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Bilingual Sentence Processing

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North-Holland

BILINGUAL SENTENCE PROCESSING

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Con Cariño,
Roberto R. Heredia and Jeanette Altarriba

Preface

The presentation of a volume on bilingual sentence processing is timely (indeed, it seems long overdue) for several reasons. Perhaps the most obvious of these, though not necessarily what might first come to mind, is the recognition of the prevalence of multilingualism around the world. Except in the United States, bilingualism generally is the rule rather than the exception. Even in the United States, which has come slowly to this recognition, greater attention than ever before is being paid to bilingualism. This interest is reflected in studies of second-language acquisition and pedagogy. As it becomes clearer that multilingualism is increasingly important in a shrinking world, greater understanding of the processes of language learning and teaching becomes critical.

Interest in bilingualism is reflected as well in the growing body of literature, exemplified by the present volume, concerning cognitive processes in bilingual speakers. Researchers and educators interested in issues of bilingualism will find the present treatment to be comprehensive in its consideration of language processes in bilingual speakers, from the representation of individual words in two languages, to the processing of figurative language. For many years, research in this area was dominated by questions regarding the representation in memory of lexical information in two languages. One can see from the chapters here that research and theory have progressed far beyond the word level. The topics span the entire range of issues commonly found in psycholinguistics texts, including syntactic and semantic processing, memory representation, and language acquisition.

The present book, therefore, provides for the first time a comprehensive treatment of issues of bilingualism and their implications for issues of language processes in general, and for sentence processing, in particular. After consideration of methodological issues in the study of bilingual language processing, two connectionist models are presented. Like other models of this type, these two go far beyond consideration of a single level of representation or processing, and should prove fruitful for researchers studying interactions among processing domains by bilinguals. The third section of the book, on *Memory Representation in Sentence Processing*, represents what is perhaps the most traditional area in bilingual research. The chapters here, however, again exceed the questions of word representation that have been dominant in the past, and also introduce new procedures for researchers in bilingualism (such as the repetition-blindness paradigm). The use of context in the recognition of words in two languages is a well-traveled ground, but here these studies involve consideration of cross-language homographs and of context greater than the single word or sentence.

In *Psycholinguistic Theory and Research*, the implications for issues outside bilingualism itself are perhaps the clearest. Hypotheses concerning, for example, parsing strategies are usually based on assumptions of universal aspects of language and language processing. Studies of bilingual speakers are therefore critical to tests of these hypotheses of syntactic processes. Similarly, the studies of figurative

language that are reported here tell us as much about figurative language as they tell us about bilingual speakers, dealing with issues such as the processing of syntactic ambiguity in phrasal verbs, and visual imagery and idiom processing. Finally, the acquisition of two languages in children is given its proper due. Indeed, no topic could be more central to bilingualism. Here again, however, the discussion is not restricted to issues concerning characteristics of the learner and learning environment. Written language comprehension and production have not been widely considered in the past, and these chapters show how much research in bilingual language acquisition has progressed in recent years.

Partly because of the promise of its educational applications, bilingualism is a legitimate field of study in its own right. This fact might be enough to capture the passion of psycholinguists generally, but alas, to date it seems not to have done so. What could capture this passion is the recognition that the bilingual language processor might offer a unique medium for understanding fundamental language processes that go beyond bilingualism itself. There is a disappointing tendency, certainly among many American researchers, to consider studies conducted in any language other than English to be *about* that language. Their own research, conducted in English, is naturally assumed to be concerned with the architecture of language processing in general. Similarly, research on bilingual processing may be neglected because it is perceived to shed light only on the issue of bilingualism *per se*. Obviously, the present authors are not guilty of such provincialism. Ultimately, promoting the recognition of the relevance of the issues discussed here in the context of the bilingual speaker to broader issues of language processing may be one of this volume's greatest contributions to the field.

Greg B. Simpson
University of Kansas
October 28, 2001

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Introduction and Overview

Bilingual research has increased a great deal in the past ten years. Within the field of psycholinguistics, bilingual research has focused on a broad range of topics from bilingual memory representation to language processing issues such as the nature of word representation, bilingual word recognition, and reading. Because of the universality of bilingualism, being much more the rule than the exception, interest in the field of bilingual sentence processing is growing significantly. Indeed, the study of bilingualism attracts a broad range of individuals from disciplines such as linguistics, psycholinguistics, cognitive science, communication, and artificial intelligence, just to name a few. A comprehensive volume such as the current one was intended to keep students and researchers interested in bilingual sentence processing issues and motivate them to pursue investigations into various related areas in bilingualism.

