Informa-
tional encapsulation does not separate the processes that map onto
logical form from those that map onto discourse models.

**Shallow Output**

Fodor claims that the output of the language input system is restricted to
whatever can be computed without reference to "background data." This,
however, is not a diagnostic feature at all—it is the basic point at issue.

It is our position that the diagnostics discussed by Fodor, and briefly
analyzed here, do not select out an output level corresponding to logical
form. Rather, they select an output level that is at least partially non-
linguistic in nature. Although the output of the class of mandatory, fast
processes may be relatively "shallow," it does not fall at a level of the
system that distinguishes either modular processes from central processes
(as defined by Fodor) or the linguistic from the nonlinguistic.

**Experimental Evidence**

In this section we will review some of the evidence supporting our po-
sition. In particular, we will argue for three main claims, each of which is in
conflict with one or more of the major assumptions upon which Fodor has
based the modularity hypothesis. These claims are the following:

(i) that the mapping of the incoming utterance onto a discourse model is
indistinguishable in its rapidity from the mapping onto "logical form" (or
equivalently shallow levels)

(ii) that the discourse mapping process is not significantly slowed down
even when the correct mapping onto discourse antecedents requires prag-
matic inference (showing that speed per se does not distinguish processes
involving only bottom-up linguistic computation from processes involv-
ing, at least potentially, "everything the perceiver knows")

(iii) that, if we do assume a representational difference in on-line processing
between a level of logical form and a post-linguistic level situated in a
discourse model, then there is clear evidence for top-down influences on
syntactic choice during first-pass processing and not only after the event.
The evidence for these claims derives from a variety of different experiments. We will proceed here by describing each class of experiment separately, showing in each case how it bears on the three claims.

Word-Monitoring Experiments
This research provides evidence for the speed of discourse mapping and for the rapid on-line computation of pragmatic inferences. The first of these experiments (Marslen-Wilson and Tyler 1975, 1980a) was designed to track the availability of different types of processing information as these became available during the processing of an utterance.

The experiment used three types of prose materials (see table 2). The Normal Prose strings were normal sentences that could be analyzed both semantically and syntactically. The second prose type, Anomalous Prose, was syntactically still relatively normal but had no coherent semantic interpretation. The third condition, Scrambled Prose, could not be analyzed syntactically or semantically. Sentences of each of these three types were presented either in isolation or preceded by a lead-in sentence. This allowed us to observe the effects of the presence or absence of a discourse context. Each test sentence also contained a monitoring target word, such as lead in the sample set given in table 2. These target words occurred in different serial positions across the test sentences, varying from the second to the tenth position. By measuring the monitoring response time at different points across each type of test material, we could determine the time course with which syntactic and semantic processing information became available, and how this was affected by whether or not a discourse context was available.

We will concentrate here on the relationship between Normal Prose and the other two prose conditions at the early target positions as a function of the presence or absence of a discourse context. The upper panel of figure 1 gives the response curves for the discourse condition, where the lead-in

Table 2
Sample word-monitoring materials.

<table>
<thead>
<tr>
<th>Normal prose</th>
<th>Anomalous prose</th>
<th>Scrambled prose</th>
</tr>
</thead>
<tbody>
<tr>
<td>The church was broken into last night.</td>
<td>The power was located in great water.</td>
<td>In was power water the great located.</td>
</tr>
<tr>
<td>Some thieves stole most of the lead off the roof.</td>
<td>No buns puzzle some in the lead off the text.</td>
<td>Some the no puzzle buns in lead text the off.</td>
</tr>
</tbody>
</table>
Figure 1
Mean reaction times (in milliseconds) for word monitoring in three prose contexts, presented either with a preceding context sentence (a) or without one (b) and plotted across word positions 1–9. The unbroken lines represent responses in normal prose, the broken lines responses in anomalous prose, and the dotted lines responses in scrambled prose.
sentence is present. Here, targets in Normal Prose are responded to faster than those in Anomalous or Scrambled Prose even at the earliest word positions. The average difference in intercept between Normal Prose and the other conditions (for Identical and Rhyme monitoring) is 53 msec. This means that the extra processing information that Normal Prose provides is being developed by the listener right from the beginning of the utterance.

The critical point, illustrated by the lower panel of figure 1, is that this early advantage of Normal Prose depends on the presence of the lead-in sentence. When no lead-in sentence is present, the extra facilitation of monitoring responses in Normal Prose contexts develops later in the utterance, and the mean intercept difference between Normal Prose and the other two conditions falls to a nonsignificant 12 msec.

