Abstract

Title of Dissertation: CROSS-LANGUAGE TRANSFER OF PHONOLOGICAL AND ORTHOGRAPHIC PROCESSING SKILLS IN SPANISH-SPEAKING CHILDREN LEARNING TO READ AND SPELL IN ENGLISH

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This dissertation included two studies designed to examine how young children acquire biliteracy skills. Specifically, I aimed to determine how reading and spelling acquisition in English second language (L2) is influenced by Spanish first language (L1). Study 1 investigated the contribution of Spanish phonological and orthographic processing skills to English reading and spelling in 89 Spanish-English bilingual children in grades 2 (n = 42) and 3 (n = 47). Comparable measures in English and Spanish tapping phonological and orthographic processing were administered to the bilingual children and to 53 monolingual English-speaking children in grades 2 (n = 32) and 3 (n = 21) as a comparison group. We found that cross language phonological and orthographic transfer occurs from Spanish to English for real word and pseudoword reading. However, Spanish orthographic processing only predicted reading, not spelling. Study 2 examined spelling errors committed on specific linguistic units – vowels that are spelled differently in the two languages (i.e., contrastive vowels) – to determine whether Spanish-speaking children spell these vowels using Spanish spelling rules. Participants for Study 2 were carefully recruited; these Spanish-speaking students had received about 2.2 years of literacy instruction in their native language, ensuring that they would have adequate orthographic knowledge to read and spell in Spanish. Error analyses indicated that the 27

native Spanish-speaking children who received prior literacy instruction in Spanish did indeed spell these contrastive vowels using Spanish orthography; therefore, these errors were influenced by their L1 orthographic knowledge. Taken together, these two studies highlight the importance of taking into consideration bilingual children's L1 phonological and orthographic knowledge in understanding L2 reading and spelling acquisition. The results of the two studies enhance the theoretical frameworks by providing empirical evidence to support the notion that bilingual children are indeed both positively and negatively affected by the differences in orthographic depths of the languages.

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by

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Dedication

I dedicate this dissertation to my family. Throughout this 6 year process, my husband, Ken, has wholeheartedly supported me. My two children, Grayson and Cami, both born during my years at the University of Maryland, have endured and been understanding of their very busy mom. Finally, I thank my mother, without whom none of this would have been possible.

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Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Introduction

Children develop phonological processing skills at a young age, which assists them in becoming successful readers later in school (Badian, 1998; Bryant, 1986). When children have successfully become emergent readers, they gain insight into the specific orthographic patterns of words, and they are further introduced to the task of spelling. Phonological processing, orthographic processing, word reading, and spelling skills are highly related in English (Ehri, 1993; McBride-Chang, 1998). Relations among phonological processing, orthographic processing, word reading and spelling skills have been found for monolingual Spanish speakers, as well (Denton, Hasbrouck, Weaver, & Riccio, 2000; Durgunoglu, Nagy, & Hancin-Bhatt, 1993). Before proceeding, it is important to define the following terms based on the context of my research: phonological processing, orthographic processing, word reading, and spelling. Phonological processing skill refers to the abilities to distinguish and manipulate sounds within spoken words (Castles & Coltheart, 2004; Goswami & Bryant, 1990). Orthographic processing skill refers to the general understanding of the conventions used in the written aspect of a language. It can be defined as the knowledge of conventional spellings and spelling rules (Varnhagen, Boechler, & Steffler, 1999). Spelling, in this case, refers to the ability to map graphemes, or letters, to phonemes, or sounds, in dictation of single real words and pseudowords. Word reading refers to single word identification, both with real words and pseudowords.

One of the central issues in research with bilingualism and biliteracy is how the language and literacy skills that children are acquiring simultaneously are related to each other. With the growing interest in this interaction between the two languages of bilingual children (e.g. Rickard Liow & Lau, 2006; Wang & Geva, 2003a, 2003b; Wang, Perfetti, & Liu, 2005; Wang, Park, & Lee, 2006), this dissertation aimed to examine how bilingual children's knowledge of Spanish can transfer to their English word reading and spelling. This dissertation is composed of two studies. The purpose of Study 1 was to investigate whether phonological and orthographic processing skills in Spanish (L1) contribute to word reading and spelling in English (L2), over and above the contribution made by phonological and orthographic processing skills in English. Study 2 investigated whether native Spanish-speaking children make more spelling errors with vowels in English than their English-speaking counterparts, and to determine if these errors are consistent with Spanish orthography.

Study 1 focused on the predictive power of Spanish phonological and orthographic processing skills in explaining English word reading and spelling performance. Previous research addressed cross-language transfer at the phonological level. These studies have successfully demonstrated a robust and universal cross-language phonological transfer phenomenon for various alphabetic systems, such as French-English (Comeau, Cormier, Grandmaison, & Lacroix, 1999), Hebrew-English (Geva & Siegel, 2000), Italian-English (D'Angiulli, Siegel, & Serra, 2001), and Spanish-English (Durgunoglu et al., 1993). However, limited research has been conducted about possible transfer at the orthographic level.

The theoretical framework for Study 1 comes from Cummins' (1979, 2000) Linguistic Interdependence Hypothesis. This hypothesis suggests that once the child develops reading skills in an L1, he or she is able to transfer those skills to an L2. High levels of L1 language competence allow a child to develop similar levels of competence in L2. According to the hypothesis, a child with strong phonological processing skills in the L1 is better able to develop strong phonological processing skills in L2 while maintaining high levels of competence in the L1. Does this phenomenon also apply to orthographic processing skills?

The research questions for Study 1 were: a) Do Spanish phonological processing skills contribute to English word reading and spelling, over and above English phonological and orthographic processing skills, in Spanish-speaking second and third graders who are learning to read and spell in English and b) Do Spanish orthographic processing skills contribute to English word reading and spelling, over and above English phonological and orthographic processing skills and Spanish phonological processing skills in the same group of bilingual children?

I hypothesized that Spanish phonological processing skill would contribute a significant amount of variance to English word reading and spelling, over and above the contribution made by English phonological and orthographic processing. This would be consistent with previous findings that Spanish phonological processing skills predict English word reading performance (e.g. Gottardo, 2002; Lindsey, Manis & Bailey, 2003; Manis, Lindsey & Bailey, 2004) and that these skills play important roles in both word reading and spelling (McBride-Chang, 1998; Morris & Perney, 1984). With respect to Spanish orthographic processing skill’s effect on English word reading and spelling, I hypothesized that there would be limited cross-language transfer. In other words, Spanish orthographic processing would not significantly predict performance in English word reading and spelling. Even though both English and Spanish have alphabetic, linear writing systems and share many phonemes, many orthographic patterns are specific to the individual languages (Durgunoglu, Mir, & Ariño-Martí, 2002). In contrast to phonological processing, orthographic patterns are not necessarily universal across languages. Also, due to English's deep orthography, it must be acknowledged that level of awareness of Spanish's transparent orthography may not be helpful in predicting how well a native Spanish-speaking child performs on English reading and spelling tasks.

While potential cross-language orthographic transfer is of both theoretical and practical value in bilingual and biliteracy research, a different level of analysis allows us to delve into a more specific level of transfer. Study 2 focused on how Spanish-speaking children spell vowel sounds that are represented by different graphemes in English and Spanish. To ensure that the participants would have adequate Spanish orthographic knowledge, students who had received previous literacy instruction in Spanish were selected from the larger sample used in Study 1. Few studies have examined various spelling errors committed by Spanish speakers in English words (Cronnell, 1985; Justicia, Defior, Pelegrina, & Martos, 1999), and even fewer have focused specifically on errors committed in vowel sounds (Fashola, Drum, Mayer & Kang, 1996; Rolla San Francisco, Mo, Carlo, August, & Snow, 2006).

Vowels are of particular interest and importance when studying the effect of cross-language transfer from Spanish to English. Of the ten vowel phonemes shared by English and Spanish (monophthongs /a/, /ɛ/, /ɪ/, /o/, /u/; diphthongs /aI/, /e/, /aʊ/, /ju/, /ɔɪ/), I focused on four that are spelled differently in the two languages: /e/, /i/, /u/, and /aI/. In English, the /e/ sound can be spelled as *ai* in *maid*, *ay* in *day*, and *a-e* in *gate*, *ey* in *grey, eigh* in *weigh*; the /i/ sound can be spelled as *ee* in *seed, ea* in *meat, ie* in *believe; e-e* in *impede;* the /u/ sound can be spelled as *oo* in *room, ue* in *due, u-e* in *rude; ough* in *through;* and the /aɪ/ sound can be spelled as *ie* in *pie, ye* in *bye, i-e* in *ride*. In Spanish, however, the phoneme /e/ can only be spelled *ei* or *ey;* the phoneme /i/ can only be spelled with an *i;* the phoneme /aɪ/ can be spelled *ai* or *ay;* and the phoneme /u/ can only be spelled with a *u.* This discrepancy between the two orthographies could easily cause difficulties for a Spanish-speaking child learning to read and spell in English.

