# Using priming methods to study L2 learning and teaching*

Pavel Trofimovich and Kim McDonough
Concordia University, Montreal

## Introduction

The field of second language (L2) acquisition is witnessing increased interest in research investigating psycholinguistic bases of language learning. A search in the *PsychInfo* abstract database for the period 2006 to 2010, for example, yields 340 citations of studies investigating psycholinguistic (processing) aspects of L2 acquisition, a nearly 30% increase from the number of studies (266) published on similar and related topics between 2001 and 2005. Despite this heightened interest in psycholinguistics, the majority of published psycholinguistic research has been purely theoretical and has not been written for researchers and teachers interested in applied and pedagogical aspects of L2 acquisition. The goal of this volume is to fill this gap.

This volume features a collection of empirical studies which use priming to explore the comprehension, production, and acquisition of L2 phonology, syntax, and lexicon. The term "priming" refers to the phenomenon in which prior exposure to specific language forms or meanings either facilitates or interferes with a speaker's subsequent language comprehension or production. Psycholinguists frequently use priming to examine how the input available to learners is related to their comprehension and production of the L2. To give a few examples, auditory priming reveals how learners perceive L2 speech while semantic priming demonstrates how learners access and use their L2 lexicon. Syntactic priming sheds light on L2 learners' knowledge of grammar and how that knowledge develops over time.

---

\*   Some portions of this chapter appeared in an entry on priming research in the Wiley-Blackwell *Encyclopedia of Applied Linguistics* and are reprinted with permission.

To date, however, most priming research in L2 acquisition has appeared in specialized psychology journals and has been written in language which is generally inaccessible to researchers and practitioners working in language teaching and learning. At least one reason for this is that most publications which feature priming methods focus on theoretical issues and are written with cognitive psychologists in mind. Therefore, the principal contribution of this book is to bring together the various strands of priming research into a single volume that specifically addresses the interests of researchers, teachers, and university students interested in L2 teaching and learning. By way of introduction, we first provide some background information about the nature of priming methods and then discuss the historical origins of priming research along with its core issues and findings.

### What are priming methods?

Priming methods are one of the predominant experimental paradigms employed to study cognitive aspects of language learning and use. These methods originated in psycholinguistics, but have become increasingly common in applied linguistics over the past two decades. The term "priming" refers to the phenomenon in which prior exposure to specific language forms or meanings either facilitates or interferes with a speaker's subsequent language comprehension or production. Priming is believed to be an implicit process that occurs with little awareness, and this implicit nature makes priming part of a larger system of human memory – implicit memory. Briefly, implicit memory involves memory for cognitive operations or procedures which are learned (often without much explicit, conscious effort) through repeated use. As an implicit cognitive phenomenon, priming suggests that language users' prior experience with language shapes their subsequent language use, which is often interpreted as a form of implicit learning (learning without much conscious effort and awareness).

Although the term "priming" describes all situations in which prior language exposure influences subsequent language processing, different types of priming have been defined in the literature (McDonough & Trofimovich 2008). For instance, language users will access the meaning of the word *cat* more quickly if they recently read the word *dog* as opposed to an unrelated word, such as *shoe*. By activating the meaning of *dog* in comprehension or production, speakers more quickly activate the meaning of *cat* due to the shared meaning between the two. This kind of priming is called **semantic priming**, and it describes the tendency for speakers to process a word more quickly and/or more accurately when they have been previously exposed to a word related in meaning. In an example of a different kind of priming, if a speaker uses a prepositional dative, such as "the

teacher gave a bad mark to the student", later in the conversation her interlocutor is likely to produce another prepositional dative ("the office worker sent her resignation letter to the manager") rather than a double-object dative ("the office worker sent the manager her resignation letter"). This type of priming is called **syntactic priming** because it refers to the tendency for speakers to produce a syntactic structure that appeared in the recent discourse, as opposed to an equally acceptable alternative. Another example of priming is called **auditory priming**. For example, if a speaker hears a particular word spoken by her interlocutor, she is likely to understand this word faster and more accurately when it is used again in the same conversation. Auditory priming thus describes the tendency for people to process a spoken word or word combination more quickly and more accurately when they have had previous exposure to that word or word combination in speech.

