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SEGMENTAL PRODUCTION IN BILINGUAL SPEECH:

A PSYCHOLINGUISTIC APPROACH

A Thesis in

Spanish

by

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ABSTRACT

A great deal of past psycholinguistic research has focused on the mechanisms that govern bilingual lexical processing. There is general agreement in the field that the bilingual lexicon is nonselective in nature, meaning that a bilingual individual is incapable of "turning off" his/her other language currently not in use within any given language context; therefore, the lexical counterpart that is not in use at any moment remains active in the mind of the bilingual.

Research focusing on the acquisition of L2 phonology, on the other hand, has provided a great deal of evidence toward the notion of sound similarity being a detriment to ultimate attainment of authentic L2 phonetic production. In other words, if there is a phonemic counterpart between a learner's two languages, the phonemic boundaries, or the categorical phonetic properties of a particular sound will be governed more strongly by the L1 phonetic category established for that sound. Therefore, for cross-language sounds bearing close phonetic similarity, the learner will experience greater difficulty in producing them in a perfectly accurate manner, or as a native speaker of that language would produce them.

In light of the findings in these traditionally distinct fields of research, the present study seeks to bring them together by means of examining cognates, one class of lexical items bearing a high degree of cross-language similarity. Generally defined, cognates are words that bear a high degree of cross-language similarity on the semantic, orthographic and phonological dimensions. Since past psycholinguistic research, using reaction time (RT) as its principal indicator of cross-language activation, has shown that bilingual word

recognition is a function of the degree to which words are similar across languages and past research on the acquisition of L2 phonology has shown that cross-language sound similarity is a detriment to ultimate accurate attainment of the L2 sound system, the present study exploits the presence of cognates in English and Spanish to examine the relation between these phenomena. The specific aim of the study is to examine how L2 learners at different stages of acquisition process cognates. The goal is to determine whether speech planning stage and phonetic realization, or speech execution, are related and whether the context of L2 learning and the level of L2 proficiency modulates this relationship. To address these issues, the present study examines RT, a traditional psycholinguistic measure of lexical processing and performance, voice onset time (VOT), a traditional measure of phonetic performance at the segmental level of production, and overall word duration from onset to offset of articulation. In addition to considering the role of level of proficiency in determining how English learners of Spanish speak Spanish words, the study also examines the learning context (language immersion versus non immersion).

A major result of the study is that learners who are, by other assessments, of equal L2 proficiency perform dramatically differently in a simple task from learners who are immersed. All groups exhibit cognate facilitation in the naming task in reaction time, but the learner group differs from the other groups in both production measures: Only the learner group shows a significant cognate effect on VOT and only the learner group shows a significant cognate effect on word duration. The immersion context facilitates the inhibition of L1 phonology (as seen by the lack of a cognate effect in production). In this sense, the immersion group patterns with advanced speakers, rather than with their

proficiency equivalent counterparts. Finally, the learner group VOT and duration data support the hypothesis that cognitive processes underlying utterance planning may extend into production when planning is resource limited. L2 learners thus provide a rich testing ground for issues pertaining to modularity in language processing.

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Anyone who has ever written a graduate thesis knows very well that the process of carrying it out is so much bigger, on so many levels, than the finished product itself. It is never something separate from you as an individual; therefore, your own personal strengths and weaknesses come to the forefront with an intensity you never thought possible. It is definitely a sort of life journey and one that is very much shaped by those around you, those who have touched you and changed you along the way whether it be for better or for worse. In spite of the seemingly insurmountable challenges with which one is faced during such a project, I believe those challenges reach places beyond the confines of the mind and if you let them, open the door to your soul.

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Of course, I must thank my brother, Jason Jacobs – the one who always can make me laugh no matter how down and out I may feel, and the only one who can wake me up from a deep sleep without making me angry ☺. Even though I pitched a raging fit the day mom brought him home from the hospital in 1977, I'm damn glad she was unrelenting in the fact that he was here to stay ☺. The greatest gift my brother has given me and continues to give me is that of pure love, understanding, and of always "getting what I mean" whenever I confide in him. He is my confidant in so many ways and has given me more love and support not only now during the years spent preparing my dissertation project, but throughout our lives. Without even trying, my brother, although he may have not realized it, gave me the gift of an empathetic ear and a shoulder to lean on, something I have and always will be able to cling to in my time of need. In his placidity, I know of no force stronger than my brother. Jason, you are the personification of love, of power and of a pure spirit. You have been, are and always will be one of the most steady and powerful forces in my life. Your pure spirituality and love have brought me such peace and who and everything you are has always been and will always be my "good luck.. [as I explore]… the infinite abyss," as you are the one who has explored it and continues to explore it with a love and an understanding that I can only hope to reach.

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As I draw to a close, I find myself evaluating and analyzing this journey and accomplishment. One would assume that I am, of course, referring to the completion of this dissertation. Yes, I guess I can say that I am, but at the same time, I realize that I must measure this achievement with a proper instrument. I must not make it bigger than it is, nor should I make it smaller than it is. The dissertation itself and earning a Ph.D., in the eyes of the world, is a huge milestone, an instance of great success, the mark of a monumental academic achievement. But, as I look back at it all, I know I would be failing to appreciate the journey if I emphasize the ephemeral "value" of a diploma, as it is not a measure of me, not a reflection of my intelligence or lack thereof, and certainly does not form a significant portion of the foundation of what my life is and want it to be. In essence, if I measure this moment in terms of arbitrary merit, I sell myself short. That's why in this moment, I cannot help but think of and in my heart honor the late Jonathan Larson, the celebrated man and spirit behind the Broadway musical, *RENT*, as the message of it is so powerful and one that I put in my heart's pocket and have carried with me ever since I saw the musical for the first time. Its truth I wanted to make my truth. It's message of love I wanted to make my message of love. In the song, *Seasons of Love*, we are faced with the questions, "*…How do you measure, measure a year? In daylights, in sunsets, in midnights, in cups of coffee? In inches, in miles, in laughter, in strife? …How do you measure a year in the life?…How about love?…Measure in love."* It's when I think of this song and this powerful message, I am compelled…divinely forced, really, to look back over this journey *not* as one that I measure in banal material success or a series of mundane accomplishments that collectively formed the means to this end. If I did, it would all, in the end, be pretty meaningless. But, when I "*…measure in love…*," when I measure this experience in terms of all the love that has surrounded me, protected me, walked beside me, held me up, become part of me and carried me along the way, I am overwhelmed, completely overtaken, and left in absolute awe of the riches, of the success, and of the glory that were mine every step of the way – a love that I will carry with me not just through the end of this journey, but through many more to come…

Chapter 1

Establishing the Link Between Lexical Processing and the Acquisition of Phonology in a Second Language

A great deal of psycholinguistic research has been dedicated to examining the nature of the bilingual lexicon, both in terms of how lexical items are stored in bilingual memory, how they are accessed and how second language (L2) learners acquire proficiency in using lexical information in both languages (see Kroll & Dijkstra, 2002, for a review and references). Although historically this research yielded conflicting results (e.g., see Smith, 1997 for a review), current findings suggest that bilinguals and L2 learners access lexical information from both languages in a nonselective fashion (e.g., Brysbaert, Van Dyck, & Van de Poel, 1999; Colomé, 2001; Dijkstra, 2005; Hermans, Bongaerts, de Bot & Schreuder, 1998; Van Heuven, Dijkstra, & Grainger, 1998).

Another approach, grounded in research on phonetics and phonology has strived to discover the mechanisms and processes that underlie the perception and production of the L2 sound system as well as to reveal what exactly causes the apparent age constraints in acquiring segmental perception and production accuracy in the L2 (Best, 1990; Best, 1995; Best & Strange, 1992; Flege, 1987; Flege, 1991; Flege, 1995; Flege, 1999; Flege, 2003).

The goal of the research to be reported is to examine the relation between cross-language activation and speech production. In order to realize this objective, an empirical study examined the production of cognates, words that share semantic, orthographic and/or phonological similarity across languages. The goal of the study was to compare aspects of lexical processing and spoken production in bilinguals and L2 learners to reveal the cognitive processes that underlie the acquisition of the L2 phonological system.

A strategy that has been exploited in psycholinguistic research on L2 lexical processing is to use the presence of words that exist in whole or in part across both of the bilingual's languages. If both languages are activated in parallel, as the nonselective view proposes, then one should observe consequences of that activation even when the task itself is performed in L1, and that is precisely the pattern that has been reported in many past studies (see Dijkstra, 2005, for a review). Studies examining performance for cognates, words that are identical or similar semantically, orthographically and/or phonologically across two languages, have shown that in perception, cognates produce an *overall* facilitatory effect in terms of the rate at which bilinguals access these lexical items (Dijkstra et al., 1998; Dijkstra, Grainger, & Van Heuven, 1999; Van Hell & Dijkstra, 2002). Cognate facilitation effects have been attributed to these items' semantic and orthographic overlap, which allows bilinguals to recognize and name cognate items more quickly and accurately than noncognate items. It is important to note that most of the past research on cognate effects in word recognition have been based on the results of lexical decision, a task that is exclusively receptive in nature and requires different processing mechanisms than those engaged in production, processes which will be discussed in greater detail below since they were used as the primary experimental tasks in the studies reported here. Although semantic and orthographic similarity across translation equivalents yields facilitation in perception, as reported by Dijkstra et al. (1999), phonological similarity, produces inhibition. Yet, when combining the facilitatory properties of similar semantics and orthography with the inhibitory effects of similar phonology, an overall cognate facilitation effect is nevertheless often observed. A similar cognate facilitation effect has been observed in production, when bilinguals name pictures whose names are cognate translations across the two languages (Costa, Caramazza, & Sebastián-Gallés, 2000; Kroll, Dijkstra, Janssen, & Schriefers, 2000). Unlike the word recognition data, the evidence on picture naming suggests that there is also phonological facilitation for cognates in production because the effect is observed even when the bilingual's two languages differ in script and therefore do not share the same written form (e.g., Hoshino & Kroll, under review).

In both perception and production, there is evidence for an overall facilitatory effect in cognates; however, the loci of these effects are different in terms of the nature of the task, since perception is purportedly a bottom up task whereas production requires top down processing. The loci of these differential effects seem to lie in the intervening role of phonology in these two tasks, which will be one of the primary foci of the present investigation.

Extensive empirical research in second language phonology and phonetics, namely in L2 segmental perception and production by Flege (1992, 1995, 1999, 2003) within the framework of the Speech Learning Model, shows that phone similarity across languages produces detrimental effects at both the perception and production levels. Late

L2 learners will most likely have great difficulty acquiring L2 segmental perception and production accuracy for similar sounds and therefore be unable to achieve it. At best, (s)he will be able to modify it as to only approximate L2 phonetic norms. Consequently, in light of the empirical evidence on L2 segmental perception and production, it appears that cross-language similarity is a hindrance to native-like acquisition.

In view of the evidence from these two areas of research, one question that arises is the following: What effect does lexical similarity across languages have on L2 segmental production accuracy? The purpose of the present work is to determine whether cognate status has a significant effect on L2 production accuracy in native English speakers who have learned Spanish as a second language after early childhood. Acoustic analysis on cognate items as well as noncognate control items spoken by participants in a word-naming task was performed to determine whether there is a significant reduction in segmental production accuracy when bilinguals and learners produce cognates in the L2 relative to matched controls.

In addition, acoustic analysis was performed on the critical cognates and controls in order to obtain measures of word duration (i.e., from articulatory onset to offset). The goal of this planned analysis is to further test the notion reported in recent psycholinguistic research in the monolingual domain that speech is phonologically encoded prior to the commencement of articulation (e.g., Damian, 2003). While this claim has been challenged in research on monolingual speech as yielding differential effects in terms of task load and demand (Kawamoto, Kello, Jones, & Bame, 1998; Kello, Plaut, & MacWhinney, 2000; Kello & Plaut, 2003), the research reported in the present investigation, via measures of L2 cognate word duration, seeks to show that although discrete processing mechanisms between the pre-utterance and utterance planning stages may hold true in the monolingual domain, it actually becomes the exception and not the rule in the bilingual domain, in that such mechanisms are modulated as a function of L2 proficiency.

First, however, we examine past empirical studies in psycholinguistics (specifically in the domain of bilingual lexical processing), the acquisition of L2 phonology, and recent investigations of the processes involved in pre-utterance planning and their effects on utterance execution.

Lexical Access and the Bilingual Lexicon

Nonselective Lexical Access in Bilinguals

Extensive research on bilingual lexical access and lexical representation has provided evidence that the bilingual lexicon is, in fact, nonselective in nature. That is, information about words in both of the bilingual's two languages appears to be active when only one language is required. With respect to perception, the most comprehensive model to date illustrating the nonselectivity of bilingual lexical processing is the Bilingual Interactive Activation model (BIA)[1] posited by Dijkstra, Van Heuven and Grainger (1998; Dijkstra & Van Heuven, 1998; Van Heuven, Dijkstra, & Grainger, 1998)

[1] It is important to note, however, that Dijkstra and Van Heuven (2002) have revised their existing BIA Model and have extended its tenets in order to account for phonological and semantic lexical representations in the BIA+ Model.

which is based on the Interactive Activation model proposed by McClelland and Rumelhart (1981) to account for monolingual lexical processing. The BIA model consists of four hierarchically arranged layers; the first corresponding to the feature level, the second to the input letter string, the third to the word level and the fourth to language nodes. According to the model, lexical processing is performed as a bottom up process as feature, letter and word nodes are activated in turn, irrespective of language, until competing lexical items are suppressed and one lexical item surpasses an activation threshold to recognition. To account for language selection, there is a simultaneous top-down process, which corresponds to the "language node" layer, responsible for "selecting" the language in which the input information will finally be recognized.

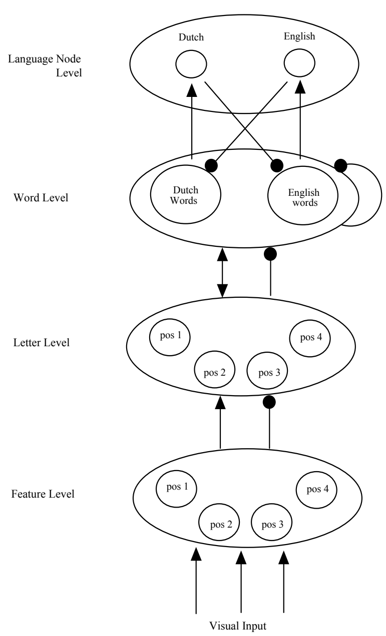

Figure 1.1. The Bilingual Interaction Activation Model[2]

[2] Adapted from Dijkstra, Van Heuven and Grainger, 1998.

With respect to spoken production, much of the preliminary evidence in which language nonselectivity has been reported is found in experiments employing some variation of a Stroop test (Stroop, 1935) to assess the degree to which a bilingual's two languages are active when processing only one of his/her languages.

Preston and Lambert (1969) and Chen and Ho (1986) both investigated the Stroop effect in a color-naming task in English-French bilinguals and found that there was a significant Stroop effect for color naming. Even when bilingual participants were asked to perform the task in one of their two languages by naming only the color in which each orthographic representation was presented and to ignore the word itself, they were unable to ignore printed words presented in their other language, therefore slowing processing. If lexical access were language selective, words in the non-target language should not have influenced their processing of the target language. Since interference effects were, in fact, observed, the results of these experiments lend support to the notion of the nonselective bilingual lexicon.

In an experiment conducted by Tzelgov, Henik, Seng and Baruch (1996) on Hebrew-English bilinguals within the Stroop paradigm, the results showed that not only was there a significant Stroop effect for color naming for these bilinguals, but there was also a significant effect for homophonic non-words in English that sounded like a Hebrew color name (e.g., כחל (*blue* in Hebrew) vs. a roughly English homophonic non-word of, for instance, *cackol*). In this condition, the participants were asked to name the color of the print of the word, but the word presented to them was an English non-word that sounded like the color "blue" in Hebrew. Although Hebrew and English have different orthographic systems, the bilinguals' processing of Hebrew was slowed by the presentation of an English word phonologically similar to a Hebrew color name. In addition to providing further evidence in support of the nonselective view of bilingual lexical access, these results indicate that non-target lexical items are also activated at the phonological level.

Further evidence for the nonselective lexical access in bilinguals is found in studies employing the picture-word Stroop interference paradigm. In an experiment conducted by Smith and Kirsner (1982) with Chinese-English bilinguals, participants showed a comparable degree of interference to monolingual results when pictures were presented with an unrelated printed word placed over it and the language of the printed word varied as participants were naming in only one language.

The overall results of another study utilizing a similar experimental paradigm carried out by Hermans, Bongaerts, de Bot and Schreuder (1998) with highly fluent Dutch-English bilinguals showed that when naming in the L2, interference is observed regardless of the language of the distracter word. Both of these studies lend support to the conclusion that bilingual lexical processing, at least early in the production process, is nonselective.

An experiment performed by Guttentag, Haith, Goodman and Hauch (1984) employing a flanker task, a variant of the Stroop color naming task, showed that bilinguals are unable to solely concentrate on one central item and ignore the flanker items both when the flanker items were in the same language that was being used for naming as well as when the flanker words appeared in the non target language. Since interference effects were obtained for both conditions, the results support the notion of a nonselective bilingual lexicon.

In a more recent study, Dijkstra, Timmermans and Schriefers (2000) investigated performance in a language decision task in which interlingual homographs were presented in mixed conditions and the word frequency of the test materials was manipulated. Dutch-English bilinguals were only able to ignore non-target interlingual homographs to a certain extent, suggesting once again that lexical information from both a bilingual's languages is available in parallel when engaging in lexical processing in only one language.

The empirical work reviewed thus far lends support to the view that lexical information in bilingual memory is accessed in parallel for both of the bilingual's languages. It is important to note, however, that the evidence seen up until now is not comprehensive, in that a complete and collective review of all empirical work dedicated to illustrating the nonselective nature of the bilingual lexicon is not reviewed,[3] although it does serve to establish the foundation on which both the theoretical premise for the present work as well as further investigation into the nature of bilingual lexical processing rest.

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[3] See Smith (1997), Francis (1999), Gollan and Kroll (2001), Kroll and Dijkstra (2002) and Sebastián-Gallés and Kroll (2003) for a more extensive review of the evidence for language nonselectivity in lexical access.

The Nonselective Bilingual Lexicon and Inhibitory Control

To What Extent are Words in Both Languages Active in Bilingual Lexical Processing?

Although there is compelling evidence to support the existence of a nonselective bilingual lexicon, the subsequent issue that must be addressed is that of how a bilingual's two languages are mediated and controlled. In other words, to what extent are the bilingual's two languages active in any given task and what are the repercussions of resolving this interlingual competition? The inhibitory control model proposed by Green (1986,1993,1998) provides a means of accounting for the mechanism bilinguals employ to suppress the non-target language in production. According to this model, aside from the bilingual's having to determine and prepare a schema for the task at hand, there will be greater costs observed in the language that requires a greater level of effort to achieve inhibition, which in virtually all cases, is the L1. The results of several empirical studies employing varied experimental paradigms serve to support this claim.

Evidence from cued picture naming experiments (e.g., Kroll, Dijkstra, Janssen & Schriefers, 1999; 2000; Kroll & Peck, 1998) show that when both languages are required to be active, there is a greater cost to L1 naming than to L2 naming. In the aforementioned cued picture naming studies, bilinguals are asked to name a picture only when they hear a tone that cues production. In blocked language naming, one tone consistently cues spoken production in one of the two languages and the other tone cues a "no" response. In mixed language naming, each of the tones cues one of the two languages. Thus, when presented with a pictured object, the bilingual must wait until (s)he hears the tone to know the language in which it must be named. In this mixed language condition, naming latencies were longer when the bilinguals were required to respond in their more dominant L1 than when responses were elicited in the less dominant L2. This effect in these studies was attributed to a "preparation" effect in which the participants continually had the less dominant L2 item "prepared", thus causing suppression of the more dominant L1 item. Consequently, when required to name pictures in the L1, reactivation of the more dominant L1 had to be accessed. Since a greater degree of L1 inhibition is necessary to allow for L2 processing, it takes longer to reactivate it to proceed with L1 processing.

In blocked conditions, the more typical pattern was observed, with L2 naming latencies slower than those for L1. Most critically, the time to name pictures in L2 was relatively unaffected by the requirement to have L1 active, suggesting that normally L2 is always active during the planning of L2 speech. However, the opposite is not inevitably true; L2 does not necessarily interfere with L1 processing when it is not required to be active (see Kroll, Bobb, & Wodniecka, 2006).

Language switching experiments (e.g., Loasby, 1998; Meuter & Allport, 1998) corroborate the results found in the cued picture naming experiments in that greater switch costs, in terms of reaction time (RT), are observed when bilinguals must switch from L2 to L1 than when switching from L1 to L2. Like the results of the cued picture naming studies, these language-switching experiments suggest that L1 is always active during L2 naming and may need to be inhibited to allow the L2 word to be spoken. The asymmetric switch costs for the L1 therefore reflect the time to reactivate the inhibited L1 after having named in L2.

In summary, the empirical work we have reviewed reveals the following about the degree of language activation in bilingual lexical processing: (1) In mixed conditions, there is a greater cost to L1 processing than to L2 when both languages are required to be active and (2) in blocked conditions, which more closely represent typical communicative situations of a bilingual, except when the bilingual engages in code switching, the L1 is active during L2 processing and interferes in L2 performance, even when L1 does not need to be active. On the other hand, L1 processing is not affected by the L2 when it is not required to be active or at least such seems to be the case with respect to the nature of the task as well as task demand (Kroll et al., 2006).

The Dynamic Nature of Bilingual Lexical Access as a Function of L2 Proficiency

Evidence from the Revised Hierarchical Model (RHM)

The literature we have reviewed thus far suggests that the bilingual lexicon is nonselective in nature. However, the nature of lexical processing in bilinguals differs in the strength of the links between the semantic/conceptual level of processing and that of lexical form for each language as a function of language proficiency, as posited by the revised hierarchical model (RHM) (Kroll & Stewart, 1990; 1994).

The RHM is an extension and revision of both the *word association model*, which states that bilinguals access L2 lexical information exclusively through the L1 translation equivalent, thus accessing conceptual information through the L1, as well as the *concept* *mediation model*, which claims that bilinguals, not considering proficiency level, access the conceptual level directly when searching for lexical items in the L2, proposed by Potter, So, Von Eckardt and Feldman (1984).

Although Potter et al. (1984) reported two experiments that demonstrate that the performance of both less and more proficient bilinguals follows the predictions of the concept mediation model, subsequent replications of their study conducted by Chen and Leung (1989) and Kroll and Curley (1988) failed to replicate the overall results. These later studies found that the performance of less proficient L2 learners supported the predictions of the word association model whereas the more proficient bilinguals, like Potter et al.'s participants, appeared to be concept mediators. Kroll and Stewart (1994) proposed the *Revised Hierarchical Model,* to account for the transition from word association to concept mediation with increasing proficiency in the L2. The model proposes a more complete explanation for asymmetries in the strength of the connections between the lexical levels in each language and the conceptual level. The model proposes that the L1 has a more dominant role in its access to the conceptual level whereas the L2 remains strongly linked at the lexical level to the translation equivalent in L1.