The theoretical framework for Study 2 is the Orthographic Depth Hypothesis (Katz & Frost, 1992), which posits that languages have different levels of orthographic depth. Ziegler and Goswami (2005) linked this original hypothesis to the well-known dual route model of reading (e.g., Coltheart, 1978; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) by proposing that the orthography of a given language determines a speaker's reliance on either the lexical or non-lexical route to read. English, which has a deep and inconsistent orthography, has a characteristically indirect phoneme-grapheme correspondence. Spanish, however, has a shallow and consistent orthography with a more direct mapping between letters and sounds. Therefore, the phonology and orthography of Spanish are highly linked—the mapping between the two systems is transparent. This link between phonology and orthography is central to the Psycholinguistic Grain Size Hypothesis (Ziegler & Goswami, 2005). In a transparent orthography that favors smaller grain size units, such as Spanish, fewer grapheme-phoneme correspondences need to be learned in order to read and write successfully. In English, however, children are first exposed to phonology, which favors larger grain size units (e.g., syllables, rime) and then later to orthography, which favors smaller grain size units (e.g., letters). The inconsistent orthography of English causes learning to read and write in English to be a more challenging task than learning to read and write in Spanish.

Study 2 aimed to address the following question: Do Spanish-speaking children, who are learning to spell in English make more vowel spelling errors than native-English speaking children? If so, are the errors that are committed in spelling vowel sounds consistent with Spanish orthographic rules? I predicted that bilingual Spanish-English-speaking children would perform more poorly on spelling tasks, particularly on words that have vowel sounds spelled differently in the two languages than the native English-speaking children due to the shift from Spanish's shallow orthography to English's deeper orthography and vowel phonemes that are represented by different graphemes. Based on prior research indicating that L1 orthographic knowledge influences L2 spelling (Fashola et al., 1996; Rolla San Francisco et al., 2006), I hypothesized that the errors made when spelling vowels would be consistent with Spanish orthographic rules. In other words, when confronted with vowel sounds that are represented by different graphemes in the two languages, Spanish-speaking children would exhibit negative transfer by using Spanish orthographic rules to spell them.

Expected findings from these studies have very important implications, both theoretical and practical. From a theoretical perspective, if Spanish phonological and orthographic processing skills contribute a unique amount of variance to English reading and spelling beyond the English-related skills, it would suggest that Spanish speakers with strong phonological and orthographic skills in their L1 would transfer this knowledge to their L2. In accordance with the Linguistic Interdependence Hypothesis, our findings would support the argument for native language, or bilingual, instruction in school. Snow, Burns, and Griffin (1998) recommended transitional bilingual education programs that teach reading in the L1 while students acquire oral proficiency in the English. Fillmore (1991) found that Spanish-speaking children lose their Spanish language skills while acquiring English, if attending all-English preschools. Preschoolers who are given the opportunity to develop their L1 skills are then armed with the phonological processing skills needed in order to learn to read in an L2 (Snow et al., 1998). August and her colleagues also suggested that transitional bilingual programs are beneficial for the development of literacy skills in the L2 (August et al., 2006)

Practically speaking, findings from this study would benefit Spanish-speaking children in the classroom. In the United States, there is a large proportion of linguistically diverse students learning English. Many of these children have difficulty acquiring even the most basic English literacy skills (Fleischman & Hopstock, 1993). Seventy-five percent of students in English as a Second Language (ESL) programs are native Spanish speakers and over 60% of these students are in kindergarten through sixth grade (Samway & McKeon, 1999). By the year 2025, there will be an estimated 5 million Spanish-speaking children under the age of five (Goldstein & Washington, 2001). The Spanish-speaking population is at-risk for reading difficulties and school drop-out (Gottardo, 2002). In the case of native Spanish-speaking children learning English, phonological and orthographic processing skills in their native language may be even more important, since many of these children do not yet read well in either their L1 or their L2. Studies on how Spanish-speaking children learn to read and spell in English will further our knowledge and allow researchers, teachers, and school administrators to better support the transition of these children into English speaking schools.

Teachers and administrators would be armed with additional knowledge about how Spanish-speaking children may spell English spelling words. Knowledge of the Spanish language could aid in the development of teaching strategies to facilitate learning in English. How the L1 (Spanish) contributes to L2 (English) reading and spelling would be of particular importance when working with native Spanish-speaking children with limited English experience. Curriculum adjustments could also be considered in terms of teaching Spanish-speaking children how to spell English words—possibly even changes to grading criteria. These changes would not give Spanish speakers an advantage; however, they would minimize the grade penalties such students might face.

The next chapter presents a review of the literature on phonological and orthographic skills in English, which is followed by a discussion of the relation between the two skills. The theoretical frameworks of the two studies are based on two main hypotheses: the Linguistic Interdependence Hypothesis and the Orthographic Depth Hypothesis; more specifically, the Psycholinguistic Grain Size Hypothesis addresses differences in different orthographies. I will then review the literature on Spanish phonology and orthography and their interrelation as well as their comparison to English. Finally, bilingual and biliteracy research will be reviewed. The review of the research in this area will begin with a general overview and continue to a more specific examination of cross-language transfer from Spanish to English, leading to my research questions. Do phonological and orthographic skills transfer in young Spanish-speaking children learning to read and spell in English? If so, how do they transfer? Does the transparent nature of Spanish orthography have a positive or a negative effect in learning to spell in the more opaque orthography of English?

Definition of Terms

The following terms are defined within the context of the current studies. The definitions are presented to provide additional clarity throughout the dissertation. *Phonological processing skills* include the abilities to distinguish and manipulate onsets, rimes, and individual phonemes within spoken words (Castles & Coltheart, 2004; Goswami & Bryant, 1990). Syllables are composed of an onset and a rime (e.g., *c-at*) and phonemes are the smallest unit of sound in spoken language. *Orthographic processing skill* refers to the general understanding of the conventions used in the written aspect of a language. For the purposes of the current studies, it is defined as the knowledge of conventional spellings and spelling rules (Varnhager, Boechler, & Steffler, 1999) and spelling patterns. *Word reading* refers to the identification of single words. Specifically, word reading is defined as the ability to decode both real word and pseudowords. *Spelling* refers to the ability toc correctly map graphemes to phonemes in dictation of single real words and pseudowords. *Phonological transfer* can be defined as the process by which phonological processing skills (i.e., the ability to distinguish and manipulate the sounds in spoken words) in one language faciliatate reading and/or spelling in another language. Finally, o*rthographic transfer*r can be defined as the process by which orthographic knowledge (i.e., knowledge of conventional spelling, spelling patterns, spelling rules) in one language facilitate reading and/or spelling in another language.

CHAPTER 2: BACKGROUND LITERATURE

The Role of Phonological Processing in Learning to Read English

Phonological processing skills have been shown to be imperative for becoming a skilled reader of English (Adams, 1990; Badian, 1998; Bryant, 1986; de Jong & van der Leij, 2002). The concept of phonological processing has been thoroughly described as the ability to distinguish and manipulate the sounds in spoken words (Castles & Coltheart, 2004; Goswami & Bryant, 1990). Several studies have found early phonological processing skills to predict later word reading ability (Badian, 1998; Bryant, MacLean, Bradley, & Crossland, 1990; de Jong & van der Leij, 2002; MacLean, Bradley, & Bryant, 1987). In other words, beginning phonological processing skills in the preschool years are highly associated with word reading in later years (MacLean et al., 1987). In a review of the role that phonological processing skills play in reading acquisition, Castles and Coltheart (2004) cited numerous studies in which findings contributed additional evidence for the notion that phonological processing skills are highly related to word reading ability. In fact, studies examining phonological processing skills and reading concurrently, as well as short-term longitudinal studies, found that phonological skills are strongly associated with word reading ability (see Castles & Coltheart, 2004, for a review).

In the vast amount of literature on phonological processing skills, two central issues emerge. One focuses on the size of the unit that is crucial to the prediction of word reading. Unit sizes range from phonemes, the smallest unit, to rimes and syllables, the larger and more accessible units of language. The other issue concerns the causality of the relationship between phonological processing and word reading.

The tasks involved in assessing phonological processing skills can be categorized into five levels of difficulty. First, children acquire the ability to recognize rhymes (e.g., *tame* and *game*). They then recognize alliteration (e.g. the *b*ig *b*all *b*ounces), focusing on smaller parts, specifically the onset, of the words. Third, a familiarity with blending and splitting syllables emerges. Fourth, children learn to segment syllables into phonemes. The fifth and most difficult area for emergent readers is the ability to manipulate individual phonemes (Stahl & Murray, 1998). Each type of task and level of difficulty seems to be related to the other levels (Ellis & Cataldo, 1992). In effect, some levels build upon previous levels and others are reciprocal in nature. For example, partial segmentation of syllables is needed in order to successfully sound out words (Stahl & Murray, 1998).

