DOCUMENT RESUME

ED 136 207 CS 003 257

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TITLE Effect of Semantic Constraints on Processing Ambiguous Words.
PUB DATE 76
NOTE 12p.; Paper presented at the Annual Meeting of the American Psychological Association (84th, Washington, D.C., September 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Ambiguity; *Cognitive Processes; *Comprehension; *Context Clues; Language Research; Models; *Phonemes; Psychological Studies; *Semantics

ABSTRACT

Native English speakers performed a phoneme-monitoring task to assess whether ambiguous words (homographs) require extra processing capacity under two conditions: no prior context and prior context provided by disambiguating subject-noun and verb combinations. Phoneme detection latencies were reliably longer for homographs than for control words when no prior context was provided. This difference disappeared with appropriate subject-noun and verb contexts. These data support a prior-context model for processing ambiguous lexical items. (Author)

ED136207

Effect of Semantic Constraints on Processing Ambiguous Words

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Presented at the 84th annual meeting of the American Psychological Association, Washington D.C. Sept. 1976

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Effect of Semantic Constraints on Processing Ambiguous Words

Native English speakers performed a phoneme-monitoring task to assess whether ambiguous words (homographs) require extra processing capacity under two conditions: no prior context and prior context provided by disambiguating subject-noun and verb combinations. Phoneme detection latencies were reliably longer for homographs than for control words when no prior context was provided. This difference disappeared with appropriate subject-noun and verb contexts. These data support a prior context model for processing ambiguous lexical items.

A word is lexically ambiguous if it has at least two distinct meanings. for example, the word "ring" is lexically ambiguous because it can refer to either a type of jewelry or to the sound of a bell. Since we are not in the habit of mistaking a telephone ring for a wedding ring, there must be some sort of mechanism to tell one "ring" from the other.

We often use clues from the context of the surrounding discourse. Thus, the sentences:

1. The diamond ring was very beautiful.

and

2. The telephone began to ring.

tell us which meaning of the word ring is appropriate. However, there are also sentences which give us no clue at all to the identity of the word, for instance:

3. John gave Mary a ring.

Our clue to the identity of this "ring" is presumably somewhere else in the discourse. So if the sentence following was either:

4. But it was too small for her finger.

or

5. But her phone was out of order.

then our confusion is, more or less, cleared up.

What then, is our strategy for understanding an ambiguous word? When we listen to a sentence, we try to decode its correct meaning on-line, that is, while it is still being heard.

A complex word or phrase takes longer to process than a simple word or phrase. A way to test this complexity is to have someone listen for a sound in a sentence. The sound will occur immediately after the word whose complexity is at issue. If the word is ambiguous, and therefore presumably complex, then the person will take longer to detect the sound. This is because he is still working on the word he has just heard. But if the word is simple, the person can understand it quickly, and therefore be ready to detect the sound. This technique was developed by Foss, and is called phoneme monitoring. In Foss's experiments, people were asked to listen for a specified phoneme at the beginning of a word. This phoneme always occurred after an ambiguous or a nonambiguous word. When the phoneme started, it also started a timer. The timer was stopped when the person pressed a button indicating he had detected the phoneme.

For instance, in Foss and Jenkins's 1973 experiment, subjects heard the following sequence:

6. Ready /b/
The jeweler counted eight rings before someone interrupted her.

where /b/ in the word "before" is the target phoneme, and "rings" is the ambiguous word. Foss and Jenkins found that subjects had longer reaction times to detect phonemes after ambiguous words than after nonambiguous ones. This reaction time was assumed to reflect the words processing complexity.

The issue I want to discuss is whether sentence context can make an ambiguous word as simple to understand as a non-ambiguous word. There are two main theories about how ambiguous words (or homographs) are processed.

If, at the instant we hear the word "ring," we access all the meanings of ring and then compare each to context, then no amount of prior context can simplify processing. Foss and Jenkins call this the Choice Point Decision model. The data of Foss and his colleagues strongly support this model. In 1973, they used nouns to constrain the meaning of ambiguous words. There was no effect. In 1975, they used adjectives; also finding no reduction in reaction time following ambiguous words. These results support the Choice Point Decision model. Despite their context manipulations, phoneme detection had taken longer after ambiguous words than after nonambiguous words.

