Memory for words in sentences: The influence of word frequency and fixation time

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Little is known about the factors that influence episodic memory for words encountered in the course of normal language comprehension. However, the recognition memory literature has shown a reliable benefit for low-frequency (LF) items: The mirror effect is a classic finding in which LF words are both better recognized as old when previously studied (higher hit rate) and better rejected as new when not previously studied (lower false alarm rate) compared to HF words (Glanzer & Adams, 1985; 1990). The present study tested whether 1) LF words are also better remembered after they are encountered in normal reading, in the absence of any explicit instructions to remember target words, and 2) the time the eyes spend on a word predicts later memory for that word, independent of any frequency effect.

Subjects (N = 28) each read 100 sentences for comprehension while their eye movements were monitored. Each sentence contained a critical HF or LF word, which was not marked in any way; the words were closely matched on a range of lexical characteristics. Linear mixed effects models revealed standard frequency effects on eye movements (Inhoff & Rayner, 1986; Rayner & Duffy, 1986), with longer first fixation durations ($b = .10$, $SE = .02$, $t = 5.30$), gaze durations ($b = .24$, $SE = .03$, $t = 7.51$), and total times ($b = .32$, $SE = .04$, $t = 8.44$) on LF words. At test, studied words and an equal number of new words were presented in a standard recognition design. The mirror effect was evident, as LF words had both higher hit rates [.72 vs. .66; $t = -2.12$, $p = .043$] and lower false alarm rates [.25 vs. .38; $t = 5.27$, $p < .001$]. Surprisingly, the time spent fixating a word, whether measured by first fixation duration, gaze duration, or total reading time, did not predict later memory accuracy for that word after including frequency in mixed-effects logistic regression models (first fixation: $b = -.009$, $SE = .17$, $z = -.05$, $p = .958$; gaze: $b = .04$, $SE = .13$, $z = .35$, $p = .730$; total time: $b = .04$, $SE = .13$, $z = .35$, $p = .730$). This was a convincing null effect, as examination of fixation times as a function of later ‘hit’ or ‘miss’ revealed no consistent trends.

The critical results of this study are that word frequency does affect memory for words encountered in normal reading, but the time spent fixating a word does not independently predict memory performance. We emphasize that this latter finding has implications for encoding-based accounts of the mirror effect. With respect to language processing, the present results imply that even words that receive only very brief eye fixations in reading are encoded well enough to be remembered on a subsequent recognition test. We regard this conclusion as consistent with the assumption that the eyes do not move on from a word until the process of lexical access is essentially complete (e.g., Reichle, Rayner, & Pollatsek, 2003).