We can take for granted that the on-line interpretability of the early words of the test sentence depends on their syntactic well-formedness, so that the early advantage of Normal Prose reflects in part the speed and earliness with which a syntactic analysis of the incoming material is being computed. But the effects of removing the lead-in sentence show that the mapping onto a discourse model must be taking place at least as early and at least as rapidly as any putative mapping onto logical form. There is nothing in the data to suggest the sort of temporal lag in the accessibility of these two kinds of perceptual target that would support the modularity hypothesis.

It is possible to devise modular systems in which predictions about the differential speed of different types of process do not play a role, so that the absence of a difference here is not fatal. But what it does mean is that speed of processing cannot be used as a diagnostic criterion for distinguishing processes that map onto purely linguistic levels of representation from those that map onto mental models. This, in turn, undermines Fodor’s basic assumption that speed requires modular processing. If you can map onto a discourse level as rapidly as you can map onto a shallow linguistic level, then modularity and encapsulation cannot be the prerequisites for very fast processing.

A second word-monitoring experiment (Brown, Marslen-Wilson, and Tyler, in preparation) again illustrates the speed of processing and, in particular, the rapidity with which pragmatic inferences can be made during on-line processing. Instead of the global disruption of prose context in the previous experiment, this experiment used only Normal Prose sentence pairs containing local anomalies of different types. A typical stimulus set, illustrated in table 3, shows a neutral lead-in sentence followed by four different continuation sentences. The same target word (guitar) occurs in all four sentences. Variation of the preceding verb creates four different context conditions.

In condition A there are no anomalies; the sentence is normal. In con-
Table 3
Sample materials for local-anomaly experiment.

<table>
<thead>
<tr>
<th>Condition A</th>
<th>The crowd was waiting eagerly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The young man carried the <em>guifar</em> ....</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Condition B</th>
<th>The crowd was waiting eagerly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The young man buried the <em>guifar</em> ....</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Condition C</th>
<th>The crowd was waiting eagerly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The young man drank the <em>guitar</em> ....</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Condition D</th>
<th>The crowd was waiting eagerly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The young man slept the <em>guifar</em> ....</td>
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dition B there is no syntactic or semantic violation, but the combination of critical verb and target is pragmatically anomalous—whatever one does with guitars, one does not normally bury them. Conditions C and D involve stronger violations—in C of semantic-selection restrictions, and in D of subcategorization constraints. Presented to subjects in a standard monitoring task, these materials produce a steady increase in mean response time across conditions, from 241 msec for targets in the normal sentences to 320 msec for the subcategorization violations.

We are concerned here with the significant effects of pragmatic anomaly (mean: 267 msec) and what these imply for the speed with which representations of different sorts can be computed. The point about condition B is that the relative slowness to respond to *guifar* in the context of burying, as opposed to the context of carrying in condition A, cannot be attributed to any *linguistic* differences between the two conditions. It must instead be attributed to the listeners' inferences about likely actions involving guitars. The implausibility of burying guitars as opposed to carrying them is something that needs to be deduced from other things that the listener knows about guitars, burying, carrying, and so on. And yet, despite the potential unboundedness of the inferences that might have to be drawn here, the listener can apparently compute sufficient consequences, in the interval between recognizing the verb and responding to the target, for these inferences to significantly affect response time.7

The possibility of very rapid pragmatic inferencing during language processing is also supported by the on-line performance of certain aphasic patients. In one case of classic agrammatism (Tyler 1985, 1986) we found a selective deficit in syntactic processing such that the patient could not construct global structural units. When this patient was tested on the set of contrasts described above, we found a much greater dependency on prag-
matic information, as reflected in his greatly increased latencies to the pragmatic anomaly condition relative to normal subjects and relative to his own performance in the other conditions (see figure 2). Again, the pragmatically plausible relationship between verb and potential object was being computed very rapidly as the utterance was being heard.

Resolution of Syntactic Ambiguity
The research described in this section bears on all three of the claims at issue, but it speaks most directly to the on-line contextual guidance of syntactic parsing. It does so by looking at the processing of phrasal fragments (such as landing planes) when they are placed in different kinds of discourse contexts.

Ambiguous fragments of this type have two different readings, which we will refer to here, following Townsend and Bever (1982), as the adjectival and the gerund reading. The question at issue is whether prior non-linguistic context can resolve such ambiguities, and the timing with which this contextual disambiguation might occur. The crucial claim for the modularity hypothesis is that context cannot act predictively, so that the first-pass analysis of such structures will be conducted on the basis of purely linguistic considerations.
In our first examination of this question (Tyler and Marslen-Wilson 1977) we placed the ambiguous fragments in disambiguating contexts of the following types.

*Adjectival bias:* If you walk too near the runway, landing planes...

*Gerund bias:* If you've been trained as a pilot, landing planes...

