To cite, please refer to: Dunn, A. L. & Fox Tree, J. E. (2014). More on language mode.
International Journal of Bilingualism, 18(6) 605–613.

More on Language Mode

Alexandra L. Dunn and Jean E. Fox Tree

University of California Santa Cruz

Psychology Department

273 Social Sciences 2

Santa Cruz, CA 95064

Corresponding author: Jean E. Fox Tree, foxtree@ucsc.edu, Psychology Department, Social Sciences II room 277, University of California, Santa Cruz, CA, 95064, (831) 459-5181.

Abstract

Language mode theory (Grosjean, 2001) proposes that language activation can span from a monolingual mode (predominant activation of one language) to bilingual mode (both languages activated). While some argue that linguistic performance is influenced by the language mode the bilingual speaker is in (Soares & Grosjean, 1984), others have found that language mode activation has no affect on performance (Dijkstra & van Hell, 2003). We show that changes in language mode can influence bilinguals' language processing. Spanish-English bilinguals with both languages active (bilingual mode) took longer to reject nonwords than Spanish-English bilinguals with one language active (monolingual English mode) and English monolinguals. Additionally, reaction times for nonwords were longer the more Spanish weighted the bilinguals were, with a linear relationship between nonword reaction times and bilingual dominance. Results can be best described by extending the BIMOLA model of speech perception (Grosjean, 1988; 1997) to reading.

Keywords

Bilingualism, lexical access, language dominance, language mode

More on Language Mode

The concept of *language mode* has a contentious history. The basic proposal is that language activation spans from a monolingual mode of overwhelming activation of one language to a bilingual mode where both languages are activated (Grosjean, 2001; first proposed in Grosjean, 1982). We demonstrate that conflicting prior findings can be explained by the extent to which speakers were in bilingual or monolingual mode during testing and by speakers' language dominances. Results can be best described by extending the BIMOLA model of speech perception (Grosjean, 1988; 1997) to reading.

For and Against Language Mode

Many researchers have demonstrated that bilinguals experience cross-language interference when both languages are activated (e.g. Marian & Spivey, 2003; Hermans, Bongaerts, de Bot & Schreuder, 1998; Costa & Caramazza, 1999; Costa, Colomé, Gómez & Sebastián-Gallés, 2003). We ask whether the interference is as prevalent during monolingual mode as it is during bilingual mode, and, if it is, whether the interference depends on the level of bilingual dominance. Currently, there are only three studies that have tested language activation for bilinguals in monolingual mode, with mixed results (Soares & Grosjean, 1984; Dijkstra & Van Hell, 2003; Marian & Spivey, 2003). None have looked at gradient levels of dominance.

In a test of lexical decision reaction times, Soares and Grosjean (1984) found that participants in bilingual mode took longer to recognize real words than in monolingual mode, but that nonwords took equally long to recognize regardless of mode. They argued that because both top-down language nodes were activated, participants had to search both lexicons to access the real words. Another way to describe this is that participants demonstrated interference due to the excitation of both languages.

In response, Dijkstra and Van Hell (2003) tested trilingual speakers (Dutch, English, French trilinguals) in an effort to control for various aspects of language mode. A speaker's third language (L3) was found to have an effect on first language processing even in monolingual language mode. If the language mode theory were correct, a speaker's L2 or L3 should have little or no bearing on L1 processing in (near) monolingual mode.

Dijkstra and Van Hell (2003) tested the language mode theory by comparing activation of homographs (words that are orthographically similar in both languages but have different meanings) and cognates (words that look similar and have the same meaning) to non-homographs and non-cognates. Cognates and homographs were facilitated (created cross-language activation) in comparison to non-cognates and non-homographs across all conditions. Dijkstra and Van Hell (2003) concluded that this demonstrated that participants used all of their lexical knowledge regardless of language mode.