### Historical origins of priming research

One of the first observations of priming as a phenomenon is attributed to James Cattell (1860–1944), an American psychologist who between 1883 and 1886 worked in Wilhelm Wundt's psychological laboratory in Leipzig, Germany. Cattell's time in Germany coincided with what has been called the Golden Age of the chronometric approach to the study of the human mind (Meyer, Osman, Irwin & Yantis 1988). The chronometric approach relies on the use of reaction times (response latencies) to study various mental processes, including language comprehension and production. While in Leipzig, Cattell conducted numerous experiments of this kind, examining the speed with which people reacted to letters, words, and sentences in their first language (L1) and their L2. In one experiment, Cattell (1885/1947) discovered that it takes people about twice as long to read a string of unrelated words than to read words in a sentence. This demonstration suggested that a meaningful context has a facilitatory effect on the processing of individual words.

It appears that the term "priming" was first used by Feldman and Weld (1939), who defined it as a state of attentional preparedness for perception (e.g., a decision to wake up early increases the likelihood that the alarm will be heard), and later by Lashley (1951) who used it to describe internal activation or readiness of linguistic elements in speech production (i.e., preparing a structural configuration of an utterance before producing it). However, in the sense we use it now, the term "priming" did not become mainstream until the early 1960s when Segal and Cofer (1960) published a study which replicated and extended an earlier experiment by Storms (1958). Segal and Cofer demonstrated that when language

users are exposed to a list of words, they are more likely to reuse these words to perform a subsequent task. They referred to this phenomenon as priming. Since then, priming has been used as an experimental technique to address many interesting questions about how languages are organized in the human mind and how people learn them. Examples of such questions can be found in seminal early investigations by Meyer and Schvaneveldt (1971) on semantic priming and by Bock (1986) on syntactic priming, and in recent reviews of priming literature by McNamara (2005), McDonough and Trofimovich (2008), and Pickering and Ferreira (2008). Beyond the study of language, examples of priming research in the wider context of cognitive psychology can be found in edited volumes by Bowers and Marsolek (2003) and Kinoshita and Lupker (2003).

The history of priming research is closely tied to the development of instruments that have allowed researchers to present different kinds of language materials to participants and to measure their responses to these materials. For example, Cattell used a gravity chronometer to present language materials (e.g., letters or words) to participants. The gravity chronometer was an early version of a tachistoscope, an instrument which was used for over 100 years in psycholinguistic research to present visual stimuli to participants rapidly, for a given amount of time (Benschop 1998). The Cattell version of the gravity chronometer featured an electromagnet controlling a screen; when the electric current flowing through the spiral of the electromagnet was broken, the screen would fall and would reveal an object to be seen by the participant (for example, a card with a word written on it). To record participants' reaction times, Cattell used another sophisticated device of the day – a Hipp chronoscope (depicted in Cattell 1886a). The chronoscope was an electromechanically controlled timer which allowed researchers to record reaction times with millisecond accuracy when participants pressed a telegraphic key or even when they simply spoke in response to a stimulus (Benschop & Draaisma 2000; Schmidgen 2005).

Yet another early technological invention used in psycholinguistic research was a memory drum. This device consisted of a rotating kymograph drum which showed lists of words or sentences, or series of pictures for fixed intervals of time so that participants could view them and respond to them individually (Haupt 2001). According to Haupt, the memory drum was the standard way of presenting language materials in research on memory and language for almost 100 years, from about the 1890s to approximately the mid 1970s, when affordable computers and monitors became available (Bailey & Polson 1975). Over the past several decades, nearly all psycholinguistic research, including priming research, has been carried out by using powerful personal computers running multifunctional psychological software which allows researchers to present various kinds of stimuli to participants (e.g., images, texts, audio, video) and

to measure participants' reactions to these stimuli (e.g., in terms of accuracy, speed, duration). Examples of common psychological presentation software are E-Prime (Schneider, Eschman & Zuccolotto 2002), DMDX (Forster & Forster 2003), PsyScope (Cohen, MacWhinney, Flatt & Provost 1993), and SuperLab (Cedrus Corporation 2008).