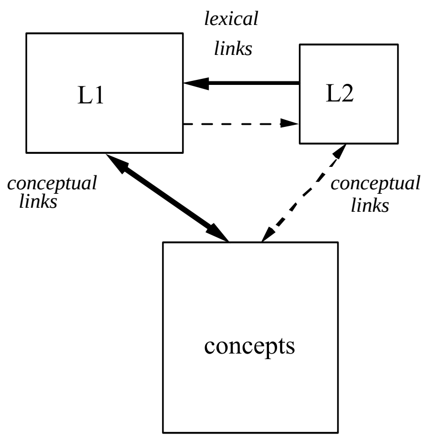

Figure 1.2. The Revised Hierarchical Model[4]

In order to test the predictions of the Revised Hierarchical Model, Kroll and Stewart (1994) examined the performance of highly fluent Dutch-English bilinguals in bi-directional translation tasks to assess the level to which L1 conceptual representations mediated L2 lexical processing. Participants were asked to translate both from L1 to L2 and from L2 to L1. In one condition the words were semantically categorized and in the other, the words were semantically unrelated. In the unrelated condition, translation from L1 to L2 was slower than translation from L2 to L1. The critical finding was that semantic organization affected translation only from L1 to L2 but not from L2 to L1. These results suggest that the conceptual level of lexical processing is more highly active in forward translation, therefore showing that backwards translation (i.e., L2 to L1) is mediated more strongly by links at the lexical level rather than the conceptual level.

In addition to the study reported by Kroll and Stewart (1994), other evidence supporting the predictions of the RHM has been reported in studies of translation performance (e.g., De Groot, Dannenburg, & Van Hell, 1994; Sholl, Sankaranarayanan,

[4] Adapted from Kroll and Stewart, 1994.

& Kroll, 1995), cross-language priming (Fox, 1996; Keatley, Spinks, & De Gelder, 1994), cross-language masked priming (Gollan, Forster, & Frost, 1997; Jiang, 1998), and from neuroimaging investigations (Klein, Milner, Zatorre, Meyer, & Evans, 1995). Although such evidence has not gone unchallenged (see Kroll & De Groot, 1997 for a review and discussion of incongruous results), more recent evidence continues to lend support to the RHM (e.g. Costa, Caramazza, & Sebastián-Gallés, 2000; Kroll, Michael, Tokowicz, & Dufour, 2002).

Models of Bilingual Lexical Processing

How the Revised Hierarchical Model (RHM) and the Bilingual Interactive Activation Model (BIA) Differentially Account for Nonselectivity

In the work we have reviewed, the Revised Hierarchical Model (Kroll & Stewart, 1994) and the Bilingual Interactive Activation Model (Dijkstra, Van Heuven, & Grainger, 1998; Dijkstra & Van Heuven, 1998; Dijkstra & Grainger, 1998) are models that account for language nonselectivity in both production and perception, respectively. The BIA model posits the activation of form neighbors. When L2 words are presented, L1 words that resemble the L2 words in lexical form (i.e., orthography or phonology) are also predicted to be active to some degree. Since cognates share lexical form across languages, the convergence of cross-language interactions from form to meaning will generally facilitate processing, although the requirement to select a word to be spoken may be delayed when the language status of the word is highly ambiguous. In contrast to the BIA model, the RHM predicts that when an L2 word is processed, the translation equivalent in L1 is active, at least when the task requires production.

Sunderman and Kroll (2006) tested the alternative predictions of the RHM and the BIA models to determine the specific nature of L1 activity during the development of L2 proficiency. The results of the study revealed that participant performance on both lexical form relatives of both the target word (e.g., *cara-card*) as well as that of the translation equivalent (e.g., *cara-fact*), along with meaning relatedness, work as a function of and are therefore modulated by L2 proficiency (inhibitory effects were observed for both less proficient and advanced proficiency learners). In terms of the semantically related translation equivalents, (e.g., *hombre-mujer*), only the advanced proficiency learners showed inhibitory effects, but not the lower proficiency learners. Such results would be expected based on the respective tenets of bilingual lexical processing for the BIA and the RHM. In other words, the link between the conceptual link and the L2 lexical level, or "lexico-orthographic" level (the language node, in terms of the BIA), grows stronger with increasing L2 proficiency, although the link to the L1 lexical level is always strongest.

Finally, the results point to a clear inhibitory effect or sensitivity to incongruence of grammatical class between target items and distracters. Regardless of L2 proficiency level, unmatched grammatical class of items invariably produced inhibitory effects.

In summary, in regards to this study, we see that both the RHM and the BIA models, taken together, provide us with an accurate account of the intricacies of bilingual lexical processing.

The Role of Phonology in Bilingual Lexical Access

Further Evidence for a Nonselective Lexicon

Although perception and production involve the use of differing cognitive resources (Kroll & Dijkstra, 2002), there is a great deal of evidence from both these modes of processing that bilingual lexical access is nonselective. In this section, the empirical evidence from both comprehension and production illustrating the late intervening role of the phonology of the non-target language in bilingual lexical processing will be reviewed.

Comprehension

The results of a study carried out by Nas (1983) on fluent Dutch-English bilinguals revealed that, in an English lexical decision task, participants were slower to reject and made more errors with cross-language pseudohomophones, English non-words whose orthography differed from a Dutch word, but whose phonology was similar to a Dutch word. (e.g., *SNEE (Dutch word)– SNAY* (English pseudohomophone derived from the Dutch, "*SNEE*", meaning "cut"). Such findings not only lend further support to the notion of the nonselective bilingual lexicon, but also demonstrate that even the phonology of non-target lexical items is active during lexical processing.

Similar results were reported by Doctor and Klein (1992) in a study with English-Afrikaans bilinguals in that in a language non-specific lexical decision task, participants were slower to respond to interlingual homophones than to the homographs, also showing that non-target language phonology is active, and in the case of interlingual homophones, produces inhibitory effects.

Gollan, Forster and Frost (1997) also found evidence for active non-target language phonology in bilinguals whose two languages use distinct scripts, English and Hebrew. In the absence of shared orthography in the participants' two languages, cross-language priming effects were still obtained in a lexical decision task for cognates, suggesting that phonological similarity across languages was sufficient to produce the observed interactions. Virtually identical findings were reported by Brysbaert, Van Dyck and Van de Poel (1999) in a study that showed that phonologically similar words from a participants' dominant language primed target words in their non-dominant language in a lexical decision task.

Dijkstra et al. (1999), using an English lexical decision task with Dutch-English bilinguals, found that English-Dutch homophones gave rise to longer decision latencies than matched English control words, suggesting that reading words in the less dominant language activates phonological representations in the dominant language, even when that language is not required to be active.

Likewise, Jared and Kroll (2001) in a study with English-French bilinguals found that more but not less proficient bilinguals, after an interposed block of French naming trials between blocks of English naming trials, were sensitive to both within-language and cross-language items having identical word bodies, but different spelling-to-sound correspondences. In other words, naming latencies for these items were significantly slowed when naming in English (e.g., English *BAIT* vs. French *FAIT,* where *–AIT* is pronounced as a short “e”). These results demonstrate the influence and thus, activation of non-target language phonological representations even when the bilingual is not consciously engaged in processing that language.

Production

To determine whether the phonology of nontarget alternatives were active during speech planning, Peterson and Savoy (1998) modified the picture-word Stroop interference paradigm. In the standard version of the task, a participant is told to name the picture and ignore the distracter word. In the variant of the task used by Peterson and Savoy, a picture was presented and followed by a cue for naming. When participants saw the cue, they were to speak the picture’s name. The cue was present on most trials. However, on a small proportion of trials, a word replaced the cue and the participants were told to name the word instead of the picture. The timing of the word’s presentation was varied relative to the onset of the picture itself. The critical materials in this study were pictures whose names were close synonyms (e.g., *bunny* vs. *rabbit* or *couch* vs. *sofa*). Peterson and Savoy found facilitation for words that were phonologically similar to the subordinate alternative (e.g., “soda” sounds like “sofa) and that facilitation extended far into the time course of speech planning. The result was taken as support for a cascading model of speech production in which related candidates are activated in parallel and compete for selection.

Although this experiment was conducted on English monolingual speakers, the results are applicable to the bilingual case. Whereas monolingual speakers may have only a small set of close synonyms in their vocabulary, and may therefore be able to avoid the effects of lexical competition under most circumstances, proficient bilinguals have at least one alternative name for each concept in each language (i.e., the translation equivalent). The results suggest that the planning of single word utterances by bilingual speakers may involve parallel activation of translation equivalents and subsequent competition among activated alternatives.

The Peterson and Savoy results, showing that nearly semantically identical items are active in processing just prior to production in the monolingual domain, can also be applied to the bilingual case, which is corroborated by the findings reported by Kroll, Dijkstra, Janssen and Schriefers (1999; 2000) in a cued picture-naming task with highly proficient Dutch-English and French-English bilinguals. The result of the Kroll et al. picture-naming study of most interest in terms of cognate production is that in the blocked condition, cognate facilitation was observed for the L2, indicating that the phonology of the non-target language was active and influenced its course of processing even when the language of naming was known in advance. However, not only did these authors observe cognate facilitation effects in the blocked L2 condition, but also inhibitory effects for L2 homophones (words that share identical orthography and phonology, but different semantics e.g., *spring* (the coil) and *spring* (the season) in English) in the same condition. It is interesting to note that the words were presented as distracters for 50ms along with the presentation of the picture to be named, such that the participants were not consciously aware of their presence, but affected processing just the same. Such a result provides further evidence for the activation of non-target phonology in bilingual lexical processing.

In a phoneme monitoring study, Colomé (2001) showed Catalan-Spanish bilinguals pictures and asked them to determine if a given phoneme was present in the name of the picture. The results showed that non-target phonology was, in fact, active even though processing in only one language (i.e. Catalan) was required. Since response times were slowed when a phoneme present in the Spanish translation equivalent of the picture was presented, Colomé concluded that such a result was due to the activation and therefore influence of non-target phonology in target language processing.

In summary, the evidence from both comprehension and production studies shows that non-target language phonology is active in bilingual lexical processing. However, the point to which non-target phonology is active in the production process is still a matter of considerable debate in the literature and will be addressed in a later section.

Interim Summary

Bilingual Lexical Access

Our review of the empirical and theoretical evidence thus far allows us to make the following basic assumptions about bilingual lexical access:

1. The bilingual lexicon is non-selective in nature.

2. The L1 holds a stronger link to semantic/conceptual representations than the L2. Therefore, access of L2 lexical items is more strongly regulated via L1 lexical representations, which in turn is directly linked to the semantic/conceptual level. However, links between L2 lexical representations and the conceptual level become increasingly stronger as a function of increasing L2 proficiency. Even though the link between L2 representations and the conceptual level become increasingly stronger, L1 always holds the preferential link to the conceptual level in spite of a high level of L2 proficiency.
3. The phonology of alternative non-target lexical items is active in bilingual lexical processing.

Cognate Facilitation Effects in Bilingual Lexical Access

The cognate facilitation effect has been well documented in the literature on bilingual lexical processing. It is widely known and accepted that cognates, words with similar semantics, orthography and phonology between two languages are recognized in the L2 more quickly and with less errors than noncognate items (Dijkstra, Van Heuven, & Grainger, 1998; 1999; Gerard & Scarborough, 1989; Gollan, Forster, & Frost, 1997). It is important to keep in mind, however, that in perception, as the results of Dijkstra et al. (1999) indicate, the cognate facilitation effects are observed, but the role of the phonological dimension within the observed facilitation effects is not reliable. In other words, similar cross-language semantics and orthography are most likely responsible for the facilitation effects; however to what degree phonology acts as an inhibitory or facilitatory factor remains unclear.

In production, the cognate facilitation effect seems to be attributable to the overlap of semantics, orthography and phonology, as shown in studies employing picture naming (Caramazza, & Sebastián-Gallés, 2000) and cued picture naming (Kroll et al., 2000). Although to a lesser degree in L1 than in L2, the cognate facilitation effect is observable in both L1 and L2 in mixed and blocked conditions in both perception and production. The evidence illustrating such an effect is found, for production, in picture naming (Costa et al., 2000) and cued picture naming (Kroll et al., 2000) experiments. Van Hell and Dijkstra (2002) have also shown cognate facilitation in lexical decision in the L1 even when bilinguals were not aware that languages other than the L1 were relevant to their performance.

In the next section, we examine the issue of the cognate facilitation effect with respect to cross-language phonological activation.

How Long Is the Phonology of Non-Target Lexical Nodes Active in Bilingual Lexical Processing Prior to Production?

Evidence from Cognate Status

As Costa, Caramazza and Sebastián-Gallés (2000) point out, recent empirical evidence supports cascaded models of lexical access (Caramazza, 1997; Dell, 1986; Dell

& O'Seaghdha, 1991,1992; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; Harley, 1993; Humphreys, Riddoch, & Quilan, 1988; Peterson & Savoy, 1998) as opposed to the discrete or serial models (Levelt, 1989; Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992; Schriefers, Meyer, & Levelt, 1990).

According to the cascaded models of lexical access, activation proceeds continuously from the lexical layer to the phonological layer. Therefore, all activated lexical nodes receive phonological activation, even if they are not selected. On the other hand, the discrete or serial models assert that only the selected lexical item proceeds to the phonological level to receive phonological specification.

L2 Phonology

From the Onset of Acquisition to Ultimate Attainment

The Speech Learning Model

The phonologies of late bilinguals, meaning those who begin learning an L2 following early childhood [at approximately the age of 5 to 6 (see Asher & García, 1969; Flege & Fletcher, 1992)], are quite different from those of early bilinguals. The leading model to date used to describe as well as explain the behavior of the phonologies of late bilinguals is Flege's Speech Learning Model (SLM) (Flege, 1987; 1991; 1992; 1995; 1999; 2003). According to the SLM, an adult learner's ability to acquire, on both the perceptual and production levels, L2 sounds depends primarily on the degree of perceived similarity between a phone in the L2 with respect to that sound's closest L1 counterpart. Phones in the L2 having a close counterpart or a high perceived level of similarity with a previously established L1 phonetic category are defined as *similar phones*, whereas those not having an L1 counterpart, and therefore having a low degree of perceived similarity with any L1 phonetic category, are classified as *new phones.*

Since *new phones* are those having the least degree of perceived similarity with any L1 phonetic category, the research conducted by Flege and his colleagues which has served in the formulation of the SLM indicates that adult learners are, in fact, capable of forming new phonetic categories for L2 sounds not having a close equivalent in the L1. Therefore, with the sufficient amount of quality input, the L2 learner, over time, will be able to establish a new phonetic category for the *new* L2 sound thus enabling him/her to produce it authentically[5].

Similar phones, on the other hand, are those having a high degree of perceived similarity between a given L2 phone and an already established L1 phonetic category. Therefore, due to the effects of *equivalence classification* (Flege 1987; 1991), the L2 learner will only be able to approximate authentic production of the L2 phone and, thus, will be incapable of producing it as a monolingual native speaker of that language would. Again, the degree of approximation is contingent upon the amount of quality input the learner receives as well as the assumed development of the ability to make auditory

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[5] Although adult L2 learners are capable of forming new phonetic categories of these sounds, they do not utilize the same perceptual processes as native speakers of the L2 to identify or perceive these sounds. However, in spite of these differences in perceptual processing, the L2 learners are capable of identifying the phones correctly.

distinctions between the phonetic properties of L1 and L2 *similar phones*, which serves as a perceptual target governing production. This is not to say, however, that perception leads production since the exact nature of the relationship between perception and production in L2 phonology is still, for the most part, not fully understood. Furthermore, as Flege (1995) indicates, there are other factors besides perception that could account for production errors, such as "motoric output constraints based on permissible syllable types in the L1…(238)". However, on a basic level, it is generally believed that perceptual difficulties lead to production errors.

Traditionally, this inability on the part of the adult L2 learner to produce L2 similar phones in an authentic manner would be attributed simply to L1 interference, in which the already established phonetic categories of the dominant language (the L1) will hinder and ultimately impede authentic production of these phones in the non-dominant language (the L2). However, evidence for the *merger hypothesis* obtained by Flege (1987; 1991) shows that the effect of L1 phones on L2 similar phones is not, as once believed, unidirectional (e.g., Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973), rather bidirectional in nature. Therefore, the relationship between L1 phones and L2 similar phones cannot be defined in terms of interference since, as Flege (1987) points out, "'Interference' implies a unidirectional effect of L1 on L2 (62)".

According to the *merger hypothesis*, not only does the L1 affect the production of similar L2 phones, but the L2 also affects the production of these phones in the L1. For instance, an adult native English speaker having learned and achieved a high level of proficiency in Spanish after the onset of puberty, aside from producing the L2 voiceless stops with longer voice onset time (VOT) values than would a monolingual Spanish speaker (due to the effects of *equivalence classification*), (s)he will also produce English voiceless stops with shorter VOT values than a monolingual English speaker as a result of the *merging* of the L1 and L2 phonetic categories for a given pair of similar phones[6]. As we have seen earlier, the effects of *equivalence classification* impede the L2 learner from establishing a new phonetic category for the similar L2 sound; therefore, the already existing L1 phonetic category is reorganized in order to accommodate the perceptual as well as phonetic properties of the L1 and L2, although imperfectly.

The Perceptual Assimilation Model

Best's (1995) Perceptual Assimilation Model (PAM) could be considered as complementary to Flege's Speech Learning Model in that it establishes criteria through which ease or difficulty in perceiving non-native contrasts is predicted. According to this model, non-native sounds will be assimilated to a native phonetic category in terms of their degree of perceived similarity to these native *gestural constellations*[7]. Perceptual difficulty or lack thereof is predicted on the basis of how (or even if) the members of a non-native contrast are assimilated to native phonetic categories.

Although empirical research conducted by Best and her colleagues (e.g., Best, 1990; Best, McRoberts & Sithole, 1988; Best & Strange, 1992) supports the predictions

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[6] This type of effect for voiceless stops occurs in late Spanish -English bilinguals since the fact that Spanish voiceless stops have short lag VOT values whereas English voiceless stops have long lag VOT values.

[7] This term, with respect to the Perceptual Assimilation Model, refers to phonetic categories in terms of their articulatory "reality". Unlike other models, which define phones more or less exclusively in terms of acoustic properties and/or neuromotor processing (on a perceptual level), the PAM describes perception in terms of "distal articulatory gestures" (176) in which an interlocutor processes as well as makes use of physical articulatory motions or gestures as a fundamental element of the perception process.

of the PAM, its application to L2 phonology as a whole is still relatively premature. Best (1995) herself points out that " a[n] …issue that needs further work is the development of a detailed, objective means for predicting assimilation patterns and discrimination of particular non-native contrasts, given the phonological properties of the listener's own language (including listener languages other than English)" (198). Furthermore, by using L1 and L2 phonetic similarities and dissimilarities as a basis, the model is limited to making predictions about the L2 learner's ease or difficulty in perceiving non-native phonetic contrasts and does not address such polemics as ultimate L2 attainment, the relationship between perception and production, and the exact reasons *why* L2 acquisition is impoverished after the onset of puberty.

Together, Flege's SLM and Best's PAM account for a great deal of empirical evidence on late L2 learners' speech perception and production in a second language, both developmentally and roughly, in terms of ultimate attainment. In the next section, we will combine the evidence reviewed on bilingual lexical access and that of the acquisition of second language phonology to lay the theoretical foundation for as well as make predictions about the present studies.

From Phonological Encoding to Phonetic Realization of Cognates in Word Naming

Perception, Production, Facilitation and Inhibition

The most striking aspect of the word-naming task is the need to employ dual processing mechanisms while carrying it out. In other words, both perception and production are required to perform this task and, as we have mentioned in a previous section, perception appears to be strictly a bottom-up process while production requires top-down processing to be engaged, with concepts identified before phonology can be assigned. Therefore, when naming words, bilinguals must first engage perceptual mechanisms by processing the input features; first, the letter string, then the word and finally, the language to be spoken must be selected (Dijkstra, et al., 1998; Dijkstra et al., 1998; Van Heuven, et al., 1998).

However, unlike the top-down processing sequence envisioned for tasks such as picture naming or translation (e.g., Hermans, 2000; Poulisse & Bongaerts, 1994), the presence of the orthographic input in the word-naming task allows the spelling to be mapped to the phonology more directly, without semantic influence. Unlike other production tasks, word naming is rarely affected by semantic factors, unless the task is slowed when materials are difficult to name or speakers are less familiar with the items (e.g., Gernsbacher, 1984; La Heij, Kerling, & Van der Velden, 1996; Lupker, 1984; Strain, Patterson, & Seidenberg, 1995). However, word naming is not restricted to mappings between orthography and phonology; there is evidence for lexical involvement (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001).

Kroll, Michael, Tokowicz, and Dufour (2002) examined the effect of cognate status on naming latencies for both low and high proficiency learners. They found facilitation for cognates in L2 word naming but inhibition for L1 cognate naming in blocked conditions, although the effect was much greater for the low proficiency group than the high proficiency group. An experiment by Schwartz, Kroll and Díaz (2000) investigated the manner in which cognate naming might be influenced by the cross-language similarity of orthography and phonology. They found no overall effect of cognate status; in general, cognates were not named more quickly than noncognates. However, the time to name cognates was a function of the subtle interactions between the orthography and phonology of the words in the bilingual's two languages. When orthography and phonology matched, so that orthography and phonology were both similar or both distinct, response latencies were fast. When orthography and phonology mismatched, there were clear processing costs. The pattern of results suggests not only that both of the bilingual's languages are active even when naming in one language alone, but also that the mapping of orthography to phonology is open to influence from the non-target language.

The contrast in the findings for word naming with those previously reported for other tasks (e.g., picture naming, translation, lexical decision), suggest at least two different ways in which cognate status may be revealed in processing. For tasks in which semantics are engaged, there may be retrieval benefits associated with cognate status. That is, L2 speakers may be faster to retrieve the meaning of L2 words when they resemble L1 words. However, for a task such as word naming, in which the specification of phonology may be more critical than retrieval, there is likely to be a cost observed in speaking L2 when the competing L1 phonology is activated. Since cross-language phonology is rarely identical, tasks that reflect this process will be likely to reveal inhibitory rather than facilitatory effects of cognate status.

In light of this evidence, we can predict that in L2 naming the relation between the orthography and phonology will be critical in determining the level of competition between L1 and L2 phonological representations just prior to output, since, as cascading models of lexical access predict, the phonologies of both selected and non-selected lexical items are activated. The general expectation is that cross-language effects of phonology, like those described in the psycholinguistic literature and in the context of Flege's Speech Learning Model (1992; 1995; 1999; 2003) will be exaggerated by cognate status. Given that, by definition, cognates will consist largely of similar phones, we can expect that cognate items will be produced in a more accented fashion in the L2 than noncognate items. In addition, the effect is predicted to be much greater in lower proficiency learners than those with a high L2 proficiency.