We contend that the use of homographs and cognates eliminated the monolingual mode condition. Dijkstra and Van Hell (2003) discussed this possibility, but asserted that if this were the case, the language mode hypothesis would have to be restricted to a small amount of non-overlapping words that weren't cognates or homographs. They further pointed out that eliminating homographs and cognates would be overly restrictive for their study given the large number of cognates between English and Dutch. While this may be true of English and Dutch, it is not true for many other language combinations such as English and Cantonese.

How Dominance Might Affect Language Mode

Although not specifically addressed by the language mode theory, a potentially important component is language dominance. For example, a result that seemingly goes against the language mode theory is the finding that Russian-English bilinguals gazed at phonetically similar distractors from another language during monolingual mode (Marian and Spivey, 2003). However, dual language activation was found only for English (L2), not for Russian (L1). That is, Russian was active for most of these bilinguals during English monolingual mode, but not the reverse.

Dijkstra and Van Hell (2003) noted the importance of dominance. Initially, they did not find the cognate facilitation effect between Dutch and French due to their participants' low fluency in French. Although they replicated their bilingual study with more equally balanced L2 and L3 trilinguals, they introduced another possible confound into their study. To find higher fluency in French, participants had to be recruited from the French language department. While the description of the experiment and recruitment process did not overtly mention the importance of participants' fluency in French, the way the population was accessed may have influenced the results, pushing these particular trilinguals into a more bi(tri)lingual mode.

We believe that language mode is mediated by dominance level. Bilinguals gain and lose fluency in one or both languages throughout their life spans. For language mode to be most useful, it must attenuate in a way that allows for access to the stronger language if a speaker is unable to access a word in the weaker one. For example, if a speaker is considered fluent in both languages, but has yet to gain a quick direct access to their L2 lexicon, they may fall back on internally translating words from their L1 into their L2. If language mode were unable to cope with an imbalance in fluency levels it would hinder access rather than facilitate it. An English-weighted bilingual in a monolingual Spanish situation would not be served well with little to no access to her English lexicon or grammar. Realistically, an English-weighted bilingual may never be in monolingual Spanish mode. A viable theory of language mode must take dominance into account.

Models of Bilingual Lexical Access

Three main models of bilingual lexical access have been proposed, each using an interactive model of speech perception such as the TRACE model (McClelland & Elman, 1986) as its foundation: (1) the BIA model (Dijkstra & Van Heuven, 1998), (2) the BIA+ model (Dijkstra & Van Heuven, 2002), and (3) the BIMOLA model (Grosjean, 1988; 1997). Each model proposes relationships among different resting levels of activation and word frequency, as well as general proficiency in one language over another. As a specific example, a Spanish/English bilingual who is Spanish weighted would have an overall lower resting level for all English words, but within English, common words would have higher resting levels than less common words. The three models differ in exactly what they model. BIA and BIA+ model visual word recognition, while BIMOLA models auditory speech perception.

The three also differ in how words are activated. The BIA model (Dijkstra & Van Heuven, 1998) uses a language tag or node to convey information to the lexical nodes of the corresponding language. The BIMOLA model, on the other hand, relies on emergent global language information to excite specific lexicons (Grosjean, 1997). In the BIA model, the base language inhibits non-base languages. While this may be a plausible account for monolingual modes, there is evidence for excitation over inhibition: increased code-switching by participants increased the speed at which non-base language words were identified (Soares & Grosjean, 1984). The BIMOLA model allows excitation of both lexicons, one lexicon, or neither, depending on the given language mode or task at hand. Dijkstra and Van Heuven (2002) counter these issues with the BIA+ model which collapses the language nodes. Because both languages are activated at once, fast code-switching is no longer a problem. However, turning off a language (or, exciting only one language), such as in the proposed monolingual mode for a bilingual speaker, is no longer possible.

In the current study, we compared lexical decision times of Spanish-English bilingual speakers in bilingual mode and in monolingual mode to English monolinguals. We ensured that bilingual participants in monolingual mode were unaware that their bilingual knowledge was relevant and that stimuli did not include cognates or roots of cognates that could excite the non-target language. We further assessed bilingual participants' dominances using a gradient measure.

