Computational Modeling of Bilingualism

Symposium Organizer:
Ping Li (pli@richmond.edu)
Department of Psychology, University of Richmond
Richmond, VA 23173 USA

Introduction

Computational modeling and bilingualism have had until recently only limited interactions (see reviews in French & Jacquet, 2004; Hernandez, Li, & MacWhinney, 2005; Li & Farkas, 2002; Thomas & van Heuven, 2005). Bilingualism has been the norm rather than the exception in our globalized world, but the acquisition of two languages entails significant complexity that challenges empirical methodology. Computational modeling, because of its flexibility in parameter variation and hypothesis testing, is ideally suited for identifying mechanisms underlying bilingual language acquisition and representation. In this symposium, we propose to integrate current computational studies of bilingualism and second language acquisition.

Summary of Presentations

Robert French will begin by reviewing the state of the art in the study of bilingual lexical memory, pointing out crucial issues in the field. He will then present the *BSRN*, a bilingual simple recurrent network model. The model learns both English and French NVN strings, intermixed at the sentence level for the two languages. The simulations show that BSRN can develop distinct representations not only for individual lexical categories in each language (as in Elman, 1990), but also for the two languages in general. Thus, the model can display distinct behaviors for the bilingual's two lexicons without invoking separate mechanisms for each language, providing evidence to the idea of "single mechanism, variable representations" from bilingualism.

In the second talk *Curt Burgess* will present the bilingual HAL model. Using language co-occurrences to model language or memory raises a number of controversial issues on the nature of lexical and semantic representations. In addition, using lexical co-occurrence to model bilingualism introduces crucial theoretical considerations since it is incumbent on the model to account for the transformation of the different lexical codes of multiple languages into similar semantic representations. On the surface this may seem straightforward. However, since co-occurrence models function (at some point in the encoding process) by counting the number of co-occurrences between specific lexical items, one has to provide an account of how the co-occurrence vectors for L1 can merge or co-exist with the vectors for L2. Burgess will discuss this memory consolidation process, a step that is not required in high-dimensional models that encodes only one language.

In the third talk *Ping Li* will present a self-organizing neural network model that simulates developmental stages of the bilingual lexicon. The model is based on *DevLex*, a connectionist developmental lexical model (Li et al., 2004). It considers learner variables (e.g., time of L2 learning and proficiency) and input variables (word types and bilingual distance) to assess determinants of bilingual lexical acquisition. It examines the time course of acquisition, the emergence of structured lexical representations in L1 and L2, and the effect of learning history on learning plasticity. The model attempts to account for important processes such as *competition*, the extent to which the two lexicons compete for resources in the lexical space over time; *entrenchment*, the extent to which lexical structures are consolidated in L1 affects the learning of L2, and vice versa; and *plasticity*, the extent to which structural consolidation of L1 impacts the learning of L2.

In the final talk *Michael Thomas* will review the recent application of connectionist models of language processing to bilingualism. Connectionist models have frequently appealed to two different architectures, localist interactive activation models and distributed processing models. These architectures have been used to explore different phenomena within bilingual language processing, including localist models of visual and auditory word recognition and distributed models of lexical and syntactic acquisition. Recent approaches employing self-organization attempt to bridge the two types of model. The range of existing models of monolingual language processing suggest clear avenues for future bilingual research to pursue, in particular focusing on dynamic aspects of (1) bilingual acquisition, (2) gradual changes in language dominance, (3) real-time switching between languages, (4) bilingual aphasia and recovery, and (5) language decay. Finally, Thomas will conclude with his recent modeling work exploring critical periods and their implications for second language acquisition.

Ping Li will give an introduction and overview of the symposium at the beginning, and *Yasuhiro Shirai* will provide an integrative discussion at the end.

References

French, R., & Jacquet, M. (2004). Understanding bilingual memory: models and data. *Trends in Cognitive Sciences, 8*, 87-93.

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Thomas, M., & van Heuven, W. (2005). Computational models of bilingual comprehension. In J. F. Kroll & A. de Groot (eds.) *Handbook of Bilingualism: Psycholinguistic Approaches*. Oxford University Press.