As far as the inhibitory effect of cognates in L1 word naming, we can predict that phonetic realization of L1 cognate items for the lower proficiency learners will not be affected, simply because their level of proficiency will not have allowed for a reorganization of their phonological representations (Flege, 1991). The inhibitory effect in L1 cognate naming for lower proficiency learners reported by Kroll et al. (2002) could be attributed to a preparation effect resulting from the participants' knowledge of the bilingual nature of the experiment, as these investigators note.

On the other hand, in the case of the high proficiency learners, we could expect to see a possible merger effect in the phonetic realization of L1 cognate items to an even greater extent than non cognate items since (1) at high levels of L2 proficiency, learners produced merged VOT values of similar phones in L1 (Flege, 1991), and (2) at higher levels of proficiency L2 lexical items are mediated less and less via the L1 lexical level (Kroll & Stewart, 1994). Therefore, activation of L2 phonological representations could be high enough as to cause a greater level of merging at the phonetic level in L1 cognate naming.

From Phonological Encoding to Phonetic Realization in Picture Naming

Will the Cognate Facilitation Effect Turn to Interference?

According to what we have seen from the cognate facilitation effect in production, namely in a picture naming task, if non selected items receive phonological activation to an extent that is proportional to their level of activation, and L1 (dominant) lexical nodes are more highly activated than those of L2 (the non dominant language), L1 phonology will be dominant over L2 phonology just prior to output, or phonetic realization of the cognate item. Therefore, when an L2 learner produces a cognate in the L2 while performing a picture naming task, basing our predictions on both the cognate facilitation results obtained by Costa et al. (2000) for picture naming in the L2 and Flege's Speech Learning Model (since we are dealing with cognates, we can, generally speaking, assume we are dealing with similar phones), we can expect that the phonetic properties of the word upon output will approximate L1 phonetic norms to an even greater extent than noncognate items. In other words, cognates will be more accented than non-cognate items.

Cognate items produced in the L1 (the dominant language) should not differ significantly from non cognate phonetically matched control items in low proficiency learners, but may differ slightly from non cognate items in high proficiency learners. In other words, for the advanced learners, the phonetic properties of the cognate items may more closely approximate L2 phonetic norms in L1 production than the non-cognate items.

The basis for this prediction is drawn from both the evidence obtained by Costa et al. (2000) for cognate naming in the dominant language (L1) as well as Flege's (1987; 1991) *merger hypothesis*. Costa et al. found a cognate facilitation effect in L1 picture naming, although to a lesser degree than the effect obtained for L2 picture naming. Recall that the bilinguals in this study were highly proficient bilinguals. Flege's (1987; 1991) *merger hypothesis* states that late L2 learners who have reached a high level of proficiency in the L2 will exhibit reverse interference in L1 similar phone production. Therefore, L2 learners with a high L2 proficiency level will produce L1 sounds that have an L2 counterpart with phonetic properties approximating L2 phonetic norms, with respect to monolingual speakers of the L1.

In light of this evidence, we can predict that (1) low proficiency learners' L1 phonetic realizations of cognate items will not differ from non-cognate items. Actually, they will probably not differ from monolingual controls, since L1 remains a highly dominant force in L2. Therefore, L2 should not show any effect on L1 at this stage of L2 acquisition. (2) Since a cognate facilitation effect was, in fact, obtained by Costa, et al.

(2000) in L1 picture naming, there is evidence that at high L2 proficiency levels the link between the semantic/conceptual level and the lexical level is much stronger and activation of L2 phonology may be strong enough to affect and/or interfere with L1 phonology. Therefore, this evidence combined with the predictions of the *merger hypothesis* would predict an even greater degree of approximation to L2 phonetic norms for cognate items than noncognate items in L1 production.

It is important to note, however, that the predictions being made regarding segmental production accuracy of cognate items are based on the psycholinguistic research that has used reaction time to assess the relative activation of non-target language and phonology in bilingual lexical processing. Since, to my knowledge, the psycholinguistic literature nor that dealing with the acquisition of L2 phonology has addressed this issue, one of the primary foci of the present investigation, aside from testing the effect of cognate status on segmental production accuracy in both L1 and L2 cognate items, will be to identify the relation between the processing levels identified in the psycholinguistic literature and the "post phonology" level of processing, meaning, the phase involving the launching of neuromotor mechanisms in order to carry out phonetic realization. Therefore, not only will the acoustic properties (VOT) of cognate items be examined in the present investigation, but also word duration, reaction time and response error analysis in order to discover if there is a relationship between lexical processing and phonetic realization mechanisms or if they are distinct processes in their own right.

Chapter 2

General Approach and Methods

In the three experiments to follow, I examine the effect of cognate status on segmental production in native speakers of English who have learned or are in the process of acquiring Spanish as a second language. To accomplish this task, I compare the performance of three groups; an advanced proficiency group, which will be referred to as “advanced speakers” and two intermediate proficiency groups. One of the intermediate proficiency groups at the time of the study was formed by students in a classroom environment only, thus deemed “classroom learners,” whereas the other group was involved in an immersion program in which the use of the L1, English, was strictly prohibited, subsequently labeled the “immersed learners.”

In order to examine the L2 production performance of these three groups, all participants performed a word-naming task, in which they were asked to name out loud as quickly and accurately as possible a randomized list of Spanish words, each of which appeared one at a time on a computer screen. The list of words included two types of cognates, control words matched for onset and word frequency for each cognate, and of an additional set of control words matched for phonetic structure (described more in detail below) for each cognate.

As mentioned previously, a cognate, generally defined, is a word that shares semantic and orthographic and/or phonological properties across two languages. The degree of similarity between cognates can be characterized more precisely in terms of their relative similarity along the dimensions of orthography, phonology, and semantics (e.g., see Dijkstra et al., 1999; Schwartz et al., 2000; Schwartz & Kroll, 2006).

In order to accurately determine the degree of similarity across these dimensions, both Dijkstra et al. and Schwartz et al. first used two previously established techniques to determine the cognate status of a given word (See De Groot & Nas, 1991; Friel & Kennison, 2002; Kroll & Stewart, 1994). The first method, reported by De Groot and Nas, consisted of having bilingual speakers rate visually presented item pairs across languages on a scale of 1 to 7 (one being completely dissimilar and 7 being very similar) where they collectively considered the semantic, orthographic and phonological properties of the word in order to make a similarity judgment. Kroll and Stewart (1994) used an alternative method, translation elicitation, in which monolingual speakers of one of the languages being studied were presented with a list of words in the language of which they had no prior knowledge or experience and were asked to “guess” the correct translation of each of the words on the list. The words that the participants were able to translate correctly, in spite of having no prior knowledge in the other language being studied, were then defined as cognates. The advantage of Kroll and Stewart’s method over the rating procedure used by De Groot and Nas is that it allows false cognates to be more easily identified. For example, if a monolingual English speaker is presented with the Spanish word *pan*, (s)he would most likely respond that it is a (*cooking) pan* and would not say that it means *bread.* Although the two methods provide different types of information, a study by Friel and Kennison (2002) reported that they were highly correlated.

Dijkstra el al. (1999) and Schwartz et al. (in press) refined the differences among cognates further to assess the relative contribution of orthographic, phonological, and semantic overlap, respectively. For example, a cognate pair can be quite similar or even identical orthographically, but less similar phonologically. To illustrate, a word such as *audible*[8] is identical orthographically in Spanish and English, but its pronunciation in each language is quite distinct. Therefore, we can characterize this word as having the property of +O (similar orthography) and –P (dissimilar phonology).

Schwartz et al. (in press) computed orthographic similarity using the measure of grapheme overlap described by Van Orden (1987). To assess perceived phonological similarity, two bilingual speakers were recorded, with one speaking the cognate in English and the other speaking the cognate in Spanish. A group of monolingual English speakers then heard the recording and were asked to rate the phonological similarity of the spoken cognates. The orthographic and phonological similarity measures were then used to form the two cognate conditions examined in the present studies. The two types of cognates that were examined were those defined as +O+P (similar orthography and similar phonology) and +O-P (similar orthography and dissimilar phonology) (see Appendix A for the list of materials). The cognate items and matched frequency control items that were used in the present experiments were identical to those employed in Schwartz et al. These two conditions were employed in an attempt to replicate the cognate effects previously found in RT research in both word-naming (Schwartz et al., in press) and in lexical decision (Dijkstra et al., 1999; Schwartz, 2003) and to use them as a

[8] This example was drawn from the list of materials used in the studies reported here and taken from Schwartz (2003), a study in which cognate materials were normed to determine their semantic, orthographic, and phonological properties.

means to determine whether cross-language processing extends beyond the onset of articulation into the execution of speech.

Schwartz et al. (in press) found that these subtle distinctions in the mapping of orthography to phonology produced clear differences in word-naming performance. For cognates with similar orthography (i.e. +O), naming latencies were faster when the phonology for both language alternatives was similar (+O+P) than when it was different (+O-P). When onset and frequency matched controls were introduced (Schwartz, 2003), the +P effect appeared to be facilitatory whereas the –P effect appeared to be inhibitory.

The goal of the present study is to determine whether the evidence for the activation of the nontarget language during spoken production extends beyond the planning of the utterance into the stage of phonetic realization.

Research on speech production within the L1 generally assumes that once an utterance has been planned, the phonology is fully specified with execution of the articulatory plan following in a separate, discrete process from the planning stage (Damian, 2003; Kawamoto, Kello, Jones, & Bame, 1998; Kello et al., 2000; Kello & Plaut, 2003).

However, some recent studies (e.g., Kello et al., 2000) have shown that there are task conditions that reveal that planning and execution processes may be less separate than previously thought. Kello et al. demonstrated that manipulating the rate of processing in a Stoop-type interference task determined whether or not incongruence effects were observed not only in RTs, but also in articulatory duration. When time constraints were imposed, interference effects were observed for both measures.

However, when processing time was sufficient prior to the onset of articulation, the articulatory duration measure indicated no further consequences of Stroop interference.

The implication of these results is that whether the speech execution stages take place independently of utterance planning depends on whether the planning stage is adequate to completely specify the phonology. Although other experiments (e.g., Damian, 2003) fail to provide support for a spillover or cascaded effect into the actual execution of a single word utterance, the range of conditions over which this hypothesis has been tested is relatively small.

The experiments were based on previous models of lexical processing, such as the triangle framework of word reading developed by Seidenberg and McClelland (1989) and the Dual Route Model, empirically driven by work reported by Coltheart et al. (1993).

Although these models are fundamentally different in their treatment of the pathways from word recognition (reading) to the stages just prior to utterance execution, they both incorporate two basic routes to output; one is a lexically driven route where the spelling to sound correspondences, orthography (O) and phonology (P) are assembled via semantics (S). In other words, especially for high frequency words, the "memorized" lexical units allow the individual to process and produce words, and assemble the orthographic and phonological elements via stored frequent lexical representations, stored both syllabically and lexically at the word level. This route is the one used to most quickly process irregular words, such as *pint* (Kello & Plaut, 2003), which allow the individual to recognize the item lexically before assembling the "regular" phonology of this word. Therefore, we can say that semantics drives the assembly and the ultimate processing of this type of word.

On the other hand, both the aforementioned models account for a "sub-lexical" route in which output is organized and driven primarily via spelling to sound correspondences, and essentially bypasses the semantic level. Such a processing route would be useful for non-words or low frequency words, since the individual does not possess readily available stored lexical units by which to execute the preplanning stage of word reading.

However, evidence in terms of the preplanning stage of processing and that of speech execution suggest that once the utterance is planned, meaning that the phonology is "ready to go", at that time, speech commences. In other words, these models support a discrete model of processing in the word reading domain such that semantic, orthographic and phonological processes are "set" before speech begins. Although, it is important to note, that these models deal with the monolingual domain and do not account for processing behaviors in L2 learners and bilinguals.

In light of this fact, we can now ask the question that if these models hold true in the second language domain, what kinds of predictions can we make regarding processing in L2 learners at different stages of proficiency while taking phonology status (+P versus –P) and cognate status into account?

Assuming the discrete models of processing are true, what we might predict about the performance of the L2 learner is that word durations would not be affected, but we would see faster RT latencies especially for cognate items with +P phonology with respect to matched controls because the simultaneously activated L1 phonology coincides more closely with the L2 phonology. For cognates with less similar phonology, (-P), we would expect longer latencies compared to control items since the activated L1 phonology will produce a conflict with the L2 phonology and the resulting competition will have to be resolved. Essentially, if utterance pre-planning and speech production are discrete processes, the learner cannot "speak" until (s)he has something "ready to say". Therefore, no effects would be predicted in word duration, strictly a speech measure, but the consequences of cross-language activation would be observed during the pre-utterance planning process.

The presence of duration effects per se would not necessarily refute the predictions of a serial model of word naming. If duration effects are observed, one could still argue that they are not effects of processing continuing into the utterance, but rather that the L2 phonology is simply underdeveloped and effects of slower duration are thus observed not due to "poor planning", but to the inability to accurately produce the phonetic features contained within the abstract representations of the L2 phonology. However, if this were the case, we would expect to see these effects diminish as L2 proficiency increases. Furthermore, a discrete model would predict that duration effects attributable to the inability to rapidly execute the articulatory plan in the L2 would not be influenced by the same effects of cross-language activation that are present during the planning of the utterance. On this view, longer durations might be predicted for less than for more proficient L2 learners but the effect should not be modulated by cognate status and there should be no effect of the phonological similarity of the word to its L1 translation.

In essence, utterance planning may still be taking place at word onset and even into the proceeding vowel (which illustrates the co-articulation effect), but this same utterance planning is complete by the time the onset and co-articulation of the following vowel element takes place. However, Rastle et al. (2000) do not make claims regarding to what extent planning continues into articulation since the scope of the study dealt only with onset and co-articulation effects in word reading. In addition, it is important to keep in mind that this work examines the L1 domain only and does not treat the case of the L2 learner.

According to cascaded models, we might expect to observe that the effects of cross-language competition continue beyond the pre-planning stage into speech for cognate items in both the +P and –P manipulations. Since even highly proficient L2 speakers are likely to be more dominant in their L1, we might expect that even at high levels of L2 proficiency, we will see "spill over effects" into the speech beyond the pre-planning stage. Since the research reviewed earlier on bilingual lexical processing provides evidence that when a bilingual is processing lexical items in the L2, the L1 is still highly active even into late stages of processing, and Rastle et al. (2000) have reported evidence for processing continuing into the spoken utterance in the L1 domain, we might expect that effects of cross-language competition will be present in the acoustic record of speech, namely in word duration. Unlike the effects predicted by discrete word-naming models, as previously mentioned, we would expect not only low proficiency learners to yield duration effects, which could be explained either by the discrete or cascaded model accounts, but high proficiency learners as well to exhibit effects of word duration in cognate word naming. In contrast, high proficiency learners showing effects of word duration on cognate status and degree of cross-language phonological similarity could only be explained by a cascaded account of processing. Due to the fact that they are high proficiency learners, as past research indicates, they have developed a relatively high degree of automaticity in L2 speech planning and the effects could not, then, simply be accounted for via poor pre-utterance planning and/or underdeveloped phonology, as it could be for the low proficiency learners.

Therefore, in light of the contrasting models that seek to characterize the pre-planning stage of speech with the actual stage of utterance in L1 as either discrete or non-discrete processes, respectively, the goal of the research reported here was to use the performance of L2 learners as a means of testing alternative models of speech production and to examine the way in which the planning of utterances changes as L2 skill advances and is acquired.

Participant Groups

Three groups of native English speakers with varying proficiency in Spanish participated in the study. All participant were late learners of Spanish in that they began learning Spanish on or after their tenth birthday. Past research suggests that an individual can be considered a late learner, at least in the phonological domain, if exposure to the L2 occurred after the age of seven (e.g., Asher & García, 1969; Flege & Fletcher, 1992). In addition, none of the participants had above a basic level of proficiency in a third language. Given the focus on phonology, this criterion was critical in order to eliminate possible intervening effects from proficiency in a third language.

The participants in one experimental group, the advanced speakers, were drawn from the Spanish instructor/graduate student population in the Department of Spanish, Italian and Portuguese at the Pennsylvania State University.

The second group, the immersed learners, was comprised of students enrolled in the summer Spanish School at Middlebury College during the summer of 2003. It is important to note that although this group was considered to have intermediate-level proficiency, as the group label indicates, they differed from the other two groups in that these learners were, at the time of the study, participating in a Spanish language immersion program. We will see that this immersion context yielded differential results with respect to the other two groups that are presumably attributable to the immersion environment. This particular immersion experience is unique in that the learners are explicitly prohibited to use the L1 at any time during the program, a constraint that does not exist in other immersion contexts, such as in study abroad programs, in which learners are free to maintain their L1 and L2 as required. The consequences of enforced inhibition of the L1 are considered in more detail in the following chapters.

The third group of participants, the classroom learners, was defined as also having intermediate L2 proficiency, but the participants' exposure to Spanish, as indicated by the group name, was limited to the classroom environment at the time of the study. These participants were recruited from both the Spanish phonology course (Spanish 414) and the Advanced Oral Expression course (Spanish 410) at the Pennsylvania State University.

The three participant groups were identified according to the context in which they used the L2 prior to commencing the study. The measures described below were used to verify if this a priori classification was in fact, accurate. One of the criteria for verifying the proficiency levels of these groups was established using the information drawn from the Language History Questionnaire (see Appendix B) that each participant completed at the conclusion of each individual experimental session. This questionnaire was designed to obtain information such as native language, age of first exposure to the L2, and self-ratings of proficiency in four dimensions of both the learners' L1 and L2. Study abroad experience and self-rated L2 proficiency were two of the criteria by which proficiency by group was defined.

A second independent measure used to verify L2 proficiency level by group was non-word accuracy on a lexical decision task in Spanish. In a lexical decision task, participants are presented with individual sets of letter strings that appear in the middle of a computer screen. The task involves making a decision as to whether each string of letters they see forms a real word in Spanish or not. Participants were instructed to indicate as quickly and as accurately as possible whether the string of letters presented formed a real word in Spanish by pressing buttons corresponding to "yes" and "no", respectively. The task was prefaced with a short block of practice trials in order for the participants to familiarize themselves with the nature of the task.

The accuracy of non-words was used as an independent processing measure of proficiency due to the fact that a high "false alarm rate" is an indicator of lower L2 proficiency. Since all letter strings adhered to Spanish phonotactic constraints, an individual with a lower L2 proficiency is more likely to falsely indicate that a non-word is a word, since his/her lexical inventory is much lower than an individual with high L2 proficiency. In contrast, an individual with high L2 proficiency and therefore a higher L2 lexical inventory will be able to more easily distinguish a word from a non-word in spite of the non-word adherence to Spanish phonotactic rules.

The results of the language history questionnaire and the mean non-word RT accuracy in the L2 lexical decision task are summarized below in Table 2.1 for each of the three learner groups.

Table 2.1.

Language History Questionnaire and Lexical Decision Data

Group	Classroom learners	Immersed learners	Advanced speakers
Number of participants	24	51	10
Mean age of participants (yrs)	20	26	37
Mean age of first L2 exposure (yrs)	13	17	14
Mean number of years of L2 use	7	9	23
Percent who studied abroad	42	78	100
L1 speaking rating	9.8	9.2	9.7
L1 oral comprehension rating	9.6	9.6	9.9
L1 writing rating	9.4	9.0	9.4
L1 reading rating	9.5	9.4	9.5
Overall L1 proficiency rating	9.6	9.3	9.6
L2 speaking rating	5.8	5.6	7.9
L2 oral comprehension rating	6.6	6.9	8.7
L2 writing rating	6.4	5.9	7.5
L2 reading rating	6.4	6.1	8.1
Overall L2 proficiency rating	6.3	6.1	8.1
Lexical decision mean percentage of non-word accuracy	65.9	68.8	82.6
Lexical decision mean RT (ms)	996	1043	972

Note. Participants self-rated L1 and L2 proficiency, respectively, on a scale from 1-10 with 1 being the lowest level and 10 being the highest.

Results for Proficiency Ratings for All Groups

A 2-factor repeated measures ANOVA showed that there was a main effect of group and of language; first of L1 [$\underline{F_1}$ (2,80) = 6.91, MSE = 1.41, $\underline{p}$ < .05] and secondly, of L2 ratings [$\underline{F_1}$ (1,80) = 428.16, MSE = 399.29, $\underline{p}$ < .05]. These main effects were further qualified by a significant interaction of the main effects of group and language [F_1 (2,79) = 3.58, MSE = 0.93, $p < .05$], showing that there was no significant difference among the groups for L1 ratings, but they were significantly different for L2 ratings.

In order to examine the rating data in more detail, the individual L1 ratings (i.e., L1 speaking, L1 aural comprehension, L1 reading and L1 writing) were compared for the three proficiency groups. The effect of proficiency group was not significant for L1 [F_1 (2,81) = 1.43, MSE = 0.47, $p > .05$]. The L2 proficiency ratings across groups, based on the same language skills outlined above for the L1 self-proficiency ratings, yielded a significant result, [F_1 (2,79) = 8.67, MSE = 7.22, $p < .05$].

The advanced speakers' L2 ratings were strikingly higher than those of the other two groups. An additional analysis was conducted in order to determine if there was a significant difference between the immersed and classroom learners. The analysis showed that the L1 proficiency ratings did not differ significantly for these two groups [F_1 (1,71) = 0.91, MSE = 1.54, $p > .05$].

The results for the L2 ratings revealed a significant difference between the classroom learners and the immersed learners [F_1 (1,71) = 382.73, MSE = 0.963, $p < .05$]. However, the direction of the result was opposite to what was predicted; the classroom learners rated themselves more highly in L2 than the immersed learners. Because the immersed learners were participating in a Spanish only program, the context in which the ratings were performed may account for the observed difference.

Age of Acquisition and Years of L2 Use

Two additional analyses were performed to determine whether there were significant differences in the age of L2 acquisition and in the number of years of L2 use for the three groups. The number of years of L2 use was estimated by subtracting the age at which the participant began learning Spanish as an L2 and his or her current age.

The analysis on age of L2 learning revealed a significant effect of groups [$F_1(2,81) = 21.63$, $MSE = 43.43$, $p < .05$]. The analysis on the years of L2 use was also significant [$F_1(1,72) = 4.81$, $MSE = 28.46$, $p < .05$]. Therefore, at least in terms of age and length of exposure to the L2, we can classify the immersed learners as such within this dimension. Post-hoc t-test comparisons using Bonferroni correction revealed that there is a significant difference in years of L2 study between both intermediate groups and the advanced speakers ($p < .001$), but there is not a significant difference between the two intermediate groups ($p > .001$). Therefore, we can reliably assume that both the classroom and immersed learners share a common intermediate proficiency level.