Method

Participants

One hundred and five students from the UCSC subject pool participated in exchange for course credit. As is true for all studies at UCSC using the subject pool, participants completed an on-line survey in order to enter the experiment registration system. After completing this survey, students saw a selection of experiments for which they could register. They did not know if the particular experiment they registered for contained any restrictions to participation. Our experiment appeared for both monolinguals and bilinguals, so participants had no reason to expect that their knowledge of Spanish would be relevant for the study.

Part of the on-line survey included ratings of participants' Spanish language abilities. All subject pool participants provided this rating. The choices were: (1) I do not speak Spanish. (2) I have taken Spanish classes/I speak a little Spanish. (3) I can speak Spanish fairly well, but I don't use it often. (4) I am fluent in Spanish and use it fairly often, but I am more comfortable speaking English. (5) I am more comfortable speaking Spanish than English. To participate as a monolingual English speaker, participants had to select 1 or 2 on this rating system. To participate as a bilingual speaker, participants had to select 4 or 5 on this rating system.

Of the 107 participants, 32 were English monolinguals and 75 were Spanish-English bilinguals. Bilingual participants were randomly assigned to either the bilingual mode group (N = 34) or the monolingual mode group (N = 39). At no time prior to Part 2 (described below) were participants in the bilingual mode group made aware that the experiment would make use of their bilingual skills.

Materials

Two hundred real words and 200 nonwords were selected from a larger stimuli list used in a prior lexical decision experiment (Kotz, 2001). All stimuli were vetted for Latinate roots by two native Spanish speaking research assistants. Each word and nonword root was further cross-checked with a computer version of the New Oxford American dictionary. One hundred words and non-words were randomly selected and used in Part 1 of the experiment, and the other 100 words and non-words were used in Part 3. The two lexical decision tasks were prepared and run using Superlab experiment-generating software.

A Pink Panther cartoon with music and sounds but no spoken language was used in Part 2. The story was about five and a half minutes long and concerned a cuckoo clock and a sleepy Pink Panther.

At the end of the experiment, a bilingual dominance scale was used to assess participants' language dominance (Dunn & Fox Tree, 2009).

Procedure

To reduce individual differences in lexical decision reaction times, the experiment was carried out in a matched pair design with three Parts (initial LDT measure, manipulation, and final LDT measure). In Part 1, participants were greeted by a non-Latino experimenter and asked to perform a lexical decision task in English. In Part 2, participants viewed the Pink Panther video and retold the story to the experimenter. In Part 3, participants performed another lexical decision task.

In Part 2, all English monolingual participants and half the Spanish-English bilingual participants retold the story in English. To ensure maintenance of English mode for the bilingual participants, no mention of Spanish-speaking abilities was made. Participants were allowed to assume that their retellings should be in English, and they all did. The other half of the Spanish-English bilingual participants retold the story in Spanish. Prior to viewing the Pink Panther video, a Latina experimenter entered the room and revealed her ability to speak and understand Spanish. She asked the participants to retell the story in Spanish, providing the cover story that Spanish retellings would enrich the database.

After Part 3, bilingual participants filled out the bilingual dominance scale assessment. After completion of the experiment, participants were debriefed.

Results

Reaction times under 100 ms and over 3000 ms were treated as errors and excluded from analysis. The first fifty trials from the first LDT and the first twenty-five trials of the second LDT were considered practice trials and excluded from analyses.

Five participants were excluded from analysis because their difference scores were more than 2.5 standard deviations from their group mean. A further exploration of these five participants showed that each had unusually slow first-time LDT scores and normal second-time LDT scores, yielding extreme differences between the two LDTs. We interpret this as evidence implying that these participants were not paying attention during the first LDT.

As is usual with lexical decision tasks, all participants were faster identifying words, M = 1102 ms, sd = 143 ms, than nonwords, M = 1403 ms, sd = 274 ms, $t(100) = -15.2$, $p < .001$. Additionally, participants improved in speed from their first, M = 1285 ms, sd = 183 ms, to their second LDT, M = 1195 ms, sd = 178 ms, $t(98) = -10.1$, $p < .001$. This can be interpreted as a practice effect.