To date, there are no other books or specialized texts devoted exclusively to the topic of bilingual sentence processing. The aim of the current work was to fill this void in the literature by collecting works that emphasize theoretical issues and the presentation of empirical findings or evidence in support of different theoretical positions. Research from both the visual and spoken modalities was included along with a comprehensive selection of paradigms and methods that have been applied in the cross-linguistic domain. A volume such as this one provides both the beginning researcher and the seasoned researcher with the latest on bilingual investigations. It serves as a technical handbook in the field as well as a tutorial reader that can provide a starting point for almost any direction in the bilingual language domain.

We would be remiss if we did not cite some of the earlier books published on bilingual research as they helped to shape the direction and focus of the work reported in the current volume. Books such as *Language Processing in Bilinguals* edited by Vaid (1986), *Cognitive Processing in Bilinguals* edited by Harris (1992), and *The Bilingual Lexicon*, edited by Schreuder and Weltens (1993) introduced researchers and theoreticians to the basic issues and debates that structured the framework for exploring bilingual language issues that has been expanded upon in recent years. Most of these works contained papers that focused on the word level of language representation and its various attributes such as orthography, phonology, semantics, pragmatics and the like. They laid the groundwork for the investigations that are presented in the current work, as issues related to the processing of words in sentential contexts were informed by the previously published investigations.

The central focus of *Bilingual Sentence Processing* was the presentation of an overview of the literature on bilingual sentence processing from a psycholinguistic and linguistic perspective. To do this, noted researchers in the field of bilingual language processing agreed to contribute works ranging from the development of connectionist models, to the representation of cross-linguistic figurative language, to investigations of reading and comprehension in bilingual children and adults. The volume is divided into six sections each describing work that can be viewed as a

major theme within the current thinking in the field. The work opens with a discussion of the methods used in bilingual research. This work provides an overview of the various on-line tasks that have been used to investigate language processing in bilinguals at the sentence level. The second section begins with the fundamental issue of mental representation and the nature of the structure of the two languages in memory, with the presentation and description of two connectionist models of bilingual language processing. Next, the interplay between language contexts, memory, and reading is explored by examining effects such as repetition blindness, lexical ambiguity, and sentence constraint. The fourth section has its strengths in the presentation of linguistic theory and research and examines those questions that surround the syntactic parsing and strategic processing that occurs specifically within sentence contexts. The nuts and bolts of the linguistics surrounding sentence comprehension are included here. A fifth grouping of chapters emphasizes an area that has often been overlooked in previous volumes on language processing--the representation and use of figurative language (i.e., metaphors, idioms and the like). This novel inclusion should draw the attention of individuals who are interested in the broader questions of language acquisition, the implicitness of language representation, and the interpretation of inferences and linguistic implicatures. They make for interesting reading, as well, as the examples provided should alert the reader to the fact that figurative language exists across all languages and is often an interesting link to the representation of thought within a particular language group or culture. Last but not least, a growing interest in second language acquisition prompted the inclusion of the final section of the current volume on the development of language skills in bilingual children. Questions regarding the representation of vocabulary in the two mental lexicons of bilinguals, to the extraction of semantic meaning from stories and narratives, to the implications of code-switching in verbal descriptions was included, rounding out a complete selection of topics in the area of sentence processing.

Several debates abound in the area of bilingual sentence research. Quite notable is the issue regarding on-line versus off-line processing. Measures that record behavior in an on-line fashion are aimed towards examining language processing *as it occurs* in a natural state of reading and listening, and word identification (cf. Chapters 1 & 6). Tasks such as those recorded by eyetracking systems and self-paced reading tasks that may involve moving windows are an example of on-line procedures (cf. Chapters 5, 9, & 11). Other studies, particularly those interested in the processing occurring after encoded material is processed and integrated may rely on measures that are considered "off-line." Work in recall of words from mixed-language presentations or the measure of semantic comprehension after material is read are examples of this type of processing (cf. Chapters 4 & 7). It is clear that while some information can be gained within each paradigm, the ultimate decision as to which to employ should depend on the research question under investigation. Would one want to capture processes that are pre-lexical or those that occur early in the stages of language processing, or, would issues regarding memory retrieval and the time course of forgetting or interference in memory be of interest? Both types of approaches have value and research should continue to focus on existing tasks and the development of new tasks in both domains. Another concern seems to reside with the factors implicit in language learning that contribute to the

