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The Effects of Word Processing, Recognition and Context in Lexical Ambiguity Resolution

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Abstract

This article aims to discuss the effects of word processing, recognition and context in lexical ambiguity resolution, trying to find an answer to how the reader-listener determines the contextually appropriate meaning of a word. Ambiguity resolution is analyzed and explored in two perspectives: the context in which the lexical items appear and the activation of all the meanings that an ambiguous word has. There is no clear-cut answer to lexical ambiguity resolution and there is a great debate about the role of the context in the activation of the meaning of ambiguous words.

Keywords: Lexical ambiguity, word processing, word recognition, context.

Lexical Ambiguity

One of the main questions that puzzle psycholinguistic research is how a reader or a listener copes with an ambiguity problem. Lexical ambiguity research has addressed how the reader-listener determines the contextually appropriate meaning of a word with multiple senses. Lexical ambiguities pervade natural language, with words exhibiting different types and degrees of ambiguity. For example, the alternative senses of ambiguous words can be spelled and pronounced the same (rose), spelled the same but pronounced differently (wind or bass) (MacDonald, Pearlmuter, & Seidenberg, 1994). Almost all words in the English lexicon exhibit a nonzero degree of ambiguity. For example, the American Heritage dictionary lists around 40 separate meanings of take, some of which have multiple related senses. During normal language comprehension, we go further than just recognizing individual words. We also integrate the syntactic and semantic properties of the recognized word into a representation of the whole utterance. For instance, consider the following sentence:

The boy who climbed the tree bruised his knee on the sharp bark.

Why do we read *bark* to mean "tough protective covering of the woody stems and roots of tree" instead of "the sound made by a dog" (WordNet Online Lexical



Database). We may suggest that we do so because the sentence creates a context which is compatible with one meaning and not any other. Let's consider another example:

Rumor had it that, for years, the government building had been plagued with problems. The man was not surprised when he found several spiders, roaches, and other bugs in the corner of the room (Swinney, 1979, p.650).

Here, we read bugs to mean "general term for any insect" instead of "a fault or defect in a system or machine" or "a small hidden microphone". Another example clearly indicates the problem regarding the choice of meaning when a stance includes a word with more than possible meaning:

My sister cannot bear children.

When we read or hear the sentence above, we might interpret that the sister of the speaker/writer either cannot stand/endure children or she cannot give birth to children. If we would like to make the meaning clear or resolve this ambiguity, we might add a subordinate clause such as *although she has attempted several fertility treatments*.

Considering the debates over ambiguous words and activation of the meanings, it appears that there are two possible scenarios:

- Comprehension processes are highly interactive, thereby selecting appropriate word meanings during lexical access;
- Comprehension processes are autonomous, thereby selecting word senses after all lexical information is accessed.

In addition to these two scenarios, it is highly possible that the ambiguous words in the sentences given above include high frequency words. That is, these words are the words that we encounter in natural language. Therefore, it can be stated that the reader and/or listener might know the other possible meanings and can quickly eliminate unrelated meanings due to the nature of high-frequency of these words (Rayner & Duffy, 1986; Joseph, Nation, & Liversedge, 2013).

How we process words

Lexical processing is a well-investigated phenomenon in psycholinguistics. Most researchers will agree on its components that include lexical access, selection and integration. The output analysis is projected on toward form representations in the mental lexicon. Lexical access differs for visual and auditory modalities.

The continuity of the speech signal in spoken input is different from the boundaries in written input. A listener is challenged to segment speech and to control the speed of its input. When a language user read a text in a book, s/he can go back and reread it. But when s/he tries to understand what some is saying, s/he



can lose track of the conversational flow. An influential model in this respect is the Cohort model of Wilson (Gleason & Rather, 1998).

The model assumes that processing in speech starts with the very first sound or phoneme that the listener has identified as the onset of a word. It is clear that when not all the information is available, more than one representation will be activated because more than one representation will fit the first part of the output. This means that of the activated word form representations, the one that best matches the sensory input has to be selected. In this model, selecting the appropriate word form depends on the incoming sensory information and the number of competitors in the word initial cohort. Words are not processed in isolation most of the time. Instead, they are processed in the context of other words. In order to understand words in their context, one has to integrate syntactic and semantic properties of the word.

Models of word recognition

In general, three types of models do explain word comprehension: Modular models, interactive models and hybrid models (Gazzaniga, Ivry, & Mangun, 1998). Modular models suggest that language comprehension is executed within independent modules. Higher-level representations cannot influence the lower-level ones and as a result, the flow is bottom-up.

These models claim that context information cannot affect lexical access or selection process. Interactive models, on the contrary, suggest that all types of information participate in the process together with context changing the status of the word form in the mental lexicon. Hybrid models have the notion that lexical access and selection can be affected by the preceding context which can reeducate the number of activated candidates.

As Gazzaniga, Ivry and Mangun suggested, "We do not know which type of model fits word comprehension the best, but there is growing evidence that at least lexical selection is influenced by higher-level context information" (p. 299).