English monolingual speakers got more answers correct than bilingual speakers (M = 294 words, sd = 27 words, for monolinguals; M = 278 words, sd = 28 words, for bilinguals in monolingual mode; M = 273 words, sd = 37 words, for bilinguals in bilingual mode, $F(1, 98) = 3.78$, $p = .03$). This can be interpreted as a familiarity effect. Less frequent words such as *hearth*, *steward*, and *sleet* were more likely to be timed out or decided on incorrectly by bilinguals than monolinguals.

In the first LDT, reaction times for words and nonwords did not differ between language mode groups (M = 1130 ms, sd = 125 ms for words, M = 1449 ms, sd = 325 ms for nonwords, for monolinguals; M = 1163 ms, sd = 128 ms for words, M = 1552 ms, sd = 253 ms for nonwords, for bilinguals in monolingual mode; M = 1069 ms, sd = 182 ms for words, M = 1425 ms, sd = 324 ms for nonwords, for bilinguals in bilingual mode, $F(2,96) = .77$, $p = .47$). In addition, planned contrasts showed that (1) bilingual reaction times did not differ from English monolingual reaction times, $F(1,96) = 1.12$, $p = .29$, and (2) bilingual reaction times did not differ across language mode groups, $F(1,96) = 0.31$, $p = .58$.

To assess language mode, the first LDT reaction time was used as a covariate in a 2 x 3 MANCOVA model (word/nonword within-subject to bilingual-in-bilingual-mode/bilingual-in-monolingual-mode/monolingual between-subject) to predict performance differences in the second LDT. This is a common within-subjects design used to decrease individual variability, thereby allowing manipulation effects to be observed. Language mode affected reaction time, $F(2, 94) = 3.28$, $p = .04$, (see Figure 1). Although there was no effect for words, $F(1, 96) = .44$, $p = .51$, there was an effect for nonwords, $F(1, 96) = 4.22$, p = .04. Nonwords showed a difference between the bilinguals in bilingual mode versus the two monolingual mode groups combined. Planned contrasts showed that both monolingual mode groups differed from the bilingual mode group, $F(1, 94) = 6.29$, $p = .01$, and that English monolinguals and bilinguals in monolingual mode did not differ from each another, $F(1, 94) = .20$, $p = .66$. So, although the bilinguals in the two groups were similar (average rating on the gradient dominance scale was -7.8, *sd* 10.7, for the bilinguals in bilingual mode and -6.2, *sd* 11, for the bilinguals in monolingual mode), bilinguals in monolingual mode performed similarly to English monolinguals and differently from bilinguals in bilingual mode.

Bilingual dominance further predicted bilingual performance. In a MANCOVA incorporating both language mode and bilingual dominance, both dominance, $F(1, 58) = 4.98$, $p = .03$, and language mode, $F(1, 58) = 7.21$, $p = .01$, predicted nonword reaction time. Bilinguals who were more English weighted responded faster to nonwords than those who were more balanced or Spanish weighted, $F(1, 61) = 4.54$, $p = .04$. But they did not respond more quickly to words, $F(1, 61) = .03$, $p = .87$.

Discussion

To further inform the debate about the existence of language mode, we compared lexical decision performance across bilingual speakers in bilingual mode, bilingual speakers in monolingual mode, and monolingual speakers. To correct for earlier designs that may have encouraged priming of multiple languages in the monolingual mode condition, we ensured that participants had no idea that their non-base language would be relevant for this experiment and that the stimuli contained no cognates that would excite the non-target language. We also assessed participants' bilingual dominance and compared that to mode performance.