The subjects heard one of the two context clauses, followed by the ambiguous fragment. Immediately after the acoustic offset of the fragments (e.g., at the end of the /s/ of planes), a visual probe was flashed up, which was either an appropriate or an inappropriate continuation of the fragment. The probe was always either the word *is* or the word *are*, and its appropriateness depended on the preceding context. For the cases above, *is* is an appropriate continuation of *landing planes* when this has the gerund reading, but not when it has the adjectival reading. The opposite holds for the probe *are*.

The results of the experiment seemed clear-cut. There was a significantly faster naming latency to appropriate probes. These on-line preferences, we argued at the time, could be explained only if we assumed that the listener was rapidly evaluating the structural readings of the ambiguous fragments relative to the meanings of the words involved and relative to the pragmatic plausibility of each reading in the given context. Furthermore, since the inappropriateness effects were just as strong for these ambiguous fragments as they were for a comparison group of unambiguous fragments (e.g., smiling faces), we argued in favor of a single computation. Instead of arguing that both analyses were being computed and that one was later selected, we argued that context affected the parsing process directly, so that only one reading was ever computed.

This first experiment was criticized, primarily on methodological grounds, by Townsend and Bever (1982) and by Cowart (1983), who pointed out that the stimuli contained a number of potential confounds, of which the most serious was the distribution of singular and plural cataphoric pronouns in the context sentences. Examination of the stimulus materials shows that the adjectival contexts tended to contain such pronouns as *they* and *them*, whereas the gerund contexts contained pronouns such as *it*. For example, for the ambiguous phrase *cooking apples*, the adjectival context was *Although they may be very tart . . .*; the gerund context was *Although it doesn't require much work . . .*

Given that these sentences appear in isolation, such pronouns tend to be treated as cataphoric—that is, as co-referential with an entity that has not yet been mentioned. They may create, therefore, the expectation that either singular or plural potential referents will be occurring later in the text. This is a type of contextual bias that could potentially be handled within the syntactic parser, without reference to pragmatic variables.
Although this pronoun effect can just as easily be attributed to an interaction with discourse context, it is nonetheless important to show whether or not a discourse bias can still be observed when the pronoun effect is neutralized.

To this end, a further experiment was carried out (W. Marslen-Wilson and A. Young, manuscript in preparation) with pairs of context sentences having exactly parallel structures, containing identical pronouns, and differing only in their pragmatic implications—for example, the following.

Adjectival bias: If you want a cheap holiday, visiting relatives ....

Gerund bias: If you have a spare bedroom, visiting relatives ....

The results, summarized in figure 3, show that there was still a significant effect of contextual appropriateness on response times to the is and are probes. Responses were slower for is when it followed an ambiguous phrase heard in an adjectival context, and slower for are when the same phrase followed a gerund context. Even when all forms of potential syntactic or lexical bias were removed from the context clauses, we still saw an immediate effect on the structure assigned to these ambiguous fragments.

These results confirm that nonlinguistic context affects the assignment of a syntactic analysis, and they tell us that it does so very early. The probe word comes immediately after the end of the fragment, at the point where the ambiguity of the fragment first becomes fully established—note that the ambiguity of these sequences depends on knowing both words in the

![Figure 3](image_url)

Mean naming latencies for appropriate and inappropriate is and are targets.
fragment; sequences like *landing lights* are not ambiguous in the same way. This means that we are finding significant context effects at what is effectively the earliest point at which we can measure.

What does this mean for the modularity hypothesis and its claims for informational encapsulation? The results do not force a single-computation account. No matter how early context effects are detected, it is always possible to argue that multiple readings were nonetheless computed, so that what we are picking up are after-the-event selection effects rather than direct control of the initial syntactic parse. But the cost of this move is that it makes it very difficult to discriminate the modular version of interaction from an account that allows continuous or even predictive interactions between levels. The modular account simply fails to make empirically distinct predictions. And if this is the case, then the claim for informational encapsulation cannot help us to distinguish modular from central processes.

**Pragmatic Inference in Anaphor Resolution**

A third class of experiments, using the same naming task, looked at the processing relationship between an utterance and its discourse context. They were specifically designed to test the claim that even when the linkage between an utterance and its discourse context can only be based on pragmatic inference, this will not slow down the on-line mapping process.

In the first of these experiments (Marslen-Wilson and Tyler 1980b; Tyler and Marslen-Wilson 1982), two context sentences were followed by one of three continuation fragments (see table 4). Each of these fragments contained an anaphoric device linking the fragments to the preceding discourse. In fragment 1 the device was the name of some individual previously mentioned; in fragment 2 it was an unambiguous personal pronoun; in fragment 3 (an example of zero anaphora) there were no explicit lexical cues at all.

