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Evidence accumulation as a model for lexical selection



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ABSTRACT

We propose and demonstrate evidence accumulation as a plausible theoretical and/or empirical model for the lexical selection process of lexical retrieval. A number of current psycholinguistic theories consider lexical selection as a process related to selecting a lexical target from a number of alternatives, which each have varying activations (or signal supports), that are largely resultant of an initial stimulus recognition. We thoroughly present a case for how such a process may be theoretically explained by the evidence accumulation paradigm, and we demonstrate how this paradigm can be directly related or combined with conventional psycholinguistic theory and their simulatory instantiations (generally, neural network models). Then with a demonstrative application on a large new real data set, we establish how the empirical evidence accumulation approach is able to provide parameter results that are informative to leading psycholinguistic theory, and that motivate future theoretical development.

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1. Introduction

Lexical selection may be broadly defined as the process of selecting a lexical target from a number of alternatives, such as when one names an object or a concept. There are a number of conventional

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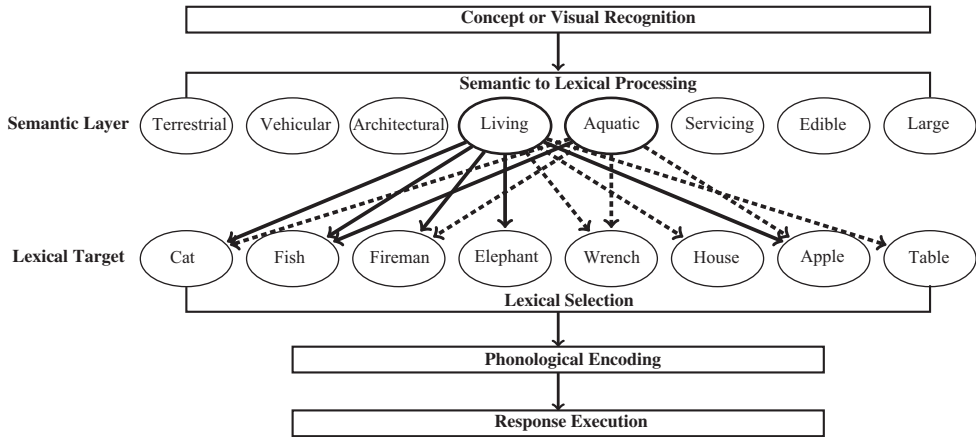


Fig. 1. A depiction of the process involved in lexical retrieval, with focus on the details between semantic to lexical processing; in the style of preexisting theories (Dell & Gordon, 2003; Dell & O'Seaghdha, 1992; Dell et al., 1997; Oppenheim et al., 2010). Semantic features 'Living' and 'Aquatic' are activated by the stimulus, which provide excitatory (solid lines) and inhibitory (dashed lines) activations to lexical targets. In a later lexical selection process upstream, it is likely that 'Fish' will win, as earlier it received more excitatory activation inputs than the alternative lexical targets.

psycholinguistic theories aimed to explain the principles that underlie lexical selection (e.g., Chen & Mirman, 2012; Howard, Nickels, Coltheart, & Cole-Virtue, 2006; Levelt, Roelofs, & Meyer, 1999; Oppenheim, Dell, & Schwartz, 2010), and they notably specify lexico-semantic interactions (semantic interactions on lexical alternatives, as in Fig. 1). These theories vary in the nature of the principles they propose, and their levels of specificity. For example, if they also specify details of morphological and phonological element interactions. They may also vary in how far they can be extended, such as if they can account for lexical selection in individuals also with cognitive impairments.

We propose that it may be a disadvantage however, that none of these theories argue it is an evidence accumulation (sequential sampling) kind of process that underlies lexical selection; and/or that none of these theories utilize evidence accumulation models empirically, as a more sophisticated method of analysis to more deeply inform or support their claims. In this paper, we develop a case for both of these statements, and also provide demonstrations. Specifically, we newly propose and demonstrate evidence accumulation as a model for the lexical selection process of lexical retrieval, and further discuss it in the context of conventional psycholinguistic theory and tradition. Secondly and to our knowledge, we provide the first quantitative data fitting of a lexical selection data set (in the picture naming task) with an evidence accumulation model, and we also contribute a new large lexical retrieval data set to this effort. Thirdly, we newly show how this empirical approach with evidence accumulation modeling, can provide parameter results that are informative to a leading psycholinguistic theory, and that motivate future theoretical development.

2. Proposing evidence accumulation for lexical selection

In this section, we begin with a discussion of how conventional psycholinguistic theories can benefit from using the evidence accumulation approach empirically. Then, we discuss ways in which the evidence accumulation approach can be embedded within current psycholinguistic theory, for modeling the lexical selection process.

2.1. The empirical approach

Conventional psycholinguistic theories are generally conceived of by a combination of scholarly interpretations of many prior empirical results, consisting generally of the lexical choice patterns

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