We found that bilinguals in monolingual mode rejected nonwords in the same amount of time as English monolinguals, but that bilinguals in bilingual mode took longer than both. All groups responded to words similarly. These data suggest that bilinguals' unused languages are inhibited (here, Spanish was inhibited). When the inhibition is lowered, such as when a bilingual speaker is in bilingual language mode, there is an effect on linguistic processing, although not on the words of the base language (here, English). Only nonwords are affected by language inhibition. While word stimuli may compete slightly when inhibition is lowered for both languages, the stimuli reach the recognition point before full competition between languages is realized. Said another way, bilinguals in bilingual mode recognize real-word stimuli from the base language (English) without the partial activation from Spanish impacting the recognition point. The reason nonwords are affected by language inhibition is that bilinguals who have lowered inhibition on their non-base language now have both their languages competing when activations do not reach the recognition level (the level at which a word is recognized as a word). Similar to the present findings, bilinguals in a mixed-language condition took longer to respond to nonwords than bilinguals in non-mixed-language conditions (Lemhöfer & Radach, 2009). Lemhöfer and Radach (2009) posit that bilinguals in the mixed-language condition set a longer deadline to decide on whether to reject a stimulus or accept it as a word.

The proposed explanation of our data fits the BIA model (Dijkstra & Van Heuven, 1998) but not the revised BIA+ model (Dijkstra & Van Heuven, 2002). The language nodes in the BIA model can inhibit activation of words from the non-base language, supporting the finding of faster reaction times to nonwords in the monolingual mode condition compared to the bilingual mode condition. Said another way, the activation of both nodes in the bilingual mode condition allows for a time-lag in the rejection of nonwords, supporting the finding of longer reaction times. The BIA+ model, however, always has both language nodes active. There is no way to model the current findings where speakers are either in bilingual mode or monolingual mode.

The proposed explanation also fits the BIMOLA model (Grosjean, 1988). Rather than using inhibitory connections to the opposite language as in the BIA model, the BIMOLA model uses excitatory connections to the language at hand. Bilinguals in bilingual mode would have excitatory connections to both lexicons, yielding added items to reject when identifying nonwords. In contrast, for word stimuli the overall activation of the word would be high enough to bypass competition and reach the recognition level before any trivial amount of excitation from a non-base lexicon could compete.

Some previous findings appear to conflict with our observations: Soares and Grosjean (1984) found that bilinguals in bilingual mode responded more slowly to words than bilinguals in monolingual mode. We believe these results do not speak to language mode at all, and instead reflect code-switching difficulty. Other earlier data from the same paper align with our observations. Soares and Grosjean (1984) also observed that bilinguals and monolinguals had comparable lexical decision times on words, but different lexical decision times on nonwords, with bilinguals' being much slower. They interpreted this as evidence that bilinguals searched one lexicon for words, but both lexicons for nonwords. We believe that this explanation is correct, but only for bilinguals in bilingual mode. We too demonstrated that some bilinguals have much slower lexical decision times on nonwords – but we showed that this was only true for bilinguals in bilingual mode, with bilinguals in monolingual mode responding similarly to monolinguals. Soares and Grosjean (1984) originally framed their results as a general explanation for all bilinguals, including bilinguals in monolingual mode, but Grosjean (1998) later mentioned that the participants in Soares and Grosjean (1984) study were most likely not in monolingual mode. So, we replicated some of Soares and Grosjean's (1984) findings, but discovered new evidence that only bilinguals in bilingual mode take longer to respond to nonwords but not words.

Finally, we found that language dominance influenced reaction times. The more Spanish-weighted the bilingual speakers, the longer they took to reject nonwords. Lemhöfer and Radach (2009) posited that when nonword stimuli are more similar to the language a bilingual is less proficient in, the bilingual will take longer to respond. We believe this explanation applies to our stimuli. Because nonwords were vetted to not contain Latinate roots, the words became more Germanic and harder for Spanish-weighted bilinguals to respond to.

Although there was no interaction between language mode and bilingual dominance, language mode can be made clearer when bilingual proficiency is controlled. This is a vital point because (1) there is potential that previous studies may have missed minor changes in language mode activation because of the variability in bilingual proficiency, and (2) there is a prevailing view that language mode activation may vary when comparing balanced bilinguals versus unbalanced bilinguals. For example, a heavily Spanish weighted bilingual may never be able to fully inhibit her Spanish lexicon whereas a more balanced bilingual who feels comfortable in English may be able to do so.

