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Single-word predictions of upcoming language during comprehension: Evidence from the cumulative semantic interference task



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ABSTRACT

Comprehenders predict upcoming speech and text on the basis of linguistic input. How many predictions do comprehenders make for an upcoming word? If a listener strongly expects to hear the word “sock”, is the word “shirt” partially expected as well, is it actively inhibited, or is it ignored? The present research addressed these questions by measuring the “downstream” effects of prediction on the processing of subsequently presented stimuli using the cumulative semantic interference paradigm. In three experiments, subjects named pictures (*sock*) that were presented either in isolation or after strongly constraining sentence frames (“After doing his laundry, Mark always seemed to be missing one...”). Naming *sock* slowed the subsequent naming of the picture *shirt* – the standard cumulative semantic interference effect. However, although picture naming was much faster after sentence frames, the interference effect was not modulated by the context (bare vs. sentence) in which either picture was presented. According to the only model of cumulative semantic interference that can account for such a pattern of data, this indicates that comprehenders pre-activated and maintained the pre-activation of best sentence completions (*sock*) but did not maintain the pre-activation of less likely completions (*shirt*). Thus, comprehenders predicted only the most probable completion for each sentence.

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1. Introduction

Language comprehenders and horror movie victims have something in common: Both would benefit from knowing what's going to happen next. The ability to anticipate upcoming events on the basis of current information is useful in a wide variety of situations, as it helps drivers brake for pedestrians who intend to cross the street, allows batters to hit baseballs thrown at high speeds, and increases the likelihood of successfully evading a hockey mask-wearing pursuer.

One domain in which anticipation is especially helpful is language processing. As a sentence unfolds over time, listeners must rapidly recognize each word and integrate it into the preceding context to recover the speaker's intended meaning. The difficulty of this process could be reduced if listeners were capable of generating expectations about words prior to hearing them. For example, consider this sentence fragment: "After doing his laundry, Mark always seemed to be missing one . . ." It is easy to see that the next word is likely to be an article of clothing; furthermore, it is the kind of article that is often misplaced. To the extent that listeners can make efficient use of this real-world knowledge, they might be able to anticipate (correctly) that the next word will be "sock", making it easier to recognize the word once they actually hear it.

Existing research suggests that listeners and readers do in fact engage in such anticipatory behavior, generating predictions of upcoming speech and text that can vary in scope from semantic features (Szwedczyk & Schriefers, 2013) to the level of individual words (DeLong, Urbach, & Kutas, 2005; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; Wicha, Bates, Moreno, & Kutas, 2003; Wicha, Moreno, & Kutas, 2003, 2004). These predictions may be either conscious and controlled in nature (as suggested above) or they may be more passive, with contextually relevant words rising and falling in accessibility as a sentence or discourse unfolds (Myers & O'Brien, 1998; Van Berkum, 2009). Either way, predicting a word affects processing by increasing the activation (i.e., accessibility) of its representation in the mental lexicon, often called its lemma. This increase facilitates the subsequent access of the predicted word when the prediction is correct.¹

However, prediction may also affect the activation of words other than the most likely candidate, including those that are semantically related to it (e.g., *shirt* for the "sock" sentence above). These related words might receive activation directly from the sentence, as they share overlapping conceptual representations with the most strongly predicted word and thus are likely to appear in the same kinds of contexts, or indirectly, via spreading activation. The present research focuses on how prediction affects these semantically related words on two different timescales. Specifically, how does the "sock" sentence affect the activation of the *shirt* lemma (a) as the sentence unfolds (the immediate effects of prediction), and (b) when similar contexts are encountered in the future (the "downstream" effects of prediction)?

We will present a novel way of examining these effects by combining sentence comprehension with a paradigm from language production research. As a first step, we focus here on a situation that encourages comprehenders to make specific predictions about the identity of an upcoming word by using strongly constraining sentences. It is fair to note at this point that confining our investigation to a task context that encourages very specific predictions may limit the extent to which our conclusions can be generalized. We address this point in Section 6 in light of the observed results, and speculate on how future research can use this paradigm to investigate the scope of prediction more generally, including discriminating between situations in which comprehenders do and do not make single-word predictions.

1.1. Effects of sentential constraint on non-target words

There are three possible ways that the "sock" sentence might affect the activation of non-target lemmas. As it seems likely that non-target lemmas become (either directly or indirectly) activated

¹ Alternative accounts argue that some facilitation from context may be attributable to the ease with which a word can be integrated into that context (e.g., Hagoort, Baggio, & Willems, 2009). The current data will not be able to adjudicate this long-standing debate, but results will be framed in terms of pre-activation.

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