mental representations of a bilingual's lexicons. The relative significance of age of acquisition is not well understood and is often either overlooked or squarely emphasized as an important source of variance in language learning (see e.g., Chapter 2 vs. Chapter 9). Another intriguing focus that currently motivates quite a bit of research in the bilingual domain centers on the question of whether or not language use is selective or non-selective. That is, can an individual functionally process information in one language without interference from a second language? Work involving the Stroop paradigm in which words that name colors in a given language are presented in varying ink colors, indicates that languages may not be entirely separable when processing. The processing of ambiguity within and between languages also addresses the question as to the separateness of multiple languages (cf. Chapters 1, 5, 9, & 12). Finally, as in the monolingual domain, questions regarding the nature of the architecture of the mental lexicon(s) in the brain has led to the development of models of representation that are neurally inspired. The current volume includes two such models that challenge the current capacity models of information processing across languages by describing both localist and distributed properties of language. These connectionist models not only describe representation but also describe the processes involved in language learning. They can aptly predict findings for both priming effects and effects of interference across languages.

Despite the varied approaches and abundance of data described in the current volume, the need ultimately remains to provide evidence regarding bilingual sentence processing in cases in which the exact same stimuli are used across a variety of experimental paradigms. Likewise, an investigation into the relative similarities and differences in processing as a function of languages from different historical origins is in order. Despite these issues in the field, a strength in the current volume lies in the fact that sentence processing has been reviewed at various levels from the most basic and theoretical to applications within education and specifically, within the classroom. Whereas researchers may typically focus on the level of theoretical constructs and their empirical counterparts, the current book also offers ways in which this work can be applied to a most pressing and timely topic--the acquisition of a new language. In this way, we hope this volume becomes a type of "handbook" for researchers wanting to know how to conduct work that will have practical implications as well as answer theoretical queries of general interest. Finally, we hope that this work will serve as a springboard for new research that moves this area of intrigue ahead by having summed up what we know up until the present.

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Part I: Methods in Bilingual Research

1 On-Line Methods in Bilingual Spoken Language Research

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Abstract

In this chapter, we review several methodological approaches to studying spoken language comprehension in bilinguals. In particular, we focus on those tasks that allow for closer scrutiny of sentence level processing, including gating (Grosjean, 1980, 1996), cued shadowing (Bates & Liu, 1996), cross-modal lexical priming (Swinney, 1979), and the auditory moving-window (Ferreira, Henderson, Anes, Weeks, & McFarlane, 1996). Throughout the chapter, we offer suggestions as to how these techniques might be used to investigate a host of issues important to researchers in bilingualism, including but not limited to grammatical priming, ambiguity resolution, and contextual priming. We highlight the potential strengths and weaknesses of each paradigm and, whenever possible, offer suggestions as to future work that might be conducted using a particular experimental procedure. In the end, our hope is that the reader will come away with a stronger sense of the sorts of techniques that are available and are being used by researchers in the field of bilingual sentence processing.

While research at the word level, and primarily in the visual modality, has examined the question of whether bilinguals organize their two languages into one or two memory systems (e.g., Durgunoğlu & Roediger, 1987; Glanzer & Duarte, 1971; MacNamara & Kushnir, 1971), and most recently, the organization of the bilingual lexicon (e.g., de Groot, Dannenburg, & van Hell, 1994; Heredia, 1997; Kroll & Stewart, 1994), considerably less is known about how bilinguals process connected speech, both at the sentential and discourse levels, during the communicative process. This state of affairs is interesting given how much we rely on our auditory sense for our linguistic information in our everyday communication in our first and second languages (cf. Ferreira, Henderson et al., 1996). More important, however, is the fact that in most bilingual communities, communication between bilinguals is largely spoken, with comparatively little at the written level. For example, it is not unusual for Spanish-English bilinguals in the Southwest of the United States to show high language proficiency levels in understanding spoken language and in their ability to speak their two languages. However, these same bilinguals show limited ability in their written and

reading skills (e.g., Heredia & Altarriba, 2001; cf. Hernández, Ávila, & Bates, 1996; see also Favreau & Segalowitz, 1982, 1983; Segalowitz, 1986). Moreover, it could be argued that certain linguistic forms of bilingualism occur at the spoken language modality and not necessarily at the written language level (e.g., Ferreira, Henderson et al., 1996). For instance, code switching or language mixing in which bilinguals substitute a word or a phrase in one language for a word or phrase in a second language (Li, 1996a) is mainly a spoken language phenomenon. This is not to say, that code switching can only be studied in the spoken language modality because there are impressive research findings that have used reading to study this phenomenon (e.g., Altarriba, Kroll, Sholl, & Rayner, 1996; see also Peynircioğlu & Durgunoğlu, this volume).