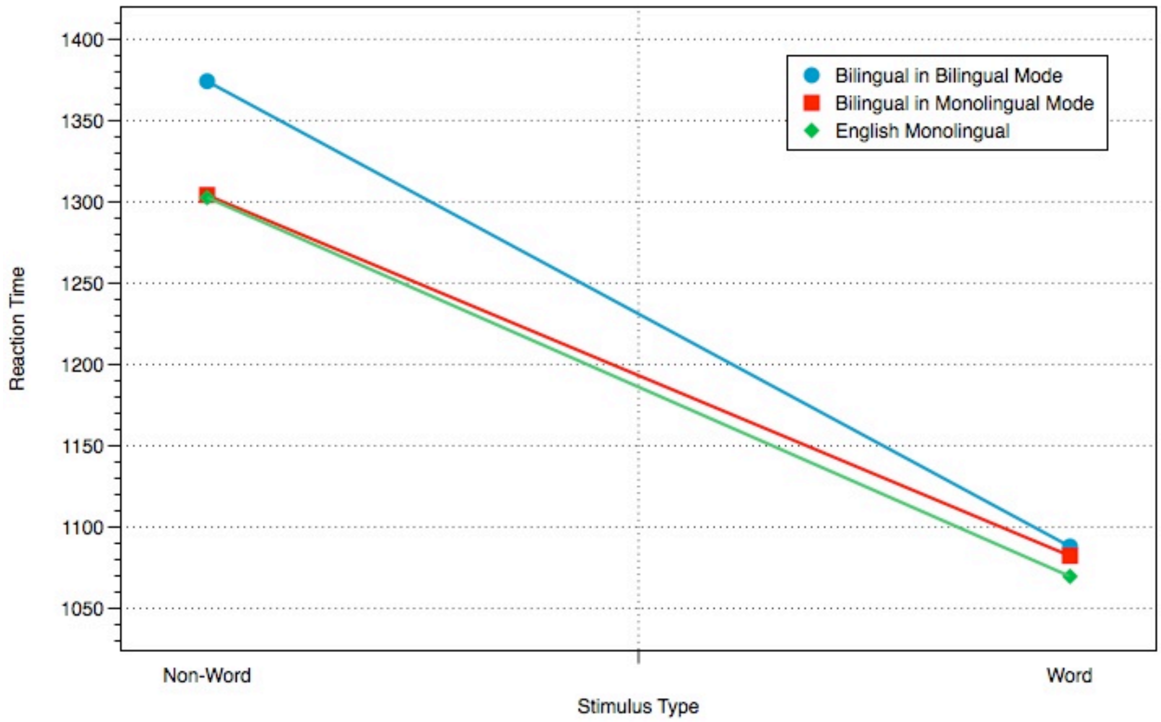
The methodological choices we made contrast with previous language mode studies. Dijkstra and Van Hell's (2003) LDT stimuli contained at least one-quarter cognates and homographs allowing for cross-language activation by viewing these stimuli. We made an effort to eliminate any Spanish-English cognates or homographs from word stimuli or any Latinate roots from nonwords that could be perceived as near-cognates or homographs. Our efforts created a stimuli set that was meant to eliminate any chance of bilingual language mode activation due to stimuli.

Additionally, we made a large effort to keep bilingual participants unaware of the bilingual nature of the study. Bilingual participants could not know that they were targeted for this study as English monolinguals were also targeted with the same named study. All research assistants for the first portion of the study were non-Latino and we scheduled bilingual experiment times to avoid participants' encountering any known bilingual or Latino participants, students, or graduate students in the laboratory. Indeed, all bilingual participants in English mode expressed surprise at the end of the study when research assistants asked them to fill out the bilingual dominance questionnaire.