In each case, to interpret the fragment, it is necessary to determine who is the agent of the action denoted by the verb, and to evaluate this with

<table>
<thead>
<tr>
<th>Table 4</th>
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<tbody>
<tr>
<td><strong>Sample materials for anaphora experiment.</strong></td>
</tr>
<tr>
<td><strong>Context sentences</strong></td>
</tr>
<tr>
<td>As Philip was walking back from the shop he saw an old woman trip and fall flat on her face in the street. She seemed unable to get up again.</td>
</tr>
<tr>
<td><strong>Continuation fragments</strong></td>
</tr>
<tr>
<td>(1) Philip ran towards...</td>
</tr>
<tr>
<td>(2) He ran towards...</td>
</tr>
<tr>
<td>(3) Running towards...</td>
</tr>
</tbody>
</table>
respect to the preceding discourse. In fragments 1 and 2 the agent is directly lexically specified (Philip; He), and can be unambiguously related to possible antecedents on the basis of this lexical information alone. It is case 3 that concerns us here. The only way in which agency can be assigned is on the basis of differential pragmatic inference that matches the properties of Running towards ... to the properties of the potential antecedents in the discourse. It is necessary to infer who is most likely running towards whom.

To measure the timing of anaphoric linkage in these three conditions, we used the naming technique described in the preceding section. The subjects heard the context sentences together with one of the three continuation fragments. At the acoustic offset of the fragment (e.g., at the end of towards), a visual probe word was presented to them, which they had to name as quickly as possible. For the examples given in table 4, the probe word would have been either him or her. For each case, her is a more appropriate continuation than him. The critical experimental question was whether the size of the expected preference effect (slower naming of inappropriate probes) would be the same for all three continuations.

This bears upon the claims of the modularity hypothesis in two ways. First, it measures the speed and the on-line effectiveness of discourse linkages based on pragmatic inference, in direct comparison with linkages that can be based on less computationally costly search and matching processes. Second, it asks whether top-down context can act upon the syntactic parser in ways that are prohibited by the modularity hypothesis. If the appropriateness effect is as strong in the zero case as in the other two, then, on our analysis, the missing subject of the verb will have been filled in, on-line, on the basis of a process of differential pragmatic inference. This will mean that contextual considerations can determine the assignment of predicate-argument relations in logical form. But the modularity hypothesis specifically excludes central processes from having this kind of influence on syntactic representations. Context can give the parser Yes/No feedback, but it can never directly tell the parser what the content of its analyses should be.

The results, summarized in table 5, show that there is a marked appropri-

Table 5
Results of anaphora experiment.

<table>
<thead>
<tr>
<th>Type of anaphor</th>
<th>Mean naming latencies (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
</tr>
<tr>
<td>Repeated name</td>
<td>379</td>
</tr>
<tr>
<td>Pronoun</td>
<td>385</td>
</tr>
<tr>
<td>Zero anaphor</td>
<td>384</td>
</tr>
</tbody>
</table>
ateness effect in each condition, and that the size of the effect does not vary significantly. This confirms that utterances are immediately integrated with their discourse contexts, since the inappropriateness of him or her, in all three conditions, depends on the relationship between the discourse properties of the antecedent and the properties assigned to that antecedent in the continuation sentence. It also shows that when the linkage can depend only on pragmatic inference, as in the Zero Anaphor case, this does not significantly impair or slow down the on-line integration process.

The speed of these integration processes is underlined by the outcome of another manipulation in the experiment. This was a variation in the length of the verb phrase in the continuation fragment, so that, in the zero case, the probe could appear anywhere from the second to the fifth word of the fragment. These variations had no effect on the size of the inappropriateness effect for the Zero Anaphor conditions. The difference between appropriate and inappropriate probes averaged 36 msec for the shortest verb phrases and 33 msec for the longest verb phrases.

As we noted above, the effects for the zero condition suggest a form of top-down effect on syntactic representations that is incompatible with the claim for informational encapsulation. The inappropriateness effect depends on the inferrr of agency; to the extent that this leads to the top-down filling of the empty subject slot in the argument structure of the verb, then context is specifying the actual content of a representation within the linguistic input system.

The results of this first study were elaborated and confirmed in a subsequent experiment using similar materials and techniques. The first goal of this second experiment (Marslen-Wilson, Tyler, and Koster, in preparation) was to ensure that the effects we have attributed here to differential pragmatic inference had not been confounded with the effects of discourse focus. In a narrative discourse, a particular individual may become salient—or "in focus"—and this can lead listeners to expect that this individual will continue to be mentioned, especially as subject, in subsequent utterances (see Karmiloff-Smith 1980, 1985; Marslen-Wilson and Tyler 1980b; Marslen-Wilson, Levy, and Tyler 1982). This possibility was not fully controlled for in the first experiment.