Context Effect

The theories that have been dominant over the years suggest that lexical ambiguity resolution has been heavily influenced by the finding that language users briefly activate multiple meanings of ambiguous words even in disambiguating contexts (Swinney, 1979; Samuel, 1986).

Swinney's study aimed to find out whether a local linguistic context constrained access to the appropriate meaning of an ambiguous word as implied by the context, or other meanings of the ambiguous words are also activated. In order to test this, he used cross-modal lexical priming, "in which an auditory sentence containing an ambiguous or unambiguous control, was paired with a visual probe word" (MacDonald, Pearlmuter, & Seidenberg, p. 677).

Swinney tape recorded a person reading the following passage at a normal rate of speed and at the instant the word *bugs* was heard by the participants,



Swinney flashed on a lexical decision which included a word that was contextually appropriate (ant), or a word that is contextually inappropriate (spy), or a control word that was unrelated to the meaning (sew).

Rumor had it that, for years, the government building had been plagued with problems. The man was not surprised when he found several spiders, roaches, and other bugs [1] in the [2] corner of the room.

Some of the participants were given the word "ant" immediately after the ambiguous word (1) while some were given after several syllables later (2). The results of the study were as follows:

- Lexical decision for words related to all readings of an ambiguity is facilitated
- Effect holds even in conditions where there is a strongly biasing semantic context.
- Facilitation of irrelevant word senses decays after three syllables, which means all senses are initially activated, but only very briefly.

Many of the studies conducted on lexical ambiguity resolution have used Swinney's cross-modal priming paradigm. A number of different paradigms have also been used to examine the effects of context on ambiguous words, notably: phoneme monitoring, word monitoring, sentence decision, Rapid Serial Visual Presentation. Studies demonstrating that ambiguous words place an increased load on processing based on tasks such as phoneme or word monitoring offer indirect evidence for multiple accesses of meanings.

The main finding obtained in numerous studies is that when visual targets are presented immediately after the ambiguous word, there is significant facilitation in responding to targets that are related to either alternative meaning of the ambiguous word. If targets presented somewhat later (a delay of 200 ms or several words), there is facilitation only for the target related to the contextually appropriate meaning (Onifer & Swinney, 1981; Seidenberg, Tanenhaus, Leiman, & Beienkowski, 1982; Kintsch & Mross, 1985; Till, Mross, & Kintsch, 1988; Blitner & Sommer, 1988).

It could also be case that context will reduce processing load in such studies by allowing faster access to one or both meanings, but will not restrict access to just one meaning (Onifer & Swinney, 1981). However, an alternative account is also present to explain the situation. It is also supported by a number of studies (Seidenberg, Tanenhaus, Leiman, & Beienkowski, 1982; Kintsch & Mross, 1985; Van Petten & Kutas 1987). According to these studies, the effect of sentence context is interpreted as demonstrating the interaction between lexical access and the developing interpretation of the sentence. As the sentence is processed, activation feeds back to the lexical access process. Concepts related to the sentence interpretation are primed.

As processing continues, the feedback loop leads to the activation of the appropriate meaning and elimination of the inappropriate meanings. Word forms frequently encountered together become associated and they give rise to activation



of one member of pair in the presence of the other. St John provides us with an example which shows that "gambler", "deal", and "cards" are semantic associates and claims that in the sentence "The sly gambler dealt the hand from the bottom of the deck, participants may respond quickly to "cards" since it is semantically associated to other words. Samuel (1986) claimed that "... in many paradigms, subjects are better at reporting common words (high frequency of occurrence) than unusual ones (low frequency) (p. 95). For example, "bank" is used far more frequently in financial situation sense. There are several important findings regarding frequency. The studies provide clear evidence that frequency of meaning has an impact on processing.

Studies are also differentiated with respect to whether the ambiguous target word is presented in the context of a pair or triplet of isolated words or rather in the context of a sentence. This difference is important as a paradigm in which words are presented as isolated pairs allows and even encourages looking for relationships between words. This is likely to increase the effects of a context over those effects normally available in discourse processing. Sentence contexts are more likely to disallow intentional processing. While all paradigms allow examination of some type of context effects, they cannot be compared directly, nor will results using one of type of context necessarily predict effects observed when using the other (Prather & Swinney, 1988).

Conclusion

The context normally helps to disambiguate the word and we sometimes may not even be aware of any other possible meanings. It is also not rare that we cannot understand or find the sentence/utterance difficult to comprehend due to lack of other possible meanings since we have only one meaning on our minds. If when talking about beer, we use the word glasses, it will not probably occur to us that the same word can also mean corrective lenses. The association with the idea of a drink container might be provided automatically by the context. In terms of interactive activation-base models, we can think of the context as providing additional activation to the appropriate meaning, which is then selected by some activation-sensitive process. However, there is a great debate about the role of the context in the activation of the meaning of ambiguous words. Considering the studies discussed above, one suggestion is that the initial activation of the ambiguous word meaning is due to the context, as the context only primes the meaning that is consistent with it, making it unnecessary to access the other meanings, while the other is that when an ambiguous word is presented, all its meanings are activated, and the context selects the meaning consistent with it. As we can see, the effect of the context is still an open question.



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