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Sentence Processing and Lexical Access: The Influence of the Focus-Identifying Task

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The influence of sentence focus on the lexical processing of ambiguous words during language comprehension was investigated by means of a cross-modal semantic priming task which was combined with a procedure for manipulating sentence focus (A. Cutler & J. A. Fodor's (1979, *Cognition*, 7, 49–59) focus-identifying task). The main findings were that both readings of an ambiguous word were activated at its offset if the ambiguous word formed part of the semantic focus of the sentence; no reading was activated if the ambiguous word was placed outside of focus. However, with a delay of 350 ms, the contextually biased reading was activated on both focus conditions. These results suggest that sentence focus may affect the process of lexical recognition immediately—mainly by affecting its form-driven parts. The consequences of this view are discussed in regard to current debates of lexical access, context effects, and the modularity thesis.

An important and long debated issue in psycholinguistics concerns the modularity thesis of human language performance. The modularity thesis, in short, claims that language processing is composed of a set of isolable, autonomous substages, where these substages constitute domain specific processing modules. These modules operate independently of whatever else is going on in the system and interact with other modules of the system only at the level of outputs (for details, see Garrett, 1978; Forster, 1976, 1979, 1981; Fodor, 1983). Alternately, there are language processing models that question the modularity thesis and adopt an interactive processing view instead. The radical interactionist version sees the language processor as a single, fully interactive system, in which at least potentially every processing component can come under the direction of every other processing component (e.g., Morton, 1970; Johnson-Laird, 1977; Marslen-Wilson & Welsh, 1978).

One domain in which extensive experimental efforts have been made to examine the modularity question is that of lexical recognition. Clearly, the process of lexical recognition during normal sentence comprehension is characterized by the integration of two different kinds of information—sensory input and contextually determined top-down constraints. The empirical question under discussion is whether or not this process is organized in a modular fashion, where a contextually independent, form-driven lexical access subsystem (an input module in the sense of Fodor, 1983) can be separated from a postaccess integration mechanism. A common tool to investigate this question is to use ambiguous words and to study the effects of biasing context on the processing of such words. The modular view holds that all meanings of the word are initially accessed, since the lex-

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ical access mechanism disregards contextual information, and all meanings are then passed to the integration level, where context selects the proper one (the Post Decision Hypothesis). The interactive view holds that context affects the lexical access level immediately, so that only a single meaning is accessed (the Prior Decision Hypothesis).

Early research produced mixed results, but recent work by Swinney (1979), Tanenhaus, Leiman, and Seidenberg (1979), Seidenberg, Tanenhaus, Leiman, and Bienkowski (1982), and Kintsch and Mross (1985), who have examined the time course of lexical access, has given strong support for the modular view. In these experiments a cross-modal semantic priming method has been used. In Swinney's experiment, the subject would hear a sentence such as the following (we here give one of the German examples that we ourselves made use of):

(1) Die Landschaft mit dem Mast$_{\langle 1\rangle}$ enttäuschte$_{\langle 2\rangle}$ die Besucher der Ausstellung

(The scenery with the mast$_{\langle 1\rangle}$ disappointed$_{\langle 2\rangle}$ the visitors of the gallery)

This sentence contains an ambiguous word (*Mast*) with two independent readings (1. telephone pole, 2. food). The contextual information provided by the sentence resolves the lexical ambiguity (biasing the telephone pole reading in the given example). Immediately following the presentation of the ambiguous word (test point ⟨1⟩) or with some delay (test point ⟨2⟩, usually 200–600 ms after ⟨1⟩), a string of letters would appear on a screen and the subject would have to press one of two keys depending on whether the string was a word or not (lexical decision task). Recent work with cross-modality semantic priming has demonstrated that visual lexical decisions are facilitated following auditory processing of a semantically related unit (e.g., Swinney, Onifer, Prather, & Hirshkowitz, 1978). By using targets related to the contextually biased meaning of the ambiguity, (PFAHL [stake]), targets related to the alternative meaning (FUTTER [food]), and unrelated control words (KLANG [sound]), this method makes it possible to test the activation of the different meanings of the ambiguous word at different test points in the sentence (realizing a variable stimulus onset asynchrony (SOA)).