In this chapter, we review some of the main methodologies in the existing bilingual literature that have taken the sentence or discourse level information as their focus to examine bilingual language processing and semantic memory issues. Our discussion is limited to only those studies that have used the auditory modality (for an overview of other tasks using spoken language see, Guillelmon & Grosjean, 2001; Grosjean & Frauenfelder, 1996). We conclude by describing two research techniques that are currently being explored in our laboratories to study issues related to bilingual lexical access and the phenomenon of code switching. We now turn to our discussion of the various on-line psycholinguistic tasks used in examining bilingual sentence processing.

The Sentence Interpretation Task

One of the first paradigms to be used to investigate bilingual sentence processing was the sentence interpretation task (e.g., Hernández, Bates, & Ávila, 1994; Kilborn, 1987, 1989; Li, Bates, Liu, & MacWhinney, 1992; MacWhinney, 1987; MacWhinney & Bates, 1989; McDonald, 1987a; McDonald & Heilenman, 1991, 1992; Vaid & Pandit, 1991). In this task, participants listen to a sentence such as (1a) below and are asked to report aloud as quickly and as accurately as possible who or what in the sentence is doing the action (Kilborn, 1989). Thus, in the example below, the correct verbal response would be *dog*. One variation has been to ask participants to make a timed choice between a pair of pictures (e.g., *dog* vs. *cup*) (Hernández et al., 1994).

(1a) The dog is chasing the cups

This particular version of the task has been used predominantly in cross-linguistic studies (e.g., Bates, Devescovi, & Wulfeck, 2001; MacWhinney & Bates, 1989) seeking to understand how speakers utilize the various sources of information provided by a particular language, and how speakers incorporate and use these sources of information during the language comprehension process. For example, sentence (1a) above provides important sources of information that the English speaker must consider during sentence processing. These sources of information are, (a) the position of the first noun that is doing the action (e.g., *dog*); (b) the agreement between subject and verb in person and number; and (c) a contrast in animacy between the subject *dog*,

which is animate and the object *cups*, which is inanimate (Li et al., 1992). How these sources of information are utilized depends on the particular language. Languages such as English rely more on word order (e.g., SVO: subject-verb-object), than other languages such as Spanish that rely mainly on morphological information such as noun and verb agreement and less on word order. For instance, sentence (2a) is grammatically correct in English because it follows the SVO word order. Sentence (2b) on the other hand, is grammatically incorrect because it does not follow the English SVO word order, and without the subject *I*, it is unclear *who wants the television*. In Spanish, on the other hand, sentence (2b) is correct because the verb carries information about the subject. That is, in Spanish the subject is optional and word order is not restricted to SVO. (Please note that grammatically incorrect sentences are indicated by double asterisks “**”).

(2a) I want the television (Yo quiero el televisor)

(2b) **Want the television (Quiero el televisor)

Hernández et al. (1994) used a version of this task to examine sentence interpretation strategies in Spanish-English bilinguals compared to Spanish and English monolinguals. The question of interest was whether Spanish-English bilinguals would behave like English monolinguals during the comprehension of English sentences, or like Spanish monolinguals during the comprehension of Spanish sentences. Spanish-English bilinguals received both Spanish and English versions of sentences such as (3a-3d) below that experimentally manipulated different variations of word order (e.g., NVN: noun-verb-noun; VNN: verb-noun-noun, and NNV: noun-noun-verb), agreement between noun and verb (sentences 3a-3d), and animacy, where the first noun was animate (e.g., 3a, 3b, and 3c) or inanimate (e.g., 3d), and the second noun was animate (e.g., 3a and 3d) or inanimate (e.g., 3b and 3c).

(3a) The dog is chasing the cow (both nouns agree with verb)

(3b) **The dog are chasing the cups (second noun agrees with the verb)

(3c) The dog is chasing the cups (first noun agrees with verb)

(3d) **The cup are chasing the dogs (second noun agrees with the verb)

Spanish and English monolinguals, on the other hand, received the sentences in their respective language only. Participants were instructed to press a button corresponding to the side on which a picture of the noun appeared (e.g., for sentence 3a, a picture of a *dog* or a *cow*). In general, Hernández et al. (1994) found that English monolinguals were faster in sentence interpretation when sentences conformed to the SVO or NVN word order, followed by verb agreement and animacy. In other words, English monolinguals were faster to decide who was doing the action when the sentences followed the English SVO canonical word order. For the Spanish monolinguals, on the other hand, noun verb agreement produced the fastest sentence interpretation reaction times, followed by animacy and word order. More important, a comparison between bilinguals and English monolinguals showed remarkable similarities. Bilinguals, like English monolinguals were very sensitive to word order,