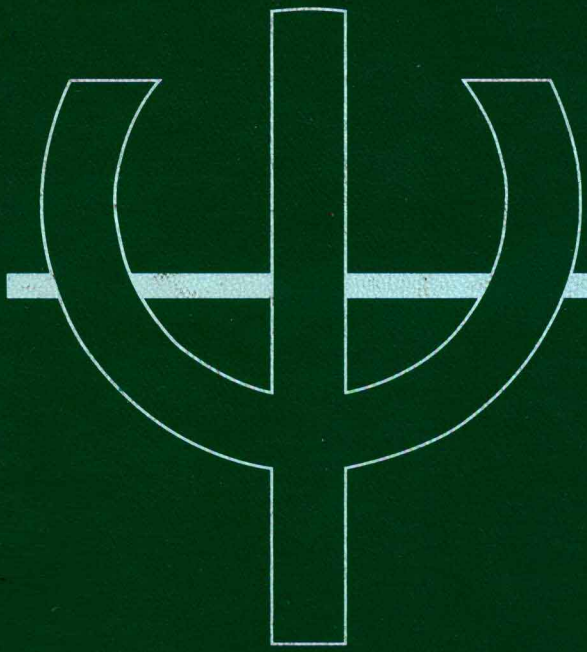

ADVANCES IN PSYCHOLOGY

77

Understanding Word and Sentence

Greg B. Simpson
Editor

North-Holland

UNDERSTANDING WORD AND SENTENCE

Edited by

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Editors:

G. E. STELMACH

P. A. VROON

NORTH-HOLLAND
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To

Mary Margaret and May

Preface

Research concerning structure and processing in the mental lexicon has achieved central prominence within cognitive psychology and psycholinguistics. The importance of lexical processing for consideration of higher levels of language comprehension is taken for granted. Historically, however, much of the research on the lexicon originated not with an eye to understanding language processing, but rather as a way of studying semantic memory. That is, words are an obvious and convenient medium with which to examine human semantic processing. Of course, the relevance of semantic memory for language comprehension was also assumed, but only rarely addressed directly. Consequently, lexical research was for many years dominated by "priming" studies, which focus on the effects of processing one meaningful stimulus (most often a single word) on the subsequent recognition of another. Through this research, we have gained some understanding of how lexical information may be organized, but considerably less about the ways in which that information is used in understanding natural language.

The picture has changed dramatically in the past several years, with proportionally less work devoted to word recognition *per se*, and more to exploring the role of the lexicon, its processes and output, in other aspects of comprehension. This volume represents an attempt to gather together the work of some of those researchers who are responsible for this shift of emphasis. The modern descendants of the earlier word recognition research are well represented, as is that research which emphasizes the place of lexical information in syntactic and pragmatic processing.

The first several chapters extend the priming literature to explore more fully the effects of sentence context on word recognition. Tabossi, Schwanenflugel, and Kellas and colleagues all consider the roles of sentence constraint and the activation of featural information in word recognition. Tabossi and Kellas et al. focus also on the problem of lexical ambiguity (the processing of multiple-meaning words) a topic that has figured especially prominently in the debate over whether the various component stages of language processing are autonomous or interactive. O'Seaghdha examines more completely the problem mentioned above, namely, that sentence context research occupies a position between psycholinguistic and more general cognitive concerns. O'Seaghdha discusses his own research on the relation between syntactic and lexical information in word recognition, and also gives consideration to some of the methodological issues often raised in this research.

Gernsbacher and Faust discuss two general cognitive processes, the enhancement and suppression of information in memory, and the role that the latter plays in comprehension. They argue that the efficiency of suppression processes is a key factor underlying individual differences in comprehension skill.

Van Petten and Kutas describe their research on event-related brain potentials (ERP) as indicators of lexical processing in sentence context. Their discus-

sion entails examination of several variables important to word recognition (e.g., word frequency, ambiguity, and sentence constraint), as well as an assessment of several prominent word recognition models in light of their behavioral and ERP data. Rayner and Morris also expand on the ambiguity research, considering not only word-level ambiguity, but also word sense, syntactic, and syntactic-category ambiguity. Their eye-movement studies indicate a discontinuity among these types of ambiguity, and provide insight into the different processing operations that occur at these levels of comprehension. Whitney and Waring complete the discussion of the effects of context on the activation of semantic information. The contexts they consider, however, range from the single word to the prose passage, and the activated information similarly ranges from the single word to the elaborative inference.