As the data by Swinney (1979) and others show, at the immediate test point, both readings of the ambiguous word generate significant levels of priming even in a biasing context. With a delay, the biased reading generates a significant priming effect only. These results clearly appear to favor the Post Decision Hypothesis. It is important to note that these results apply to a variety of structural conditions: different types of context (Swinney, 1982; Tanenhaus et al., 1979; Kintsch & Mross, 1985), different types of ambiguous words (e.g., Seidenberg et. al., 1982), polarized and unpolarized ambiguities (Onifer & Swinney, 1981), and different structural positions within the sentence (e.g., before and after a clause boundary; Seidenberg et al., 1982). All of these results support a modular, autonomous view of lexical access.

However, an interesting and important variable has so far been neglected: *focus structure*. Focus structure divides the information provided by a sentence into two parts: a focussed part which is *new* (explicitly communicated) information and a remaining part which is *given* (presupposed) information (cf. Jackendoff, 1972). It was pointed out that, psychologically, focus structure is one of the main factors controlling the hearer's attention in language understanding, so that he pays more attention to the processing of focussed sentence parts than he does to that of nonfocussed parts (Engelkamp, 1982; Hornby, 1974; Cutler & Fodor, 1979). This paper attempts to show the impact that sentence focus has on lexical recognition, using the results to

make a critical reexamination of the modularity thesis.

To manipulate focus, linguists have been discussing pairs of presupposition-sharing sentences in which a preceding question restricts the focus of a proper response sentence (e.g., Chomsky, 1971). This device, call it the focus-identifying task, has been used by Cutler and Fodor (1979) to investigate the impact that sentence focus has on the process of phoneme detection. The focus-identifying task also seems suitable for examining the influence of the focus on the process of identifying word meanings. Let us consider sentence (1) once again, now preceding it with either (2) or (3):

(2) Welche Landschaft enttäuschte die Besucher?
(Which scenery disappointed the visitors?)

(3) Welche Besucher enttäuschte die Landschaft?
(Which visitors did the scenery disappoint?)

When (1) is preceded by (2), *Mast* will be part of the focussed information in (1). When (1) is preceded by (3), *Mast* will be outside the information focus.

If the focus-identifying task is combined with Swinney's (1979) cross-modal semantic priming task—which is precisely what we did in the experiment reported below—it should be possible to investigate the influence of focus structure on the process of recognizing word meanings through measuring cross-modal priming effects. What we mainly tried to find out in this experiment was whether the autonomous (context-independent) nature of lexical access can be maintained under either focus condition. The modularity thesis says that it can. This arises from the fact that the impact of the focussing question will certainly be based on extralexical processing, which should not influence the access subsystem. A noteworthy methodological point is that an unwanted variability of the spoken input across focus conditions (which might have some prelexical effect on the recognition process) is here excluded with the help of the focus manipulating technique evolved by Cutler and Fodor (1979). This prodecure makes it possible to vary position of focus within the sentence while keeping all acoustic aspects of the sentence itself constant.

A secondary aim of the present experiment was to find out whether the structural position of the ambiguous word within the sentence may affect lexical ambiguity resolution. Whereas pairs (2, 1) and (3, 1) deal with focussing and distraction in the case of an ambiguous word in the *early* part of the response sentence, pairs like (4, 6) and (5, 6) deal with the same focus conditions in the case of an ambiguous word (*Ball* = 1. dance, 2. football) in the *later* part of the sentence.

(4) Welche Eröffnung verzögerten die Gäste?
(Which kind of opening did the guests delay?)

(5) Welche Gäste verzögerten die Eröffnung?
(Which guests delayed the opening?)

(6) Die Gäste aus dem Ausland verzögerten die Eröffnung des Balls$_{\langle 1\rangle\,\langle 2\rangle}$

(The guests from abroad delayed the opening of the ball)$_{\langle 1\rangle\,\langle 2\rangle}$

This manipulation seems particularly appropriate when it comes to evaluating the role of clausal processing strategies (Bever, Garrett, & Hurtig, 1973; note that in (1) the lexical decision task is performed *prior* to a clause break but in (6) *after* it).

METHOD

Subjects

Seventy-two members of the Academy of Science community served as paid subjects in the experiment.