To deal with this problem, and to look more specifically at how different sources of constraint were integrated to determine the mapping of an utterance onto its discourse context, the second experiment co-varied in a semi-factorial manner three different factors: discourse focus, the pragmatic implications of the verb, and the lexical specificity of anaphors. The subset of these contrasts that concern us here are given in table 6, which lists some sample context stories and (in capitals) their associated continuation fragments and visual probes.

For all three main conditions, a strong discourse bias was set up. Each
known in the discourse about the two protagonists. This was co-located
is the occurrence of the actions denoted by the verb with what was already
The light manipulation was the pragmatic implications of the verb—that
(two protagonists).
Two selected the individual who was not in discourse focus (the second of the
sentence was selected in the preceding context). For the B, two conditions were imposed: the
pronoun was always co-located with the lexically empty zero anaphor case. The two pronouns co-located with
the biregional anaphors (for these examples, the pronouns He and She) and the
variation in the lexical specificity of the anaphor in subject position in the
The second manipulation was applying to all three conditions. was the
condition of discourse focus.

Subject position. This was the manipulation of discourse focus.
subject position. This was the manipulation of discourse focus. The
following sentence to have the main actor continuing in
expected the following sentence to have the main actor continuing in
subsequent sentences. Presents of these materials showed that listeners
first sentence and continued to function as the main actor for at least two
and the other not. The principal actor appeared in subject position in the
context story always contained two protagonists, with one foregrounded
with the other two factors. Thus, in condition 1, the verb bias fitted the discourse bias. These two together were also congruent with the pronoun for continuation 1A, but not for 1B. In condition 1C, verb bias and discourse bias worked together. In condition 2, the pragmatics of the verb were neutral and were designed to be equally compatible with both potential antecedents. This allowed us to measure, in continuation 2C, the effects of discourse bias when no other cues were available.

Finally, in condition 3, the verb bias was in conflict with discourse bias. The crucial test was in 3C, the Zero Anaphor condition. If verb semantics can be interpreted on-line to select the pragmatically appropriate antecedent, then we should detect this effect even here, where discourse focus favored a different antecedent in subject position.

To test for the effects of these variations, we again used the naming task. Subjects heard the context story together with one of the continuation fragments, and were asked to name as rapidly as possible a visual probe that appeared at the acoustic offset of the fragment. The relative speed of their responses to the probes—which were always unambiguously coreferential with one of the two protagonists in the preceding context story—were taken to reflect the way in which the listeners had linked the continuation fragment to the discourse context.

The probes were not labeled “appropriate” or “inappropriate” in advance, since for many conditions the appropriateness of a given probe was itself the question at issue. Instead, we adopted the convention of referring to probe 1 and probe 2. Probe 1 was always the probe that was consistent with the discourse bias and with the subject pronoun in continuation A—in table 6, for example, probe 1 is her for conditions 1A and 2A, and him for 3A. The term consistent means here that a given pronoun probe in object position is consistent with a given assignment of an agent to subject position. A probe will be consistent with a source of constraint, such as discourse bias, if this favors the instantiation in subject position of a suitable agent.

The results of this experiment, listed in table 7, bear upon the modularity hypothesis in two ways. First, there is the confirmation that pragmatic inference, operating alone, can link utterances to discourses as effectively as pronouns and names. In condition 3C, where the pragmatic implications of the verb actually go against discourse bias—therefore ruling out any possibility of a confounding with discourse effects—there is an appropriateness effect of 48 msec.

Consider the example in table 6, where the discourse in condition 3 sets up the character Mary in discourse focus. In our pretests of this context, listeners produced continuation sentences that kept Mary in focus as subject and main actor. In the experimental materials, however, the verb in the
Table 7
Results of factorial anaphora experiment.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean naming latency (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probe 1</td>
</tr>
<tr>
<td>Discourse bias and congruent verb</td>
<td></td>
</tr>
<tr>
<td>1A: Congruent pronoun</td>
<td>481</td>
</tr>
<tr>
<td>1B: Incongruent pronoun</td>
<td>532</td>
</tr>
<tr>
<td>1C: Zero anaphor</td>
<td>500</td>
</tr>
<tr>
<td>Discourse bias and neutral verb</td>
<td></td>
</tr>
<tr>
<td>2A: Congruent pronoun</td>
<td>472</td>
</tr>
<tr>
<td>2B: Incongruent pronoun</td>
<td>527</td>
</tr>
<tr>
<td>2C: Zero anaphor</td>
<td>496</td>
</tr>
<tr>
<td>Discourse bias and incongruent verb</td>
<td></td>
</tr>
<tr>
<td>3A: Congruent pronoun</td>
<td>511</td>
</tr>
<tr>
<td>3B: Incongruent pronoun</td>
<td>549</td>
</tr>
<tr>
<td>3C: Zero anaphor</td>
<td>530</td>
</tr>
</tbody>
</table>

continuation fragment (Overtaking) is inconsistent with the listener's mental model of the relationship between Mary and her competitor Andrew. Mary, slipping and stumbling, is in no position to be overtaking someone, and it is this that determines who the listener instantiates as agent of the action. It is probe 2 (her) that is treated as appropriate, and not the probe that is consistent with the discourse bias. The size of the effect compares favorably with cases like 1A and 2A, where a congruent pronoun is present as well.