Nonword Accuracy in the Lexical Decision RTs

The lexical decision task was used as an independent online measure of L2 proficiency. The measure most critical in this regard is nonword error rate or false alarms to nonwords, but the nonword RTs were also analyzed. There were no significant group differences in RT [$F_1(2,81) = 0.45$, $MSE = 70526.71$, $p > .05$]. For nonword accuracy, there was a main effect of group [$F_1(2,81) = 4.38$, $MSE = .067$, $p < .05$]. Post hoc comparisons with Bonferroni correction revealed that there was a significant difference in the performance of the advanced speakers vs. both learner groups ($p < .025$), yet, the analysis of nonword accuracy revealed that there were no significant differences in accuracy between the two learner groups ($p > .05$).

A curious aspect of the proficiency profile of these three groups is that the immersed learners appear to be quite similar to the classroom learners in some respects but in others, they appear less proficient. They were slower on the L2 RT task and rated themselves lower than the other groups on the self-assessed language skills. The most likely explanation for these differences is that the immersed learners were tested in an immersion environment in which the use of English was prohibited and in which the implicit comparison was to more proficient or native speakers of Spanish. At the same time, the classroom learners may rate themselves somewhat higher than what their actual L2 proficiency merits due to their perceived implicit comparison with others in the classroom.

The fact that the immersed learners were generally slower in lexical decision non-word RT than the classroom intermediate proficiency group may be understood as the result of a higher level attention to the Spanish materials in the immersion context that corresponded to a more conservative decision criterion for what constituted a genuine Spanish word. Since all of the non-words in the lexical decision task adhered to Spanish phonotactic constraints and these participants, at the time of the study, were in a unique situation in which any L1 language information was to be actively inhibited, the non-words may have been more likely to appear to be Spanish words. It should be noted, however, that the immersed learners exhibited a higher degree of LDT nonword accuracy, had a greater level of study abroad experience in addition to the present immersion environment at the time of the study, and had a longer number of years of exposure to the L2 than the classroom learners. Regardless of the precision of the absolute classification of these proficiency groups, we will see that the immersed learners performed differently than either the advanced speakers or classroom learners on the main experimental tasks. We return to the issue of characterizing the groups further after the results are presented.

General Approach

To examine the effect of cognate status on L2 phonetic production, several factors at the pre and post utterance levels were analyzed. The first goal was to replicate previous findings in the psycholinguistic literature regarding cross-language RT effects as a function of cognate status. RTs and accuracy in the word-naming task for each group were analyzed to determine whether there was a difference in naming cognates and noncognate controls; for the cognates, this procedure was carried out to further determine whether there was an effect of the similarity of the phonology of the L1 and L2 version of the cognate.

In order to conduct these analyses, RT measures were obtained for the critical cognate items, and the two sets of noncognate controls; one matched to the cognates on frequency and other matched on phonetic syllable structure. With the two types of cognates (+O+P and +O-P), this resulted in a total of 52 cognate items (27 in the +O+P condition and 25 in the +O-P condition), all of which had a corresponding frequency-matched control item; again, 27 in the +O+P condition and 25 in the +O-P condition. In terms of the phonetically-matched controls, there were 53 items in the +O+P condition and 41 in the +O-P condition.

Speaking overall, however, the total number of items participants named for the different analyses performed in the present work was 198 Spanish words. For a breakdown and illustration of the matching of cognates to controls in all conditions (i.e., +O+P and +O-P items matched to frequency-matched and phonetically-matched controls, respectively) please see Appendix A.

The second goal was to evaluate the effects of cognate status and phonological similarity during the execution of the spoken L2 word. To examine phonetic realization, two principal measures were analyzed: 1) VOT (voice onset time) of voiceless occlusive consonants in stressed syllables of the cognates and their respective controls and 2) overall word duration from onset of articulation to offset.

Voice onset time, for voiceless occlusive consonants, is defined as the time period between which the occlusion is released and glottal pulsation for the following vowel begins. This measure was chosen to examine the effect of cognate status on L2 phonetic production accuracy because it is a straightforward measure for indicating L2 accentedness. In Spanish, VOT for voiceless occlusive consonants is relatively short (ranging between 0 and 30ms), whereas in English, voiceless occlusive consonants in stressed syllables have a relatively long VOT (approximately 30 to 65ms) (Lisker & Abrahamson, 1964). Therefore, words produced in Spanish falling within the VOT range for English voiceless occlusive consonants provide a clear indication of accentedness in the L2.

Word duration, on the other hand, was examined to further test the claims of Damian (2003) and Kello et al. (2000). Contrary to Kello et al., Damian reported that word duration is not affected by task demands and that processing effects in the pre-utterance planning stage do not affect the actual stage of spoken execution. In other words, the results of these particular studies indicate that pre-utterance and articulatory processes are discrete in nature, meaning that once an utterance is planned, the articulatory stage is executed independently. Since L2 production is likely to require that additional cognitive resources be allocated prior to speaking, the present study constitutes an alternative means of evaluating the task demand hypothesis.

It is widely known in the psycholinguistic literature that task demand is a major factor that modulates processing and performance of a given task for monolinguals and bilinguals alike. In fact, there are studies showing that bilinguals, as a function of task demand, are at a disadvantage as compared to monolingual speakers in terms of speed of lexical retrieval in some tasks and that working memory or the ability to suppress irrelevant information is a predictor of ultimate success in L2 acquisition (see Michael & Gollan, 2005, for a review).

For example, in a picture naming/picture classification study carried out by Gollan, Montoya, Fennema-Notestine, and Morris (2003), Spanish-English bilinguals were slower to name pictures in English, including those participants who reported English as their dominant language or being equally proficient in both Spanish and English. This result is due simply to the fact that the bilinguals are grappling with a greater number of lexical competitors for selection. In other words, bilinguals must resolve the competition among the lexical competitors in the English semantic field relating to a pictorially represented concept as it simultaneously does the same with the Spanish semantic field, whereas the monolingual participants only needed to resolve the competition among English semantically related items for final selection of the matching lexical item to the picture presented. Therefore, we can conclude that a task demand involving a high level of semantic activation, such as picture naming, will put the bilingual at a disadvantage in terms of processing speed due to a greater number of competitors among which (s)he must ultimately choose for selection.

Yet, individual differences among bilinguals, namely working memory, certainly plays an important role in determining the level of semantic fluency of a bilingual, meaning, the bilingual's ability to suppress irrelevant information (i.e., the non-target language in a given task) and direct his/her attention more exclusively to the processing and production of the target language (Rosen & Engle, 1997).

It is important to note that these studies refer to levels of lexical competition at the pre-utterance stage; however, the present studies seek to shed further light on whether these factors outlined in the above studies carry over into the utterance stage.

In the experiments to follow, word duration effects were examined for the three groups for cognates relative to matched controls (see Appendix C and also below for a specific explanation of the matched controls used for the phonetically based analysis) in order to determine whether pre-utterance planning affects the articulatory stage of speech production in a second language. It could be argued that at the beginning stages of L2 acquisition, there may be a "spill over effect" from the pre-planning stages of speech into the articulatory stage. Since cognates share semantic, orthographic and phonological properties and therefore provide converging support from both the L1 and L2, one could predict that lower proficiency learners may exhibit shorter durations for cognates (in the +P condition due to the higher degree of phonological similarity) than matched controls due to the fact that they may process it, in essence, as an English word. Since previous research indicates that naming latencies are faster in the L1 overall, regardless of cognate status, it could be argued that at lower levels of proficiency, the learner, upon possibly interpreting the cognate stimulus as an L1 item, may display a shorter utterance duration since the faster processing time may spill over into the actual utterance. This may simply be due to the fact that the learner has less command and therefore less control of the L2 and is more apt to exhibit cascaded effects between the pre-utterance and articulatory stages of speech. On the other hand, this effect may lessen or even disappear at more advanced stages of proficiency since the learner has developed a higher level of automaticity in terms of L2 language processing and production. Furthermore, although not to a full extent, these learners may be more able to process the L2 cognate item as an L2 lexical item in its own right (Kroll & Stewart, 1994).

As noted previously, the critical materials in these experiments were cognate and control words taken from Schwartz (2003). The controls were noncognates that were matched to the cognates as closely as possible on word frequency, word length and onset. However, to conduct the analyses on the VOT and word duration measures, a second set of control items was added to the experiment to allow comparisons between the phonetic properties of the cognates and controls. This new set of control items, unlike the RT control items, were not matched for word frequency, rather one or more control items were selected for a single cognate item that were representative of the syllable structure and stress pattern for different elements/syllables of the critical items. Using these control items, VOT was compared between the cognate items in each condition (i.e., +O+P and +O-P) with a matched phonetic control that contained an identical syllable structure for the syllable being examined in the cognate item. The materials were designed originally to allow for comparison not only on the VOT dimension, but also for vowel formant frequency in stressed syllables, vowel reduction in unstressed syllables, vowel rhoticization as well as flapping in Spanish intervocalic dental occlusive consonants. For this reason, a number of the cognate items had more than one control item to capture an accurate phonetic comparison between the cognate and noncognate control. In the results to be presented, however, VOT was used as a means of determining an effect of cognate status on L2 segmental production. To illustrate the method for selecting control items, for the +O+P cognate, *poeta*, the following phonetic controls were chosen for the purpose of conducting the acoustic analyses: *anoeta*, to examine several dimensions: a) the [o-e] in the strong vowel syllables of *poeta* and b) the [ta] syllable of *poeta.* The [ta] syllable could be measured for unstressed vowel centralization as well as flapping of the final syllable onset element, [t] in *poeta.* On the other hand, *pocero* was chosen to examine the [po] onset syllable that is shared with *poeta* in the VOT dimension (see Appendix A for the complete list of materials). In the final analysis, only one control was selected to examine the VOT differences in order to be able to conduct the analyses in relation to the other lexical processing dimensions (i.e., RT and word dimension). In order to analyze VOT for each critical and matched control item, the critical words were extracted from the digital recording obtained in the word naming experiment and individual sound files were created for each cognate and critical control item. These individual sound files were then used to perform acoustic analyses, or measure VOT for all items that were measurable for VOT using PRAAT© acoustic software. VOT measurements were taken for each participant on 2 critical cognate-phonetic control word pairs in the +O+P condition (i.e., PIANO – *piante*; POETA – *pocero*) and on 3 critical word pairs in the +O-P condition (i.e., CABLE – *cabe*; PALMA – *pala*; TIGRE – *tipo*).

To enable the word duration analyses, a subset of items was selected so that critical and control items were matched on both word and phoneme length. Word duration measurements were taken for each participant on 25 critical cognate-phonetic control word pairs in the +O+P condition and on 25 critical word pairs in the +O-P condition, totaling 100 Spanish words used to measure this aspect of word production. The criteria used for selecting the control items for the duration analyses were based on a set of factors that would create the closest match possible between cognates and controls on syllable structure, stress placement, and word and phoneme length. For each item, the experimenter examined critical item-by-item pairs to determine which control would most closely match the properties of the cognate items. The first criterion for each word pair was to attain the closest word length and stress pattern match and then to choose the control that contained the same stressed syllable structure in the cognate item and its closest counterpart. For example, the +O+P cognate item, *METAL*, in the original set of materials had two different matched control items for different purposes in the acoustic analysis, *meter* and *retal*, respectively. For the word duration matched control, however, the control item that was chosen was *retal* since they share an identical word-final stressed syllable where the majority of the intersyllabic acoustic energy is exerted. In other words, it is the highest point of energy shared between the cognate and control item, which would account for the majority of the acoustic word production time course. Furthermore, the word length of these items is quite closely matched.

If such a match was unable to be made, such as the item set previously described, the next best criteria employed to match the items for duration would be a combination, depending on the critical word pair, including factors such as onset, unstressed matched syllable structure and word length (see Appendix C for a more detailed explanation of the criteria used to select the best matched control item for the word duration analysis).

After using these criteria to select the control items for the purpose of analyzing articulatory duration, independent samples t-tests were performed between the cognate and control items for number of syllables, number of phonemes, and number of graphemes. These analyses were to ensure that the length of the cognate and control words did not differ significantly along these dimensions. In all three cases, there were no significant differences found between cognates and controls; number of syllables (t (93) = -.134; p = .893, tested at $p > .05$; number of phonemes (t (93) = .80; p = .425, tested at $p > .05$; number of graphemes (t (93) = .628; p = .532, tested at $p > .05$.

In order to analyze word duration for each cognate and matched control item, the critical words were extracted from the digital recording obtained in the word naming experiment and individual sound files were created for each word. The sound files were then used to perform acoustic analyses, or to measure word duration on all critical items using PRAAT© acoustic software.

Experimental Method

To obtain data used to perform the analyses described above, all groups participated in an experimental session lasting approximately one hour. Prior to the experimental portions of the session, participants were asked to complete an informed consent form. The participant was then taken to an isolated, quiet room in which the experiment was performed. Each participant was asked to put on a Shure© professional unidirectional head-worn dynamic microphone on his/her head with the microphone placed to the left side of the mouth. The experimenter, with the permission of the participant, adjusted the microphone so that it was positioned approximately 35° to the left of the center point of the mouth and at a distance of approximately 3/4 inches from the participant's left side of the mouth. This technique was utilized to ensure that head movement would not compromise sound quality since the distance of the mouth from the microphone would not change regardless if the participant made sudden head movements. In addition, placing the microphone at a lateral position with respect to the mouth prevented excessive reception of sound aspiration, which occurs namely upon pronouncing voiceless occlusive stops. Each participant's speech was recorded using a Marantz© Professional CD recorder CDR300 with voice sampling settings fixed at 44.1Khz and a bit depth of 16 bits, a setting appropriate for obtaining clear, quality samples of human speech. This speech sampling technique was utilized to perform both VOT measurements at select segmental points for the cognate items and critical controls and also for measurement of overall word duration.

In addition to recording speech, each individual was simultaneously asked to perform a word-naming task in which (s)he was instructed to name aloud the Spanish words appearing on the computer screen as quickly and accurately as possible. The task began by presenting a short set of practice items to allow the participants to familiarize themselves with the nature of the task. Instructions on how to perform the task were written on the computer screen in Spanish for participants to read prior to beginning the practice trials and a period was given during which they could ask any questions concerning the nature of the experimental task. The task was self-paced in that once the voice key of the button box connected to E-Prime© experimental software recorded the onset of articulation of the word being presented, the following trial immediately appeared on the computer screen. The voice key was used to record the reaction time, which consisted of the time between the stimulus presentation and the onset of articulation. Participants were asked to continue to name these stimuli in a quick and accurate manner following the ongoing “rhythm”. If they took too long to name a particular word, the stimulus “timed out” at 1000ms and moved on to the next trial. Missed trials were coded as errors.

Following the experimental word-naming task, participants performed the Spanish lexical decision task included as an independent measure to determine L2 proficiency.

Finally, all participants were asked to complete a language history questionnaire to obtain self-rating of the four principal language skills: reading comprehension, writing, oral comprehension and speaking in both the L1 and the L2, respectively, as the questionnaire included questions about age, age of first exposure to the L2 as well as time, if any, spent studying abroad in a Spanish speaking country (see Appendix B).

The general procedure described above was identical for each of the experimental groups. Modifications that were specific to each group will be discussed in more detail in each of the chapters that follow.

Chapter 3

Experiment 1: Advanced Speakers

In the present chapter, I report the results for advanced speakers of Spanish. This group consisted of ten instructors/graduate students in the Department of Spanish, Italian and Portuguese at the Pennsylvania State University. As described in the general methods section, each of these participants performed a speeded word-naming task. Their data were analyzed to examine two aspects of speech planning, RTs based on the onset of articulation and accuracy of response, and two aspects of the produced speech, VOTs and articulatory duration. In the report of these data, analyses for each of these measures are described separately. For each measure, analyses of variance were performed with participants as the random factor and also with items as the random factor. In each case, the data were analyzed to examine the effects of cognate status and the phonological similarity between the cognate and its English translation. The goal of Experiment 1 was first to determine whether previous findings of cross-language influence from L1 to L2 would be observed in the Spanish naming latencies and then to see whether these effects extended into the realization of the spoken words.

Results

Reaction Time (RT)

RT Analysis Using Onset and Frequency Matched Controls

A 2x2 repeated measures ANOVA was performed on the RT data comparing cognate status (cognates vs. onset and frequency matched noncognate controls) and phonological status (+P vs. –P). In the analysis by participants, these factors were varied within participant. In the analysis by items, the same factors were varied between items. These data are shown in Table 3.1.

Table 3.1.

Advanced Speakers Cognate RTs x Frequency-Matched Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	657	652	654
Noncognate controls	675	673	674
Effect of phonological similarity	666	663	

Although the mean RTs suggest that cognates were named more quickly than noncognates, the 20 ms difference was not statistically significant by participants [F_1 (1, 9) = 1.76, $p > .05$] nor by items [F_2 (1, 97) = 1.78, $p > .05$]. Phonological status did not significantly affect reaction times by participants [F_1 (1, 9) < 1], nor by items [F_2 (1, 97)

< 1]. Finally, there was not an interaction of cognate status and phonological status by participants [F_1 (1, 9) < 1], nor by items [F_2 (1, 97) < 1].

Although previous studies using these materials in speeded word naming tasks have reported evidence for facilitation for cognates that are matched orthographically and phonologically (e.g., +O+P) and inhibition for cognates with mismatched orthography and phonology (+O-P) (see Schwartz, 2003; Schwartz et al., 2000), neither of these effects was obtained in the present analysis at a significant level. There are at least two possible reasons for the failure to replicate the previous results. Although the sample of advanced speakers was quite small, the group was, in fact, more proficient overall than the participants in the earlier studies examining cross-language effects in speeded word-naming tasks as a function of cognate status. It is thus possible that the advanced speakers in this study have achieved a level of inhibitory control that permits them to process each language autonomously (e.g., Costa & Santesteban, 2004; Green, 1998; Segalowitz & Hulstijn, 2004), or at least appear so as a function of the locus of speech planning and language selection imposed by L2 proficiency and task demand (Kroll, Bobb, & Wodniecka, 2006). However, the small sample size requires caution in interpreting the failure to obtain significant results from these data. If the results reflect a high level of L2 skill, then we might expect that the performance of these advanced speakers will resemble that of native monolingual speakers of Spanish, for whom the influence of English phonology and lexical status is irrelevant. We return to consider this possibility at the end of the chapter when we compare these data to naming data for native Spanish speakers on the same materials.

RT Analysis Using Phonetically Matched Controls

A second set of analyses was performed, formally identical to those described above but substituting the phonetic controls for the onset and frequency-matched controls. Recall that the phonetic controls were constructed for the purpose of the acoustic analyses. However, since naming latencies were also available for these items, it was logically important to determine whether the pattern of results would replicate across the two types of controls. Unlike the controls for the previous RT analysis, it was not possible to match the phonetic controls to the critical cognate items on word frequency. Therefore, all item analyses in this chapter and in the subsequent chapters will include the results of an ANOVA followed by an additional analysis of covariance (with log frequency as the covariate) to determine whether effects of cognate status and phonological similarity remain after factoring out this intervening variable. Since there is abundant evidence in the psycholinguistic literature that high frequency words are named faster than low frequency words (e.g., Frederiksen & Kroll, 1976), any main effects found in the initial item analysis could be attributable to the lower word frequency of the control items relative to the cognates. Log frequency will be entered as the covariate in all cases since frequency is typically measured on a logarithmic scale and used in this form to perform statistical analyses.

Unlike the results for the analyses using the onset and frequency-matched controls, there was a main effect of cognate status by participant [F_1 (1, 9) = 8.733; $p < .05$] and by items [F_2 (1, 96) = 6.70; $p < .05$]. This significant by-items result remains after including frequency as a covariate in the analysis [F_2 (1, 95) = 5.30; $p < .05$]. There was a main effect of phonological status by participants [F_1 (1, 9) = 7.582; $p < .05$], but not by items [F_2 (1, 96) < 1] nor in the analysis including the covariate [F_2 (1, 95) < 1]. In addition, there was no interaction to further qualify the main effects by participants [F_1 (1, 9) = 2.804; $p > .05$], nor by items [F_2 (1, 96) < 1], including the analysis employing the covariate [F_2 (1, 95) < 1]. These data are shown in Table 3.2.

Table 3.2.

Advanced Speakers Cognate RTs x Phonetic Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	657	652	654
Noncognate controls	709	684	696
Effect of phonological similarity	683	668	

The main effect of cognate status both by participants and by items reveals that cognates were named significantly faster than the noncognate control items. To a degree, this result replicates the pattern usually found in this type of experimental task. Although facilitation effects for cognates have been reported in word-naming experiments, they are modulated by subtle relationships between word bodies and lexical properties across languages (e.g., Schwartz, 2003; Schwartz et al., in press), thus making facilitation or inhibition effects the product of factors that are much more precise than the wider scope of cognate status alone.

Analysis of Accuracy

Cognates Compared to Frequency Matched Control Items

The analysis of accuracy performed by participant was done using the Arcsine transform values of the percentages of accuracy in order to provide a more precise representation of the participants' accuracy rates. These values will be used for all statistical analyses of accuracy performed in all experiments in the present work, although mean accuracy data will be reported as actual percent correct. The mean accuracy data are reported in Table 3.3.

Table 3.3.

Advanced Speakers Cognate x Frequency-Matched Control Items Accuracy Analysis

	+P	-P	Effect of Cognate Status
Cognates	93.7	90.8	92.3
Noncognate controls	86.2	89.2	87.7
Effect of phonological similarity	89.9	90.0	

The analysis of accuracy by participant revealed that there was a significant main effect of cognate status by participants [$\underline{F}_1$ (1, 9) = 13.50; $\underline{p} < .05$] and by items [$\underline{F}_2$ (1, 97) = 4.61; $\underline{p} < .05$], showing that cognates were named significantly more accurately than noncognate control items, a finding replicating past results in the psycholinguistic literature (e.g., Costa, Caramazza, & Sebastián-Gallés, 2000). On the other hand, there was not a significant difference in terms of accuracy for phonological status by participants [F_1 (1, 9) < 1], nor by items [F_2 (1, 97) < 1]; nor was there a significant interaction of cognate status and phonological status by participants [F_1 (1, 9) = 2.80; p >.05], nor by items [F_2 (1, 97) = 1.23; p >.05]. Contrary to the initial RT analysis, the accuracy data suggest that the advanced speakers were indeed influenced by L1 in producing L2 words. To the extent that these effects are a reflection of their bilingualism rather than a property of the materials, we would not expect to see a cognate effect in accuracy for monolingual Spanish speakers. We return to this issue later in the chapter.

Cognates Compared to the Phonetically Matched Control Items

A second set of analyses was again performed on the cognates compared to the phonetically matched controls. These data are reported in Table 3.4.

Table 3.4.