Examining several specific skills involved in phonological processing, studies found that phonemic awareness, a finer grained phonological skill, is a better predictor of word reading than other skills involving larger units (Adams, 1990; Hulme, Hatcher, Nation, Brown, Adams, & Stuart, 2002). Hulme et al. (2002) examined phonological processing skills in five- and six- year old children through deletion, oddity, and detection tasks that assessed children's awareness of initial phoneme, final phoneme, onset, and rime. The authors hypothesized that while children would find tasks involving onset-rime judgment easier than those involving phonemes, phonemic awareness would emerge as the better predictor of word reading performance. As predicted, phoneme awareness was found to be the only predictor of word reading skill in both high-level and low-level readers, while neither onset nor rime awareness contributed a significant amount of variance to word reading in either group.

Other studies, however, found that experience with rhymes has been found to predict reading skills independent of intelligence (Bradley & Bryant, 1983). One of the first skills mastered, even before alphabetic knowledge, is the ability to detect rhyme and alliteration. Maclean et al. (1987) studied preschool aged children's knowledge of nursery rhymes. They found a significant correlation between children's knowledge of nursery rhymes and phonological processing skills. This 15-month longitudinal study identified a correlation that existed between nursery rhyme knowledge and early word reading ability. Rhyme and alliteration detection in young children was also found to be highly correlated with word reading and spelling in 1st grade (Bryant et al., 1990). Bryant et al. (1990) argue that rhyme distinction is separate from phonemic sensitivity and that, although contrary to other research findings, performance on rhyme and alliteration measures is often a better predictor of later word reading than phonemic detection. In a four-year longitudinal study, Bradley and Bryant (1983) began examining children at ages four and five and found that the ability to detect rhyme and alliteration predicted later word reading ability at ages eight and nine. In addition, children's poor rhyme recognition was related to their lower reading ability later in life (Bryant, 1986).

Clearly, there is disagreement among researchers regarding the predictive power of phonemic awareness versus rhyme awareness to reading success. Bradley and her colleagues would argue that phonemic awareness is not as strong of a predictor as larger units, such as rime, on word reading ability, whereas Hulme and his colleagues would argue otherwise. However, while Hulme et al (2002) did find phonemic awareness to be the strongest predictor of word reading ability in both skilled and poor readers, the authors clearly state that they do not advocate for phoneme-focused teaching for poor readers, thereby acknowledging the importance of all phonological processing skills in reading success. The research, overall, supports the notion that all phonological processing skills, which include phonemic, rhyme, and alliteration awareness are important in children's development of reading skills. The results of cross-sectional and longitudinal studies indicate that fostering the development of strong phonological processing skills at an early age predicts greater success in reading.

With regard to the causal relationship between phonological processing and reading, Castles and Coltheart (2004) reviewed studies exploring this relationship. While they reviewed numerous longitudinal and cross-sectional studies, their conclusion is that none of these studies provided indisputable evidence for a causal link between phonological processing and reading and spelling. They suggest that possessing phonological processing skills does not directly enable children to read; rather, that phonological awareness enables children to *improve* their reading. In other words, these studies have strengthened the argument for a *correlation* between phonological processing and later reading ability, but have not provided solid evidence for a causal relationship.

Another important point is that phonological processing skills may develop *after* exposure to literacy. Therefore, at the very least, there may be a reciprocal causal relationship between phonological skills and reading. Castles and her colleagues argue that the two variables, phonological processing skills and reading, are highly correlated but believe that the causal relation has been overestimated (see also Castles, Holmes, Neath, & Kinoshita, 2003).

In response to Castles and Coltheart's (2004) arguments against the causal relationship between phonological skills and reading, others have posited that their notion of "causation" is too narrowly defined, thereby eliminating the discovery of other possible effects on reading, such as letter knowledge (Hulme, Snowling, Caravolas, & Carroll, 2005). While Hulme et al. (2005) wholeheartedly agree that other factors, in addition to phoneme awareness, contribute to, and moderate success in reading, they maintain their stance that a causal relationship exists, even if other processes do, in fact, interact.

Despite Castles et al.'s (2004) criticisms, many other studies have found that phonological processing skills do predict later reading ability. For example, in a ten-year longitudinal study, Cunningham and Stanovich (1997) administered reading tasks to children in 1^{st} grade and then again in 11^{th} grade. Even when the cognitive ability measures were accounted for in 1^{st} grade, 1^{st} grade reading ability predicted reading comprehension, vocabulary, and general knowledge in the 11^{th} grade. Measures of reading ability in the 3^{rd} and 5^{th} grades were even stronger predictors than measures in 1^{st} grade.

Phonological processing skills also play an important role in other alphabetic languages. Having acknowledged its importance in predicting English reading ability, I will now examine the differences in the role of phonological processing in a transparent versus an opaque language. Patel, Snowling, and de Jong (2004) conducted a study with 6- to 11-year old Dutch and English monolingual children. The study focused on the similarities and differences of a transparent language (Dutch) and an opaque one (English) in learning to read. Administering a series of phonological processing and word reading tasks to both groups, the researchers found that phonemic awareness was, in fact, the strongest predictor of word reading for both Dutch and English speakers. Studies on the effect of phonological processing skill in another transparent language, Spanish, have also found that phonological processing skills predict later word reading ability (Denton et al., 2000; Durgunoglu et al., 1993). Taken together, these studies provide support for the notion that in alphabetic languages, whether transparent or opaque, strong phonemic processing skills facilitate greater reading success.

In summary, an abundance of studies examining phonological processing skills have largely focused on two central issues: the different levels of phonological processing (e.g. phoneme, syllable) and their relation to reading; and the causal relationship between these processes and reading in various alphabetic languages (Badian, 1998; Bryant, MacLean, Bradley, & Crossland, 1990; de Jong & van der Leij, 2002; MacLean et al., 1987). The abilities to detect rhyme and alliteration are acquired earliest, while syllables and phonemes are acquired later. Some research has found phonemic awareness, the most difficult skill to master, to be the strongest predictor of word reading ability (e.g., Hulme et al., 2002) while other research argues that the larger units (e.g., syllables and rhyme) are better predictors (e.g., Bradley & Bryant, 1983). Phonological processing skills vary in difficulty, and therefore are not acquired simultaneously. In terms of the causality of these processes for reading, Castles and Coltheart (2004) reviewed a series of studies that found phonological processing to be highly related to, but not necessarily predictive of, word reading ability. Regardless of the opposing views on whether phonological processing skills are indeed a causal factor for reading and spelling, phonological processing appears to play a significant role in determining later reading ability in

English, as well as several other languages such as Dutch (Patel et al., 2004), Spanish (Denton et al., 2000; Durgunoglu et al., 1993), and Portuguese (Defior, Martos, & Cary, 2002). Let us now examine the role that orthography plays in reading acquisition.

The Role of Orthographic Processing in Learning to Read English

Although a multitude of research has focused on the role of phonological processing in learning to read, fewer studies have examined the importance of orthography, independent of phonology. Previous research has, for the most part, neglected spelling as an important factor that influences and is influenced by phonological awareness and reading (Ellis & Cataldo, 1992). Orthographic knowledge is generally defined as the knowledge of conventional spellings and spelling rules (Varnhagen et al., 1999) in a language. Similarly, orthography can be defined as "correct, standard spelling" (B. Kessler, email, August 5, 2006).

Implementing a longitudinal study spanning about four years, Ellis and Cataldo (1992) charted the development of spelling, reading, and phonological processing skills in young children's acquisition of literacy skills. Forty English-speaking children were assessed at 4- or 5-years old, at the end of 1st grade, the beginning of 2nd grade, and the beginning of 3rd grade. The resulting model of reading and spelling development describes the three phases that children progress through while acquiring literacy skills. The three phases correspond with a) first year in school, b) spring of first year to fall of second year, and c) beginning of second year to beginning to third year. General results indicated that during the first phase, spelling played a large part in early reading. The second phase demonstrated similar results. By the third phase, however, phonological processing was the strongest predictor only of word reading, not spelling. In other words, the contribution of spelling to phonological processing and reading is significant during early literacy, but phonological processing skills dominate reading acquisition later in development.

While phonological processing is certainly believed to be the most important contributing factor to reading success, recently, researchers have agreed that orthographic processing skills could be the second most important factor. The fact that some children have solid phonological processing skills, but are not good readers, led researchers to infer that some other factor played an important role, specifically, orthographic knowledge. To test this theory, Cunningham and Stanovich (1989) administered several phonological and orthographic processing tasks, including phoneme deletion, phonological choice, orthographic choice, and homophone choice. They also included a Title Recognition Test (TRT). The TRT was developed for children, based on a previous measure developed for adults. The TRT aimed to examine children's exposure to print by measuring their familiarity with popular book titles. Results from several hierarchical regression analyses indicated that not only did orthographic skill account for word recognition independent of phonological processing ability, but that orthographic skill was linked to print exposure differences, as measured by the TRT. While Cunningham and Stanovich's (1997) longitudinal study predominantly investigated reading ability, they also found that exposure to print played a role in reading comprehension in the 11th grade. These findings have implications for encouraging more print exposure at home and at school to facilitate reading success.