Conclusion

Language mode influenced lexical decision for bilingual speakers. Bilinguals in English monolingual mode behaved like English monolinguals but bilinguals in Spanish-English bilingual mode behaved differently. Additionally, we found a main effect of bilingual dominance on the identification of nonwords, such that it took longer for Spanish weighted bilinguals to identify nonwords than English weighted bilinguals, in a gradient fashion. Results can be best described by extending the BIMOLA model of speech perception (Grosjean, 1988; 1997) to reading.

Figure 1: Lexical Decision RTs by Condition



References

Costa, A., & Caramazza, A. (1999). Is lexical selection in bilingual speech production language specific? Further evidence from Spanish-English and English-Spanish bilinguals. *Bilingualism: Language and Cognition*, *2*, 231-244.

Costa, A., Colomé, A., Gómez, O., & Sebastian-Galles, N. (2003). Another look at cross-language competition in bilingual speech production: Lexical and phonological factors. *Bilingualism: Language and Cognition*, *6*, 167-179. doi: 10.1017/S1366728903001111

Dijkstra, T., & Van Hell, J. G. (2003). Testing the language mode hypothesis using trilinguals. *International Journal of Bilingual Education and Bilingualism*, *6*, 2-16.

Dijkstra, T., & van Heuven, W. J. B. (1998). The BIA model and bilingual word recognition. In J. Grainger & A. M. Jacobs (Eds.), *Localist connectionist approaches to human cognition* (pp. 189-225).

Dijkstra, T., & van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, *5*, 175-197. doi: 10.1017/S1366728902003012

Dunn, A., & Fox Tree, J. F. T. (2009). A quick, gradient bilingual dominance scale. *Bilingualism: Language and Cognition*, *12*, 237-289. doi: 10.1017/S1366728909990113

Grosjean, F. (1982). Life with Two Languages: An Introduction to Bilingualism. Cambridge, Mass: Harvard University Press.

Grosjean, F. (1988). Exploring the recognition of guest words in bilingual speech. *Language and Cognitive Processes*, *3*, 233-274.

Grosjean, F. (1997). Processing mixed languages: Issues, findings, and models. In A. de Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 225-254). Mahwah, NJ: LEA.

Grosjean, F. (1998). Studying bilinguals: Methodological and conceptual issues. *Bilingualism: Language and Cognition*, *1*, 131-149.

Grosjean, F. (2001). The bilingual's language modes. In J. L. Nicol (Ed.), *One mind, two languages: Bilingual language processing*. (pp. 1-22). Oxford: Blackwell.

Hermans, D., Bongaerts, T., de Bot, K., & Schreuder, R. (1998). Producing words in a foreign language: Can speakers prevent interference from their first language? *Bilingualism: Language and Cognition*, *1*, 213-229.

Kotz, S. A. (2001). Neurolinguistic evidence for bilingual language representation: A comparison of reaction times and event-related brain potentials. *Bilingualism: Language and Cognition*, *4*, 143-154.

Lemhöfer, K. L., & Radach, R. (2009). Task context effects in bilingual nonword processing. *Experimental Psychology*, *56*, 41-47. doi: 10.1027/1618-3169.56.1.41

Marian, V., & Spivey, M. (2003). Competing activation in bilingual language processing: Within- and between-language competition. *Bilingualism: Language and Cognition*, *6*, 97-115. doi: 10.1017/S1366728903001068

McClelland, J. L., & Elman, J. L. (1986). The TRACE model of speech perception. *Cognitive Psychology*, *18*, 1-86.

Soares, C., & Grosjean, F. (1984). Bilinguals in a monolingual and a bilingual speech mode: The effect on lexical access. *Memory & Cognition*, *12*, 380-386.

Acknowledgments

We thank our many research assistants who aided in data collection and coding, with a special thanks to Katy Pelton, Brenda Garibay, Natalie Orozco, Vicente Rodriguez, Malaika Santa Cruz, Jessica Acosta, and Janine Ramirez.

Funding

This research was supported by faculty research funds granted by the University of California Santa Cruz and by *Language Learning*'s Small Grants Research Program.