Equally significant, the results show that discourse focus on its own can also control the on-line interpretation of utterance fragments. Discourse bias is the weakest of the three variables, and its effects are usually obscured by the other two sources of constraint. But when these other sources are neutralized (as in condition 2C, where there is no pronoun and the verb is pragmatically neutral) there is a clear discourse-based appropriateness effect, which is just as strong as the effects produced by pronouns or verbs in other conditions. Once again agency is being assigned under conditions where the parser could have no basis for doing so on purely linguistic grounds. It is only in the representation of the discourse that any basis exists for choosing between one actor or the other as subject of the verb in the continuation fragment. If the way the effect operates is by affecting the assignment of predicate-argument relations in logical form, then it is doing so, in contradiction to the crucial predictions of the modularity hypothesis.

The effect of discourse bias in 2C demonstrates, in addition, that these
assignment processes take place as the continuation fragment is being heard—in particular, before the presentation of the visual probe. If an assignment of agency had not already been made before the subject knew what the visual probe was, there would not have been any inappropriateness effect. The effects in 2A and 2B show that the assignment of either protagonist as agent is equally acceptable here—the probe her is named just as rapidly after He waved at . . . as the probe him after She waved at . . . .

Equally, there is nothing about the sequence Waving at him (with the female actor as agent) that makes it any less appropriate in the given discourse context than Waving at her (with the male as subject).

To explain the appropriateness effects, we have to assume a particular ordering of processing events. At the moment when the continuation fragment starts, the manipulation of discourse focus has led to the expectation that the actor in focus will continue in subject position. Unless the subject pronoun is inconsistent with this expectation (as in 2B), and unless the semantics of the verb select the other protagonist (as in 3C), the listener will go ahead and assign agency on this basis. He or she can do this as soon as the information becomes available that the verb is pragmatically neutral. Evidence from other studies (see the subsection on word-monitoring experiments) shows that this occurs while the verb is still being heard. Thus, by the time the visual probe appears, a commitment has already been made to the discourse mapping of the continuation fragment. Given this assignment, probe 2 will be perceived as inappropriate.

More generally, the results over the nine conditions reveal a pattern of dependencies between the discourse model and the current utterance that is difficult to handle within a system based on the rigidly bottom-up communication paths that characterize the modularity hypothesis. In particular, we are dealing here with a system that is highly flexible, even opportunistic, in its use of different types of processing information to achieve the perceptual goal of relating an utterance to its discourse context.

We see in the results that all three types of constraint—pronoun constraint, discourse bias, and pragmatic coherence—are equally capable, under the right conditions, of controlling the outcome of this process, and we see this occurring within the kind of on-line time frame that is supposed to characterize modular processes. This flexibility in using different sources of constraint, as and when they are available, means that the process of discourse linkage is not dependent on information being made available to it in a fixed order or in a fixed format. This stands in opposition to the central argument of the modularity thesis: that language comprehension is centered around a system that is entirely fixed in its properties and that is entirely insensitive to the changing informational circumstances within which utterances occur.
**Implications**

The evidence presented in the preceding section, and the analyses discussed earlier, lead to a view of language processing that is in many ways quite similar to the approach put forward by Fodor. It shares Fodor's emphasis on the remarkable speed and efficiency of real-time language processing, and it accepts that these processes normally operate in a mandatory fashion. It also accepts a certain degree of functional encapsulation, in the sense that contextual influences do not operate in a top-down manner in normal first-pass processing.

But it diverges from Fodor's approach in two major respects. First, it does not attempt to explain the special properties of language processing by postulating a distinct type of cognitive entity called an input system or a module. Second, it includes within the domain of these special processes the aspect of language comprehension that Fodor is most eager to exclude: the computing of inferences that draw upon nonlinguistic knowledge.

What is the nature of the approach we are advocating, and how does it accommodate the kinds of phenomena that Fodor hoped to explain with the concept of a module? How, in particular, does it accommodate the kinds of phenomena that behave as if they were modular, on Fodor's account, but nonetheless involve extramodular processes? We repeat below the view of language processing that we began to lay out in our 1980a, 1980b, and 1981 papers.

- We assume that language comprehension is mediated by a stable set of highly skilled, automatized processes that apply obligatorily to their characteristic inputs. Such a system has fixed properties in the sense that there is a mandatory sequence of operations that must always apply to a given input.