Advanced Speakers Cognate x Phonetically Matched Control Items Accuracy Analysis

	+P	-P	Effect of Cognate Status
Cognates	93.7	90.8	92.0
Noncognate controls	90.4	84.9	87.8
Effect of phonological similarity	89.9	90.0	

The accuracy analysis by participants for cognates vs. phonetically-matched control items again revealed a main effect of cognate status [F_1 (1, 9) = 13.0; p < .05], by items [F_2 (1, 96) = 10.85; p < .05] and by items including the frequency covariate [F_2 (1, 95) = 9.79; p < .05]. There was a main effect of phonological status by participants [F_1 (1, 9) = 6.18; p < .05], but not by items [F_2 (1, 96) < 1] nor by items including the frequency covariate

[F_2 (1, 95) < 1]. There was not a significant interaction between cognate status and phonological status by participants [F_1 (1, 9) < 1], by items [F_2 (1, 96) < 1] or by items including the frequency covariate [F_2 (1, 95) < 1].

The RT and accuracy analyses suggest that advanced speakers may still be sensitive to the cognate status of words in the L2, a result that is consistent with other reports of word recognition performance among highly proficient Dutch-English bilinguals (e.g., Dijkstra et al., 1998). However, in the present word naming experiment, when these effects appeared (e.g., in the RT analysis with phonetic controls and in both of the accuracy analyses), they were not modulated by the phonological properties of the cognates. The presence of a main effect of cognate status in the absence of an interaction with phonological similarity raises the possibility that there are two distinct loci for cross-language influences (Kroll, et al., 2006). One, at a lexical level, may reflect facilitation in lexical access for cognates in L2 because their similarity to higher frequency or more familiar words in the L1 may provide a cue to lexical retrieval in L2. The effects of phonological similarity and their interaction with cognate status are more likely to operate at a sublexical level where orthographic representations are mapped to their phonological properties. The data presented thus far suggest that high proficiency learners may still benefit from the greater accessibility of L2 words that have L1-like lexical form, but that the planning of L2 utterances proceeds independently of the L1 phonology. If this hypothesis is correct, then we might predict that advanced speakers will not show effects of L1 phonology in the VOT and duration measures that reflect the realization of speech.

Voice Onset Time (VOT)

A 2x2 repeated measures ANOVA was performed on the VOT data comparing cognate status (cognates vs. phonetically matched noncognates) and phonological status (+P vs. –P). These data are shown in Table 3.5.

Table 3.5.
Advanced Speakers Cognate VOTs x Phonetic Control Item VOTs

	+P	-P	Effect of Cognate Status
Cognates	24.4	25.7	25.1
Noncognate controls	24.6	24.4	24.5
Effect of phonological similarity	24.5	25.1	

There was no main effect of cognate status by participants [F_1 (1, 9) < 1], by items [F_2 (1, 26) = 1.043; p >.05] or by items including the frequency covariate [F_2 (1, 25) = 1.34; p >.05]. In terms of phonological status, there was no main effect by participants [F_1 (1, 9) < 1], by items [F_2 (1, 26) < 1] or by items including the frequency covariate [F_2 (1, 25) < 1]. However, there was a marginal interaction of cognate status and phonological status such that the VOTs of the –P cognates were slightly longer than for the +P cognates by participants [F_1 (1, 9)= 3.473; p = .095]. A post-hoc analysis was performed in order to determine the direction and magnitude of this effect. Paired sample t-tests comparing VOT measures for cognates and controls separately for the +P and –P conditions showed that there was not a significant effect of cognate status for the +P condition, where cognates had shorter VOTs than the matched controls (t (9) < 1, tested at p < .025 with Bonferroni correction for multiple comparisons. On the other hand, the effect of cognate status was marginally significant for the –P condition (t (9) = 2.515; p = .033, tested at p

< .025. This –P effect was distinct from what was observed for the +P condition in that –P cognates were produced with marginally significant longer VOTs than matched control items. By items, however, there was not a significant interaction of cognate status and phonological status [F_2 (1, 26) < 1] or by items including the frequency covariate [F_2 (1, 25) = 1.01; p >.05].

Overall, the marginally significant interaction by participants provides some indication that, at the production level, the phonological status of a cognate modulates production accuracy. According to the original hypothesis, we would have expected that cognates bearing more similar cross-language phonological properties (+P) would be produced in a more English-like manner at the phonetic level, or at the stage of utterance execution. Instead, the results suggest that when the L1 phonology conflicts with the L2 phonology, there is competition and the eventual production is influenced by the L1 competitor.

On the other hand, the –P cognates, judging from the shorter response latencies produced by these participants, the cross-language phonology was different enough as to not inhibit response time nor trigger a need for more careful "planning" at the pre-utterance stage. Therefore, it could be conjectured that the faster response times came at a cost to L2 phonetic production accuracy. In other words, since –P cognates were produced more quickly than +P cognates, the speed of naming latency acted as to degrade speech planning, resulting in longer, more English-like VOTs for the –P cognates.

Analysis of Accuracy

Cognate VOTs Compared to Phonetically Matched Control Items

The analyses of accuracy for the VOT data were performed by using the subset of the total number of critical items that could be measured for VOT. It is important to note that for the VOT dimension, any critical item pair (i.e., cognate and control item) in which there was an error in one of the items required that both items be eliminated from the analysis[9]. To achieve a precise phonetic analysis, it was necessary to have each cognate item matched to its respective control item produced by the same speaker.

Since errors were coded by critical item pairs, the by-items error analysis performed on the cognates compared to the phonetically matched controls was done via a one-way ANOVA comparing accuracy according to phonological status. The consequence of the procedure of eliminating cognate/control pairs resulted in cognate status' being unable to be included in the analysis. The critical question in this analysis is whether phonological similarity affected the performance of advanced learners.

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[9] The same procedure was followed for the analysis of articulatory duration, the analyses of which are discussed in the following section. Therefore, accuracy measures for the VOT dimension apply identically to articulatory duration accuracy.

In Table 3.6, the mean accuracy is presented in percent correct according to phonological status.

Table 3.6.

Advanced Learners +P VOT x –P VOT Items Analysis of Accuracy

	Percent Accuracy
+P items	91.4
-P items	95.0

The one-way ANOVA performed on the percent accuracy of items measured for VOT according to phonological status did not reveal a significant difference in performance accuracy [F_2 (1, 28) = 1.505; p >.05], illustrating that for the subset of items that were measured for VOT, accuracy was not influenced by phonological status.

Articulatory Duration

A 2x2 repeated measures ANOVA was performed on the articulatory duration data comparing cognate status (cognates vs. phonetically matched noncognates) and phonological status (+P vs. –P). These data are shown in Table 3.7.

Table 3.7.

Advanced Learners Cognate Articulatory Duration x Phonetically Matched Control Items

	+P	-P	Effect of Cognate Status
Cognates	540	541	540
Noncognate controls	550	529	540
Effect of phonological similarity	545	535	

There was no main effect of cognate status by participants [F_1 (1, 9) < 1], by items [F_2 (1, 96) < 1], nor by items including frequency as the covariate [F_2 (1, 95) < 1]. There was a significant main effect of phonological status by participants [F_1 (1, 9) = 5.60; $p < .05$], but not by items [F_2 (1, 96) < 1] or by items with frequency as the covariate [F_2 (1, 95) < 1]. By participants, the main effect of phonological status was qualified by a significant interaction of cognate status and phonological status [F_1 (1, 9) = 7.62; $p < .05$]. A post-hoc analysis was carried out to determine the direction and magnitude of the interaction. Paired sample t-tests comparing cognates and controls separately for the +P and –P conditions showed that there was a significant effect of cognate status for the +P condition, where cognates had shorter durations than matched controls (t (9) = 3.098; p = .013, tested at $p < .025$ with Bonferroni correction for multiple comparisons. The effect of cognate status neared but did not reach significance for the –P condition (t (9) = 2.306; p = .047, tested at $p < .025$. This interaction should be interpreted with caution since the +P and –P cognates had similar articulatory durations. Therefore, we can surmise that there was something about the control items that was affecting the results for articulatory duration and not so much the +P/-P distinction.

On the other hand, a significant interaction of cognate status x phonological status was not found by items [F_2 (1, 96) < 1] or with frequency included in the analysis as the covariate [F_2 (1, 95) < 1]. Phonological status only appeared to modulate word duration for the noncognate control items. Since the +P/-P distinction has no real meaning for the control items, this result suggests that in the process of matching phonetic controls to the critical cognate items, there may have been residual structural differences across items that affected articulatory duration.

Discussion

Although the results outlined above illustrate that advanced speakers' naming speed and accuracy are affected by cognate status as well as phonological status, the abundance of nonsignificant results seems to indicate that advanced speakers are, in fact, able to perform in the L2 with quite a high level of automaticity, therefore being influenced very little by L1 lexical properties. An alternative explanation for the relative absence of cross-language effects in the L2 for this group, as compared to the degree of effects reported in studies conducted on learners of a similar L2 proficiency level (e.g. Schwartz, 2003; Schwartz et al., 2000) is the small sample size of this group, therefore making the results unrepresentative of the entirety of this particular population of L2 speakers.

If the group of speakers whose performance was examined in Experiment 1 were so proficient as to have achieved a level of L2 production that approximates native speakers of Spanish, then we might expect that their data would look similar to those of native Spanish speakers. Gerfen and Rizzo (2005) performed a study with monolingual Spanish speakers on the same word-naming task used in the present work, however only RT and accuracy were measured.[10] If the performance of the advanced speakers and the monolingual Spanish-speakers does not differ significantly, it would be evidence that, at least at the conceptual or pre-utterance stage of language skill, it is possible for late L2

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[10] These data were collected from a group of university students in Granada, Spain who reported having very little or no proficiency in a language other than Spanish.

learners to attain competence akin to that of a native speaker of their L2. It is important to note, however, that further investigation would be required to determine if such ability carries into the utterance stage as tested by the VOT and duration data in the present work. For the monolingual Spanish speakers, no cognate effects should be observed since for these participants, who speak only one language, cognate status is functionally and practically nonexistent. Yet, if the performance of the advanced speakers is slower and more error prone than that of the monolingual speakers of Spanish, it would provide further evidence that L2 learners / bilinguals are fundamentally different than monolinguals in terms of language processing and do not reach a level of automaticity in the language to nearly the same degree as a native speaker.

Data comparison of Spanish monolinguals with advanced learners of Spanish

In Table 3.8, we see the RT data for cognates vs. phonetically matched controls for the advanced speakers compared to Gerfen and Rizzo’s (2005) monolingual Spanish speakers.

Table 3.8.

Advanced Speakers Cognate RTs x Phonetic Control Item RTs Compared to Spanish Monolingual Cognate RTs x Phonetic Control Item RTs

	Advanced proficiency learners			Monolingual Spanish speakers		
	+P	-P	Effect of Cognate Status	+P	-P	Effect of Cognate Status
Cognates	672	707	690	545	529	537
Noncognate controls	693	753	723	556	550	553
Effect of phonological similarity	683	730		551	540	

A 2x2x2 (group x cognate status x phonological status) repeated measures ANOVA by items revealed that the Spanish monolinguals named Spanish words faster than the advanced speakers named Spanish words in their L2 [$\underline{F}_2$ (1, 35) = 130.77; $\underline{p}$ < .05]. This first analysis reveals at least in terms of proficiency, as indicated in naming speed, that the advanced speakers do not approximate Spanish monolinguals' level of proficiency.

For phonological status, by items, there was a significant interaction between group and phonological status, such that the advanced speakers showed differential sensitivity to the degree of cross-language phonological similarity in the stimuli, whereas the Spanish monolingual participants did not [$\underline{F}_2$ (1, 35) = 4.27; $\underline{p}$ < .05]. However, the by-items analysis performed including the frequency covariate yielded only a marginally significant interaction between group and phonological status, showing that the mismatched word frequency accounted for a great deal of the overall significant effect [$\underline{F}_2$ (1, 34) = 4.00; $\underline{p}$ = .055]. Nevertheless, this result must be interpreted with caution, especially since the sample size of the advanced speakers was so small and since phonological similarity itself is averaged across cognates, for which it's a meaningful variable, and noncognate controls, for which it's not a meaningful variable. There were no significant interactions found by items for group x cognate status [F_2 (1, 35) < 1] or for group x cognate status x phonological status [F_2 (1, 35) < 1]. The same result was found in the by items analysis with frequency included as the covariate (i.e., group x cognate status [F_2 (1, 34) < 1] and group x cognate status x phonological status [F_2 (1, 34) < 1].

The general results obtained from this group's performance on a speeded word-naming task in their L2 provided some indication that although to a limited degree, even advanced speakers are sensitive to cross-language lexical properties, more specifically in terms of orthographic and phonological similarity, in a manner contrary to the original hypothesis. In the chapters to follow, we will examine the results of the same tasks performed by learners of Spanish with an intermediate proficiency level. For those participants, we can expect to see a much larger effect or role of the L1 in their processing of lexical items in the L2, at least to a much greater degree than the advanced speakers. However, we will return to our discussion of the results found for this group and the remaining groups in Chapter 6 when cross-group comparisons will be made, therefore providing an analysis of differential L2 performance as a function of proficiency and learning environment.

Chapter 4

Experiment 2: Immersed Learners

In this chapter, I report the results for immersed learners who were participating in a domestic immersion program at the Middlebury College Spanish Language School during the summer of 2003. This group consisted of 51 students (both undergraduate and graduate students) from universities across the United States. The data were analyzed in the same manner described in the general method section and identically to the analyses conducted in Experiment 1.

One of the primary goals of Experiment 2 was first to determine whether and/or to what degree previous findings of cross-language influence from L1 to L2 would be observed in the Spanish naming latencies and then to see whether these effects extended into the realization of the spoken words. Secondly, this experiment sought to determine if an L2 immersion context would have an observable effect on the measures taken (i.e., RT, VOT and articulatory duration) from the task performed by these participants.

With respect to the advanced speakers discussed in Chapter 3, for these learners, due to the respective lower proficiency level, we can feasibly expect to see results in which cognate status plays a greater role in processing for these participants, as L2 processing, being that this group possess an intermediate level of proficiency, is more likely to be modulated more strongly by the L1 system than for the advanced speakers. In addition, more salient effects of phonological status may be observed as a result of the lower level of L2 automaticity combined with the similar, yet articulatory and therefore acoustically distinct phonetic properties of English and Spanish with which these participants were faced upon performing the speeded word-naming task.

On the other hand, if we take the immersion context in which these participants were involved at the time of the study into account, it is also highly feasible to expect effects that are quite distinct from both the advanced speakers and the classroom learners, which will be discussed in Chapter 5. Even though there may be a greater influence of the L1 in L2 processing due to the overall lower proficiency level of this group with respect to the advanced speakers, those effects may be observed to a lesser degree than if this group were an intermediate proficiency group not participating in a Spanish language immersion program. However, it is important to note that the observed effects may be completely different than those expected from an intermediate group not in an immersion environment. We will make comparisons between this group and the classroom learners in later chapters.

Results

Reaction Time (RT)

RT Analysis Using Onset and Frequency Matched Controls

A 2x2 repeated measures ANOVA was performed on the RT data comparing cognate status (cognates vs. onset and frequency matched non-cognates) and phonological status (+P vs. –P). In the analysis by participants, these factors were varied within participant. In the analysis by items, these factors were varied between items. These data are shown in Table 4.1.

Table 4.1.

Immersed Learners Cognate RTs x Frequency Matched Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	611	621	616
Noncognate controls	629	636	633
Effect of phonological similarity	620	629	

The mean RTs show that cognates were named more quickly than noncognates, a result that was statistically significant by participants [F_1 (1, 49) = 19.63, $p < .05$], but not by items [F_2 (1, 97) < 1] . Phonological status significantly affected reaction times by participants [F_1 (1, 49) = 6.391; $p < .05$], but not by items [F_2 (1, 97) = 2.19, $p > .05$].

Finally, there was not an interaction of cognate status and phonological status by participants [F_1 (1, 49) = .204; $p > .05$], nor by items [F_2 (1, 97) = 1.12, $p > .05$]

The significant main effect of cognate status and phonological status by participants are expected results, as they show that the L1 plays an important role in processing for these participants. In terms of cognate status, it shows a clear facilitation effect in that the “support” from the L1 similarity while naming in the L2 speeds processing time. With respect to phonological status, again, similarity speeded processing time. However, the nonsignificant interaction of cognate status and phonological status seems to indicate that although the L1 affects processing in terms of cognate status and phonological status respectively, cognate status is not modulated by phonological status, nor vice versa; rather the main effect of cognate status could be the function of an access cue, where the reinforcement from the L1 form corresponding to the L2 cognate speeds naming latencies, as is the case for phonological status, respectively speaking.

RT Analysis Using Phonetically Matched Controls

A second set of analyses was performed, formally identical to the ones described above, but substituting the phonetic controls for the onset and frequency-matched controls. As mentioned in the previous chapter, the phonetic controls were constructed for the purpose of the acoustic analyses. However, as in Experiment 1, since naming latencies were also available for these items, it was important to determine whether the pattern of results would replicate across the two types of controls.

The mean cognate and phonetic control RTs by condition are shown in Table 4.2.

Table 4.2.

Immersed Learners Cognate RTs x Phonetically Matched Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	611	622	617
Noncognate controls	656	642	649
Effect of phonological similarity	634	632	

Unlike the results for the analyses using the onset and frequency-matched controls, there was a main effect of cognate status by participants [F_1 (1, 49) = 36.65; p< .05] and by items [F_2 (1, 96) = 4.19; p =.043] which became only marginally significant with the frequency covariate included [F_2 (1, 95) = 2.79; p =.098]. There was no significant main effect of phonological status found by participants [F_1 (1, 49) < 1], although there was a marginally significant main effect of phonological status by items [F_2 (1, 96) = 3.24; p = .075] which remained so by items with the frequency covariate included [F_2 (1, 95) = 3.90; p = .051] in the analysis. The marginal main effect of cognate status by items, in this analysis, could feasibly be attributed to the frequency difference between the cognates and the phonetically matched controls, since this by-items effect was not present in the analysis with the frequency-matched controls. Although this factor was accounted for in the by-items analysis by including frequency as a covariate in the analysis, the frequency of the control words was much lower than the cognate items, which inevitably had an effect on processing. At any rate, the main effect of cognate status indicates that the L1 was influencing processing for these participants in that naming latencies were speeded.

In order to clarify the nature of the significant interaction of cognate status and phonological status found by participants [F_1 (1, 49) = 9.58; $p < .05$], a post-hoc analysis was performed. Paired sample t-tests comparing cognates and controls separately for the +P and –P conditions revealed that there was a significant effect of cognate status for the +P condition, where cognates had faster naming latencies than matched controls (t (49) = 5.555; $p = .00$, tested at $p < .025$ with Bonferroni correction for multiple comparisons. There was also a significant effect of cognate status in the –P condition (t (49) = 4.205; $p = .00$, tested at $p < .025$. The interaction of cognate status x phonological status indicates that this group of participants was virtually unaffected by level of phonological similarity, but very much affected by cognate status. In other words, form similarity seemed to be the factor determining naming latencies for this group rather than phonological similarity. The speed of naming in the L2 seems to be very strongly linked to the immersion environment in which these participants were enrolled at Middlebury College in that the L2, for these learners, was always "ready" for selection and therefore to be used in speech production. Additionally, since the cognates were reinforced in the L1 via orthographic and phonological similarity across the two languages, generally speaking a cognate would greatly speed processing as it may be viewed almost as an access cue stored in the non-selective lexicon.

On the other hand, there was not a significant interaction of cognate status x phonological status by items [F_2 (1, 96) = .144; $p< .05$] or with the frequency covariate included in the analysis [F_2 (1, 95) < 1].

Analysis of Accuracy

Cognates Compared to Frequency Matched Control Items

As stated previously, the accuracy analysis performed by subject was done using the Arcsine values of accuracy in order to provide a more precise representation of error rates. However, in Table 4.3, the mean accuracy is presented in percent correct.

Table 4.3.

Immersed Learners Cognate x Frequency Matched Control Items Accuracy Analysis

	+P	-P	Effect of Cognate Status
Cognates	90.6	82.9	86.7
Noncognate controls	86.5	85.0	85.7
Effect of phonological similarity	88.5	83.9	

The accuracy analysis by participants revealed that there was not a significant main effect of cognate status [$\underline{F}_1$ (1, 49) < 1], or by items [$\underline{F}_2$ (1, 97) < 1] showing that cognates were not named significantly more accurately than noncognate control items. There was a significant difference in terms of accuracy for phonological status by participants [$\underline{F}_1$ (1, 49) = 18.66; $\underline{p}$ < .05], but not by items [$\underline{F}_2$ (1, 97) = 1.77; $\underline{p}$ > .05]. The significant main effect of phonological status for accuracy is most likely due to participants' unusually fast naming latencies in the –P condition that, as this result seems to indicate, came at a cost to accuracy. To further qualify the significant main effect of phonological status, a significant interaction of cognate status and phonological status was obtained by participants [F_1 (1, 49) = 18.95; $p < .05$]. Post-hoc paired samples t-tests revealed that there was a significant effect of cognate status in terms of accuracy for the +P condition (t (49) = -63.897; $p = .000$, tested at $p < .025$ with Bonferroni correction for multiple comparisons. On the other hand, there was only a marginally significant effect of cognate status in terms of accuracy for the –P condition (t (49) = -2.083; $p = .042$, tested at $p < .025$. Therefore, +P cognates were named significantly more accurately with respect to matched controls than the –P cognates. There was no significant interaction obtained by items [F_2 (1, 97) < 1].

Cognates Compared to the Phonetically Matched Control Items

The by-participants accuracy means are presented in Table 4.4.

Table 4.4.

Immersed Learners Cognate x Phonetically Matched Control Items Accuracy Analysis

	+P	-P	Effect of Cognate Status
Cognates	90.6	82.9	86.7
Noncognate controls	83.0	80.6	81.8
Effect of phonological similarity	86.8	81.7	

The accuracy analysis by participants for cognates vs. phonetically-matched control items revealed a main effect of cognate status [F_1 (1, 49) = 34.52; $p < .05$], as well as by items [F_2 (1, 96) = 5.14; $p < .05$], although after including the frequency covariate, the main effect was only marginally significant [F_2 (1, 95) = 3.79; $p = .055$]. This result indicates that cognates were named significantly more accurately than noncognate control items. A main effect of phonological status was found by participants [F_1 (1, 49) = 38.22; $p <$ .05], but not by items [F_2 (1, 96) < 1] or when including the frequency covariate [F_2 (1, 95) < 1], showing that, by participants, +P items were named significantly more accurately than –P items, but such was not the case by items. Again, as in the accuracy analysis for cognate RT accuracy x frequency-matched control RT, the significant main effect of phonological status for accuracy is most likely due to participants' unusually fast naming latencies in the –P condition that, as this result seems to indicate, came at a cost to accuracy. There was also a significant interaction between cognate status and phonological status in terms of accuracy by participants [F_1 (1, 49) = 18.42; $p < .05$]. Post-hoc paired samples t-tests revealed that there was a significant effect of cognate status in terms of accuracy for the +P condition (t (49) = -6.683; $p = .000$, tested at $p <$ .025 with Bonferroni correction for multiple comparisons. On the other hand, there was only a marginally significant effect of cognate status in terms of accuracy for the –P condition (t (49) = -2.029; $p = .048$, tested at $p < .025$. Therefore, +P cognates were named significantly more accurately with respect to their matched controls, whereas –P cognates, only marginally so with respect to matched controls.