The role of orthography in reading and spelling has begun to receive more attention in research. Cunningham and Stanovich (1989) found that orthographic skill accounted for word recognition, independent of phonological skill; therefore, it jointly contributes to reading success. Wright and Ehri's (2007) recently conducted a study with Kindergarten and first grade children and found that the children used their knowledge of orthographic patterns, specifically, doubled consonants, to read words. This study provides evidence of the role that orthography plays in reading, independent of dictate phonology, because these orthographic patterns are not based on phonological rules.

Orthographic/Spelling Rules in English

Although the two skills of reading and writing are often believed to be highly interrelated, why is it that some good readers are poor spellers? Also, why are some people capable spellers while others struggle? One superficial answer to this question is that skilled spellers make efficient use of their memory and can recall words effectively (Goulandris, 1992). Another possible answer is that spelling is inherently more difficult than word reading due to spelling and reading's asymmetrical relation (Kessler & Treiman, 2001). Also, spelling may require stronger phonological processing skills than word reading because by the time children are beginning to read, they are starting to make use of memorization or sight words (Ehri, 1998). Spelling infrequently used words, therefore, may still require strong phonological processing skills as the child "sounds out" words in order to spell the word correctly, or at least phonetically

English orthography has 26 graphemes. However, several graphemes have more than one corresponding sound, or phoneme. Each of the five vowels has at least two sounds (e.g. long and short; *o* as in *open* and *off*). Dewey (1971) listed all of the different spellings for each phoneme and stated that there was an average of twelve spellings per phoneme. Kessler and Treiman (2003) noted that while this may technically be true, if we truly spell using any of the various spellings corresponding with the phoneme, it would be nearly impossible to spell any words correctly! An example of a grapheme with multiple phonemes is the letter *a.* In each of the following words, *a* is pronounced differently: *cat, water, paper, harm,* etc. To complicate matters, many spelling-to-sound rules do not work in reverse (Adams, 1990). As an example, Adams explains that "the letter **f** quite reliably symbolizes the phoneme /f/. In contrast, the phoneme /f/ can be spelled as f, ff, ph, or gh" (p. 390).

Rather than simply guessing at each possible spelling, children must learn to spell English words through knowledge of the spelling rules (Bryant, 2002; Kessler & Treiman, 2003). They must learn the alternative spellings for the same sound as well as how to use these alternative spellings. Although some may believe spelling in English would be immensely difficult due to the orthographic rules and the large number of sounds per letter, others believe that it is not as complex as once thought (Kessler & Treiman, 2003), as evidenced by the fact that children *can* and *do* learn to spell words correctly. One traditional example that is used when illustrating the confusing orthography of English is *ghoti* which scholars have often said, according to other English words, can be pronounced as *fish.* However, Kessler and Treiman (2003) convincingly pointed out that this argument is illogical since *gh* never makes the /f/ sound at the beginning of a word and *ti* never makes the /ʃ/ sound at the end of a word. The position of the grapheme or cluster often determines its corresponding sound (Venezky, 1967). Kessler and Treiman (2003) also pointed out that children learn orthographic rules very early on. For example, the double letters (pp) cannot appear at the beginning of a word. According to Venezky's (1967) review of English orthography, almost each spelling pattern follows some rule, albeit complex. While an in-depth discussion of the numerous English orthographic rules is beyond the scope of this dissertation, it is important to acknowledge the abundance of rules, which cause learning to spell in English to be quite difficult, particularly when compared to more transparent and consistent languages, such as Spanish. It is important to provide more details on English vowels and the difficulty encountered when spelling them, since the second portion of this study will examine English vowel spelling.

Vowel errors represent a large part of children's spelling mistakes (Treiman, 1993; Varnhagen et al., 1999). Children often substitute vowels that are phonetically similar (Treiman, 1993). Spelling English vowels is especially difficult because each phoneme can be represented in a variety of ways. Vowels have a much more inconsistent mapping from phoneme to grapheme than consonants (Kessler & Treiman, 2001). The spelling of any given vowel can be determined by several factors, including graphemic and morphemic structures (Venezky, 1967). For example, Perry and Ziegler (2004) found that "body neighbors" predicted vowel spellings. Body neighbors are words that share an orthographic pattern with the body unit. For example, the body neighbors of the word *tick* are *sick, lick, chick, pick,* etc.

Orthographic Development in English

According to Bryant (2002), children initially spell words based solely on sounds, and then learn the rules for spelling, which can be applied to future writing. In the first stage, children use one spelling rule in all possible situations. Therefore, some words are spelled correctly while others are not. For example, children first learn that /k/ is spelled with a *c,* as in *cat.* In this case, children might spell the word *pick* as *pic* . Next, as children learn the alternative spelling rules, they often begin to confuse when to use a specific rule. Words they once spelled correctly are now spelled incorrectly. For example, when they learn that /k/ can also be spelled *ck,* they may spell the word *cat* as *ckat*. Finally, children learn when and how to utilize the correct spelling rules and therefore, begin spelling more words correctly (Bryant, 2002). They eventually begin to see the fit between phonology and orthography (Ehri, 1993; Treiman & Bourassa, 2000).

Research with pseudoword reading and spelling has shown that children do, in fact, learn the orthographic rules needed for spelling. By spelling pseudowords in the same way they would spell real words with alternative spelling, it is apparent that they must be applying some traditional spelling rules. In addition, examining how children spell pseudowords provides additional insight into their levels of phonological and orthographic processing skill. The current studies utilize both real word and pseudoword spelling tasks in order to get a broader picture of the children's spelling skills. By incorporating pseudoword spelling tasks, I am minimizing their use of whole word memorization for spelling.

The only alternative explanation for children developing their spelling skills is that the children learn to spell every word by rote memorization, which is highly unlikely given the vast number of words they would need to hold in their visual memory (Bryant, 2002). Finally, just as good reading skills enhance spelling, learning to spell correctly can enhance reading proficiency. Spelling correctly may also improve children's oral language and pronunciation (Adams, 1990).

The Relation Between Phonological and Orthographic Processing in English

Ehri (1992) proposed four stages of spelling development, condensing Henderson's (1980) original six stages. Ehri's stages are labeled with regard to children's spelling development because she defined them in terms of the relation between orthographic and phonological units (Ehri, 1992, 1993). She proposed the *precommunicative, semiphonetic, phonetic,* and *morphemic* stages. The *precommunicative* stage occurs early, when preschoolers become familiar with how written language appears. Children often write letters and numbers that do not correspond with the spoken word. An example of this would be spelling the word *tack* as P. The *semiphonetic* stage occurs when children begin to learn grapheme-phoneme correspondences. In this stage, spellings can range anywhere from YF for *wife* to JYV for *drive.* During this stage, while the spellings are not orthographically correct, they are logical, given the basic knowledge of letter names and sounds. In the third of Ehri's stages, the *phonetic* stage, many more letters appear in spellings and are beginning to follow more conventional spelling rules. For example, children might spell *boat* as BOTE, using the familiar spelling pattern of the silent E to make the initial vowel long. In the *morphemic* stage, children begin to use conventional spelling rules for frequently used words and to transfer these rules to less frequently used words.

The development of spelling and writing in English is highly related to phonological processes (Ehri, 1993). In order to understand how spelling knowledge develops, several researchers have examined the development of "invented spelling" (Ehri, 1993; McBride-Chang, 1998). Invented spelling is the way in which young children spell words phonetically, without following traditional English spelling rules.

McBride-Chang (1998) found that measures of invented spelling were associated with measures of phonological processing skills, thereby demonstrating that invented spelling is yet another way in which to measure these skills. By studying the invented spelling of young children, researchers are able to determine how children begin to understand letter sounds and how they are combined in words. Invented spelling occurs and progresses throughout Ehri's final three stages, in which children are actively matching sounds with their corresponding letters. In each stage, children add more letters to the words as they are able to distinguish the distinct phonemes in each word. Letter-sound correspondence begins to increase as children's phonological processing skills develop (see Treiman & Bourassa, 2000, for a comprehensive review of spelling development). Phonological processing skills play an important role in both learning to read and learning to spell (Ehri, 1993; Gill, 1989; McBride-Chang, 1998). Several studies have found strong correlations between word reading skills and spelling skills in young children (McBride-Chang, 1998; Morris & Perney, 1984). Invented spelling appears to be "an excellent predictor of word recognition" (McBride-Chang, p. 157).

While invented spelling predicts word reading, so does the spelling of pseudowords, or nonwords (Goulandris, 1992). Goulandris (1992) found that measures of nonword or pseudoword spelling actually predicted reading a year later, indicating that orthographic knowledge is dependent on "alphabetic expertise" (p. 154). As children gain alphabetic knowledge, orthographic rules can be combined and therefore, reduce the memory load of spellings of words. Apparently, a combination of phonological skills and orthographic knowledge fosters the greatest success in reading and spelling.

