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EDITORIAL

Computational approaches to word retrieval in bilinguals

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The cognitive architecture of human language processing has been studied for decades, but using computational modeling for such studies is a relatively recent topic. Indeed, computational approaches to language processing have become increasingly popular in our field, mainly due to advances in computational modeling techniques and the availability of large collections of experimental data. Language learning, particularly child language learning, has been the subject of many computational models. By simulating the process of child language learning, computational models may indeed teach us which linguistic representations are learnable from the input that children have access to (and which are not), as well as which mechanisms yield the same patterns of behavior that are found in children's language performance.

One excellent testing ground for the application of computational models is the field of bilingualism. Research on computational models of bilingualism started out from adapting existing computational models of monolingual language learning/processing to bilingual language performance, by modifying these models to account for particular features of bilingualism such as cross-language interference, the relative level of proficiency in each language, and language dominance. Up till now, several computational models have been proposed to account for specific aspects of bilingual processing, in particular with respect to word comprehension and production (Green, 1998; Kroll & Stewart, 1994; Li & Farkas, 2002; Roelofs, Dijkstra & Gerakaki, 2013; Zhao & Li, 2010, 2013), as well as with respect to code mixing; see the Keynote Article by Goldrick, Putnam and Schwarz (2016) plus commentaries in this journal. In the domain of bilingual word recognition, reference is often made to the connectionist Bilingual Interactive Activation (BIA) model originally developed by Dijkstra and collaborators (BIA; Dijkstra & Van Heuven, 1998; Van Heuven, Dijkstra & Grainger, 1998) and its immediate successor, the BIA+ model (Dijkstra & Van Heuven, 2002).

We are delighted to present in the current issue of Bilingualism: Language and Cognition a Keynote Article by Dijkstra and coauthors (2019a) which introduces their Multilink model, a novel extension of the BIA+ model that also integrates basic assumptions of the Revised Hierarchical Model (RHM; Kroll & Stewart, 1994). In their own words, Multilink simulates the recognition and production of cognates and non-cognates of different lengths and frequencies, in tasks such as monolingual and bilingual lexical decision, word naming, and word translation. Moreover, Multilink also takes into account effects of a variety of psycholinguistic variables such as lexical similarity, relative L2 proficiency, and translation direction. Dijkstra and coworkers (2019a) provide us with a model-to-model comparison emphasizing that Multilink provides higher correlations with empirical data than both the BIA and BIA+ models.

We have invited 10 commentaries to critically analyze and provide opinions on the Multilink model. Some authors of the commentaries praise the intention, scope and novelty of this model. Goral (2019) highlights Multilink's attention to word-frequency as modulated by language experience variables. Likewise, Li and Grant (2019) recognize in Multilink an important step forward in the refinement of bilingual word processing modeling. Li and Grant underline that the implementation of a computational (rather than verbal) model allows more explicit assumptions to be formulated and more explicit predictions to be tested. Costa and Pickering (2019) emphasize another important feature, i.e., the role of learning on the integrated bilingual lexicon underlying the Multilink model. Along similar lines, Ivanova and Kleinman (2019) praise the computational nature of Multilink and consider the model's applicability to other multilingual language production tasks, highlighting where the model's assumptions might need revision.

Some authors, on the other hand, provide suggestions for further improvement, while others point out shortcomings. As to the latter, Van Hell (2019) underlines how Multilink fails in integrating the impact of linguistic context (i.e., semantic and syntactic information in sentences) on bilingual word processing. Among the model's limitations, Mishra (2019) notes that Multilink overemphasizes lexical dimensions such as cognate status and orthographic similarity, which may be relevant for word processing in Dutch–English bilinguals, but possibly less so for speakers that use different types of orthographies and phonologies (see also Jiang, 2019). Van Heuven and Wen (2019) make similar suggestions: the need to evaluate Multilink with findings from studies involving different-script bilinguals, as the model focuses only on studies with stimuli from alphabetic languages. Tokowicz (2019) emphasizes that while Multilink does

indeed address some shortcomings of previous models (BIA and BIA+), there are additional ways in which the model could be expanded, including a sharper focus on individual differences among speakers. A very interesting observation comes from Declerck, Meade and Grainger (2019), who focus on one particular aspect of bilingual language processing: inhibitory control. The authors question the exclusion of inhibitory processes in the Multilink model in favor of bidirectional excitatory connections; they instead suggest that inhibitory processes should be maintained, in line with the authors' previous models of bilingual word processing. Finally, in their commentary Johns and Putnam (2019) build upon the integrated lexicon underlying the Multilink model to propose a novel approach to representing language membership as the result of gradient emergent principles.

In response to these commentaries, Dijkstra and coworkers (2019b) thoroughly address each of these issues and provide further directions for the Multilink model.

We hope that our readers will enjoy reading the keynote article, the commentaries, and the response to the commentaries as much as we have.

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