A significant interaction between cognate status and phonological status with phonetically matched controls by accuracy was not found by items [F_2 (1, 96) = 1.08; p >.05], or when the frequency was included as a covariate in the analysis [F_2 (1, 95) < 1].

Voice Onset Time (VOT)

A 2x2 repeated measures ANOVA was performed on the VOT data for this group comparing cognate status (cognates vs. phonetically matched non-cognates) and phonological status (+P vs. –P). These data are shown in Table 4.5.

Table 4.5.

Immersed Learners Cognate VOTs x Phonetic Control Items VOTs

	+P	-P	Effect of Cognate Status
Cognates	27.0	29.6	28.3
Noncognate controls	28.2	28.9	28.6
Effect of phonological similarity	27.6	29.3	

There was no main effect of cognate status by participants [F_1 (1, 49) < 1], by items [F_2 (1, 26) < 1], or with the frequency covariate included [F_2 (1, 25) < 1]. In terms of phonological status, there was a main effect by participants [F_1 (1, 49) = 8.01; $p < .05$], but not by items, [F_2 (1, 26) < 1] or with the frequency covariate included [F_2 (1, 25) < 1]. In the by-participants analysis, there was a significant interaction of cognate status and phonological status [F_1 (1, 49) = 9.36; $p < .05$], although no such interaction was found by items [F_2 (1, 26) < 1] or when including the frequency covariate [F_2 (1, 25) < 1]. For the significant by-participants interaction of cognate and phonological status on VOT measures, post hoc paired t-tests analyses indicated that there was a significant effect of cognate status for the +P condition (t (49) = -3.083; p = .003, tested at $p < .025$ with Bonferroni correction for multiple comparisons, but not for cognate status in the –P condition (t (49) = 1.506; p = .138, tested at $p < .025$.

For this group, not only were +P naming latencies significantly faster than their matched controls, but the participants *also* were able to produce them with a more Spanish-like pronunciation, most likely due to the L2 being "ready" for processing and therefore speech production. Since the L2 language system was held so closely at the forefront, in terms of processing, the Spanish phonological system was more highly activated, thus causing participants to produce +P cognates with more Spanish-like VOTs, regardless of the conflicting cross-language phonetic norms mixed with cross-language orthographic similarity in the critical cognate items. Clearly, there is a noteworthy effect of the immersion environment itself on this group of participants. This issue will be explored further in Chapters 6 and 7.

Analysis of Accuracy

Cognate VOTs Compared to Phonetically Matched Control Items

The error analyses for the VOT dimension outlined in the present section was performed by using the subset of the total number of critical items for which it was possible to measure VOT. It is important to note that for the VOT dimension, as was done in the analyses reported in Chapter 3, for any critical item pair (i.e., cognate and control item) in which there was an error in one of the items, both items were deemed as errors and the pair was eliminated from the analysis[11]. Due to the fact that this analysis is phonetically driven, it is imperative to not have an unmatched number of cognate items and control items due to the fact that the analyses rely exclusively on the cognate items being matched to the control item produced by the same speaker.

Since errors were coded by critical item pairs, the by items accuracy analysis performed on the cognates compared to the phonetically matched controls was done via a one way ANOVA comparing accuracy according to phonological status. Accuracy analysis according to phonological status is the factor of interest in this case in that it serves to illustrate whether errors were more prevalent in the +P or the –P condition. In other words, the critical question is whether phonological similarity or dissimilarity caused the greatest degree of difficulty for this group of learners. In Table 4.6, the mean accuracy is presented in percent correct according to phonological status.

Table 4.6.

Immersed Learners +P VOT x –P VOT Items Accuracy Analysis

	Percent Accuracy
+P items	91.6
-P items	89.7

The one-way ANOVA performed on the percent accuracy of items measured for VOT according to phonological status did not reveal a significant difference in performance accuracy [F_2 (1, 28) <1], illustrating that for the subset of items that were measured for VOT, accuracy was not influenced significantly by phonological status.

[11] The same procedure was followed for the analysis of articulatory duration, the analyses of which are discussed in the following section. Therefore, accuracy measures for the VOT dimension apply identically to articulatory duration accuracy.

Articulatory Duration

A 2x2 repeated measures ANOVA was performed on the articulatory duration data for this group comparing cognate status (cognates vs. phonetically matched noncognates) and phonological status (+P vs. –P). These data are shown in Table 4.7.

Table 4.7.

Immersed Learners Cognate Articulatory Duration x Phonetic Control Items

	+P	-P	Effect of Cognate Status
Cognates	543	559	551
Noncognate controls	559	552	555
Effect of phonological similarity	551	555	

There was a marginally significant main effect of cognate status by participants [F_1 (1, 49) = 3.89; $p = .054$], but not by items [F_2 (1, 96) < 1] or with the frequency covariate included in the analysis [F_2 (1, 95) <1], which means that as a “trend”, the duration for cognates was shorter than for the matched controls. There was not a significant main effect of phonological status by participants [F_1 (1, 49) = 1.85; $p > .05$], by items [F_2 (1, 96) < 1] or by items including the frequency covariate [F_2 (1, 95) < 1]. By participants, there was a significant interaction of cognate status and phonological status [F_1 (1, 49) = 29.0; $p < .05$], but not by items [F_2 (1, 96) < 1] or by items with the frequency covariate included [F_2 (1, 95) < 1]. For the significant by-participants interaction of cognate and phonological status on articulatory duration measures, post-hoc paired t-tests analyses indicated that there was a significant effect of cognate status for the +P condition (t (49) = -4.441; $p = .000$, tested at $p < .025$ with Bonferroni correction for multiple comparisons, as well as for cognate status in the –P condition (t (49) = 2.868; p = .006, tested at $p < .025$, which would mean, according to the means given above, that +P cognates were produced with significantly shorter durations than their respective controls and that –P cognates were produced with significantly longer durations than their respective controls.

Again, due to these learners' L2 being active at a much more elevated level as a result of the immersion environment, the activation of the L1 simply provided processing reinforcement to processing speed at both pre-utterance and utterance stage latencies. In addition, by virtue of being in an immersion environment and therefore having the L2 constantly more active, they are faster at producing L2 items much more so than if they were not in an immersion environment. In chapter 6, when we examine the between group comparisons, we will see that their naming latencies were much faster than the advanced speakers and, relevant to the present analysis, the articulatory durations means in each condition were very similar for both the advanced speakers and the immersed learners, providing evidence that being in an immersion environment has a strong effect on the speed of lexical processing in the L2.

On the other hand, it is reasonable to surmise that in the –P condition, cross-language competition at the phonological level increased cognitive load, therefore producing "spill over" effects from the pre-planning stage into the utterance stage, thus producing longer articulatory durations, overall, for this experimental condition.

Discussion

The results outlined above illustrate that the immersed learners' naming speed and accuracy are affected by cognate status as well as phonological status. However, although their accuracy is not characteristic of advanced L2 learners, their naming speed, is, incidentally, faster than that of the advanced speakers. As previously mentioned, this group, at the time of the study, was participating in an L2 immersion program at Middlebury College. It is hypothesized, therefore, that these effects could be attributable to the environment in which the participants were immersed at the time of the study. In terms of the collective results of the analyses performed for this group of L2 learners, it appears that cognate status and therefore the L1 is quite influential in lexical processing for this group in spite of the fact that the L2 was literally "forced" to be so readily active at all times for these participants at the time of the study. However, we know from numerous psycholinguistic studies that bilinguals cannot "turn off" the language not in use at any given time, even in a case where one language is "forced" to be more active and more available in any given circumstance (see Kroll, & Dijkstra, 2002 for a discussion). Therefore, regardless of the linguistic context, the L1 continues to play a role in L2 lexical processing.

As stated above, L1 influenced processing for these participants even though naming latencies were much faster than those of the advanced speakers (a more detailed comparison and analysis of these results will be provided in Chapter 6). On the other hand, this group's performance seemed to be much more modulated by degree of phonological similarity than the advanced proficiency group, especially in terms of speech execution (i.e., VOT and articulatory duration results). In terms of VOT, the production of cognate items in the +P condition was more accurate in terms of Spanish phonetic norms than those in the –P condition, a result that is contrary to the original hypothesis. One would expect that the higher degree of cross-language similarity would impede L2 phonetic accuracy; however, it seems that an effect of being in an immersion environment and therefore having the L2 system so readily available for production almost overrides the possible cross-language competition and creates a condition such that the L2 phonological system is more readily available for production. On the other hand, phonological dissimilarity combined with orthographic similarity may have brought cross-language competition more "to the surface" and therefore caused the L1 phonology to play a more prominent role in processing and in turn create a hindrance to L2 phonetic production accuracy, producing, if we compare it to the monolingual domain, a "homograph effect" (Gottlob et al., 1999).

In terms of articulatory duration, it is plausible to assert that the same theoretical explanation provided above for the VOT results can also account for the articulatory duration results, due to the fact that they follow the same "pattern", only within a different dimension of speech production.

More detailed analyses and between-group comparisons, however, will be examined and explained in greater detail in Chapter 6.

Chapter 5

Experiment 3: Classroom Learners

In the present chapter, I report the results for classroom learners that, at the time of the study, were students in 400 level Spanish classes, namely Spanish 414 (Spanish phonetics and phonology) and Spanish 410 (Advanced Oral Expression) at the Pennsylvania State University during the spring semester of 2004. This group consisted of 24 students. As described in the general method, each of these participants performed a speeded word-naming task. Their data were analyzed to examine two aspects of planning, RTs based on the onset of articulation and accuracy of response, and two aspects of the produced speech, VOTs and articulatory duration. In the report of these data, analyses for each of these measures are described separately. For each measure, analyses of variance were performed with participants as the random factor and also with items as the random factor. In each case, the data were analyzed to examine the effects of cognate status and the phonological similarity between the cognate and its English translation. One of the primary goals of Experiment 3 was first to determine whether previous findings of cross-language influence from L1 to L2 would be observed in the Spanish naming latencies and then to see whether these effects extended into the realization of the spoken words.

By virtue of the fact that these are classroom learners and that these participants were not involved in an immersion program at the time of the study, we can expect to see much stronger effects of cognate status in that the L1 will play a major role in their processing of L2 lexical items, namely cognates. Since the majority of these participants have not spent time in a study abroad program/immersion context, their only contact with Spanish has been mainly in the classroom. Therefore, it is reasonable to surmise that performance in L2 word naming will not exhibit nearly the level of processing automaticity observed for the advanced speakers or even for the immersed learners.

Given this expected lack of automaticity in L2 production, we can expect to see as well a much greater sensitivity to differences in phonological similarity of the cognate items. Since most of their time, at the time of the study, was spent using the L1 in their everyday lives, it is reasonable to expect that the cross-language similarity will have detrimental effects not so much at the pre-utterance stage, but very much so at the stage of speech execution. It is very likely that, even though they were fully aware that the task was conducted using strictly the L2, upon viewing a stimulus (i.e., a cognate) bearing such high similarity to an L1 lexical item, the participants immediately “fell back” on the L1 system, since their L2 system, at the time of the study, was not highly developed at least in terms of oral production accuracy and fluency.

Therefore, in naming latencies, for this group, we can expect to see faster naming latencies of cognate items with respect to matched controls, namely, in the +P condition; however, in terms of speech execution, it is most likely we will find higher levels of L1 interference when cross-language form and phonetic similarity are exaggerated as a result of the experimental setting and subsequently observe costs to production accuracy, in terms of Spanish phonetic norms, due to the elevated level of access competition, especially for these learners.

Results

Reaction Time (RT)

RT Analysis Using Onset and Frequency Matched Controls

A 2x2 repeated measures ANOVA was performed on the RT data comparing cognate status (cognates vs. onset and frequency matched non-cognates) and phonological status (+P vs. –P). In the analysis by participants, these factors were varied within participant. In the analysis by items, these factors were varied between items. These data are shown in Table 5.1.

Table 5.1.

Classroom Learners Cognate RTs x Frequency Matched Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	659	658	658
Noncognate controls	677	685	681
Effect of phonological similarity	668	671	

The mean RTs show that, by participants, cognates were named significantly more quickly than noncognates [F_1 (1, 23) = 11.43, $p < .05$]. A significant result was also found by items [F_2 (1, 97) = 5.03, $p < .05$] . Phonological status did not significantly affect reaction times by participants [F_1 (1, 23) < 1], nor by items [F_2 (1, 97) < 1]. Finally, there was not a significant interaction of cognate status and phonological status by participants [F_1 (1, 23) < 1], nor by items [F_2 (1, 97) < 1].

The results of the by-subject analyses were, generally speaking, consistent with previous studies using these materials in which the results provided evidence for facilitation with +P cognates and inhibition for –P cognates (e.g., Schwartz, 2003; Schwartz et al., 2000), although as stated in Chapter 3, in word-naming tasks, facilitation effects, although they have been observed, have not been consistently so in several replications of similar work.

The most important result observed here, however, is that the highly significant main effect of cognate status reveals that these participants were very strongly influenced by the L1 when naming cognates; however, the nonsignificant interaction of cognate status x phonological status indicates that this effect was not modulated by degree of phonological similarity.

RT analysis using phonetically matched controls

A second set of analyses was performed, formally identical to the ones described above but substituting the phonetic controls for the onset and frequency-matched controls. As mentioned in the previous chapter, the phonetic controls were constructed for the purpose of the acoustic analyses. However, as in Experiments 1 and 2, since naming latencies were also available for these items, it was important to determine whether the pattern of results would replicate across the two types of controls.

The mean cognate and phonetic control RTs by condition are shown in Table 5.2.

Table 5.2.

Classroom Learners Cognate RTs x Phonetically Matched Control Item RTs

	+P	-P	Effect of Cognate Status
Cognates	659	658	658
Noncognate controls	696	699	698
Effect of phonological similarity	677	679	

Like the results for the analyses using the onset and frequency-matched controls, there was a main effect of cognate status by participants [F_1 (1, 23) = 21.37; $p < .05$], but only marginally significant by items [F_2 (1, 96) = 3.43; $p = .067$]. The effect, however, is no longer significant with the frequency covariate included [F_2 (1, 95) = 2.13; $p > .05$]. There was no significant main effect of phonological status found by participants [F_1 (1, 23) < 1], by items [F_2 (1, 96) = 1.06; $p > .05$], or by items taking the frequency covariate into account [F_2 (1, 95) = 1.42; $p > .05$]. There was no significant interaction of cognate status and phonological status found by participants [F_1 (1, 23) < 1] by items [F_2 (1, 96) < 1] or by items with the frequency covariate included in the analysis [F_2 (1, 95) < 1].

The main effect of cognate status reveals that cognates were named significantly faster than the non-cognate control items, therefore showing that the L1 was a strong force in L2 processing of the critical cognate items. Again, the nonsignificant interaction of cognate status and phonological status shows that the cognate effect was not modulated by degree of phonological similarity.

Analysis of Accuracy

Cognates Compared to Frequency Matched Control Items

In Table 5.3, the mean accuracy is presented in percent correct.

Table 5.3.

Classroom Learners Cognate x Frequency Matched Control Items Accuracy Analysis

	+P	-P	Effect of Cognate Status
Cognates	94.2	81.0	87.5
Noncognate controls	86.2	81.0	83.6
Effect of phonological similarity	90.2	80.8	

The accuracy analysis by participants revealed that there was a significant main effect of cognate status by participants [F_1 (1, 23) = 19.36; $p < .05$] and by items [F_2 (1, 97) = 5.23; $p < .05$], showing that cognates were named significantly more accurately than noncognate control items. There was a significant difference in terms of accuracy for phonological status by participants [F_1 (1, 23) = 31.12; $p < .05$] as well as by items [F_2 (1, 97) = 10.23; $p < .05$], such that +P items were named more accurately than –P items. To further qualify the significant main effect of phonological status in terms of accuracy by participants, a significant interaction of cognate status and phonological status was found [F_1 (1, 23) = 19.36; $p < .05$], but not by items [F_2 (1, 97) = 1.79; $p > .05$]. Post-hoc paired samples t-tests were used to clarify the direction of the interaction. The results of the post-hoc analyses revealed that there was a significant effect of cognate status in terms of accuracy for the +P condition (t (23) = -62.051; p = .000, tested at $p < .025$ with Bonferroni correction for multiple comparisons. On the other hand, there was not a significant effect of cognate status in terms of accuracy for the –P condition (t (23) = -.320; p = .752, tested at $p < .025$. These results concur with that typically found in the psycholinguistic literature on accuracy in cognate naming (e.g., Costa, Caramazza, & Sebastián-Gallés, 2000; Schwartz, 2003) in that +O+P cognates are named significantly more accurately with respect to matched controls whereas cognates with mismatched orthography and phonology (+O-P) are not.

Furthermore, the matched orthography and phonology in the +O+P condition could have boosted naming accuracy simply by participants' possibly using and/or developing a strategy that when they came across a cognate item, they simply relied on L1 resources to produce the word correctly, although the degree to which it was produced in terms of Spanish phonetic norms will be discussed further below in the present chapter.

Cognates Compared to the Phonetically Matched Control Items

The by-participants accuracy means are presented in Table 5.4.

Table 5.4.
Classroom learners cognate x phonetically-matched control items accuracy analysis

	+P	-P	Effect of Cognate Status
Cognates	94.2	80.7	87.5
Noncognate controls	86.2	81.0	83.6
Effect of phonological similarity	90.3	80.8	

Accuracy analysis by participants for cognates vs. phonetically-matched control items reveals a main effect of cognate status [F_1 (1, 23) = 19.36; $p < .05$], as well as a main effect by items [F_2 (1, 96) = 6.70; $p < .05$] which remains after including the frequency covariate [F_2 (1, 95) = 5.32; $p < .05$]. This result indicates that cognates were named significantly more accurately than noncognate control items. A main effect of phonological status was found by participants [F_1 (1, 23) = 31.12; $p < .05$] and by items [F_2 (1, 96) = 4.36; $p < .05$]. This significant main effect remained when including the frequency covariate [F_2 (1, 95) = 4.80; $p < .05$], showing that, by participants and by items alike, +P items were named significantly more accurately than –P items. There was also a significant interaction between cognate status and phonological status in terms of accuracy by participants [F_1 (1, 23) = 13.60; $p < .05$], but only marginally significant by items [F_2 (1, 96) = 3.02; $p = .085$]. Upon including the frequency covariate in the analysis, the interaction by items was no longer significant [F_2 (1, 95) = 2.27; $p > .05$].

Again, post-hoc paired samples t-tests were used to clarify the direction of the by participants interaction of cognate status and phonological status in terms of accuracy. The results of the post-hoc analyses revealed that there was a significant effect of cognate status in terms of accuracy for the +P condition (t (23) = -8.479; $p = .000$, tested at $p <$ .025 with Bonferroni correction for multiple comparisons. On the other hand, there was not a significant effect of cognate status in terms of accuracy for the –P condition (t (23) = .558; $p = .582$, tested at $p < .025$. These results and subsequent rationale behind the results are highly similar in nature to those described for the accuracy results for the significant interaction of cognate status and phonological status for cognate RT x frequency-matched controls outlined in the previous section in that 1) +O+P cognates are named significantly more accurately with respect to matched controls whereas cognates with mismatched orthography and phonology (+O-P) are not and 2) learners relied heavily on L1 resources upon processing cognate items, especially when orthography and phonology were matched, thus increasing accuracy by virtue of relying, although erroneously, on the stronger L1 representation.

Voice Onset Time (VOT)

A 2x2 repeated measures ANOVA was performed on the VOT data for this group comparing cognate status (cognates vs. phonetically matched non-cognates) and phonological status (+P vs. –P). These data are shown in Table 5.5.

Table 5.5.
Classroom Learners Cognate VOTs x Phonetic Control Items VOTs

	+P	-P	Effect of Cognate Status
Cognates	32.6	32.7	32.7
Noncognate controls	30.8	29.8	30.3
Effect of phonological similarity	31.7	31.3	

There was a main effect of cognate status by participants [$\underline{F}_1$ (1, 23) = 9.99; $\underline{p} < .05$], but not by items [$\underline{F}_2$ (1, 26) < 1], or with the frequency covariate included [$\underline{F}_2$ (1, 25) < 1]. In terms of phonological status, there was not a significant main effect by participants [$\underline{F}_1$ (1, 23) < 1], nor by items [$\underline{F}_2$ (1, 26) < 1] or with the frequency covariate included [$\underline{F}_2$ (1, 25) < 1]. In the by-participants analysis, there was not a significant interaction of cognate status and phonological status [$\underline{F}_1$ (1, 23) = 1.56; $\underline{p} > .05$], nor by items [$\underline{F}_2$ (1, 26) < 1] or when including the frequency covariate [F_2 (1, 25) < 1]. The absence of a by-participants significant interaction between cognate status and phonological status suggests that, most likely, due to the low proficiency of the learners, their sensitivity to cross-language phonological differences was not very acute, since the L2 phonological system is mostly, at this stage of acquisition, pulled from the preexisting L1 system.

However, it is interesting to note that in terms of means alone, cognates were named with longer VOTs than their corresponding matched controls in each respective phonological condition. Such a result provides some evidence that the elevated degree of cross-language similarity had consequences for these learners in terms of pre-utterance planning and speech execution, in that when form and sound similarity between the two languages is increased, the resulting articulatory properties of the L2 cognate item veer more so from Spanish phonetic norms than do the matched control items.

Analysis of Accuracy

Cognate VOTs Compared to Phonetically Matched Control Items

The accuracy analyses, for the VOT dimension outlined in the present section is performed by using the subset of the total number of critical items that was able to be measured for VOT. It is important to note that for the VOT dimension, as was done in the analyses reported in Chapter 3 and 4, any critical item pair (i.e., cognate and control item) in which there was an error in one of the items, both items were deemed as errors and the pair was eliminated from the analysis[12]. Due to the fact that this analysis is phonetically driven, it is imperative to not have an unmatched number of cognate items and control items due to the fact that the analyses rely exclusively on the cognate items being matched to the control item produced by the same speaker.

Since errors were coded by critical item pairs, the by-items accuracy analysis performed on the cognates compared to the phonetically matched controls was done via a one-way ANOVA comparing accuracy according to phonological status. Accuracy analysis according to phonological status is the factor of interest in this case in that it serves to illustrate whether errors were more prevalent in the +P or the –P condition. In other words, the critical question is whether phonological similarity or dissimilarity caused the greatest degree of difficulty for this group of learners. In Table 5.6, the mean accuracy is presented in percent correct according to phonological status.