Stimulus Materials and Design

A list of twenty-four ambiguous words

with two independent and approximately equibiased readings was selected. Two sentences were constructed for each word biasing the different readings of the ambiguity. One half of the ambiguous words appeared in the earlier part of the sentence (cf. Example (1)), the other half appeared in the later part (cf. Example (6)). An attempt was made to exclude lexical items which were semantically related to either reading. Thus, it was information provided by the sentence, rather than priming from individual lexical items, which allowed disambiguation (message-level context).[1]

Two questions were constructed for each of the forty-eight sentences, one question directed to information in the sentence part containing the ambiguous word, one question directed to information in the other sentence part (thereby, distracting from the ambiguous word). This means that four possible sentence pair conditions were realized: ambiguous word position (early, late) × focus condition (focussing upon ambiguous word, distracting from ambiguous word).

Four tape recordings were made. Each tape contained 24 sentence pairs and included each ambiguous word exactly once. The four sentence pair conditions were equally represented on each tape (6 exemplars per tape). By means of tape-splicing the need for multiple recording of sentences preceded by focussing and distracting questions was avoided. All tapes also included 36 filler pairs, randomly interspersed among the test pairs. Ten practice pairs were also constructed. Practice, filler, and test materials were similar in syntactic constructions. Only the latter contained ambiguous lexical items, though.

For visual presentation a set of 48 target words was prepared assigning to each ambiguous word two target words which were associates (or synonyms) of the two readings. Targets were matched for length and frequency. For each sentence pair, a set of three words was selected from the 48 target words. One of the three was related to the biased reading of the ambiguity in the sentence, another was related to the unbiased reading, and the third was entirely unrelated to either.

Three separate lists of visual targets were constructed. Each list contained one, and only one, of the three visual words which were created in conjunction with each sentence pair. The three visual target types were equally represented on each list. Half of the materials on each list were words (4 × 24 test words, 4 × 6 words paired with filler sentences) and the other half (4 × 30) were nonwords (paired with filler sentences). The target words assigned to the practice and filler pairs were not related to meanings of any of the words in the sentence.

To sum up, there were four tapes paired with each of the three assigned visual target lists. In each of the 12 resulting combinations the factors of ambiguous word position/=target position (early, late), focus condition (focussing upon target part, distracting from target part), and visual target type (related to biased reading, related to unbiased reading, unrelated) were crossed completely so that each of the 2 × 2 × 3 possible conditions were exemplified twice. Furthermore, each visual test target appeared in each combination of focus condition and visual target type exactly once, half of them assigned to early ambiguous words, half assigned to late.

Each subject received only one tape paired with one target list. In consequence, every subject heard each critical ambiguous word only once and also saw a target word only once. Six subjects were randomly assigned to each of the 4 × 3 tape–target list pairs. To half of the subjects, the targets were presented exactly at the offset of the ambiguous words; and to the other they were presented after a delay of 350 ms. So, target position, focus condition, and target type were designed as within-

[1] Write to the first author for the experimental sentence material (with English translation).

subject factors, but SOA was between subjects. What is more, focus condition, target type, and SOA were within items (target words), target position was between items.

Procedure

Subjects were tested individually. They were instructed to pay careful attention and comprehend the sentences as they would be tested on them later. Furthermore, it was explained that a string of letters would appear on the screen during the sentences they listened to, and that they were to decide as quickly as possible whether each letter string formed a word or not. No hint was given that words and sentences might be related and, in the 10 practice trials, no such relationship existed.

Subjects were then given the 10 practice trials, followed by a tape of test trials. In each trial, subjects heard a sentence binaurally over headphones accompanied by the presentation of a target word. Target words were presented with the help of a box with a one-way mirror, which could be illuminated inside, showing the visual target. The timing tone of each sentence (exactly coincident with the offset of each critical word and inaudible to the subjects) initiated an interval timer. The length of this interval was either 0 or 350 ms. At the end of the interval the stimulus card inside the box was illuminated for 1 s and a millisecond clock began timing. The subject's action in pressing one of two buttons stopped the timing.

RESULTS

Out of a possible total of 1728 reaction time scores, 82 (4.7%) were missing. Of the missing latencies, 54 were due to equipment failure or experimenter error, 12 were due to the subject's false response; 16 very long reaction times were excluded as possible reprocessing. No more than 4 responses were lost for any one subject.

The data were subjected to separate ANOVAs treating subjects and items as random factors (Clark, 1973). In order to make for an easier description of the relevant aspects of the data, we shall only report the analyses that were separately made for each SOA.