In a longitudinal study, Huxford, Terrell, and Bradley (1992) found that if both phonological and orthographic information were not available, children were not as successful in tests of word reading and spelling. Children who had strong phonological processing skills but lacked letter-sound correspondence knowledge were unable to successfully read and spell words. Conversely, children with ample letter knowledge but little skill in phonological processing were also unable to successfully read and spell words because they were incapable of hearing more than the initial sound in any given word (Huxford et al., 1992). Therefore, letter-sound knowledge facilitates phonological processing, allowing for greater reading success.

Another important aspect of the English orthography system is the set of three organizational principles set forth by Henderson (1985): spelling by sound, spelling by pattern, and spelling by meaning. Spelling by sound refers to words such as *be* and *bet*, words that have straightforward grapheme-phoneme correspondence. Spelling by pattern refers to repeated spelling patterns across words. For example, when using the word *tap* to spell *tapping,* one must know to double the final consonant before adding the suffix –*ing*. Finally, spelling by meaning indicates that words sharing meaning also tend to share spelling. An example of this would be that words in the plural form contain the suffix *–s,* and words in the past tense contain the suffix *–ed.* Other examples, beyond inflectional endings, can be found in such words as *sign, signature, assignation*, and *signet.* These four words are semantically related. Despite the organizational principles, children in the study continued to make various errors on spelling tasks. The two most frequent errors involved consonant doubling marking. Along with a discussion of spelling development I must also explore spelling errors.

Schlagal (1992) examined patterns of orthographic development in children's spelling. By administering the Qualitative Inventory of Word Knowledge*,* which consists of lists of words on six levels of spelling difficulty, the results indicated several developmental trends. Most noticeable was the finding that reversal errors were a common occurrence at the first level of difficulty, but by the third level, only one reversal error was made. Schlagal (1992) found that another common error was the exclusion of the preconsonantal nasal (e.g. the *m* in *bump*), which was seen most often in the first level and disappeared by the fifth level. For children at all levels of spelling difficulty, the error that appeared most often was in doubling of consonants. Spelling difficulties that emerged in the more advanced levels included errors made due to new vocabulary, such as the /ʃ/ sound being spelled as *ti-, si-,* or *ci-* or the addition of words including endings of either *-able* or *–ible* and *–ance* or *–ence*. Another study of spelling errors found that English spellers had difficulty with words ending in the vowel sound /aɪ/. Of all errors made with final vowels, these spellers used the letter name corresponding to the sound 69% of the time (Pollo, Kessler, & Treiman, 2005). Treiman and her colleagues, as well as other researchers, have found that beginning spellers often spell words with letters whose names are found in the word (e.g. in English: Treiman, 1993; 1994; in Hebrew: Levin, Patel, Margalit, & Barad, 2002; in Portuguese: Martins & Silva, 2001). In sum, while many basic spelling errors disappear as children become more skilled spellers, other spelling errors begin to surface due to the more difficult words in the child's vocabulary. (For a complete explanation of the phonetic symbols used in this paper, please refer to the International Phonetic Association, 1999; see Appendix B)

Exploring the relationship between phonology and orthography in languages other than English, Defior et al. (2002) were the first to compare the relation between phonological processing skills and word reading in two transparent languages, Spanish and Portuguese. Spanish, in this case, has a more transparent orthography than Portuguese. Examining reading time for numeral reading (e.g., 1, 2, 3), number word reading (e.g. siete and sete (*seven* in Spanish and Portuguese), and pseudoword reading in groups of monolingual Spanish and monolingual Portuguese speakers, Defior and colleagues found that Spanish-speaking first and second graders read number words and pseudowords faster than their Portuguese counterparts. Spanish-speaking children also produced fewer errors when reading pseudowords. These results suggest that reading in languages with a highly predictable grapheme-phoneme correspondence is more easily acquired.

Phonological and orthographic processing skills both play important roles in the development of reading skills in English (e.g. Ehri, 1993). These skills have also been found to facilitate spelling in English, especially as demonstrated by measures examining invented spelling (Goulandris, 1992; McBride-Chang, 1998). As children develop their spelling skills, the nature of their spelling errors may change (Schlagal, 1992). Of interest, particularly for the current studies, is how these errors manifest themselves when children are learning to spell in an L2. Study 2 attempts to identify the types of errors made by native Spanish-speaking children learning to read and spell in English.

Theoretical Rationale for Cross-Language Research

Linguistic Interdependence Hypothesis

The Linguistic Interdependence Hypothesis (Cummins, 1979, 2000) proposes that L2 competence is rooted in the child's L1 level of competence. When L2 learning begins, often in formal schooling, a child's success in attaining high levels of competence in the L2 is partially dependent upon his or her level of L1 competence at the time the exposure begins. In the case of high L1 competence, the child is likely to develop high levels of L2 competence without negatively affecting the L1 competence. The Linguistic Interdependence Hypothesis is solidly based on the notion that there is an interaction between the L2 learning and the competence already developed in the L1. In fact, the interaction occurs not only between the L1 and the L2, but between the child and the educational environment. To illustrate this hypothesis as a tangible example, we can consider any bilingual language program. When a student is receiving instruction in the L2, the student is not neglecting the L1; rather, in developing L2 competence, he or she is indirectly contributing to linguistic proficiency in the L1. This principle applies to languages that are relatively similar, such as Spanish and English (e.g. Durgunoglu et al., 1993), and Italian and English (e.g. D'Angiulli et al., 2001), as well as languages that are distinctly different, such as Japanese and English (e.g. Cummins, Swain, Nakajima, Handscombe, Green, & Tran, 1984).

Supporting evidence for the Linguistic Interdependence Hypothesis comes from a set of cross language phonological transfer studies (e.g. Durgunoglu et al., 1993; Cisero & Royer, 1995; Comeau et al., 1999; D'Angiulli et al., 2001; Geva & Siegel, 2000). In a study of Italian-English bilingual children, D'Angiulli et al. (2001) administered phonological, word reading, spelling, syntactic, and working memory tasks. Across the phonological tasks, there was a significant relationship between Italian and English, supporting the hypothesis' proposal that L1 and L2 competence are interdependent and that exposure to Italian benefits the English learner. Specifically, children who have exposure to a language with high grapheme-phoneme correspondence (i.e. Italian) may develop greater phonological awareness skills in English. Another study supporting the proposal that L1 and L2 competence are interdependent is that of Geva and Siegel (2000). The authors examined elementary aged children learning to read concurrently in English (L1) and Hebrew (L2). There was a positive correlation among L1 and L2 reading measures, even though the two orthographies vary in both complexity and regularity.

Study 1 aims to provide further evidence for the Linguistic Interdependence Hypothesis by examining the predictive power of L1 (Spanish) phonological and orthographic processing skill on L2 (English) word and spelling. Pursuant to the Linguistic Interdependence Hypothesis, strong Spanish phonological and orthographic processing skills should predict English word reading. To further investigate the role of the L1 on L2 development, the current study will also examine Spanish phonological and orthographic processing skills' contribution to English spelling.

Orthographic Depth Hypothesis

The Orthographic Depth Hypothesis, first put forward by Frost and his colleagues (Frost, Katz, & Bentin, 1987; Katz and Frost, 1992), introduced the idea that languages differ in the depths of their orthographies. In an opaque, or deep, orthography, there is a relatively weak grapheme-phoneme correspondence. The graphemes do not consistently map to phonemes, or vice versa. English is a good example of an opaque orthography. For example, the phoneme /k/ can map to various graphemes, such as *c* as in *cat, cc* as in *soccer,* or *ck* as in *sick.* On the other hand, a transparent, or shallow, orthography, such as Spanish, has a very direct grapheme-phoneme correspondence. More recently, the Orthographic Depth Hypothesis has been linked to the dual route model of reading (Ziegler & Goswami, 2005). The dual route model describes two pathways in learning to read: lexical and non-lexical. The lexical model is meaning-based, whereas the non-lexical model is based on phonological cues. The Orthographic Depth Hypothesis is linked to this model through an orthographic aspect. Readers adapt their reliance on the two pathways depending on the demands of the particular orthography.

Due to English's deep orthography, with its less systematic mapping between letters and sounds, readers can rely on both the lexical and non-lexical pathways to process the words. In contrast, Spanish, Portuguese, and Dutch, more consistent orthographies, have a direct and unambiguous mapping between letters and sounds. These readers rely more on the non-lexical pathway, and are able to decode words more quickly. In other words, the reading of words can be performed successfully via phonology. Differences in orthographic depth have been shown to affect reading and spelling (Caravolas, 2004). Shallow orthographies are more conducive to learning to read because of their systematic mapping of letters to sounds.