Cacciari and Glucksberg provide a thorough discussion of the role that lexical information plays in understanding figurative language, specifically, idiomatic expressions. They present a taxonomy of idiom types, and consider the different contributions made by lexical information to each type. Wisniewski and Gentner review how the meanings of words are combined to yield new concepts. Their work makes clear that there is no unitary set of processes by which concepts are always combined, and that the mapping of word meaning to higher-level comprehension will be very complex.

Oden and colleagues use their FuzzyProp framework to describe how listeners and readers identify a linguistic message despite the noise typically present in the signal. This is considered at both the lexical and sentence levels, as contextual information combines with sensory information to yield the best match to the input message.

Ferreira and Henderson, and Boland and Tanenhaus examine the role of lexical information in syntactic processing. Ferreira and Henderson consider how verb information is used in parsing sentences, and provide data showing that this information is used not in the initial syntactic analysis of a sentence, but rather in the *re*analysis following a parsing error. Boland and Tanenhaus also provide a very thorough treatment of the kinds of information carried in lexical entries, and how these types of information are used in sentence parsing and sentence interpretation.

Finally, the paper by Swinney touches on a number of the issues raised in the preceding chapters. Specifically, the issue of indeterminacy (ambiguity) is addressed at two levels (co-reference assignment and lexical ambiguity), and data bearing on the nature and timing of context effects are reported.

It is quite clear that the authors of the papers contained here are not in complete agreement on every issue. Had the authors gathered to present these papers, a series of lively debates would undoubtedly have ensued. This must always be the case in any collection that represents the new directions taken by a field. Indeed, it is most desirable. It is hoped that the papers herein will inspire continued debate, both among the authors, and their readers.

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Contents

Understanding Word and Sentence
G.B. Simpson (Editor)

Chapter 1

Understanding Words in Context

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This paper deals with how sentential context affects the comprehension of words. In understanding a sentence, people use the information provided by lexical items to construct an internal representation of what is said in the sentence. The semantic information about words must be recovered from the mental lexicon and combined according to the syntax of the language before more complex elaborative processes can take place. Thus, the individual words constitute the building blocks of comprehension. But not only do words contribute to make up the meaning of the sentence in which they occur: In many occasions the reverse may also be true, and the internal representation constructed from a sentential context may help the various processes connected with the comprehension of a lexical item in the sentence. Consider, for instance, the following sentence:

The cook put the sugar on the cake and left it in the fridge.

Here *it* may refer to either sugar or cake and in order to resolve the referential indeterminacy and interpret *it* correctly as referring to cake, one has to take into account the overall meaning of the sentence and the general knowledge it elicits, in particular the fact that sugar is not kept in fridges, whereas cakes often are.

The example illustrates the contribution that context can give to the comprehension of anaphoric expressions. The phenomenon, however, is not restricted to these words: It is to the more general case of sentential context effects on the comprehension of content nouns that the present article is devoted.

But what is it to understand a word? A word can be considered fully comprehended when it has been adequately interpreted in its context of occurrence: *It* is understood not when it has been recognized as the neutral

pronoun, but when it has been interpreted as referring to cake, and before this result can be achieved several processes must take place. There is considerable disagreement among researchers as to how these processes should be characterized, and the terminological heterogeneity of the current literature does not contribute to the clarification of the matter. In any case, it will be sufficient for present purposes to consider those processes that are the object of interest of three of the major areas in lexical processing research: lexical interpretation, word recognition or identification, and lexical access.

Lexical interpretation is illustrated in the above example where *it* receives its interpretation according to context. Word recognition is used here to refer to the processes by which the visual or sound pattern corresponding to a word makes contact with the various kinds of information—semantic, morphological, syntactic, phonological, etc.—available to the reader/listener about that word. Finally, lexical access refers to retrieval of the semantic information related to a word, when the word is recognized. For instance, what information about the meaning of *dog* becomes available to a listener/reader when s/he recognizes the word? Does one recover all the available information about dogs or only that which is contextually relevant?

How and under what conditions sentential contexts can affect these processes is still an open question, and one whose answer has implications for models of lexical processing. These implications will be discussed in the concluding section, after considering the available evidence on the issue, starting from the least controversial of the effects of context: the interpretation of words.

Word Interpretation

Perhaps the most obvious case of sentential context effects on the interpretation of a lexical item is ambiguity. Although we hardly notice it, ambiguity is an extremely common phenomenon in language, and it is handled so efficiently by the language system that people find it easier to deal with a relatively small number of ambiguous words than with larger numbers of unambiguous lexical items. In fact, apart from function words, the more frequently a word is used, the more likely it is to be ambiguous (Miller, 1951). Context plays a central role in the comprehension of ambiguous words, and indeed it seems easier to understand an ambiguous item in context than to think of its meanings in isolation, as clearly illustrated in the following example by Phil Johnson-Laird (1983). Consider first the various meanings of *plane*. Has the word called to mind all the meanings involved in the following sentences?

