The Cognitive Science of Bilingualism

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Introduction

The world's language system is rapidly changing because of demographic trends, new technologies, and international communication (Graddol, 2004). One of the consequences is that the majority of people now speak more than one language. Such an increasing number of bilingual and multilingual speakers across the world will not only affect communication, it will also affect theoretical perspectives in the cognitive sciences. In line with this trend, the study of cognition and language in bilingual and multilingual speakers has gained prominence in the past decade (for reviews, see Kroll & de Groot, 2005; Li & Green, 2007; van Hell & Tokowicz, in press). Recent research indicates that both languages are active in the bilingual mind in on-line processing and both influence language processing even when the social and linguistic context calls for only one language. The implication is that the bilingual cognitive system is fundamentally permeable across language boundaries.

The study of bilingualism is of interest in its own right, but also provides an effective tool to examine fundamental issues in cognitive science. Studies using bilingual speakers inform cognitive scientists on basic questions related to plasticity and constraints in learning, how systems change depending on the specifics of the input environment, the resolution of competition across cognitive systems, and mechanism related to attention, inhibition, and cognitive control.

This symposium focuses on new developments in research on the learning, perception, and production of words – the basic building blocks of a language – in second language learners and proficient bilinguals. How do bilinguals juggle two language systems in one mind? Which cognitive mechanisms do bilinguals use to resolve cross-language competition? How do second language learners integrate new knowledge into an existing cognitive system? In the symposium we present to CogSci 2009, these and related questions will be addressed from different angles, integrating experimental, developmental, modeling, electrophysiological and neuroimaging perspectives.

Summary of Presentations

In the first presentation, *Laurie Feldman* focuses on how L1 speakers tune their language behavior to nonnative speakers and on how nonnative speakers tune their language behavior to native speakers. She will present recent studies in which she compared the effect of a foreign and native accent on the recognition of words in the first language (L1) and second language (L2). When English materials were presented in a cross-modal lexical decision task, morphological facilitation was weaker for native English-speaking participants when the primes were pronounced in a nonnative than in a native accent. By contrast, L2 speakers of English showed comparable facilitation when primes were pronounced in their nonnative accent and in a native accent. Morphological effects in L2 have been documented (cf. Basnight-Brown, Chen, Shu, Kostić, & Feldman, 2007). Ongoing work differentiates effects of shared morphology from shared form in native and nonnative speakers. Results

are revealing about the phonologies that underlie listening and speaking, and conditions under which aspects of meaning can offset the impairment due to mismatching phonologies (accent).

In the second talk, *Janet van Hell* and *Natasha Tokowicz* adopt a developmental perspective and focus on the learning of words in L2 in 'late' learners, individuals who learned their L2 in middle childhood or later. How do late L2 learners, who start with an already established lexico-semantic system in the L1, add novel words to this system? According to the influential Revised Hierarchical Model (RHM; Kroll & Stewart, 1994), learning words in L2 is fundamentally different from learning words in L1. The model proposes that during the early stages of L2 learning, L2 word forms are associated to the corresponding L1 word forms, and L2 learners will strongly rely on their L1 knowledge when they are processing words in the L2. As L2 learners become more proficient in L2, the RHM states that direct L2 word-to-concept mappings become stronger. The RHM is developed to account for L2 learning in adult classroom learners. Van Hell and Tokowicz examined whether the model also accounts for other types of learners, e.g., child L2 learners and learners who learned their L2 in contextually rich learning situations (e.g., by being immersed in the L2). They will discuss implications for the RHM of evidence from behavioral and ERP studies on child classroom learners, adult learners who learned their L2 when studying abroad, and adult learners who learned L2 in the classroom.

In the third talk, *Ping Li* and *Li-Hai Tan* will present evidence from functional neuroimaging and computational studies of bilingual lexical representation. Their research asks how language-specific experience with typologically distinct languages might affect the representation of linguistic categories in the bilingual brain. Previous neuroimaging research indicates that English verbs and nouns are represented in frontal and posterior brain regions, respectively, while such dissociations are absent in Chinese. Using fMRI they have found that bilingual Chinese-English speakers display distinct neural patterns in the processing of nouns and verbs in the two languages, suggesting that lexical representation may take different forms in the bilingual brain. These findings are consistent with the hypothesis that neural circuits for linguistic dimensions are weighted and modulated by language-specific characteristics, and that the bilingual brain is responsive to the specific characteristics of each language in early learning. The results are also consistent with their computational studies, in which connectionist models show that the structure of lexical representation may be fundamentally different depending on the onset time of L2 acquisition relative to that of L1. Reorganization of L2 lexical representation independent of L1 is possible only if the representational structure is plastic enough to allow for significant competition from L2 to L1.

In the fourth and final presentation, *Walter van Heuven* and *Ton Dijkstra* will revisit the BIA+ model of bilingual language comprehension (Dijkstra & van Heuven, 2002) and evaluate its processing and structural assumptions in the light of the brain sciences. The BIA+ model is based on the Interactive Activation model developed to account for word recognition in one language. To a large extent, the BIA+ model has so far been based on and supported by behavioral data. It is now time to assess to what extent the model is also supported by neuroimaging and electrophysiological data. After reviewing the model, Van Heuven and Dijkstra discuss its distinction between a language processing system and a task/decision system, and its basic assumptions. Such a distinction between a language processing system and a task/decision system is also relevant for the broader area of cognitive science. They will argue that the BIA+ model can accommodate fMRI and ERP data. Simulation data with BIA+ will illustrate its compatibility with some recently collected electrophysiological data. Finally, they will discuss how neuroimaging data can provide information about functional components of the BIA+ model that is hard to obtain from behavioral studies.

Janet van Hell will give an introduction and overview of the symposium at the beginning, and *Ping Li* will provide an integrative discussion at the conclusion.

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