Benuck and Peverly (2004) examined English-Hebrew bilingual speakers on word reading ability. Utilizing the Orthographic Depth Hypothesis as a theoretical framework for their study, the researchers hypothesized that Hebrew speakers (deep orthography) would use semantically-based information for reading Hebrew more often than when reading English. To clarify, vowels in Hebrew are represented by dashes and dots above and below the consonant letters. This vowelled form of Hebrew is a shallow orthography (i.e., strong phoneme-grapheme correspondence). However, by middle elementary school, the vowelled system is replaced by an unvowelled form (i.e., the vowels no longer appear in text). Therefore, at this point, the Hebrew orthography becomes very deep (i.e., weak phoneme-grapheme correspondence). Readers must rely on the context in which the words are presented. Seventy-seven female undergraduate students were given naming and context tasks to determine whether the lexical or non-lexical route was used to read words. Results from this study were consistent with the Orthographic Depth Hypothesis. When students read Hebrew words, they did indeed read via the lexical route more than when reading English words, because phonological information in Hebrew was ambiguous.

Several studies have investigated the cross-language transfer of spelling across languages with different orthographic transparencies. Caravolas (2004) reviewed studies of alphabetic writing systems with different levels of orthographic transparency to see if the process of learning to spell across the systems was consistent. Cross-language studies generally aim to examine the rate at which spelling develops as well as the pattern of the development. This review included studies on speakers of Czech, English, German, and French. English and French have much deeper orthographies than German and Czech. Numerous studies discussed in the review found that English speakers generally developed spelling skills at a slower rate than speakers of languages with more transparent orthographies. Learners of more consistent writing systems, such as Czech and German, learn both basic and advanced spelling skills at a faster rate than speakers of less consistent orthographies. The differences between languages were largely attributed to differences in orthographic complexity.

Psycholinguistic Grain Size Hypothesis

The Orthographic Depth Hypothesis, as discussed, is largely based upon the demands of the orthography of any given language. The Psycholinguistic Grain Size Hypothesis (PGSH), builds upon this hypothesis by adding an additional piece to the "puzzle." Grain size refers to the degree of transparency in the orthography, much like the Orthographic Depth Hypothesis. However, grain size involves, more specifically, the disparity between phonology and orthography when related to reading acquisition. According to Ziegler and Goswami (2005), phonology favors larger grain sizes while orthography favors smaller grain sizes. To illustrate this point, children are first exposed to phonology in oral language. The most salient phonological cues at this point in their language development are larger grain size units, such as syllables and onset-rimes. When children begin learning to read and spell, smaller grain size units play a more significant role and letters become a more salient phonological unit.

The Psycholinguistic Grain Size Hypothesis posits that both orthographic consistency and grain size play important roles in how difficult it is to learn to read. In consistent languages (e.g. Greek, German, and Spanish), smaller grain size units, such as letters or phonemes, are most important. In transparent alphabetic languages with strong letter-sound correspondence, such as Italian and Spanish, there are fewer phonemes that need to be learned. However, in inconsistent languages, such as Chinese, there are 3,000 visually different characters that must be memorized, a process that takes significantly more time to accomplish (Ziegler & Goswami, 2005). On average, the memorization process of Chinese characters takes about three years. Inconsistent languages favor larger grain size units. For example, the smaller units, such as phonemes, in English are more inconsistent and unreliable than larger units, such as syllables and rimes. To summarize, orthographies that are consistent and favor smaller grain size units, such as letters or phonemes, are easier to acquire than inconsistent orthographies favoring larger grain size units, such as syllables and rimes.

According to the Orthographic Depth Hypothesis, learners of Spanish, a shallow orthography, would read words via the non-lexical route. Phonological information is unambiguous and readily available to readers because of systematic mapping. Spanish orthography is consistent and favors smaller grain sizes. Therefore, acquiring reading and spelling skills in Spanish is relatively easy once the grapheme-phoneme correspondences are mastered. English, however, is inconsistent and favors larger grain sizes; therefore, it is relatively more difficult to acquire reading and spelling skills. In terms of cross-language transfer, we must address the potential complexity involved in the “movement” from Spanish to English. Study 2 addresses this specific issue, as it relates to vowels.

Based on both theoretical and empirical research, it is safe to assume that the underlying mechanisms of cross-language phonological and orthographic transfer are complicated. To illustrate this potential transfer, an individual presented with an unfamiliar word in the L2 will first draw upon available phonological or orthographic information in the L2. If this information is inadequate for decoding or spelling a word, the individual might then rely on phonological and orthographic information from the L1. To adequately address this shift from Spanish to English, we must first discuss phonological processing skills and orthographic development in the Spanish language.

The Role of Phonological Processing in Learning to Read in Spanish

Many of the young Spanish-speaking children in the United States may not have strong reading skills in either English or Spanish. Nevertheless, they should have developed some phonological processing skills in Spanish as their native spoken language. Even as they are learning English at school, their dominant spoken language is likely still Spanish, the language they speak most frequently at home, with their families and within their communities. Although phonological processing skills in a person's L1 are important, they are also useful in learning to read in a second language (Gottardo, 2002). Language skills in Spanish were found to be related to word reading ability in both Spanish and English (Gottardo, 2002), and according to various research, strong language skills have a positive impact on future reading.

A few studies of Spanish language speakers have found results consistent with the idea that phonological processing skills are related to later reading ability (Denton et al., 2000; Durgunoglu et al., 1993). In line with the pattern in which English speakers develop phonological skills, Spanish speakers also develop phonological sensitivity to onsets and rimes before individual phonemes (Denton et al., 2000). Also consistent with monolingual English speakers, Spanish students are generally able to distinguish rhyme and alliteration before reading instruction begins.

In Denton et al.'s (2000) review, several studies on the role of phonological processing in reading development for Spanish speakers were discussed. Although the various studies often resulted in different conclusions about which specific phonological skill most strongly predicted reading, they did all discern that phonological processing skills, in general, were highly correlated with later reading ability. One exception to these findings was that some students with poor reading ability still performed well on phonemic awareness tasks (Manrique & Signorini, 1997, in Denton et al., 2000). These children could spell many words that they were not able to read. This finding is possibly attributable to the fact that the Spanish language is considered to be transparent, or shallow, and has a high grapheme-phoneme correspondence, enabling children to develop spelling skills fairly easily.

The Spanish language is phonetically regular. It contains 29 graphemes (see Appendix A) which generally correspond to its approximately 25 phonemes. This is significantly fewer than the estimated 44 phonemes in English, which has 26 graphemes (Fashola et al., 1999). By about the age of 4, most Spanish-speaking children have mastered up to 75% of the Spanish phonemes (see Goldstein, 1995). Five of the graphemes have multiple phonemes and these are listed in Table 1. Examples of words containing these phonemes are also provided, with their English translations.

Because Spanish has such direct grapheme-phoneme correspondences, there is an on-going debate as to whether syllabic awareness or phonemic awareness is a more salient phonological component in Spanish word reading. Several studies have found that children's ability to segment syllables was a stronger predictor of reading success than phonemic awareness in Spanish (Carreiras, Alvarez, & De Vega, 1993; Gonzalez & Garcia, 1995). Other studies, however, have found results indicating that phonemic awareness was the most salient skill related to reading in Spanish (e.g. Manrique & Signorini, 1994).

Manrique and Signorini (1994) studied the reading and spelling abilities of Spanish-speaking 1st graders and found that better phonemic awareness led not only to

Table 1

Spanish Graphemes with Multiple Phonemes

Grapheme	Location	Corresponding Phonemes	Example
c	before *a, o, u*	/k/	casa (house)
	before *e, i*	/s/ or /θ/	cena (supper)
g	before *a, o, u*	/g/	ganar (to win)
	before *e, i*	/ɦ/	gemelo (twin)
r	middle or end of word	/r/	para (for)
	beginning of word	/R/	ropa (clothing)
y	isolation, end of word	/i/ as vowel	rey (king)
	beginning of word	/y/ as consonant	yerno (son-in-law)
x	beginning of word	/s/	xilófono (xylophone)
	all other cases	/ks/	taxi (taxi)

better performance in reading, but in spelling as well. Skilled readers performed better on phoneme segmentation, word spelling and word reading tasks. In other words, skilled readers demonstrated higher levels of phonological processing skills than less skilled readers.

The Role of Orthographic Processing in Learning to Read in Spanish

Spanish is an alphabetic language with very regular grapheme-phoneme correspondence (Defior et al., 2002; Manrique & Signorini, 1994). In addition to the same 26 graphemes as in English, Spanish orthography also includes the graphemes *ch,* *ll,* and *ñ* (*ch* and *ll* are grapheme pairs with fixed phoneme correspondences, *ch* is always pronounced /tʃ/ and *ll* is always pronounced /j/). The five vowel graphemes, *a, e, i, o,* and *u* each make only one sound, whereas in English, there are many sounds corresponding to each of the five vowel graphemes. Also, although in English there is a high frequency of consonant clusters, one of the more difficult phoneme combinations to grasp, Spanish contains few consonant clusters (e.g. *bl, fr, cl, br).* Research has found that children had much more difficulty segmenting initial phonemes that contained consonant blends in both English (Treiman & Weatherston, 1992) and Spanish (Jimenez & Haro, 1995). Although the grapheme-phoneme correspondence is high in Spanish, it is not a strictly one-to-one correspondence. There are 29 graphemes and about 25 phonemes. Nineteen of the graphemes have one corresponding phoneme. As presented in Table 1, several graphemes, *c, g, r, x, y,* map to two or more phonemes, depending on their location in a given word. A few graphemes share a single phoneme (e.g., *b* and *v* correspond to /b/) and there is also one grapheme, *h*, that does not have a corresponding phoneme, as it is a silent letter.