  We leave open the question of whether this system has fixed properties in the sense intended by Fodor—that is, because its properties are in some way genetically specified and therefore "hardwired." At present there seems to be no very convincing way of discriminating those fixed properties of language processing that derive from genetic constraints on the system from those that derive from the automatization of highly practiced skills (see Jusczyk and Cohen 1985; Sternberg 1985).

- The function of this set of core processes is to project the speech input onto a representation in the world—onto, for example, a mental model in the sense defined by Johnson-Laird (1983). It achieves this as rapidly as is informationally and neurally possible. There is no processing hiatus, no detectable change of cognitive means of transport, that coincides with the transition from the strictly linguistic to the discourse-representation or mental model. Nor is there evidence of any lag that might correspond to the requirement to map onto some linguistic level before mapping onto the
discourse model. On the contrary, there is evidence (see our subsection on pragmatic inference) that the input can be mapped onto the discourse level even when the assumed linguistic level is still incomplete.

- These obligatory core processes operate on the principle of bottom-up priority. It is the bottom-up input to the system that sets it into motion and that determines what its possible outputs can be. We see this very clearly in the behavior of the word-recognition process. The membership of the initial cohort of word candidates is determined by the sensory input alone, and it is this initial cohort that defines the universe of possible candidates (Marslen-Wilson 1984; Tyler and Wessels 1983). Such a system cannot produce an output that is incompatible with its bottom-up input.

This is not the same as informational encapsulation, although it has many of the same effects. So long as the bottom-up input is phonologically and morphosyntactically unambiguous, it will uniquely determine the output of the system, and contextual influences will be difficult to detect—in other words, the system will give the appearance of encapsulated modularity. But when the input to the system is ambiguous or incomplete (as in the landing planes experiments or the Zero Anaphora studies), one can see clearly the on-line consequences of contextual factors. (For a further discussion of the conditions under which "predictive" context effects can be observed, see chapter 12 of this volume.)

- Finally, and most controversial, these core processes permit no top-down effects in normal first-pass processing. This is because the concept of a top-down effect is defined in terms of a relationship between different representational levels arranged in a hierarchy. In Fodor's psycholinguistic ontology, a level of something like logical form exists as a representational level in the processing system, and this stands in a hierarchical relationship to some further level (or levels) of representation corresponding to the pragmatic interpretation of the utterance. The notion of informational encapsulation, forbidding certain kinds of top-down interaction, is defined by Fodor in terms of these ordered levels.

To be able to evaluate the modularity hypothesis on its own terms, and to construct tests that would be intelligible within its particular frame of reference, we have up to this point in the chapter gone along with these assumptions about levels of representation. We turn now to an alternative ontology, in which we recognize no distinct level of representation corresponding to logical form—or to any other purely syntactic analytic level.

We assume, instead, that there is no level of symbolic representation mediating between lexical representations and mental models. Instead, there are procedures and mechanisms for mapping the one onto the other; for using the information provided by what the speaker is saying to con-
struct a representation of his intended message. The apparatus of syntactic
theory is a description of the properties of this construction procedure—as
Crain and Steedman (1985, p. 323) put it, the rules of syntax “describe what
a processor does in assembling a semantic interpretation.” Notions such as
logical form, therefore, are part of a description of a process; they are not
themselves the process they are describing.

Where does this leave the context effects, and the violations of informa-
tional encapsulation, that we discussed above? The answer is, in part, that
the issue disappears. If there are not two levels standing in the necessary
hierarchical relationship to each other, there cannot be interactions between
them. The true implication of evidence for interaction may be, in the end,
that there is no interaction.

In particular, it becomes meaningless to infer “interaction” from the
filling in of insufficiencies at one level on the basis of information available
at a higher level. For a two-level, hierarchical system, the implication of the
Zero Anaphor effects discussed above was that the lower level was pene-
trable by the higher level. But where there is no lower level of structural
representation, and where the basic processing act performed by the sys-
tem is the mapping onto pragmatically coherent locations in the discourse
model, then the concept of interaction simply fails to apply.

We have, instead, multiple potential sources of cues for correct mapping,
one of which (in the experiment in question) is the explicit lexical cues
provided by the subject pronouns, but which also include the expectations
derived from the structure of the discourse, and the differential inferences
drawn from the relationship between input semantics and the state of the
discourse model and the entities it contains. If the subject slot is lexically
empty, as in our Zero Anaphor cases, the listener will assume that the
speaker intends him to recover the intended agent from some other prop-
erty of the message and its discourse environment. The end result is the
same: an instantiation of the appropriate agent in the discourse model. But
this involves no top-down influences, no creation at a lower level of mental
contents that are derivable only at a higher level. There is no lower level of
the appropriate sort, only the ability to integrate diverse information in the
construction of the discourse.