The other theory we are interested in is called the Prior Decision model. In this model, context permits only the probable meaning of an ambiguous word to be accessed. We are automatically pointed to the right meaning of the word. In this model, then, context can make ambiguous words simpler. This model is intuitively pleasing because we rarely notice double meanings in everyday discourse. Nevertheless, with the exception of Swinney, who used whole paragraphs to provide a context, no-one has been able to find any effect of prior context on processing homographs, at least with the phoneme monitoring technique.

Now, while I have ultimate faith in data over intuitions, I wondered whether these data were as strong as my intuition that the Choice Point Decision model makes no sense at all!

Our language is flooded with ambiguity. If we must always "compute" all the possible literal meanings of words or phrases or sentences, irrespective of context, we would never understand anything! Is it possible that we just haven't found an appropriate context manipulation? So far, either subject nouns or adjectives have been used to constrain the meanings of ambiguous words. Quite often these contexts do not fully disambiguate a homograph. They only bias the interpretation in one direction or another. What would happen if we <u>fully</u> constrained the interpretation of an ambiguous word?

One way to do this would be to use an appropriate noun-verb combination. We chose a set of sixteen homographic words, and embedded each as the object of a sentence in two types of sentence frames.

First, a frame in which the subject noun and verb did <u>not</u> constrain the homograph toward any single meaning.
For example:

7. The woman counted six rings before she left the room.
where "rings" is the critical word and the phoneme /b/ in the word "before" is the target phoneme.

Second, a frame in which a lexically constraining noun and verb <u>did</u> bias the homograph toward one meaning.
For instance:

8. The jeweler wore six rings before they were stolen.

In order to compare phoneme detection following homographs with detection following nonambiguous words, sixteen non-ambiguous control words were placed in the same set of sentence frames. For example:

9. The woman counted six emeralds before she left the room.

and

10. The jeweler wore six emeralds before they were stolen.

where emeralds is the critical control word and /b/ in "before" is the target phoneme to be monitored. This yielded a 2 X 2 design; Context (neutral versus constrained) by Word Type (ambiguous versus nonambiguous).

Following Foss's phoneme monitoring procedure, we asked people to press a button whenever they heard a word which began with a specified phoneme, either /b/ or /d/. A timer was started when the phoneme began and was stopped when the subjects pressed a button. The reaction times were assumed to measure the complexity of processing the word just before the target phoneme.

The data are shown in figure one of the handout. Notice first that the standard effect of ambiguity was obtained when the context was neutral (left side of figure). Phoneme detection was significantly longer following an ambiguous word than following a nonambiguous word. However, when the meaning of an ambiguous word was constrained by the preceding noun and verb of the sentence, this difference disappeared. (the right side of figure one). The apparent reversal, by the way, is not significant.

These findings provide strong support for a Prior Decision model. The processing time of ambiguous words may be shortened to the time of nonambiguous words with appropriate lexical constraints. These data are consistent with a mechanism in which the contextual bias of a noun-verb pair serves as an effective constraint on the number of meanings that need to be computed. The difference between these findings and those of earlier research can be accounted for by our context manipulation. Previous studies had used only a noun or an adjective to constrain the meaning of a homograph. In these studies, the verbs employed in the sentence frame could still permit either meaning of the homograph to "make sense". For example, listen to the sentence:

11. The jeweler counted eight rings before they were stolen.

In spite of its apparent constraints, this sentence is still very much ambiguous. Most of you would not feel garden-pathed if you heard:

12. The jeweler counted eight rings before he picked up the telephone.

Therefore, in our view, the noun alone may not form the major contextual constraint in a sentence. The combination of noun <u>and</u> verb, however, is a very effective constraint.

A necessary extension of this experiment is to see whether a verb alone can carry the major burden of lexical biasing, or whether a complete noun-verb pair is always needed. This requires a completely counterbalanced set of sentence frames. In the study we are running now, we are testing each homograph with neutral context, noun constraint alone, verb constraint alone, and noun-verb constraint. These degrees of bias are being tested over <u>both</u> primary meanings of each homograph. Control (nonambiguous) words have been chosen for each of the meanings being manipulated. In all there are sixteen sentence frames created for each homograph and control pair. This study should provide an appropriate and definitive test of the Prior Decision model of homograph processing.

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figure one

Phoneme detection latencies
(msec) as a function of context
and word type