Table 5.6.
Classroom Learners +P VOT x –P VOT Items Accuracy Analysis

	Percent Accuracy
+P items	86.3
-P items	88.5

The one-way ANOVA performed on the percent accuracy of items measured for VOT according to phonological status did not reveal a significant difference in performance accuracy [$\underline{F}_2$ (1, 28) < 1], illustrating that for the subset of items that were measured for VOT, accuracy was not influenced significantly by phonological status.

[12] The same procedure was followed for the analysis of articulatory duration, the analyses of which are discussed in the following section. Therefore, accuracy measures for the VOT dimension apply identically to articulatory duration accuracy.

Articulatory Duration

A 2x2 repeated measures ANOVA was performed on the articulatory duration data for this group comparing cognate status (cognates vs. phonetically matched noncognates) and phonological status (+P vs. –P). These data are shown in Table 5.7.

Table 5.7.

Classroom Learners Cognate Articulatory Duration x Phonetic Control Items

	+P	-P	Effect of Cognate Status
	580	590	585
Noncognate controls	609	588	598
Effect of phonological similarity	595	589	

There was a main effect of cognate status by participants [$\underline{F_1}$ (1, 23) = 21.05; $\underline{p}$ < .05], but not by items [$\underline{F_2}$ (1, 96) < 1] or with the frequency covariate included in the analysis [$\underline{F_2}$ (1, 95) < 1], which shows that cognates, overall, were named with a significantly shorter duration than their respectively matched controls. There was not a significant main effect of phonological status by participants [$\underline{F_1}$ (1, 23) = 1.36; $\underline{p}$ > .05], by items [$\underline{F_2}$ (1, 96) < 1] or by items including the frequency covariate [$\underline{F_2}$ (1, 95) < 1]. By participants, there was a significant interaction of cognate status and phonological status [$\underline{F_1}$ (1, 23) = 20.37; $\underline{p}$ < .05], but not by items [$\underline{F_2}$ (1, 96) < 1] or by items with the frequency covariate included [$\underline{F_2}$ (1, 95) < 1].

To clarify the direction of the significant by participants cognate status x phonological status interaction of articulatory duration, post-hoc paired samples t-tests were performed on the results of the interaction. The results of the post-hoc analyses revealed that there was a significant effect of cognate status in terms of articulatory duration for the +P condition ($\underline{t}$ (23) = -6.886; $\underline{p}$ = .000, tested at $\underline{p}$ < .025 with Bonferroni correction for multiple comparisons, but there was not a significant effect of cognate status in terms of articulatory duration for the –P condition ($\underline{t}$ (23) = .470; $\underline{p}$ = .643, tested at $\underline{p}$ < .025.

The results of the post hoc analyses performed on the articulatory duration data seem to indicate that +P cognates produced facilitation effects, in that the participants were able to quickly plan and execute the utterance significantly more rapidly with respect to matched controls due to the matched cross-language orthography and phonology, which would be consistent with discrete models of lexical processing and with data showing facilitation effects in words with matched lexical properties (Levelt, 1989; Levelt, Roelofs, & Meyer, 1999; Schwartz, 2003; Schwartz et al., 2000; Schwartz & Kroll, 2006). On the other hand, the mismatch of phonology, for these participants, caused them difficulty, such that the articulatory duration of the –P cognates was slower than those of their matched controls. Such a result is more consistent with models of speech production asserting that at levels of high cognitive load, as would be the case for a lower proficiency L2 learner producing a word in the L2 with mismatched lexical properties, utterance planning is not complete before the utterance actually begins, thus causing a "spill over" of at least part of the planning stage into the actual utterance, which would therefore account for longer word durations (Damian, 2003; Kawamoto, Kello, Jones, & Bame, 1998; Kello, & Plaut, 2003; Kello et al. , 2000).

Discussion

The overall results obtained for the classroom learners are quite interesting ones, in that the only experimental “manipulation” of benefit to processing for these participants is the cognate alone, regardless of phonological status. In other words, in most of the analyses performed here, it seems that degree of phonological similarity does not modulate processing, both at pre-utterance and speech production stages. As lower proficiency learners, it seems that the phonological system of Spanish is only in its incipient stages of development, given that manipulations of phonological properties of the critical items in the experiment seemed to be of little consequence to the overall results.

On the other hand, degree of phonological similarity did come into play in the analysis of articulatory duration, especially for the –P condition. +P cognates seemed to help the participants quite a bit in terms of utterance planning and execution, whereas the –P condition seemed to provide evidence of “spill over effects”, meaning, that preplanning is not complete before an utterance begins under certain conditions.

In Chapter 6, the chapter to follow, we will examine the 3 groups discussed above and will compare the results among them to cast a broader spectrum upon the cognitive processes that are taking place at different stages of L2 language learning and proficiency.

Chapter 6

Comparing Different L2 Speaker Groups

In the previous chapters we considered the performance of each of three groups of native English speakers of Spanish as the L2. We now compare these groups directly to consider how the observed differences among the groups inform models of bilingual language development and language production. The results for the advanced speakers confirmed initial predictions, but the relatively small sample of participants in that group reduced the available statistical power. In the present chapter we focus on the comparison between the two groups of learners. In this case, there are more data available to enable the comparison and we believe that the most critical changes in development may be occurring at this level and in these two contexts, in the classroom and in the immersion environment. We use the data from the advanced speakers as a benchmark for proficiency to localize the development of the two intermediate groups. What the detailed comparison across groups reveals is that immersion has two distinct consequences on L2 production, one with respect to acquisition of the L2 phonology and ability to speak L2 words, and another with respect to the influence of the L1.

Group Characteristics

In Chapter 2, the characteristics of the three groups of participants, with respect to their level of language study, self-assessed proficiency in both L1 and L2, and performance on an independent measure of lexical decision were compared in Table 2.1. In Figure 6.1 we summarize the self-rated proficiency measures for all groups.

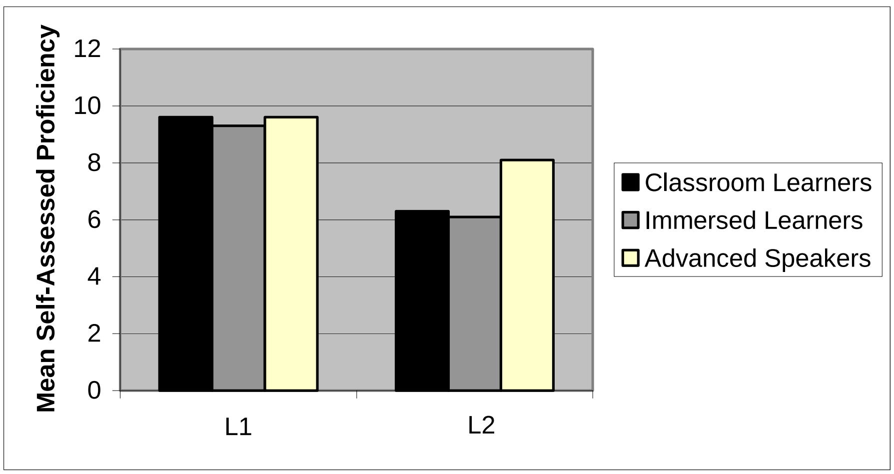

Figure 6.1. Mean self-rated proficiency in L1 and L2 on a scale from 1 (not proficient) to 10 (highly proficient) for classroom learners, immersed learners, and advanced speakers.

What can be seen is that the three groups, all native speakers of English, rated English as the L1 with equivalent and high proficiency. For L2, the advanced speakers rated themselves as more proficient in Spanish as the L2 than either of the two learner groups. Most critically, the two learner groups assigned similar ratings to Spanish as the L2, indicating an intermediate level of Spanish proficiency. On the independent processing measure of lexical proficiency in the L2 using a lexical decision task, the index of proficiency that appears to be most sensitive to L2 performance is nonword accuracy since for learners of the L2, a nonword could easily be a possible word in Spanish, since all the nonwords presented in the task adhered to Spanish phonotactic contstraints. Here, the data again suggest that the two learner groups are comparable, with nonword accuracy values of 65.9% and 68.8%, respectively, for the classroom and immersed learners. The advanced speakers were accurate on 82.6% of the nonword trials, again demonstrating higher proficiency than either of the learner groups.

Naming Latencies

The most striking result observed in the naming latency data was that the immersed learners were faster to name words in Spanish than either the classroom learners or advanced speakers. For the purpose of the overall group comparison, we focus only on the effect of cognate status, collapsed across the phonological conditions; the effect of which appeared to be more subtle in the analyses in the previous chapters. In addition, although the figures to be presented illustrate the results for all three groups, the statistical and written analyses to be reported will focus only upon the two learner groups, where the critical results are observed.

The three groups revealed a similar effect of cognate facilitation in Spanish word naming. The absolute RTs for the advanced speakers may have been relatively long because the participants in that group were significantly older than the two learner groups. The results for mean RT of cognate naming versus noncognate controls appear in Figure 6.2.

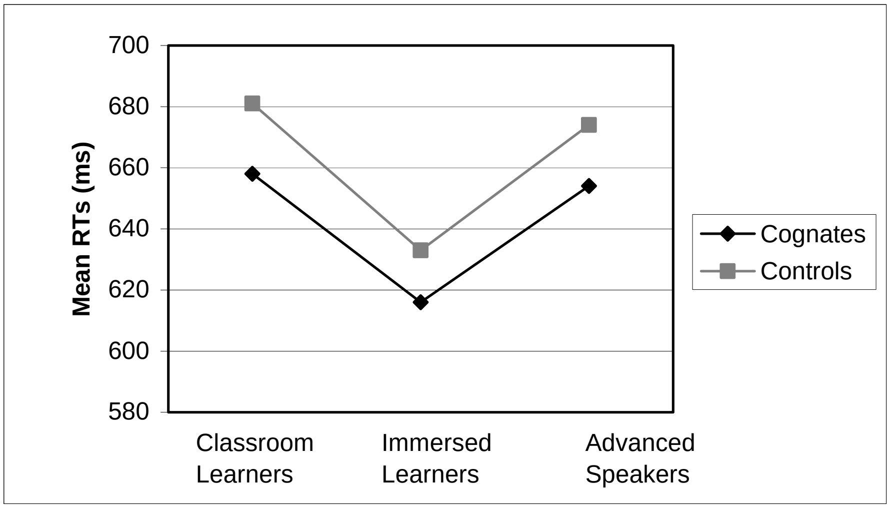

Figure 6.2. Mean naming latencies for learners, immersed learners and advanced speakers to name cognate and noncognate RT controls in Spanish.

The faster RTs for the immersed learners relative to the classroom learners is particularly striking given that the proficiency measures indicated that these two groups were otherwise similar with respect to their lexical knowledge. Thus, there is a trend in the data pointing toward an effect of immersion on the speed of L2 production. However, we can only say that there is tendency for faster naming latencies for the immersed learners since the difference in overall naming latencies between the learner groups is not significant [F_1 (1, 72) = 2.77; $p > .05$]. The observed latency advantage for the immersed learners, although not significant, could be an indication of increased proficiency in verbal fluency in the L2. In addition, it may be a consequence of the greater inhibition of the L1 in the immersion context. The presence of cognate facilitation in word naming overall, doesn't suggest that L1 is suppressed in the immersion context. If it were, then the magnitude of the facilitation observed in naming latency for cognates relative to controls should also be reduced. Furthermore, there is a significant main effect of cognate status across both groups [F_1 (1, 72) = 30.9; $p < .05$].

A related study on the effects of immersion does provide some preliminary evidence that suggests that L1 activity may be reduced in the immersion context. Linck and Kroll (2005) examined performance on a translation recognition task using the paradigm developed by Talamas, Kroll, and Dufour (1999) and Sunderman and Kroll (2006). In this task, learners were asked to decide whether the second of two words was the correct translation of the first. In the critical conditions of the study, the words were not translation equivalents but related to one another in lexical form or meaning. For example, the pair “mano-man” in Spanish and English requires a “no” response in translation recognition but the similarity of lexical form was expected to generate interference in rejecting the pair. Likewise, “hambre-man” was expected to generate interference based on lexical form similarity to the translation equivalent “hombre” in Spanish. The previous studies found that learners at low levels of proficiency were particularly sensitive to these lexical form relations whereas more proficient learners were sensitive to direct lexical form distracters such as “mano-man” but not those mediated through the translation equivalent. Linck and Kroll (2005) found that classroom learners produced each of these lexical interference effects in translation recognition. However, learners who were immersed in an L2 environment in Spain, produced none of these effects, suggesting that the activity of the L1 and its influence on L2 was reduced. The present results, from the perspective of naming latencies, do not appear to show a similar suppression of the L1. One possible reason for this is that translation recognition does not require production and the subsequent selection of a single lexical item whereas the word-naming task used in the present study includes that requirement.

To examine this issue in more detail, we now compare the groups with respect to the execution of the articulatory plan. If the processing demands associated with speaking necessarily engage the L1 even in the immersion environment, then we might expect to see a similar pattern in VOTs and articulatory duration to the naming latencies, with the presence of cognate effects throughout. A critical issue is to determine whether the immersed learners have acquired new knowledge about the L2 phonology, which should produce some overall effect on VOTs and duration, or whether these effects are modulated by the L1 activity as indexed by the presence of a cognate effect. We look at VOTs and duration in turn.

VOTs

For the VOT measure, unlike the naming latency results, we find a change in the production of cognates vs. noncognate phonetically matched controls between the classroom and the immersed learners. Again, although the independent proficiency measures indicated that these two groups did not differ, unlike the naming latency data, there is now a clear difference in the patterns for each of these groups. Figure 6.3 shows the results for all three experimental groups on the VOT dimension of production.

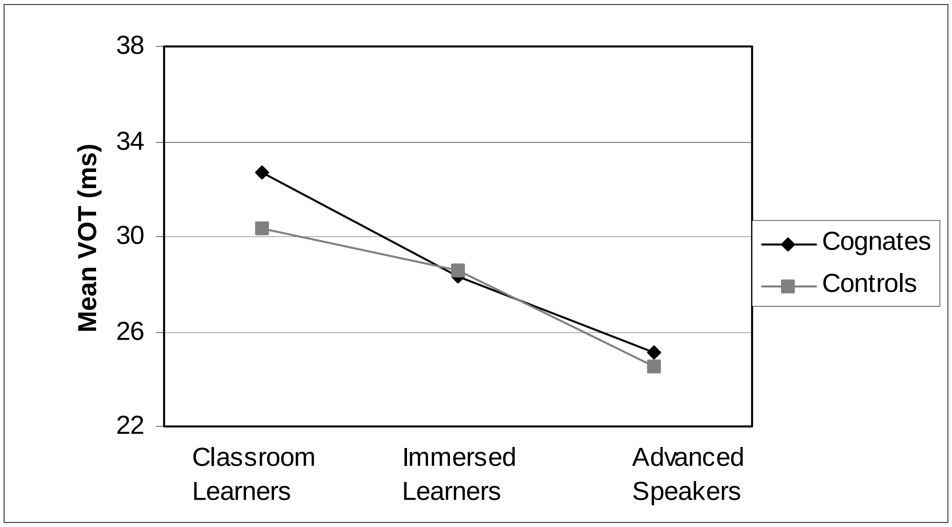

Figure 6.3. Mean VOT measures for classroom learners, immersed learners and advanced speakers to name cognate and noncognate phonetic controls in Spanish.

A 2x2 ANOVA revealed a nonsignificant main effect of group [F_1 (1, 72) = 2.11; p > .05], showing there is not a significant difference between the two learner groups, although there is a trend of a difference in the overall performance of the groups. There was a marginally significant main effect of cognate status [F_1 (1, 72) = 3.20; p = .077], showing that cognates were named with more English-like VOTs than matched controls. There was a significant interaction between group and cognate status [F_1 (1, 72) = 18.04; p >.001], showing the classroom learners produced cognates with significantly more English-like VOTs than the immersed learners.

The data in Figure 6.2 show that, as might be expected, speakers who were more proficient in Spanish had shorter VOTs than speakers who were less proficient in Spanish. For the classroom learners, there was a distinct cognate effect in that the VOTs for voiceless occlusive stops of cognates were longer for the cognates than the phonetically matched noncognate controls, indicating a strong influence of the L1 phonological system in production. VOT of occlusive consonants in syllable onset position of a tonic syllable are much longer in English than in Spanish. What these data show is that the classroom learners are less able to access Spanish phonology to speak the cognates than the noncognate controls. Critically, this suggests that there are two separable components in production, one reflecting acquisition of the L2 phonology and the other reflecting the continued influence of the L1.

The striking aspect of the data for the immersed learners is that although these participants' overall VOTs are more English-like than those of the advanced learners, we observe that the cognate effect has disappeared. In other words, the cross-language similarity of cognates seems to no longer affect articulatory processes for these learners. They have begun to process the L2 in a much more autonomous fashion. But, as mentioned in the section on naming latencies, it is possible that the absence of a cognate effect is either the result of increased proficiency in the immersion environment, increased L1 suppression and/or inhibitory control. In a domestic immersion program such as the one at Middlebury in which these learners were enrolled, they were required to speak Spanish only.

Articulatory Duration

Turning to the word duration results, we see that they resemble those obtained for VOT, providing again more evidence that there is seemingly a point along the interlanguage continuum at which word similarity or cognate status no longer modulates production (see Figure 6.4).

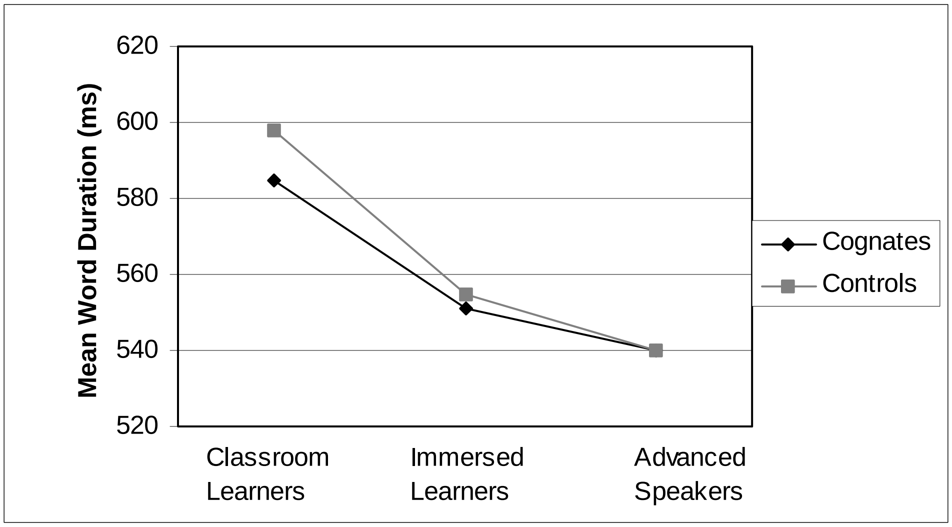

Figure 6.4 Articulatory duration of cognates vs noncognates

There was a significant main effect of group for word duration [F_1 (1, 72) = 6.6; $p < .05$], showing that word duration performance was significantly different between the two learner groups. There was a highly significant main effect of cognate status [F_1 (1, 72) = 16.6; $p < .001$] showing that cognates were named with shorter durations than matched controls overall. To further qualify these main effects, there was a significant interaction between group and cognate status [F_1 (1, 72) = 5.26; $p > .05$], showing that classroom learners, as the least proficient group in the present study, showed a clear effect of cognate status in word duration, such that cognates were spoken with shorter durations than matched controls, whereas this effect goes away in the data for the immersed learners. The performance of the classroom learners could be due, again, simply to the fact that the classroom processes the cognate as an L1 lexical item, causing them to produce the word more quickly. As reflected in the VOT data, production speed comes at a cost to L2 phonetic accuracy.

Recent work in the monolingual domain examining articulatory duration of spoken words has revealed that when the cognitive system is placed under more stressful conditions than normal such that there is an increased cognitive load, pre-utterance speech planning may not be complete by the time articulation of the utterance begins (Damian, 2003; Kello, Plaut, & MacWhinney, 2000). Under cognitive stress, there is effectively "spill over" of the factors that affect the planning of the utterance into the execution of speech itself.

In a recent paper measuring VOT of word-initial consonants and proceeding vowel formant properties in tongue twisters, Goldrick and Blumstein (2006) found evidence that the VOTs of the target onset sound of a word similar or voiceless version of the sound acting as the onset of the preceding word contained erroneous traces of the onset properties of the initial occlusive consonant of the preceding word, also evidence for "spill over" effects from the pre-planning of an utterance into speech execution. For instance, in a tongue twister utterance of "keff geff geff keff" in Goldrick and Blumstein's experiment, speakers produced the third element (geff) of the phrase, with traces of the voiceless stop [k], most likely in anticipation of the following token, "keff". In other words, this word did not exhibit "pure" acoustic characteristics of a typical English voiced stop, [g]. Since tongue twisters, by definition, place increased cognitive demands on phonetic performance in the native language, we can view this evidence as simulating to some extent the situation for L2 learners. Processing L2 engages additional cognitive resources relative to L1 even for relatively proficient speakers (e.g., Hasegawa, Carpenter, & Just, 2003). In the case of L2 learners, the situation will be even more extreme. The data we have presented suggest that for learners without immersion experience, elements of pre-utterance planning have a much stronger tendency to extend into the spoken utterance. Consequently, there will be costs to the utterance either in terms of utterance duration and/or phonetic quality of the output with respect to the phonetic norms of the language of production. For native speakers of a language or for highly proficient L2 speakers, the extension of these effects into the execution of speech will only occur when the system itself is stressed.

The results presented here suggest that the inability of the classroom learners to ignore the influence of the L1, manifest here by cognate effects in VOT and duration, came at a cost to the accuracy of the L2 phonetic realization. The results for the immersed learners, however, show that the cognate effect disappears for articulatory duration, similar to the VOT data for this group. Again, we are faced with the issue as to whether this pattern of performance can be accounted for by an increased level of L1 suppression in the immersion environment or by increased proficiency and automaticity in producing the L2 phonology. We explore different possible answers to this question and others in Chapter 7.

Chapter 7

General Discussion

The three experiments reported in this thesis examined the relationship between the variables that reflect L1 activity during L2 speech production. The logic of the study was to exploit the presence of cognates, words that are similar semantically, orthographically and/or phonologically across two languages, to determine the degree to which the L1 was active when words were spoken in the L2. The heightened degree of cross-language activation that cognates produce in word naming (e.g., Kroll et al., 2002) allows us to more clearly observe not only the effects of L1 in L2 processing, but also whether and to what degree these effects play out in speech execution, a relationship that, to our knowledge, has historically been sparsely examined in the psycholinguistic literature.

With respect to the naming latency data, we observed that for all groups, clear cognate effects were observed, with faster latencies to initiate production for cognates relative to noncognate controls regardless of L2 proficiency. The cognate effect in naming latencies indicates that at the pre-utterance stage, the L1 is very much active in L2 processing. A second factor that was manipulated in these experiments was the degree to which cognate translations were similar phonologically. Effects of phonological similarity or dissimilarity were much more subtle than the effects of cognate status.