More specifically, when the graphemes *c* and *g are* followed by *a, o,* or *u,* they have a hard pronunciation /k/ and /g/, but when they are followed by *e* or *i,* they have a soft pronunciation /s/ (or /θ/) and /h/ . Note that the /θ/ is used only in Spain (Castilian Spanish). The grapheme *r* can be pronounced either as /r/ when it is placed in the middle or end of a word, or as /R/ at the beginning of a word or following a final *n, l,* or *s* on the preceding word (e.g. *u<u>n</u> <u>r</u>eloj*). The grapheme *y* is pronounced as a vowel, /i/ at the end of a word, or on its own. However, it is pronounced as the consonant /y/ at the beginning of words. Finally, the grapheme *x* is pronounced as /s/ at the beginning of a word, but as /ks/ in all other cases (Defior et al., 2002).

Although initially, this may seem confusing, the grapheme-phoneme correspondence rules are consistent, thus making the orthography shallow and transparent. To illustrate the relative simplicity of Spanish orthography as compared to English orthography, details of both are described in Table 2. In contrast to English speakers, Spanish speakers show little difficulty in producing written vowels in Spanish. Manrique and Signorini (1998) found that very few vowels were omitted by Spanish speakers in Spanish spelling tasks. In fact, beginning spellers of Romance languages (i.e. Spanish, French, Italian, Portuguese, and Romanian) produce all-vowel spellings (Ferreiro & Teberosky, 1982), which is not the case for English speakers when spelling English words. English speakers tend to spell using only consonants (LDR for *ladder)*, as evidenced through invented spelling. The relative straightforwardness of spelling Spanish vowels may result in difficulties for Spanish-speaking children learning to spell in English, thus, making the cross-language study of English vowel spelling errors especially interesting.

The Relation Between Phonology and Orthography in Spanish

Spanish may be fairly easy to learn because of its high phoneme-grapheme correspondence. However, if children are not aware of the phoneme-grapheme correspondence rules, spelling errors can result (Justicia et al., 1999). In their study, Justicia et al. examined common spelling errors made by Spanish children 8-10 years old. Common errors included substitution, addition, omission, inversion, and fragmentation or synthesis. Substitution, the most common error (almost 68%) consisted of replacing one

Table 2

Spanish Orthography versus English Orthography

	English	Spanish
Graphemes	26	29
Phonemes	40-45	25
Spelling-to-sound rules	Inconsistent	Consistent
Silent phonemes	Various, depending on word (e.g. write, sight, benign)	h
Vowels	at least 2 sounds per grapheme 48 sounds in total*	one sound per grapheme 5 sounds in total
Consonant Digraphs	sh, th, ch	ch

*Note: this total number is described in Venezky (1967) and refers to only the vowel graphemes a, e, i, o, u.

grapheme for another (e.g. using *v* and *b* interchangeably). Many of these and other errors were produced based on the common mispronunciations of the words (Justicia et al., 1999). For example, the word *cosa* is often mispronounced as *coza* and therefore, may be mistakenly spelled with a *z* instead of an *s.* Many errors were also made due to the few grapheme-phoneme correspondences that are ambiguous. Because the grapheme *h* does not correspond to a phoneme and the phoneme /b/ can be represented by *b, v,* or *w*, these letters were often either omitted or substituted in spellings (e.g., spelling the word *haber* as *aber* or *aver*).

Children can learn letter-sound correspondences in order to read and spell more easily when there are fewer sounds associated with each letter (Manrique & Signorini, 1994). Simply learning each letter's associated sound is sufficient for "legal spellings in Spanish" (Manrique & Signorini, p. 427). The criteria for legal spellings, as defined by Bruck and Treiman (1990), are that each phoneme must be represented by letters that exist in the language in the real word, and placed in the correct order.

In Manrique and Signorini's (1994) study of 1st grade Spanish speakers, the children were given three tasks: phoneme segmentation, spelling, and word reading. Although good readers performed better on the spelling and word reading tasks, both good and poor readers performed equally well on the phoneme segmentation task. In comparing the results from this study (Manrique & Signorini, 1994) to other studies of transparent orthographies, such as Italian (see Cossu, Shankweiler, Liberman, Katz, & Tola, 1998), and studies of English speaking children, it is clear that English speaking children do not perform as well on phoneme segmentation tasks. It may be because of its shallow orthography that Spanish-speaking 1st grade children perform better in reading and spelling than children who speak languages with deeper orthographies (Defior et al., 2002; Manrique & Signorini, 1994).

In Spanish, the most important skill for learning to read and spell is knowledge of grapheme-phoneme correspondence. Due to its shallow orthography, when children know the letter sounds, they perform much better on word reading and spelling tasks. Even in the case where letters are substituted, their spellings are often deemed "legal." In these cases, there can be multiple ways to spell a phoneme and both ways are considered phonetically correct. For example, if a child mistakenly spells the word *vamos* as *bamos,* it is still considered a legal spelling. The question remains as to whether strong phonological and orthographic processing skills in one language transfer to reading and spelling in another. Let us now broadly examine cross-language transfer.

Bilingual and Biliteracy Research

Review of the Literature

Thus far, it has been clear that in alphabetic languages phonological processing skills are important in learning to read (Badian, 1998; Bryant, 1986; Caravolas, 2004; Goldstein & Washington, 2001; Patel et al., 2004). In fact, in both English and Spanish, phonological processing skills develop in a similar pattern. Children performed best on phonological processing tasks involving rhymes. Rhyme and syllable detection are easier tasks than phoneme detection in both languages (Cisero & Royer, 1995; Denton et al., 2000).

Several studies have been conducted in recent years to examine the cross-language transfer of these types of phonological processing skills. One such study conducted by Comeau et al. (1999) examined English-speaking children learning to read French. The results supported previous research findings that phonological processing and word reading in English were as strongly correlated as phonological processing and word reading in French. In fact, by extending their study to look at other factors contributing to reading (i.e., lexical entry and verbal working memory), they were still able to determine that phonological processing skills played a more important role in word decoding than the other processing abilities that were measured.

Another study examining cross-language transfer of phonological processing was conducted by Loizou and Stuart (2003). The researchers examined both monolingual and bilingual English and Greek speaking five-year-olds. The bilingual speakers were separated into two groups, English speakers learning Greek and Greek speakers learning English. It was predicted that the bilingual speakers would perform better on tasks of phonological processing based on a "bilingual enhancement" effect, which posits that bilingual speakers perform better than monolingual speakers (Loizou & Stuart, 2003). However, research found that the relative phonological structures of the two languages played a role in how well the bilingual speaker performed. The English speakers learning Greek (English-Greek bilinguals), a phonologically simpler language, outperformed monolingual English speakers on phonological processing tasks in English. However, for Greek-English bilinguals, learning a more phonologically complex language (English), actually hindered the phonological development in Greek.

A recent study conducted by Wang et al. (2006) investigated the role of phonological processing in word reading in Korean-English bilingual speakers in 1st, 2nd, and 3rd grades. Phonological processing tasks included onset-rime detection, phoneme deletion, real word naming, and pseudoword naming. The measures also included an orthographic choice task. The measures were administered in both Korean and English. The Korean language is an alphabetic system, like English, and therefore, the researchers predicted that Korean and English phonological processing would be similar. In terms of cross-language transfer, it was predicted that phonological skills in Korean would predict English word reading ability. Results supported the hypothesis that phonological processing skills in Korean would transfer to English. In other words, phonological processing skills in Korean were correlated with phonological processing skills in English. The key finding of this study was that phonological processing skills in Korean contributed to English word reading, over and above English phonological processing skills. Specifically, Korean phoneme deletion skill contributed a unique amount of variance in English pseudoword reading.

The majority of studies on cross-language transfer of phonological processing have focused on alphabetic writing systems. However, several have examined transfer from a non-alphabetic language (Chinese) to an alphabetic language (English). In a study of Chinese children (L1) learning English (L2), it was found that the phonological processing skill in Chinese that was most strongly related to English word reading performance was rhyme detection (Gottardo, Yan, Siegel, & Wade-Woolley, 2001). Consistent with prior findings in studies of alphabetic languages, phonological skill was correlated across both languages. Specifically, in this study, Chinese rhyme detection was correlated with English rhyme detection and phoneme deletion. More importantly, Chinese rhyme detection contributed unique variance to word reading, word identification, and phoneme deletion in English.