The major point of interest was the impact that the visual target type had on latencies in the lexical decision task (cross-modal priming effects). As we said earlier on, the examination of the factor of visual target type allows drawing conclusions concerning the relative activation of each of the readings of the auditorily presented ambiguous word. An analysis of its interaction with other pertinent factors may be instrumental in discovering the critical determinants affecting sense activation.

One of the factors that did *not* significantly interact with the visual target types was the position of the ambiguous word within the sentence (= target position), min $F' < 1$. Since this factor had only a marginal effect on the pattern of sense activation, means were calculated for each combination of target type × focus condition at each SOA that resulted from collapse over target position. They are presented in Table 1.

Let us first consider the data in the 0-ms SOA. Lexical decision times were significantly different statistically for the three types of target items, min $F'(2,102) = 4.18$, $p < .025$. The effect of the focus condition also reached significance, min $F'(1,55) = 6.31$, $p < .025$. Additionally, a significant interaction was found between target type and focus condition, min $F'(2,113) = 3.16$, $p < .05$. This interaction obviously resulted from the fact that there were significant priming effects only when the preceding question focussed on the target part of the experimental sentence. A significant priming effect of 53 ms was obtained for contextually biased associates, $t(35) = 3.11$, $p < .01$, and 30 ms for contextually unbiased associates, $t(35) = 1.96$, $p < .06$. The difference of 23 ms between visual targets related to biased vs. unbiased readings was not significant, $t(35) = 1.34$. In the condition in which the preceding

TABLE 1
MEAN LATENCIES (IN MS) FOR EACH TARGET TYPE × FOCUS CONDITION AT EACH SOA (COLLAPSING ACROSS TARGET POSITION)

Focus condition	Visual target type: Related to biased reading	Related to unbiased reading	Unrelated
Focussing upon target part	725	748	778
Distracting from target part	780	786	793
	SOA = 0 ms		
Focussing upon target part	710	741	749
Distracting from target part	706	762	767
	SOA = 350 ms		

question distracted from the target part of the sentence, no significant priming effects were obtained for any target word immediately following the ambiguity, $t < .7$. These results indicate that both meanings of the ambiguous word were activated when they were focussed; in the case of the distracting condition, however, neither of them was activated at the 0-ms SOA.

At the 350-ms SOA, the main effect of target type was significant, min $F'(2,96) = 7.13$, $p < .005$. Neither the effect of focus condition nor its interaction with target type reached significance, min $F' < 1$, which was in notable contrast to what was found at the immediate test point. Significant priming effects were found for contextually biased associates, both in the focussing context (39 ms $t(35) = 2.15$, $p < .05$) and the distracting context (61 ms $t(35) = 2.62$, $p < .02$). On both focus conditions, no significant priming effect was observed for contextually unbiased associates, $t < .5$. Thus, at the delayed test point only the contextually appropriate reading was activated both when it was focussed and when it was not.

Finally, there was yet another significant main effect of the target position. At both SOAs, reaction times to targets in later positions were significantly faster than reaction times to targets in earlier positions (0-ms SOA: min $F'(1,54) = 11.4$, $p < .005$; 350-ms SOA: min $F'(1,56) = 18.1$, $p < .001$). The interaction between target position and focus condition reached significance only at the 0-ms SOA. Reaction times were faster when the preceding question focussed upon the earlier part of the sentence than when it focussed upon the later part (min $F'(1,58) = 4.4$, $p < .05$). It is doubtful whether much importance should be attached to this result. These effects may presumably be attributed to phenomena of divided attention and confirm suggestions put forward by Cutler and Fodor (1979).

DISCUSSION

The present experiment shows that sentence focus has an effect on lexical access. In the condition in which the target part of the sentence was focussed, results appeared to support the Post Decision Hypothesis. In this case, the process of lexical recognition seemed to be organized in a modular fashion, with all the meanings of an ambiguous word initially accessed, and a postaccess integration mechanism following that relied on context for the suppression of inappropriate meanings. If the ambiguous word was, however, outside of focus, neither the biased meaning nor the unbiased one was accessed immediately.

Access was delayed (within a 350-s interval) and merely led to the recognition of the contextually biased reading of the ambiguity.

Two tentative conclusions may be drawn. First, the result that the variable of focus structure (controlling the hearer's attention) may exert a direct influence on the input-driven access subsystem is in line with results obtained in research into *intraperceptual* theories of attention, viewing (focussed) attention as operating within the domain of perceptual processing (Johnston & Dark, 1982). It is worth noting that Cutler and Fodor's (1979) results, which showed the impact of focus structure on phoneme detection, may also be interpreted as substantiating an intraperceptual theory of attention.