## Core issues and findings

Although a comprehensive review of the priming literature is not possible due to space limitations, this section includes a brief outline of the main strands of semantic, syntactic, and auditory priming research, with a particular emphasis on L2 processing and learning.

### Semantic priming

As was discussed earlier, semantic priming is defined as the tendency for language users to process a word more quickly and/or more accurately when they have been previously exposed to a word related in meaning. For example, the word *table* will be responded to faster if the word *chair* has been heard or seen recently. This suggests that semantically related words (like *table* and *chair*) are "stored" together or are somehow linked in the mind of a language user and that both get activated by virtue of having such links.

In the last three decades, researchers have relied on semantic priming to explore the nature of semantic networks in the mental lexicons of L1 and L2 speakers. Some researchers have used semantic priming to understand how bilinguals organize words in their two languages (e.g., Basnight-Brown & Altarriba 2007; for reviews, see Altarriba & Basnight-Brown 2007 and Williams & Cheung, this volume). For instance, if English-French bilinguals show semantic priming for word translations (e.g., *chien-dog* in French and English), then this would indicate that they organize the meanings of words in their two languages in a shared, interdependent manner. Results from this line of research are complex; they suggest that the manner in which bilinguals organize and access the meanings of words in their two languages depends on many factors, including the specific nature of words being examined (de Groot & Nas 1991), bilinguals' proficiency in the two languages (Grainger & Beauvillain 1988), and the age at which they start learning their L2 (Silverberg & Samuel 2004). To illustrate, Silverberg and Samuel showed that only early, but not late, Spanish learners of English showed semantic priming for English-Spanish word pairs such as *nail* and *tornillo* ("screw" in Spanish).

Because L2 words (like *nail*) facilitated the processing of L1 words (like *tornillo*) for the early learners, these learners appear to store the meanings of semantically related words across the two languages in a shared manner. In contrast, late learners appear to store such meanings separately.

Other researchers have investigated whether L1 and L2 speakers differ in their patterns of semantic priming in a language (e.g., Devitto & Burgess 2004; Frenck-Mestre & Prince 1997; for a review, see McDonough & Trofimovich 2008). For example, if L2 speakers do not show priming for word pairs like *table* and *chair*, while L1 speakers do, then this would indicate that L2 speakers store and access these words differently from L1 speakers. The findings from this strand of research indicate that L2 speakers who have reached a high level of proficiency can access and use the semantic information in the same way as L1 speakers do. Frenck-Mestre and Prince, for example, found that the native English speakers and the more proficient French learners of English in their study showed semantic priming for semantically related words in English (e.g., *wet-dry*). In contrast, the less proficient learners did not.

## Syntactic priming

As its name suggests, syntactic priming refers to the tendency for speakers to produce a syntactic structure that appeared in the recent discourse, as opposed to an equally acceptable alternative. For instance, speakers are more likely to produce a passive sentence if they recently heard a passive sentence or if they themselves produced one earlier in the discourse. In fact, speakers tend to produce the recently encountered syntactic structure even if the initial and subsequent utterances do not have any of the same lexical items, phonological or prosodic properties, or shared semantic information. For example, the initial utterance "the teacher gave a bad mark to the student" and a subsequently produced sentence "the office worker sent her resignation letter to the manager" are unrelated in terms of their lexis, phonology, or semantics, but share a common syntactic structure (subject–verb–direct object–prepositional object), which is responsible for a priming effect. This implies that it is easier for speakers to access a syntactic structure that has been recently activated than to access a completely new structure, and that speakers tend to implicitly "fine-tune" their use of syntactic structures in response to recent experience with language.

