

Bilingualism is in dire need of formal models

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Each year the Cognitive Science Society honors David Rumelhart by awarding the Rumelhart Prize to an outstanding cognitive scientist whose research makes a significant contribution to the formal analysis of human cognition. Formal models of language, including those of Rumelhart and his associates, are well known to psycholinguists in the monolingual context. The formalism of language in the bilingual context, however, is lamentable: to this date, there are only a handful of models (connectionist or otherwise) that are designed specifically to account for bilingual language processing and acquisition (cf. Li and Farkas, 2002). BIA is one of them. BIA+ is now another.

Bilingualism research is faced with a dilemma today. While the field lacks formal models like BIA and its variant, researchers must deal with a large number of crucial variables or factors that are believed to influence bilingual language processing, a number that starts to exceed our short-term memory buffer. These factors, as can be discerned from the keynote article, include (minimally) bilingual proficiency, history of learning, time of L2 learning, task demand in experimentation, type of words in the lexicon being tested, similarity structure of the two languages and bilingual speech mode. It is difficult to make sense of a bilingual study that does not control for these variables – indeed, many studies either ignore them in experimentation or fail to take them into account in interpretation (see discussions in Grosjean, 1998). Now the question is, how can one control for all of these variables in any study? Formalism gets us out of the dilemma with a handy control of parameters in one sweep.

The extension of BIA to BIA+ is one example of how we can explain bilingualism more precisely by considering more variables and adding newer mechanisms to the model. For example, Dijkstra and van Heuven point out that the explanatory power of BIA has been limited by its lexical representations, its ability to handle context effects and its lack of an implemented task structure. BIA+ goes beyond these limitations by incorporating phonological representations, linguistic and non-linguistic context effects, and a task-decision component.

But even this is not enough. As Dijkstra and van Heuven acknowledge, there are many other aspects that need to be considered for bilingual word recognition. One future direction they mention is how the model would develop over time in learning. In this regard, I argue that the study of language representation in adults should ultimately be connected to research in developmental bilingualism (to echo a similar point made by Bialystok, 2001). Formal models of bilingualism may take an initiative in making this connection. Such a connection can potentially reconcile conflicting results in empirical research. For example, a central argument of BIA and BIA+ is that on-line access to the bilingual lexicon is language-independent,

in contrast to the language-selective view of bilingual lexical access. However, it may be the case that developmentally, both language-independent access and language-selective access are possible, depending on the level of proficiency in bilingual language development. For highly proficient bilinguals, orthographic overlap in the bilingual lexicon leads to inhibitory effects in the access of words in the target language (Bijeljac-Babic, Biardeau and Grainger, 1997), providing evidence for language-independent access to the bilingual lexicon. For the beginning bilingual learners, however, such inhibitory effects may be much weaker or nonexistent, as shown in Bijeljac-Babic et al.'s study, in which bilingual proficiency was manipulated, thus providing evidence for language-selective access. This situation is analogous to lexical ambiguity processing in the monolingual context, where exhaustive access or selective access of multiple meanings of an ambiguous word depends on factors such as strength of context bias, frequency of each of the multiple meanings, and density of the competing meanings. Although BIA (and BIA+) is able to simulate this type of effects in bilingualism, for the most part, the model remains a “proficient bilingual model” rather than a “developmental bilingual model”.

Cognitive theories of language are notoriously dichotomous. Yet language use is a complex human behavior that lies on a continuum of multiple dimensions, and this complexity is reflected even more strongly in bilingual language processing and bilingualism in development. Thus, the very phenomenon of bilingualism requires that our interpretations take into account diverse perspectives and be non-dichotomous in nature (cf. Grosjean, 1998). Formal models of bilingualism can facilitate this process, as demonstrated by BIA and BIA+. In addition, contrary to Dijkstra and van Heuven's conclusion that the implementation of the model must wait for the accumulation of empirical knowledge, I would argue that modeling allows us to consider crucial factors more effectively, and that it can generate predictions that aren't yet available in empirical research but can be tested in empirical studies.

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