Second, the fact that an extralexical, discourse level variable can affect lexical access appears to count against modularity as a general design characteristic of the lexical recognition system and requires explaining. Abandoning the modularity thesis as a general organizational principle, we feel that an appropriate explanation may be found if a basically interactive formalism is constrained by empirically motivated principles. We believe that the interactive activation models evolved by McClelland and Rumelhart (1981), McClelland and Elman (1986), and others are the first steps in this direction. Recent research by Cottrell and Small (1984) which throws a light on modularity from the new point of view appears to support this impression (cf. also Seidenberg, 1985; Tanenhaus & Lucas, 1987). If the interactive activation framework is paired with an appropriate intraperceptual theory of attention (for an advance in this direction, cf. Grossberg & Stone, 1986), it may become possible to explain the breakdown of the modular architecture in the case of reduced attention. The examination of this suggestion is a task to be fulfilled in the future.

A secondary result was that the variable of target position (coinciding with clausal completeness in the present experiment) did not significantly interact with the visual target type. The present results do not therefore provide any reliable evidence showing that lexical ambiguity resolution is sensitive to the structural position of the ambiguous word (before or after a clause break). This is in fundamental agreement with results by Seidenberg et al. (1982) and their assessment of the role played by clausal processing strategies (Bever et al., 1973).

Finally, we give a word of caution concerning rash generalizations about the study in hand. First, the effects that sentence focus is here described as having on the processing of ambiguous words were obtained on the basis of a special type of ambiguity (ambiguous words allowing two independent and approximately equibiased noun-readings), a special type of contextual information (message level context), and a special manifestation of sentence focus (focus assignment by a preceding wh-question). It is therefore necessary that a wider range of lexical material and structural conditions should be examined if hasty conclusions are to be avoided. This will be a challenge for the future. Second, a potential reason for scepticism may be Cutler and Fodor's (1979) focus manipulating technique. The point of issue is that the intonational cues for focus may conflict with the restrictions imposed by the preceding question context. (It should not be forgotten that, in the interest of the experimental control of the acoustic stimulus, identical intonation was used in both question contexts.) This might complicate the whole experiment. To allay these fears, we saw to it that when the experimental sentences were being recorded, intonation contours were kept as neutral as possible. Care was in particular taken that no potential target phrase should be given any emphasis. There seem to be indications that question-driven focus manipulation was powerful enough to override intonation focus cues. Yet a replication in which pro-

sodic and contextual/syntactic cues for focus are manipulated (and controlled) independently might prove more convincing.[2]

Although the general validity of the proposed picture of the impact of focus structure on lexical processing may be cast doubt upon and will possibly even require modification, an important methodological insight will certainly have been gained. Suppose that natural language comprehension were among other things characterized by a systematic pattern of focussed attention, with some sections of a sentence more accented than others. It would then be methodologically sensible to take account of this parameter. However, most of the existing experimental paradigms for investigating lexical processing neglect the influence of focus structure. The study in hand can in this connection be considered as a first attempt of demonstrating how drastically the pattern of results can change when focus structure is explicitly taken into consideration.

REFERENCES

Bever, T. G., Garrett, M. F., & Hurtig, R. (1973). The interaction of perceptual processes and ambiguous sentences. *Memory & Cognition*, 1, 277–286.

CHOMSKY, N. (1971). Deep structure, surface structure, and semantic interpretation. In D. D. Steinberg & L. A. Jakobovits (Eds.), *Semantics*. London: Cambridge Univ. Press.

CLARK, H. H. (1973). The language-as-fixed-effect-fallacy: A critique of language statistics in psychological research. *Journal of Verbal Learning and Verbal Behavior*, **12**, 335–359.

COTTRELL, G. W., & SMALL, S. L. (1984). Viewing parsing as word sense discrimination: A connectionist approach. In B. G. Bara & G. Guida (Eds.), *Computational models of language processing*. Amsterdam: North-Holland.

CUTLER, A., & FODOR, J. A. (1979). Semantic focus and sentence comprehension. *Cognition*, 7, 49–59.

ENGELKAMP, J. (1982). *Given and new information: Theoretical positions and empirical evidence*. Arbeiten der Fachgruppe Psychologie der Universität des Saarlandes, No 79. Saarbrücken.