Similar to the semantic priming studies that explore how bilinguals organize their L1 and L2 lexicons, bilingual syntactic priming research has investigated how syntactic information is represented. One possibility is that bilinguals store L1 and L2 syntactic information separately, while another possibility is that at least some syntactic information used in both languages is shared. The separate-syntax account predicts that cross-language priming would not occur since activation of linguistic information in one language would not affect the linguistic information of the other language. However, the shared-syntax account predicts that cross-language priming would occur as activation of the syntactic structure in one language would facilitate production of the related structure in the other language. Cross-language syntactic priming research has demonstrated that syntactic priming occurs cross-linguistically, which supports the shared-syntax account (e.g., Bernolet, Hartsuiker & Pickering 2007; Hartsuiker, Pickering & Veltkamp 2004; Salamoura & Williams 2007; Schoonbaert, Hartsuiker & Pickering 2007). Current research is exploring how L2 proficiency impacts the development and strength of shared syntactic representations.

Other researchers have explored the occurrence of syntactic priming in L2 speech production, which is within-language priming. The initial question asked in within-language L2 syntactic priming research was simply whether it occurred, as the previous research had been carried out with L1 speakers. Researchers initially focused on demonstrating that priming occurred in L2 speech production for a variety of equally acceptable (i.e., grammatically correct) structures, such as dative constructions (Gries 2005; McDonough 2006; Schoonbaert et al. 2007), actives and passives (Kim & McDonough 2008), and alternation between adjective + noun phrases and relative clauses (Bernolet et al. 2007). Subsequent studies have explored whether syntactic priming occurs for alternation between two structures in an L2 learner's interlanguage (McDonough & Kim 2009; McDonough & Mackey 2008). In this line of research, syntactic priming is being used to encourage L2 learners to produce the developmentally-advanced structures as opposed to the less advanced or non-targetlike forms.

## Auditory priming

As was mentioned earlier, auditory priming refers to implicit, unintentional facilitation in auditory processing of language. This facilitation is most often observable as a time and/or accuracy benefit for repeated versus non-repeated spoken words and word combinations. For example, in a typical auditory priming experiment, participants are first exposed to a set of spoken words and then are tested on another set containing both words that were previously heard and words that are new to the task. A common finding here is that participants show a repetition effect, responding faster and/or more accurately to previously-heard words compared to new words.

Some researchers have used auditory priming to answer questions about how bilingual speakers store information about L1 and L2 words in their lexicons. For example, Woutersen, Cox, Weltens, and de Bot (1994) used auditory priming to determine whether bilingual speakers organize their lexicons in a separate or shared fashion (see also de Bot, Cox, Ralston, Schaufeli & Weltens 1995; Woutersen, de Bot & Weltens 1995). Overall, these researchers found that the degree to which words in bilinguals' two languages are "linked" depended on bilinguals' proficiency in the two languages. More recently, Pallier, Colomé and Sebastián-Gallés (2001) employed auditory priming to examine what information bilingual speakers store in their lexicon for words that contain difficult phonological contrasts across their two languages. For instance, Catalan words /nɛtə/ ("clean") and /netə/ ("granddaughter") are distinguished by the /ɛ/-/e/ contrast. Pallier et al. showed that even early Spanish-Catalan bilinguals (those who learned Catalan before age 6) were not able to distinguish such difficult L2 words in their lexicons, presumably because Spanish (their L1) does not have the contrast between /ɛ/ and /e/.

Few studies have to date examined auditory priming with L2 learners (Bird & Williams 2002) and only a handful have done so in detail (Trofimovich 2005, 2008; Trofimovich & Gatbonton 2006). Bird and Williams, for example, used auditory priming to evaluate the effectiveness of subtitling (simultaneously presenting auditory and textual information to improve learners' listening comprehension) as a language learning tool. In their study, advanced L2 learners of English showed auditory priming for real English words and, in some cases, also for English nonwords (i.e., novel words for these learners), revealing some benefits of subtitling for L2 learning. Trofimovich and his colleagues have studied auditory priming as a learning mechanism used by L2 learners for the processing of spoken words. These researchers compared priming across several attentional conditions (attending to word form vs. word meaning). Overall, it was found that L2 learners were less likely to use auditory priming when their attention was drawn to the meanings of words, especially while listening to non-identical repetitions of words (e.g., *wonderful* spoken by a male and repeated later by a female). Apparently, attention to meaning interferes with L2 learners' processing of the phonological forms of words, such that learners get distracted by differences in speakers' voices (e.g., voice height, voice quality) and are unable to focus on the important phonetic properties that signal the identity of the spoken word.

