

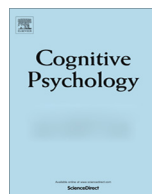


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Contents lists available at ScienceDirect

Cognitive Psychology

journal homepage: www.elsevier.com/locate/cogpsych



Limits on lexical prediction during reading



Steven G. Luke^{a,*}, Kiel Christianson^b

^aBrigham Young University, United States

^bUniversity of Illinois at Urbana-Champaign, & Beckman Institute for Advanced Science and Technology, United States

ARTICLE INFO

Article history:

Accepted 15 June 2016

Keywords:

Prediction

Reading

Word recognition

Eye movements

Cloze probability

ABSTRACT

Efficient language processing may involve generating expectations about upcoming input. To investigate the extent to which prediction might facilitate reading, a large-scale survey provided cloze scores for all 2689 words in 55 different text passages. Highly predictable words were quite rare (5% of content words), and most words had a more-expected competitor. An eye-tracking study showed sensitivity to cloze probability but no mis-prediction cost. Instead, the presence of a more-expected competitor was found to be facilitative in several measures. Further, semantic and morphosyntactic information was highly predictable even when word identity was not, and this information facilitated reading above and beyond the predictability of the full word form. The results are consistent with graded prediction but inconsistent with full lexical prediction. Implications for theories of prediction in language comprehension are discussed.

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1. Introduction

In recent years, psycholinguists have devoted considerable attention to the prediction of upcoming input by language comprehenders. This body of research has shown that highly predictable words are easier to recognize (Fischler & Bloom, 1979; Kutas & Hillyard, 1984; Schwanenflugel & LaCount, 1988; Schwanenflugel & Shoben, 1985) and to produce (Piai, Roelofs, & Maris, 2014). Research has suggested that highly constraining sentences permit the generation of highly specific predictions that include

* Corresponding author at: Department of Psychology, Brigham Young University, 1062 SWKT, Provo, UT 84602-5543, United States. Fax: +1 801 422 0602.

E-mail address: steven_luke@byu.edu (S.G. Luke).

not just semantic content (Federmeier & Kutas, 1999; Federmeier, McLennan, Ochoa, & Kutas, 2002), but also morphosyntax (Luke & Christianson, 2015; Otten, Nieuwland, & Van Berkum, 2007; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; Wicha, Bates, Moreno, & Kutas, 2003), phonology (DeLong, Urbach, & Kutas, 2005), orthography (Laszlo & Federmeier, 2009), letter position (Luke & Christianson, 2012), and visual features of objects, such as shape (Rommers, Meyer, Praamstra, & Huettig, 2013). Predictions generated from spoken language guide eye movements when looking at images (Altmann & Kamide, 1999, 2007; Kamide, Altmann, & Haywood, 2003; Staub, Abbott, & Bogartz, 2012). Further, eye-tracking studies have shown that the predictability of a word strongly influences reading times on that word (Ashby, Rayner, & Clifton, 2005; Balota, Pollatsek, & Rayner, 1985; Ehrlich & Rayner, 1981; Kliegl, Grabner, Rolfs, & Engbert, 2004; Rayner, Slattery, Drieghe, & Liversedge, 2011; Rayner & Well, 1996; Zola, 1984; for a recent review see Staub, 2015). Thus, it appears that not only are detailed and specific predictions generated in highly constraining contexts, but that these predictions facilitate auditory and visual word and sentence comprehension. As a result, many different theoretical accounts have incorporated strong predictions as an essential component of language comprehension (Christiansen & Chater, 2016; Dell & Chang, 2014; Pickering & Garrod, 2007, 2013).

In spite of the accumulated evidence that the language processor engages in prediction, there are still many questions that remain unanswered about the nature of predictive processes in language comprehension. Huettig (2015) poses four questions about prediction in language processing, of which the present paper will focus on two: When does prediction occur, and what is predicted? Traditional views of language comprehension held the role of prediction to be limited, at best, and language processing was conceptualized as a largely bottom-up process. DeLong, Troyer, and Kutas (2014; Kutas, DeLong, & Smith, 2011) outline several reasons why this might be the case, the most prominent of which is that any given linguistic input can unfold in innumerable ways in terms of lexical content and, to a lesser extent, syntactic structure (Jackendoff, 2002). Prediction should therefore be practically limited in most contexts, irrespective of theoretical predispositions. A slew of past studies have examined this question with regard to reading (Finn, 1977; Gough, 1983; Gough, Alford, & Holley-Wilcox, 1981; Nicholson & Hill, 1985; Perfetti, Goldman, & Hogaboam, 1979; Rubenstein & Aborn, 1958; Schatz & Baldwin, 1986). Using a cloze task as an estimate of predictability, in which a group of participants are given the context up to but not including the target word and are asked to provide the next word (Taylor, 1953), these researchers generally found low average predictability (0.2–0.3), and Gough (1983) found that the distribution of predictability was strongly skewed, with relatively few highly predictable words and many unpredictable ones. Based on these observations, these early researchers identified two significant problems with prediction, at least in reading. First, most words are not predictable from context. “Relatively few words could be successfully predicted on the basis of one trial and from a knowledge of the preceding context alone” (Rubenstein & Aborn, 1958, pg. 31). Second, when a prediction was made it was likely to be incorrect. “[T]he effect of . . . context cannot be mediated by a reader’s . . . predictions because, if they are precise enough to help, they are wrong too often to do so” (Gough et al., 1981, pg. 101). These concerns, and others, have led some researchers to question the necessity of predictive processes in language comprehension (Huettig & Mani, 2016).

On the surface, it appears difficult to reconcile the large body of evidence that prediction can occur with the relative unpredictability of most words in reading or listening. Is prediction a central feature of the language processor, or is it a peripheral one, a bonus that perhaps proves useful in a few specific situations? Unfortunately, language researchers have not been precise in their use of the term *prediction*. DeLong et al. (2014) note many different ways that the word *prediction* has been used by researchers (see also Staub, Grant, Astheimer, & Cohen, 2015). It can be defined as “the all-or-none process of activating a linguistic term (a word) in advance of perceptual input” (DeLong et al., 2014, p. 632), a sense that we will term *lexical prediction*. Lexical prediction is conceived of as an active process that can be facilitative if the correct word is predicted. Full lexical predictions might also be expected to incur a processing penalty when the prediction is incorrect (DeLong et al., 2014; Kutas et al., 2011; Posner & Snyder, 1975), although this may depend on whether the processor keeps multiple representations active or ‘commits’ to a single prediction (Kuperberg & Jaeger, 2016). Importantly, lexical prediction is unlikely to occur unless context is sufficiently constraining. A sentence

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