By the same token, the arguments for interaction based on the resolution
of structural ambiguity will also dissolve. In a system of the type Fodor
envisages, the existence of an early preference for the contextually appro-
priate reading of a phrase like landing planes is prima facie evidence for a
top-down effect on the operation of the syntactic parser. But again, if there
is no autonomous syntactic level of representation, and if the basic opera-
tion of the system is to construct coherent interpretations in the domain
of the discourse model, then there is no “interaction” here, and in effect, no
ambiguity either. In terms of the on-line functioning of the system, the
bottom-up input is ambiguous only to the extent that the interpretative
target in the discourse model permits it to be. And cooperative speakers
will not present their addressees with irresolvable ambiguities.

In fact, we might speculate, it is the cooperativeness of speakers and
listeners that goes the furthest in explaining how the speech process can
be so rapid, and how, in particular, inputs can be projected with such im-
mediacy onto the listener's discourse model: It is because speakers prepare
their utterances so that they cohere with what has been said before, and
because listeners run their processing systems on this assumption. This is
what gives language processing its seemingly ballistic property—that the
speaker constructs a communicative packet that is already configured to
map onto the receptive configuration of the listener.\footnote{9}

Concluding Remarks

We end with some comments on what can be regarded as the hidden
agenda of the modularity discussion—namely, the underlying question of
the kind of role that syntactic theory should play in a psychological model
of language processing. From this perspective, the modularity hypothesis
can be regarded as the very strong psychological claim for the direct
participation of the constructs of linguistic analysis in the process of lan-
guage comprehension, up to and including the level of logical form. It
saves a central role for syntactic analysis and representation, safely encap-
sulated within the language module.

This is one reason why it is so important for the modularity hypothesis
that the dividing line between modular and extramodular processes falls at
the interface between the linguistic and the nonlinguistic. Unfortunately, as
we have tried to show here, the diagnostic features that are supposed to
place the dividing line at just this crucial point fail to do so. The central
processes of language comprehension do not conveniently stop dead at the
level of logical form. This means not only that the hypothesis itself fails,
but that so do the assumptions it tries to smuggle in about the role of
linguistic theory in a model of psycholinguistic processing.

It is at this level of the discussion that we are “against modularity.” We
reject it as a claim about the relationship between linguistic construct and
psychological process. The facts of psycholinguistic performance simply do
not support the rigid dichotomy between the domains of the syntactic and
the non-syntactic that is the central claim of the modularity thesis. The
thesis is seductive, entertaining, perhaps even heuristically useful. But as a
basis for the construction of explanatory theories of human psycholinguis-
tic performance it is, we believe, fundamentally misleading. It misconstrues
the nature of the problem that is set for us by the extraordinary speed and
immediacy of on-line language comprehension, and it invites us to accept,
as a solution to this problem, a view of the organization of the language-processing system that obscures rather than clarifies the questions we now need to be asking.

Notes

1. We exclude from consideration here the immediate sensory transducers.
2. We will not discuss here three additional features that Fodor mentions: neural hardwiring, characteristic breakdown patterns, and ontogenetic uniformity. The evidence in these domains is hardly crisp enough, at the moment, to seriously distinguish the opposing views we are contrasting.
3. This is not to say that all discourse mapping is phenomenologically mandatory. Consider the following discourse pair: John couldn't decide whether to eat steak or hamburger. In the end he went for the less expensive meat. Here one has to stop and think before deciding on the referent for less expensive meat. It is worth considering how this might differ from cases where the mapping goes more smoothly.
4. It is important, nonetheless, to keep clear the relationship between speed and automaticity. Very fast processes will almost certainly be mandatory processes, but the converse does not hold. Some mandatory processes—growing old, getting hungry—are really quite slow.
5. These are cases like The detective watched the policeman with the walking-stick, where the prepositional phrase with the walking-stick is more plausibly attached to the policeman than to the detective.
6. In Identical monitoring the actual target word is specified in advance to the subjects; in Rhyme monitoring the subjects listen for a target that rhymes with a cue word given in advance.
7. These arguments hold even if one tries to take the view of monitoring performance proposed by Tanenhaus, Carlson, and Seidenberg (1985), in which the effects of context on monitoring performance are written off as a form of sophisticated guessing. Even if this is the way context effects are mediated, the difference between conditions A and B still depends on the on-line computation of the differential pragmatic plausibility of the target appearing as the object of the different verbs in these two conditions. And it is the speed of pragmatic inferencing that is at issue here.
8. We are indebted to Jerry Fodor and Merrill Garrett for extensive discussions of this aspect of the research.
9. For a detailed illustration of the extent to which a speaker fits the design of his utterances to the informational requirements of his addressee, see Marslen-Wilson et al. 1982.