## About this book

As was mentioned earlier, the goal of the present volume is to provide researchers, teachers, and university students with a collection of current, accessible psycholinguistic studies that used priming methods to investigate applied, practical (as opposed to purely theoretical) questions relevant to L2 teaching and learning. Therefore, every study included in this volume is written in language accessible to the L2 teaching and learning audience, and contains a discussion of implications for language teaching and learning. The studies featured in this volume cover a broad range of issues, employ different tasks, focus on various languages and topics, and have a wide array of applications. For example, the studies reported here are based on experimental work and employ a variety of priming techniques: from the semantic, syntactic, and auditory priming methods reviewed earlier to innovative techniques that involve the use of a complete sentence or an entire task to prime L2 learners' performance. The studies featured here also represent a wide variety of psycholinguistic tasks (lexical decision, cross-modal priming, scripted interaction, self-paced reading, rapid serial visual presentation, false memory), and focus on a variety of domains of language knowledge (lexis, phonology, grammar) and linguistic skills (syntactic processing in reading, listening comprehension). The studies also feature participants from several L1 backgrounds (English, Chinese, Thai, French, Cantonese) who are learning Spanish, English, or French as a second or third language. In terms of their applications, the studies included in this volume have implications for the teaching of L2 vocabulary, grammar, and pronunciation, for using collaborative tasks to facilitate the learning of L2 grammar, for improving cognitive fluency in processing L2 words, for the development of learners' L2 comprehension skills, and for carrying out future L2 processing research.

## Organization of the book

The book is organized into two parts, each thematically structured according to a general theme: "Using priming methods in L2 learning research," and "Innovative approaches to L2 priming research." The first theme reflects the primary goal of the book – emphasizing implications and applications of priming research to L2 learning and teaching. "Innovative approaches to L2 priming research" emerged as a separate theme for studies that feature innovative uses of cognitive psycholinguistic methods to study L2 learning and teaching.

Part I: Using priming methods in L2 learning research

The five chapters in this part use priming methods to investigate practical issues related to L2 teaching or to test theoretical claims about the processes involved in L2 learning. The chapter by **Jeanette Altarriba** and **Hugh Knickerbocker** opens this section by comparing three methods of teaching L2 vocabulary: using L1 translations, black-and-white pictures, or colour pictures to present new L2 words. Altarriba and Knickerbocker taught native speakers of English new Spanish words using these methods and compared these learners' performance in a semantic priming task, known to reveal the strength of meaning-related associations for newly learned words. The three methods led to similar learning effects, but presenting new words with their L1 translations resulted in the fastest performance.

In the second chapter, **Joe Barcroft**, **Mitchell Sommers**, and **Gretchen Sunderman** investigate the psycholinguistic benefits of using the Keyword Method to teach new L2 words (using a similar sounding L1 word to help learners retrieve the L2 word). These researchers used a priming task to compare the performance of two groups of L2 learners of Spanish: those who learned new L2 words using the Keyword Method and those who used a more traditional "rote rehearsal" method. Barcroft and his colleagues show that keywords used as primes sped up the recall of new L2 words for the rote rehearsal group but in fact slowed down the responses for the keyword group. Based on this evidence, these researchers argue against extensive use of the Keyword Method in language teaching.

In the following chapter, **John Williams** and **Amanda Cheung** use semantic priming to examine what kinds of meanings are activated by learning new words. These researchers report the results of several experiments in which Cantonese L2 learners of English were taught new words in French, their third language, first by using L2 translation equivalents, then by using images to depict the meanings of words. Williams and Cheung's results point to the conclusion that particular learning experiences that accompany novel word learning determine precisely which meanings are associated with newly learned words.

In the next chapter, **Pavel Trofimovich** and **Paul John** examine what information L2 learners store in their mental lexicons for phonologically difficult word pairs, such as *three* and *tree* for native speakers of French, and whether learners use this information to guide their L2 production. To address this issue, these researchers tested Quebec French learners of English in auditory priming and word production tasks. Their findings suggest that although learners may not be able to distinguish phonologically difficult L2 words pairs in their lexicons, they may nevertheless learn to produce them accurately through recourse to several strategies.