Phonological similarity did not play a large role in processing for the classroom learners in that the degree of similarity did not affect overall naming latencies.

For the immersed learners, degree of phonological similarity did affect naming latencies in that the facilitation effects were greater in the +P condition than in the –P condition, although facilitation effects were observed overall. In this case, we could surmise that the convergence of the three dimensions of similarity identified for cognates, semantics, orthography and phonology, acted to speed naming. What is most interesting is that this added degree of facilitation in the +P condition strengthens arguments for L1 activation being relatively highly active in L2 processing, although, as we will see below in our discussion, the effects do not necessarily persist into speech production.

For the advanced speakers, there was greater facilitation observed in the –P condition than the +P condition. A possible explanation for this result is that, by definition, the advanced speakers possess a greater degree of L2 automaticity and in such a case, matched phonology could act very much as an inhibitory factor rather than one that causes facilitation, which is what is observed here. Since the –P cognates were named faster than the +P cognates, we might speculate that for these speakers, phonological distinctiveness is most helpful in processing, since the higher level of automaticity between the speakers' two languages, as a result of the higher proficiency, causes the L2 system to operate at a more independent and autonomous degree; therefore, if L1 forms come into play in a highly developed and much more autonomous system, it stands to reason that similar phonology would produce inhibitory effects in naming latencies for these speakers.

A goal of the research reported here was to determine whether evidence of L1 activity during L2 production would persist into the execution of the speech plan. Interestingly, although we know from the RT data that L1 was active in the utterance pre-planning stage for all groups, only the classroom learners produced significant cognate effects in the production of Spanish VOTs for cognate items relative to phonetically matched controls. In fact, what is most striking in the results is that in spite of the L1 being evidently active in the preplanning stage of the utterance, the immersed learners no longer showed effects of cognate status in the VOT data. Although, overall, the VOT values for the immersed learners were more English-like than those produced by the advanced speakers, which is to be expected, it seems that the effects and/or influences of L1 phonology at the stage of articulation, generally speaking, are not at play.

At the same time, when we examine the difference between the VOTs of the classroom learners and the immersed learners, although statistically significant, it could feasibly argued that this effect is relatively small in that the magnitude of the difference is only about 3 ms. In other words, it is not a difference that will necessarily be acoustically perceptible. Yet, in a study carried out by Sancier and Fowler (1997) on a Brazilian Portuguese-English bilingual who consistently spent approximately six month intervals of time in both the U.S. and Brazil every year, acoustic analysis of her voiceless stops in both English and Portuguese were perceptibly accented, as judged by native speakers of English and Brazilian Portuguese, respectively, upon her arrival and return to each country. In spite of the fact that the acoustic differences in VOT were no more than 6 ms, the effects were, in fact, perceptible by the speakers who judged the pronunciation quality of the subject's speech. Therefore, there is evidence that even at very low degrees of acoustic variability, these differences can still be perceptible to interlocutors.

On the other hand, one could still argue that such a small margin of VOT variability, a margin of 3 ms, is not perceptible in speech. Although such a notion may be true, it does not mean, however, that the effect is not significant and not very real in terms of identifying differential effects of a bilingual's two languages in utterance planning and production. For instance, in the extensive work conducted by Flege providing support for the *merger hypothesis* (1987), stating that late L2 learners who have acquired an advanced level of proficiency in the L2 actually experience influence and effects from the L2 on their L1 speech (e.g., for an advanced late learner of Spanish whose native language is English, his/her VOTs in English will be more Spanish-like, or shorter in length, as compared to those produced by a monolingual speaker of English). These effects identified in Flege's work indicate a very clear result and real process in the development and shaping of a bilingual's phonological system; however, it does not claim that these effects are necessarily perceptible. In other words, it is not likely that an advanced late learner of Spanish as an L2 would be perceived as having accented speech in his/her L1, English.

Therefore, returning to the results of the present investigation, based on the empirical evidence we have just reviewed, although the effects of cognate status observed in VOTs between the classroom and immersed learners was small, it was statistically significant, suggesting a change in the cognitive processes taking place in the development of the L2 language system in these two groups of learners.

Recall, however, that the results of the independent proficiency measures taken from all participants in this study (i.e., lexical decision, language history questionnaire), suggested that the performance of the classroom and immersed learners, was quite similar in the L2. Therefore, according to the results, there is a very clear effect and benefit to studying/acquiring an L2 in an immersion environment. In other words, there is a strong indication that the immersion environment inhibits the L1 in a manner that allows for more accurate speech articulation of the target language. At the same time, with respect to the particular groups examined in the present study, it is important to note that the classroom learners and the immersed learners were fundamentally different kinds of language students. It is most likely that the immersed learners possessed a greater level of motivation for acquiring Spanish with respect to the classroom learners. Although we cannot definitively make any specific claims in this regard, it is essential to consider that this factor could have played a role in the results obtained here.

On the other hand, given the specific nature of the pattern of results for the immersed learners, it is unlikely that motivation alone can account for the observed results. For instance, the immersed group was no better than the classroom group with respect to their accuracy on the lexical decision task used to assess proficiency in the L2. The specific advantages of immersion appeared in the degree to which performance was influenced by the L1.

Further evidence to support the notion of L1 suppression is seen in the results for articulatory duration. Again, the classroom learners showed a significant effect of cognate status in that cognates are named with shorter word durations with respect to phonetically matched controls. On the other hand, this effect disappeared for the immersed learners, again indicating that the immersion environment allows for better articulatory control and automaticity of the target language in spite of the fact that L1 is highly active in the pre-utterance planning stage.

The differential results for the two learner groups shed light on the effects of an immersion environment in terms of the manner in which the L1 influence is manifest in speech execution. Although these results point toward one's participating in an immersion environment as highly beneficial for L2 acquisition, namely, for the speed and quality of target language pronunciation, the results give way to even more questions warranting empirical investigation, which would allow us to have a greater understanding of the effects of an L2 immersion environment.

Since the immersed learners who participated in this study were involved in a very unique immersion environment, in that the use of L1 was strictly prohibited, it would be highly beneficial to test immersed learners who study in a Spanish speaking country, an environment where the primary goal is that the target language be used as much as possible and that there is a very rich environment for L2 input, these learners *are* permitted to use the L1 as needed (e.g., talking with parents/relatives/friends on the phone, socializing with other English-speaking students in the program, providing tutoring services in English, etc.) in order to compare the results with the performance of individuals studying in the strictly L2 environment. It would allow us to explore the notion as to whether there is a greater benefit to L2 acquisition by participating in one immersion environment as opposed to the other.

Yet, a very important question to further explore would be, are these increases in L2 proficiency and performance in the L2 lasting effects of authentic L2 acquisition or are they ephemeral in nature? To answer this question, it would be necessary to take a longitudinal approach to the investigation such that participants are tested during the immersion experience and at several intervals following the program, assuming that the participants return to the United States and remain throughout the time course during which repeated testing would take place. The results of a recent study carried out by Linck and Kroll (2005) indicated that there is retention of acquired L2 performance six months after returning to the United States following a semester-long study abroad program; however, unlike the present study, effects of L1 activation on L2 production accuracy were not the focus of the experiment. Therefore, further investigation is required to determine if these gains in articulatory performance in the L2 carry on after the end of one's participation in an immersion program.

The results have a number of important implications for current models of bilingual lexical processing. Most models of speech production assume that the execution of speech begins once utterance planning is complete from both a serial account (e.g., Levelt, 1989) and a cascading account of bilingual lexical access (Costa et al., 2000; Dijkstra, et. al., 1999; Kroll & Stewart, 1994). However, a study by Kello et al. (2000) suggested that the cognitive processes that support utterance planning may extend into production when planning is resource limited, a result obtained as a general trend in the results of the three studies presented and discussed here. For L1 speech, that situation may rarely arise, but for L2, it may be commonplace, especially for lower proficiency learners.

The findings reported here also shed light on the variable characteristics of speech planning and execution both within and outside of a language immersion environment as well as show that for L2 processing, finishing lexical processing before the utterance onset is the exception, not the rule since an underdeveloped L2 system ultimately functions as the increased cognitive load as suggested in the research reported for L1 under stressed production by Kello et al. (2000). At the same time, the results suggest that underdeveloped L2 phonology is not persistently problematic, as learners seem to be able to resolve competition from L1 at even intermediate proficiency levels such that heightened levels of L1 activation are not phonetically detrimental, rather that the learner can mediate the two languages within the parameters of the developing L2 phonological system.

In conclusion, the present work suggests that speech planning in L2 is affected both by L1 and by the level of L2 proficiency. A clear implication of the present results is that L2 speakers often begin to speak before they have fully planned what they are going to say. The extension of planning factors into the execution of speech for L2 speakers makes the L2 speaker a model for studies of speech production. Ironically, the lower level of proficiency in producing the L2 reveals a planning system that is highly permeable to other language influences and, as such, provides a window into the architecture of the planning system that is often obscured in highly automatic production in the L1. The present study investigated one set of factors that influence L2 speech planning. Identifying the range of factors that constrain this process will be an important priority in the next phase of research.

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Appendix A

Stimuli

+P Condition Materials

Cognate	Word frequency	Onset/Frequency matched control	Word frequency	Phonetic control	Word frequency
ACTOR	218	árbol	196	pactar	24
				lector	260
BANDA	200	barba	120	ganga	10
FINAL	1374	libro	93	pinar	9
				panal	2
FORMAL	102	sabio	203	forjar	13
				panal	2
INSECTO	31	hidalgo	168	hincado	4
				asesta	3
LOCAL	283	lecho	91	losar	0
				troncal	2
				retal	0
METAL	103	mancha	203	meter	130
				puntal	7
				quintal	0
				retal	0
PERFECTO	239	pensado	381	percance	20
				mofeta	2
				asesta	3
PIANO	188	pájaro	208	piante	0
				mano	2168
POETA	350	pecho	645	pocero	1
				pomelo	1
				maceta	8
				anoeta	4
ROMÁNTICO	56	recogido	93	rompiéramos	199
				flamante	29
				semana	828
TRACTOR		truchas	18	tratar	266
				lector	260
				cantor	11
CALMA	172	ciego	173	calvo	46
				cama	764
CEREAL	8	cinturón	1	cereza	5
				boreal	1
CORRECTO	91	comprado		correo	53
				derecho	728
DIRECTOR	746	pregunta	458	dirimir	9

				florecer	13
ECO	136	alba	23	equis	23
				peco	3
ERROR	317	hogar	1088	herir	29
				dolor	556
HOSPITAL	256	orgullo	23	hospedar	1
				incidir	17
INSPECTOR	149	infierno	115	sospechar	78
				lector	260
				redentor	14
MORTAL	114	mármol	116	morder	20
				retal	0
PROFESOR	437	escritor	63	probador	4
				redentor	14
REFORMA	203	regalo	164	refajo	1
				alforjas	11
SUPERIOR	490	solamente	80	supieron	59
				esperar	528
TERROR	197	hombro	162	tercer	267
				lector	260
TRIPLE	77	torpe	80	tripa	31
PANDA	22			tanda	10

-P Condition Materials

Cognate	Word frequency	Onset/Frequency matched control	Word frequency	Phonetic control	Word frequency
AUDIBLE	13	abertura	21	autillo	0
				ausente	99
BENIGNO	13	vencida	23	bendito	41
				benicia	13
CANOA	11	canción	175	canosa	2
DEBATE	214	deporte	267	debajo	134
DIAGRAMA	8	desafío	97	diapasón	8
FALSO	121	fallo	88	falda	123
				falta	1218
GRADUAL	21	grabada	20	grabar	33
				mensual	21
HORRIBLE	101	borracho	89	horario	74
				arriba	572
MOTOR	186	misa	141	motín	8
				castor	1
NOTABLE	171	mentira	216	novicia	8
				potable	15
RADIO	466	ropa	405	rato	406
				rabo	53
SEVERO	54	semenal	43	sebosa	2
				cavero	1
ACRE	9	jarro	13	sacra	12
				lacre	4
				sucre	10
AIRE	1174	hijo	1257	faire	4
BASE	504	brazo	402	basa	84
CABLE	78	cabra	63	cabe	421
DIETA	144	tienda	166	diese	23
				diente	39
ESCAPE	48	empuje	41	escama	2
GENUINO	12	gemelo	23	genoma	14
IMAGEN	918	mirada	947	imanes	5
OXÍGENO	159	olvido	174	exijo	4
				indígena	20
PALMA	77	perra	60	pala	27
TIGRE	24	talón	21	tipo	1646
				mugre	13
VACANTE	13	vaciado	23	vaquero	23
				picante	26
VISIBLE	122	vecina	142	visillo	6
				risible	5

Appendix B

Language History Questionnaire

Sex: M/F Age (in years)_______ Native country______

Years spent in the U.S. ________ Years Spent in U.S. schools________

This questionnaire is designed to give us a better understanding of your experience learning a second language. We ask that you be as accurate and thorough as possible when answering the following questions and thank you for your participation in this study.

If at any time, you need more space to write, please feel free to use an extra sheet of paper. Please put the questions number beside your response.

1.) Do you have any known visual or hearing problems (corrected or uncorrected)?

____

____

2.) What is your first language (i.e., **language first spoken**)? If more than one, please briefly describe the situations in which each language was used.

____

____

3.) Which language do you consider your second language (please circle: English or Spanish)?

4.) If you have ever lived in or visited a country where languages other than your native language are spoken, please indicate below the name of the country (countries), the duration of your stay in number of months, and which languages you used while you were in the country (please indicate if you were spoken to in a language other than your first language, even if you never actually spoke that language).

Country visited	# Months there	Language(s) used

5.) List below, from most fluent to least fluent, all of the languages you know. Also, specify the age in years at which you began to learn the language and the context in which you learned it. For example, "English, birth, home". Include all languages to which you have been exposed, although you may never have had any formal training in them and may not be able to read, speak or write them.

Please remember to list your native language

Language	*Age in years*	*Learning Situation*

6.) What languages were spoken in your home while you were a child and by whom?

____

____

____

7.) How many years have you studied your second language? Please indicate the setting(s) in which you have had experience with the language (i.e., classroom, with friends, foreign country…)

Number of years____

Setting(s):____

____

____

____

8.) What Spanish courses have you taken in the past or are currently taking?

____

____

____

____

____

For the next eight questions, please circle the number of your response.

9.) Please rate your **English** reading proficiency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

10.) Please rate your **Spanish** reading proficiency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

11.) Please rate your **English** writing proficiency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

12.) Please rate your **Spanish** writing proficiency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

13.) Please rate your **English** conversational fluency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

14.) Please rate your **Spanish** conversational fluency proficiency on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

15.) Please rate your **English** speech comprehension ability on a ten-point scale.
(1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

16.) Please rate your **Spanish** speech comprehension ability on a ten-point scale. (1=not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

17.) Have you ever been immersed in your second language culture?
(please circle one) yes no

18.) Is there anything else about your language background that you would like to comment on? Please feel free to make comments about things that were not covered on this questionnaire.

____

____

____

THANK YOU FOR YOUR PARTICIPATION!

Appendix C

Final Set of Stimuli Used for VOT and Word Duration Analyses

The following set of stimuli was extracted from the original set of stimuli presented to all participants for all experiments, and represent the stimuli used in the final analyses of RT, VOT and word duration. For the cases in which there was only one control item in the original list of materials, that control, of course, was utilized. In the following tables, for the +P and –P conditions, respectively, I provide each cognate item that was chosen as well as the original set of phonetic controls designed for the corresponding cognate. The control item that was chosen as the "best" phonetic control is denoted in italics followed by a detailed explanation as to why the item was chosen as the control item to be used in the analyses of word duration. As mentioned in the main text of Chapter 2, the main criterion used for selecting the best matched control was to choose the non-cognate item that matched the stressed syllable in the cognate item as closely as possible in form, a factor that motivated the selection of the original phonetic controls. The rationale behind employing this criterion is that most of the acoustic energy in the word lies in the stressed syllable and we can therefore deduce that the stressed syllable will be the critical point at which a great deal of the word duration is accounted for.

+P Condition Materials

Cognate	Phonetic control	Explanation for choosing the control
ACTOR	pactar *lector*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
BANDA	*ganga*	Only control available
FINAL	pinar *panal*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for. Furthermore, *panal* ends in a lateral liquid, as does the critical item, *final*. Therefore, *panal* was chosen over *pinar*.
FORMAL	forjar *panal*	The stressed syllable is matched closely in form in that they both contain a nasal as the onset element, [a] as the syllable nucleus and both end with the lateral liquid [l]. In addition, the stressed syllable is matched in form, where most of the acoustic energy and therefore duration is accounted for.
INSECTO	hincado *asesta*	The stressed syllables are matched for onset and the nucleus, where a great deal of acoustic energy lies.
LOCAL	losar troncal *retal*	The stressed syllables are matched in that both have a second-syllable onset of a voiceless occlusive consonant and are matched in terms of the nucleus and the coda.
METAL	meter puntal quintal *retal*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
PERFECTO	percance mofeta *asesta*	The stressed syllable contains a roughly similar structure in that 1) the contain an identical nucleus ([e]) 2) both have a similar onset in word internal position in that both are voiceless fricative consonants and 3) both contain closed syllables in that there is a voiceless consonant in coda position.
PIANO	*piante* mano	The stressed syllable is closely matched in form, where most of the acoustic energy and therefore duration is accounted for.
POETA	pocero pomelo maceta *anoeta*	The word structure of the control item is nearly identical to the cognate in terms of form as well as stress patterning.
ROMÁNTICO	rompiéramos *flamante* semana	The stressed syllable and the syllable form are identical between the cognate and control item in that [m] is the onset, [e] is the nucleus, and the coda is [n].
TRACTOR	tratar *lector* cantor	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
CALMA	*calvo* cama	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
CEREAL	cereza *boreal*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
CORRECTO	*correo* derecho	The first and second syllables are identical in form and stress pattern in terms of onset and nucleus.
DIRECTOR	*dirimir*	The cognate and control are matched closely in terms of

	florecer	word length as well as in terms of onset and onset syllable structure.
ECO	*equis* peco	The stressed syllable is matched in form as well as followed by the same phoneme in the onset of the following syllable
ERROR	herir *dolor*	The nucleus and coda of the stressed syllable are matched in form and in length.
HOSPITAL	*hospedar* incidir	Both words are matched in terms of length as well as the structure and stress of the first syllable. The nucleus of the stressed syllable is identical and the onsets of the final syllable are identical in terms of point of articulation, although not in voicing.
INSPECTOR	sospechar *redentor*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
REFORMA	refajo *alforjas*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
SUPERIOR	*supieron* esperar	The length of both forms is identical; onset and first syllable structure are identical in terms of stress and form.
TERROR	tercer *lector*	The nucleus and coda of the stressed syllable are matched in form.
TRIPLE	*tripa*	Only control available
PANDA	*tanda*	Only control available

-P Condition Materials

Cognate	Phonetic control	Explanation for choosing the control
AUDIBLE	*autillo* ausente	The first syllable is identical in form and length; the second syllable, the stressed syllable, is matched in terms of the nucleus. The onset is identical in terms of form of articulation, but not in voicing.
BENIGNO	bendito *benicia*	The first syllable is identical in form and length; the second syllable, the stressed syllable, is matched in terms of the nucleus and onset.
CANOA	*canosa*	Only control available
DEBATE	*debajo*	Only control available
DIAGRAMA	*diapasón*	Only control available
FALSO	falda *falta*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for. Also, the onsets of the following syllables are voiceless consonants.
GRADUAL	grabar *mensual*	Both items are matched in terms of length and the nucleus and coda of the stressed syllable are identical in terms of form.
HORRIBLE	horario *arriba*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
MOTOR	motín *castor*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
NOTABLE	novicia *potable*	The cognate and control items are matched almost identically in terms of length, stress and form. Only the word onsets differ.
RADIO	rato *rabo*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for. Also, the onsets of the following syllables are voiced occlusive consonants.
SEVERO	sebosa *cavero*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for. Also, the last unstressed syllable is identical in form and length.
ACRE	*sacra* lacre sucre	The nuclei of the stressed syllables are identical as well as the codas.
AIRE	*faire*	Only control available
BASE	*basa*	Only control available
CABLE	*cabe*	Only control available
DIETA	*diese* diente	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
ESCAPE	*escama*	Only control available
GENUINO	*genoma*	Only control available
IMAGEN	*imanes*	Only control available
OXÍGENO	*exijo* indígena	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.

PALMA	*pala*	Only control available
TIGRE	*tipo* mugre	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for.
VACANTE	vaquero *picante*	The stressed syllable is matched in form and length, where most of the acoustic energy and therefore duration is accounted for. Also, the last unstressed syllable is identical in form and length.
VISIBLE	*visillo* risible	The first unstressed syllable is identical in length and form as well as the stressed syllable where most of the acoustic energy and therefore duration is accounted for.

VITA

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Education

2007 Ph.D. in Spanish Applied Linguistics, The Pennsylvania State University

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Research Support/Awards

2002 Graduate Certificate Program in Technology and Language Instruction sponsored by the National Institute for Technology and Liberal Education and the Andrew W. Mellon Foundation, Middlebury College, VT; $1000 stipend.

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Selected Presentations and Invited Colloquia

Dussias, P., Blattner, G., & Jacobs, A. (October, 2002). *Processing of local syntactic ambiguity by second language learners.* Paper presented at the Second Language Research Forum, Toronto, Canada.

Gerfen, C., Jacobs, A., & Kroll, J. F. (2005, September). *Inhibiting first language phonology in planning and producing speech in a second language.* Paper presented at the European Society for Cognitive Psychology, Leiden, The Netherlands.

Jacobs, A. L. (October, 2002). *Segmental production accuracy of cognate items in late bilinguals: Will the cognate facilitation effect turn to interference?* Paper presented at The Sixth Hispanic Linguistics Symposium together with The Fifth Conference on the Acquisition of Spanish and Portuguese as First and Second Languages. Iowa City, Iowa.

Jacobs, A. L., Kroll, J. F., & Gerfen, H. (May, 2003). *Do cognates facilitate the acquisition of L2 phonology? An examination of segmental production accuracy in adult learners of Spanish.* Paper presented at the 4th International Symposium on Bilingualism. Tempe, Arizona.

Jacobs, A. L., Kroll, J. F., & Gerfen, H. (May, 2005). *Planning and producing speech in L2: The activation of L1 affects production in L2.* Poster presented at the 5th International Symposium on Bilingualism. Barcelona, Spain.

Poteau, C. E., & Jacobs, A. L. (January, 2006). *Vocabulary attainment in distinct group-work settings in the foreign language classroom.* Paper presented at the 4th Annual Hawaii International Conference on Arts and Humanities. Honolulu, Hawaii.

Selected Awards/Honors

2003 Member of Phi Sigma Iota, The National Foreign Language Honors Society

2004 *Teaching Excellence Award* granted by the Department of Spanish, Italian and Portuguese at the Pennsylvania State University.