The plane landed on the runway.
Imagine a sphere divided equally by a plane.
The carpenter smoothed the surface of the wood with a plane.
All the trees have been cut down except the tall plane at the end.

Although ambiguity is the most striking example of sentential context effects, the phenomenon also applies to unambiguous words, which can be flexibly interpreted. In a cued recall study, Barclay, Bransford, Franks, McCarrell and Nitsch (1974) presented their subjects with sentences such as:

1. The man lifted the piano.
2. The man tuned the piano.

They found that "something heavy" was a better memory cue for Sentence 1 than for Sentence 2, whereas the reverse was true when "something with a nice sound" was the cue.

Likewise, Halff, Ortony, and Anderson (1976) gave the subjects a list of paired sentences, each containing the word *red* (e.g., "The red fire engine raced down the street," "The skin was red due to sunburn"), and asked them to judge, for each pair, whether the red in one sentence (e.g., the fire engine red) was definitely redder than, definitely less red than, or possibly equally as red as the red in the other sentence (e.g., sunburn red). The results indicated that the interpretation of *red* consistently varied according to its contexts.

Following the seminal studies in the 70's, subsequent work has further specified the nature of semantic flexibility showing, for instance, that not all the aspects of the meaning of a word are equally prone to context effects. Rather, some aspects — the 'core' meaning of the word — tend always to be present, whereas more peripheral aspects may become more or less salient depending on the contexts of occurrence of the word (Barsalou, 1982; Greenspan, 1986).

Related to semantic flexibility is the instantiation of general terms. Anderson and Ortony (1975) presented their subjects with sentences like the following:

3. The container held the apples.
4. The container held the cola.

They found that the subjects were better at remembering Sentence 3 when the cue was *basket* than when it was *bottle*, whereas the reverse was true for Sentence 4. Anderson, Pichert, Goetz, Schallert, Stevens, and Trollip (1976) extended these results, showing that *basket*, which did not occur in Sentence 3, was a better memory cue for that sentence than *container*, which did occur in it. *Container*, however, was better than *basket* for Sentence 5:

5. The container stood near the apples

showing that *basket* is not in general a better memory cue than *container*.

These data suggest that when people encounter general terms, like *container*, they tend to interpret them as more specific ones, according to context. The container was likely to be a basket in the situation described in Sentence 3 and a bottle in the situation described in Sentence 4: This is why the two words were better cues for Sentences 3 and 4, respectively. In contrast, Sentence 5 did not provide enough information to instantiate the general term that was therefore held unspecified.

Disamabiguation, semantic flexibility and instantiation show unquestionably that sentential context can affect the interpretation of a word. In addition to being well established, these phenomena have also been given a convincing theoretical account within the framework of the mental model theory (Johnson-Laird, 1983). According to this theory, understanding a sentence involves building a mental model of the state of affairs described by the sentence. A mental model is not a description of a sentence: It is the mental construction of the situation described by it, and its structure is analogous to the corresponding events in the world. Within this theory, words are cues to the construction of the model, and their meanings are functions which contribute to determine the referents of the words in the model. A central assumption of the theory is that understanding requires linguistic capability to interact with knowledge of the world. Thus information provided by individual words in the sentence is understood in relation to sentential context and general knowledge, reducing the indeterminacy, vagueness and ambiguity of lexical items.

One of the advantages of this theory is that it provides a homogeneous account for ambiguity, lexical flexibility and instantiation: In all cases, linguistc and nonlinguistic context sharpens their interpretation. But interpretation is a late process in the comprehension of a word, which in order to be interpreted must previously be identified. Indeed, as soon as the temporal dimension of lexical processing is taken into account, ambiguity, semantic flexibility and instantiaton, which look akin at the interpretative level, begin to show their differences. In the case of general terms, the semantic information relevant to their instantiation is not part of their meaning: The meaning of *container* does not include BASKET or BOTTLE any more than the meaning of *it* includes CAKE (Garnham, 1979; Johnson-Laird, 1983; for an alternative view see Halff et al., 1976). Hence, in order for instantiation to occur, the meaning of a general term must be made available by early lexical processes, and only subsequently may context and general knowledge allow inferences to make the general term more specific.

Ambiguity and semantic flexibility are different. The information to be integrated in the context is part of the meaning of the word: HARBOUR is one of the meanings of *port*, and MUSICAL or HEAVY are part of the semantic information about *piano*. It does therefore become relevant to establish when during the processes involved in the comprehension of these words context operates: at the time of their recognition and/or while accessing their meaning,