In the chapter concluding this section, **Kim McDonough** describes the design and implementation of collaborative syntactic priming activities to help Thai learners of English produce accurate wh-questions in English. McDonough shows that priming activities which include lexical repetition elicited the highest proportion of correct wh-questions. McDonough's chapter exemplifies the use of priming tasks as a teaching technique, and discusses several possibilities for the use of syntactic priming activities in L2 classrooms.

Part II: Innovative approaches to L2 priming research

This part comprises four chapters which highlight novel uses of psycholinguistic methods to study L2 teaching and learning. Although the studies included in this section do not employ traditional priming methods, they feature innovative applications of psycholinguistic techniques that similarly explore how experience with language influences subsequent processing. For example, **Norman Segalowitz**, **Guy Lacroix**, and **Jenelle Job** examine the role of attention in processing L2 words using the attentional blink paradigm. In this procedure, participants often report "blindness" to certain aspects of rapidly presented stimuli. By adapting this technique to the processing of L2 words, Segalowitz and his colleagues show that L2 learners of French, compared to fluent L1 users, are less likely to show an attentional "blink." These authors argue that this finding reflects less efficient, less automatic processing of L2 words by the learners.

In the next chapter, **Michael Leeser**, **Anel Brandl**, and **Christine Weissglass** raise a methodological question: How does a secondary task influence L2 learners' reading of L2 sentences? To address this question, Leeser and his colleagues examine how L2 learners of Spanish process grammatical and ungrammatical sentences in Spanish in a self-paced reading task as a function of a secondary task performed (making a grammaticality judgment vs. answering comprehension questions). These researchers conclude that a secondary task does influence learners' on-line processing, and that this influence also depends on the particular kind of structure under investigation. Leeser et al. convincingly argue that their findings have important implications for the design and interpretation of future L2 processing studies.

In the following chapter, **Guiling (Gloria) Hu** and **Nan Jiang** use a novel adaptation of the cross-modal priming paradigm (priming from the visual to the auditory modality) with Chinese learners of English to study L2 listening comprehension. These researchers report on important differences between native speakers and L2 learners in how they deal with auditory input, and suggest possible explanations for these differences.

In the final chapter, **Gretchen Sunderman** investigates the structure of L2 learners' lexicon using the false memory paradigm. In this procedure, participants are shown a number of highly associated words (e.g., *bed*, *rest*, *dream*). When later asked to recall these words, participants often falsely recall a highly associated word that was not presented as part of the original list (e.g., *sleep*). Sunderman adapted this technique to investigate the degree of semantic association between words in L2 learners' lexicons. Her findings show that the extent of semantic association (as revealed through the false memory procedure) depends on learners' L2 proficiency.

### Suggested uses of this book

The current volume was conceptualized with a wide audience in mind, including L2 researchers who are not familiar with priming methods and their application to L2 research, graduate students in second language acquisition (SLA) and related disciplines, and instructors who require readings for use in their graduate courses and seminars. For researchers working in areas other than psycholinguistics, the volume provides an up-to-date and accessible introduction to how priming methods can be used to address questions of interest to L2 teachers and researchers, and illustrates how a cognitive psycholinguistic approach can complement other approaches to SLA (e.g., interactionist, nativist, sociocultural). For students, the volume highlights authentic research projects which contextualize the theoretical foundations of priming research and show how priming research is relevant to understanding common issues in SLA (e.g., the benefits of interaction, the value of specific teaching methods, the role of fluency and automaticity in language learning). For instructors, in turn, the volume offers a collection of research reports contextualized in an applied area (teaching and learning languages) and provides clear examples of research designs, which is particularly useful for new graduate students who typically require guidance in how to read primary research critically. The volume could therefore serve as a complement to textbooks in a variety of graduate courses, especially those where students carry out psycholinguistic research as part of the course requirements.