FODOR, J. A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press.

FORSTER, K. I. (1976). Accessing the mental lexicon. In R. J. Wales & E. Walker (Eds.), *New approaches to language mechanisms*. Amsterdam: North-Holland.

FORSTER, K. I. (1979). Levels of processing and the structure of the language processor. In W. E. Cooper & E. C. T. Walker (Eds.), *Sentence processing*. Hillsdale, NJ: Erlbaum.

FORSTER, K. I. (1981). Priming and the effect of sentence and lexical contexts on naming time: Evidence for autonomous lexical processing. *Quarterly Journal of Experimental Psychology*, 33A, 465–495.

GARRETT, M. F. (1978). Word and sentence perception. In R. Held, H. W. Liebowitz, & H. L. Teuber (Eds). *Handbook of sensory physiology*, Vol. VIII, *Perception*. Berlin: Springer-Verlag.

GROSSBERG, S., & STONE, G. (1986). Neural dynamics of word recognition and recall: Attentional priming, learning, and resonance. *Psychological Review*, **93**, 46–74.

HORNBY, P. A. (1974). Surface structure and presupposition. *Journal of Verbal Learning and Verbal Behavior*, **13**, 530–538.

JACKENDOFF, R. (1972). *Semantic interpretation in generative grammar*. Cambridge, MA: MIT Press.

JOHNSON-LAIRD, P. N. (1977). Psycholinguistics without linguistics. In N. S. Sutherland (Ed.), *Tutorial essays in psychology*, Vol. 1, Hillsdale, NJ: Erlbaum.

JOHNSTON, W. A., & DARK, V. J. (1982). In defense of intraperceptual theories of attention. *Journal of Experimental Psychology: Human Perception and Performance*, **8**, 407–421.

KINTSCH, W., & MROSS, E. F. (1985). Context effects in word identification. *Journal of Memory and Language*, **24**, 336–349.

MARSLEN-WILSON, W. D., & WELSH, A. (1978). Processing interaction and access during word recognition in continuous speech. *Cognitive Psychology*, **10**, 29–63.

MCCLELLAND, J. L., & ELMAN, J. L. (1986). The TRACE model of speech perception. *Cognitive Psychology*, **18**, 1–86.

MCCLELLAND, J. L., & RUMELHART, D. E. (1981). An interactive activation model of context effects in letter perception. Part I: An account of basic findings. *Psychological Review*, **88**, 375–407.

MORTON, J. (1970). A functional model of human memory. In D. A. Norman (Ed.), *Models of human memory*. New York: Academic Press.

ONIFER, W., & SWINNEY, D. (1981). Accessing logical ambiguities during sentence comprehension: Ef-

[2] We express our gratitude to an anonymous *ML* journal referee for advising us to stress this point.

fects of frequency-of-meaning and contextual bias. *Memory & Cognition*, **9**, 225–236.

SEIDENBERG, M. S. (1985). Constraining models of word recognition. *Cognition*, **20**, 169–190.

SEIDENBERG, M. S. TANENHAUS, M. K., LEIMAN, J. M., & BIENKOWSKI, M. (1982). Automatic access of the meanings of ambiguous words in context: Some limitations of knowledge-based processing. *Cognitive Psychology*, **14**, 489–537.

SWINNEY, D. A. (1979). Lexical access during sentence comprehension: (Re)-consideration of context effects. *Journal of Verbal Learning and Verbal Behavior*, **18**, 645–660.

SWINNEY, D. A. (1982). The structure and time-course of information interaction during speech comprehension: Lexical segmentation, access, and interpretation. In J. Mehler, E. C. T. Walker, & M. Garrett (Eds.), *Perspectives on mental representation*. Hillsdale, NJ: Erlbaum.

SWINNEY, D., ONIFER, W., PRATHER, P., & HIRSHKOWITZ, M. (1978). Semantic facilitation across sensory modalities in the processing of individual words and sentences. *Memory & Cognition*, 7, 165–195.

TANENHAUS, M. K., LEIMAN, J. M., & SEIDENBERG, M. S. (1979). Evidence for multiple stages in the processing of ambiguous words in syntactic contexts. *Journal of Verbal Learning and Verbal Behavior*, **18**, 427–440.

TANENHAUS, M. K., & LUCAS, M. M. (1987). Context effects in lexical processing. *Cognition*, 25, 213–234.

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