### Concluding remarks

James Cattell, the researcher who conducted some of the first L2 psycholinguistic studies and who is credited with the discovery of semantic priming (Harley 2008),

noted in one of his experiments that L2 learners' speed of reading in the L2 depended on their familiarity with the language (1886b). In describing the results of this study, Cattell wrote: "These numbers show that foreign languages take up much time even after they are learned, and may lead us once more to weigh the gain and loss of a polyglot mental life" (1887:70). Ever since, the main concern of psycholinguists has been to uncover and understand the various cognitive, psychological "losses" and "gains" associated with the learning and using an L2. The contributions to this volume clearly illustrate that these psycholinguistic issues are as intriguing to L2 researchers now as they were to Cattell over 120 years ago, and highlight the importance of applying theoretical insights about cognitive aspects of L2 functioning to practical issues of L2 learning and teaching.

### References

Altarriba, J., & Basnight-Brown, D. M. (2007). Methodological considerations in performing semantic- and translation-priming experiments across languages. *Behavior Research Methods*, *39*, 1–18.

Bailey, D., & Polson, P. (1975). Real-time computing in psychology at the University of Colorado. *American Psychologist*, *30*, 212–218.

Basnight-Brown, D. M., & Altarriba, J. (2007). Differences in semantic and translation priming across languages: The role of language direction and language dominance. *Memory & Cognition*, *35*, 953–965.

Benschop, R. (1998). What is a tachistoscope? Historical explorations of an instrument. *Science in Context*, *11*, 23–50.

Benschop, R., & Draaisma, D. (2000). In pursuit of precision: The calibration of minds and machines in late nineteenth-century psychology. *Annals of Science*, *57*, 1–25.

Bernolet, S., Hartsuiker, R., & Pickering, M. (2007). Shared syntactic representations in bilinguals: Evidence for the role of word-order repetition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*, 931–949.

Bird, S., & Williams, J. (2002). The effect of bimodal input on implicit and explicit memory: An investigation into the benefits of within-language subtitling. *Applied Psycholinguistics, 23*, 509–533.

Bock, K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, *18*, 355–387.

Bowers, J. S., & Marsolek, C. J. (Eds.). (2003). *Rethinking implicit memory.* Oxford: Oxford University Press.

Cattell, J. M. (1886a). The time taken up by cerebral operations. *Mind, 11,* 220–242.

Cattell, J. M. (1886b). The time it takes to see and name objects. *Mind, 11,* 63–65.

Cattell, J. M. (1887). Experiments on the association of ideas. *Mind, 12,* 68–74.

Cattell, J. M. (1947). On the time required for recognizing and naming letters and words, pictures and colors. In *James McKeen Cattell, Man of Science* (Vol. 1, pp. 13–25). Lancaster, PA: Science Press. (Original work published 1885)

Cedrus Corporation (2008). SuperbLab (Version 4.0) [Computer software]. San Pedro, CA.

Cohen, J. D., MacWhinney, B., Flatt, M., & Provost, J. (1993). PsyScope: A new graphic interactive environment for designing psychology experiments. *Behavioral Research Methods, Instruments, and Computers*, *25,* 257–271.

de Bot, K., Cox, A., Ralston, S., Schaufeli, A., & Weltens, B. (1995). Lexical processing in bilinguals. *Second Language Research, 11,* 1–19.

de Groot, A. M. B., & Nas, G. L. J. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language*, *30*, 90–123.

Devitto, Z., & Burgess, C. (2004). Theoretical and methodological implications of language experience and vocabulary skill: Priming of strongly and weakly associated words. *Brain and Cognition*, *55*, 295–299.

Feldman, S., & Weld, H. P. (1939). Perception. In E. G. Boring, H. S. Langfeld, H. P. Weld, et al. (Eds.), *Introduction to psychology* (pp. 411–438). New York: John Wiley.

Forster, K. I., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers*, *35*, 116–124.

Frenck-Mestre, C., & Prince, P. (1997). Second language autonomy. *Journal of Memory and Language*, *37*, 487–501.

Grainger, J., & Beauvillain, C. (1988). Associative priming in bilinguals: Some limits of interlingual facilitation effects. *Canadian Journal of Psychology*, *42*, 261–273.

Gries, S. (2005). Syntactic priming: A corpus-based approach. *Journal of Psycholinguistic Research*, *34*, 365–399.

Harley, T. A. (2008). *The psychology of language: From data to theory* (3rd ed.). New York: Psychology Press.

Hartsuiker, R., Pickering, M., & Veltkamp, E. (2004). Is syntax separate or shared between languages? *Psychological Science*, *15*, 409–414.

Haupt, E. J. (2001). The first memory drum. *American Journal of Psychology*, *114*, 601–622.

Kim, Y., & McDonough, K. (2008). Learners' production of passives during syntactic priming activities. *Applied Linguistics*, *29*, 149–154.

Kinoshita, S., & Lupker, S. J. (Eds.). (2003). *Masked priming: The state of the art*. New York: Psychology Press.

Lashley, K. S. (1951). The problem of serial order. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior: The Hixon symposium* (pp. 112–146). New York: John Wiley.

McDonough, K. (2006). Interaction and syntactic priming: English L2 speakers' production of dative constructions. *Studies in Second Language Acquisition*, *28*, 179–207.

McDonough, K., & Kim, Y. (2009). Syntactic priming, type frequency, and EFL learners' production of wh-questions. *The Modern Language Journal*, *93*, 386–398.

McDonough, K., & Mackey, A. (2008). Syntactic priming and ESL question development. *Studies in Second Language Acquisition*, *30*, 31–47.

McDonough, K., & Trofimovich, P. (2008). *Using priming methods in second language research*. New York, NY: Routledge.

McNamara, T. P. (2005). *Semantic priming: Perspectives from memory and word recognition*. New York, NY: Psychology Press.

Meyer, D. E., & Schvaneveldt, R. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, *90*, 227–234.

Meyer, D. E., Osman, A. M., Irwin, D. E., & Yantis, S. (1988). Modern mental chronometry. *Biological Psychology*, *26*, 3–67.

Pallier, C., Colomé, A., & Sebastián-Gallés, N. (2001). The influence of native-language phonology on lexical access: Exemplar-based vs. abstract lexical entries. *Psychological Science, 12,* 445–449.

Pickering, M., & Ferreira, V. (2008). Structural priming: A critical review. *Psychological Bulletin*, *134*, 427–459.

Salamoura, A., & Williams, J. (2007). Processing verb argument structure across languages: Evidence for shared representations in the bilingual lexicon. *Applied Psycholinguistics*, *28*, 627–660.

Schmidgen, H. (2005). Physics, ballistics, and psychology: A history of the chronoscope in/as context, 1845–1890. *History of Psychology*, *8*, 46–78.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime user's guide*. Pittsburgh: Psychology Software Tools, Inc.

Schoonbaert, S., Hartsuiker, R., & Pickering, M. (2007). The representation of lexical and syntactic information in bilinguals: Evidence from syntactic priming. *Journal of Memory and Language*, *56*, 153–171.

Segal, S. J., & Cofer, C. N. (1960). The effect of recency and recall on word association. *American Psychologist*, *15*, 451.

Silverberg, S., & Samuel, A. G. (2004). The effect of age of second language acquisition on the representation and processing of second language words. *Journal of Memory and Language*, *51*, 381–398.

Storms, L. H. (1958). Apparent backward association: A situational effect. *Journal of Experimental Psychology*, *55*, 390–395.

Trofimovich, P. (2005). Spoken-word processing in native and second languages: An investigation of auditory word priming. *Applied Psycholinguistics, 26,* 479–504.

Trofimovich, P. (2008). What do second language listeners know about spoken words? Effects of experience and attention in spoken word processing. *Journal of Psycholinguistic Research*, *37*, 309–329.

Trofimovich, P., & Gatbonton, E. (2006). Repetition and focus on form in L2 Spanish word processing: Implications for pronunciation instruction. *The Modern Language Journal*, *90*, 519–535.

Woutersen, M., Cox, A., Weltens, A., & de Bot, K. (1994). Lexical aspects of standard dialect bilingualism. *Applied Psycholinguistics, 4,* 447–473.

Woutersen, M., de Bot, K., & Weltens, A., (1995). The bilingual lexicon: Modality effects in processing. *Journal of Psycholinguistic Research, 24*, 289–298.