Wang et al. (2005) also investigated the transfer of phonological and orthographic processing from Chinese to English. Administering both phonological and orthographic tasks to Chinese-English bilingual children, results indicated that several correlations existed between the two languages. One of the most important findings for cross-language transfer, however, was that, independent of English phoneme deletion skill, Chinese tone processing was a significant factor in English pseudoword reading. The findings from these two studies are critical because they provide verification of cross-language transfer between two languages that do not share an alphabetic system. In other words, regardless of the two languages involved, there is evidence of cross-language transfer of phonological processing ability. Phonological knowledge in the L1 has been shown to transfer and facilitate word reading in the L2 (see Durgunoglu, 2002).

In a pioneer study specifically investigating phonological processing skill in Spanish and its relation to word reading in English, Durgunoglu et al. (1993) found that children with strong phonological skills in Spanish performed better on English real word and pseudoword reading tasks. The Spanish-speaking beginning readers who participated in the study were taught in bilingual education programs. These children were taught primarily in Spanish, with English taught as a second language. Therefore, these students had little English proficiency. The children were given assessments on letter identification, English and Spanish word recognition, tests of phonological awareness, and English and Spanish oral proficiency.

The results indicated that Spanish phonological awareness and word recognition predicted English word and pseudoword reading performance. Therefore, if a student has some word reading knowledge in Spanish, he or she will tend to perform better on reading tasks in English, transferring phonological skills. Strong phonological processing skills in Spanish have also been shown to facilitate phonological skill development in English (Denton et al., 2000; Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2004; Lindsey, et al., 2003). Regardless of the specific type of phonological processing, simply learning how languages work and acquiring some language processing strategies provides insight for language learning in the L2 (Denton et al., 2000; Dickinson et al., 2004). However, in the specific case of Spanish speakers learning English, these children were more successful on word reading tasks if they had at least some knowledge of English spoken language (Gottardo, 2002). If Spanish speakers used the same letter-by-letter decoding strategy as could be used in Spanish, their English word reading often would not result in real words.

In her study with 1st graders, Gottardo (2002) found that Spanish phonological processing explained the highest proportion of variance on English word reading for English-Spanish bilingual speakers. Lindsey et al.'s (2003) and Manis et al.'s (2004) studies with Spanish-speaking Kindergartners, 1st and 2nd graders learning English, found very similar results. The tasks administered in both studies included measures of vocabulary knowledge, word reading, phonological processing, rapid automatized naming, and pseudoword naming. Results from all of these studies supported the notion that phonological processing skills predict word reading in an L1, but also in an L2 (Gottardo, 2002; Lindsey et al., 2003; Manis et al., 2004). Because learning to read in English is such an important part of academic success, it is important to understand that phonological processing skills in the L1 can be transferred to L2 word reading (Cisero & Royer 1995; Durgunoglu et al., 1993).

Although research has consistently shown a strong cross-language transfer of phonological processing skills, the current study extends that research to focus on examining cross-language orthographic transfer. Very few studies have examined orthographic transfer. Does L1 orthographic knowledge have any relation to spelling in the L2? What influence does the L1 have on L2 spelling performance?

We know that orthography and orthographic knowledge do play a role in learning to read. In a study with very similar orthographies (Spanish and Portuguese), the Spanish-speaking children showed better performance on pseudoword reading than the Portuguese speakers, which may be attributed to the more shallow orthography of Spanish (Defior et al., 2002). Both Spanish and Portuguese have transparent orthographies, but Spanish is even more consistent and transparent than Portuguese. In order to examine reading acquisition differences between languages with subtle orthographic differences, the participants were administered several word reading tasks. Although the orthographic differences were subtle, Spanish-speaking children read faster than the Portuguese-speaking children. The Spanish speakers also made fewer errors in pseudoword reading.

Examining this effect in a slightly different light, looking at orthographic transfer from a non-alphabetic language to an alphabetic language, Wang and Geva (2003a) studied Chinese-speaking children learning English as a second language. Specifically, the study found that the Chinese children had difficulty spelling words with phonemes that did not exist in their native language. Some of the more difficult phonemes to spell correctly were digraphs, such as the /θ/ and /k/ in *thick,* which both the Chinese and English speaking children struggled with. Although English speaking children had more difficulty with *ck* than *th,* Chinese children had difficulty with both digraphs. Because the /θ/ phoneme does not exist in Chinese, this digraph caused the most difficulty in spelling.

In another study of Chinese-speaking children, these same researchers also found Chinese children had poorer performance in spelling pseudowords. In tests of real word spelling, Chinese children performed as well as English speakers. However, on tasks involving pseudoword spelling, Chinese children demonstrated poorer performance. These findings supported previous research in that Chinese children can rely on the "addressed phonology" route to spell real words, but in spelling pseudowords, Chinese children have difficulty mapping the phonemes to graphemes. Due to negative L1 transfer, therefore, they are unable to make use of the "assembled phonology" route

(Wang & Geva, 2003b). Therefore, regardless of the orthographic nature of the L1, students have difficulty learning to read and spell in English, a relatively deep orthography. One might assume learning to read or spell in English as an L2 would be difficult for children with Spanish as an L1.

While orthographic depth plays a role in how quickly children read words (Defior et al., 2002), there is doubt as to whether orthographic processing skill in an L1 predicts word reading and spelling in an L2. Durgunoglu (2002) suggests that orthographic patterns are language specific. With regard to Spanish and English, two languages of very different orthographic depths, there may be no cross-linguistic orthographic transfer. Study 1 attempts to determine whether orthographic processing skill in Spanish predicts English word reading and spelling. In addition, because of the relatively transparent nature of Spanish orthography, what effect, if any, does this consistent mapping of phoneme to grapheme have when learning to spell in an inconsistent orthography, such as English?

Recently, a few researchers have embarked on an interesting and potentially important line of research – the study of cross-language orthographic transfer in Spanish children learning English. The cross-language orthographic transfer from Spanish to English is influenced by many factors. There are several orthographic rules that exist in one language but not the other. For example, Spanish phonology has no /ʃ/ and English phonology has no /R/. Therefore, a Spanish-speaker learning to spell English would have to learn new phonemes (/ʃ/) and how they are spelled (e.g. /ʃ/ is represented by two letters), and remember that others do not exist (e.g. /R/, often written as rr, doesn’t exist as a separate sound).

Because the Spanish language has a fairly consistent phoneme-grapheme correspondence, Spanish speakers learning English must learn many more spelling rules. In this case, Spanish speakers are at a disadvantage, having to learn new phonemes as well as how to spell them. For Spanish speakers, learning to spell correctly in Spanish is fairly easy, assuming they know the grapheme-phoneme correspondence rules. However, for English speakers, spelling can prove to be a daunting task until age 11, when unusual spelling patterns cease to cause as much difficulty (Spencer, 1999). Because of the innately difficult orthography in English, young Spanish speakers who have recently mastered spelling in their L1 may continue to have some difficulty in their L2. When Spanish-speaking children read and write words in Spanish, they make almost no phonological errors (Defior et al., 2002). Nevertheless, phonology does play a strong role in the types of errors that are made as evidenced by the fact that some phonemes are often mispronounced, causing spelling errors.

Many of the Spanish-speaking children in the United States will have at least minimal oral language ability in English, and some will be quite proficient. Spelling errors that children commit when spelling English words could also be attributed to an "interlanguage" (Cronnell, 1985). For example, in a study of Mexican-American bilingual students, Cronnell (1985) investigated the types of spelling errors. Participants included 3rd and 6th grade children who spoke a non-standard form of English, labeled "Chicano English." This dialect of English is influenced by the Spanish language, even if the speaker does not actually speak Spanish. By analyzing writing samples from these 78 students, errors were divided into seven categories. These categories were not based solely on Spanish phonology and orthography, but also on grammatical structure. Also, the error categories in this study were defined by analyzing the frequency of the errors. Table 3 illustrates only three error categories; Spanish spelling, pronunciation of consonants, and pronunciation of vowels – those that are relevant to the current literature review. These three categories incorporate more than one possible phonologically or orthographically related error. The Spanish phoneme is listed with the Spanish spelling. Examples are given for each type of error. For example, in Spanish, the /i/ is spelled *i.* Therefore, the English word *clean* might be mistakenly spelled as *clin* (Cronnell, 1985). Some of the errors are unidirectional while others are bidirectional. The /tʃ/ and /ʃ/ sounds are interchangeable in Spanish and therefore, errors could be produced in either direction.

The results and consequent categorization of errors from Cronnell's (1985) study suggest that English spelling errors are often the result of language differences between Spanish, English, and "interlanguage." A strong argument emerges in favor of the development of English spelling instruction to help young Spanish readers become familiar with English orthographic rules. In fact, recent research found that bilingual children who received English-only instruction made no spelling errors exhibiting Spanish orthographic patterns (Rolla San Francisco et al.,2006). As children increase their familiarity with English orthography, the hope is that spelling errors will decrease, and therefore lead to better success in writing.

In order to assess their specific spelling ability in English (L2), Fashola et al. (1996) examined the spelling errors of Spanish-speaking elementary school students learning English. The study looked at predicted and nonpredicted errors made by both Spanish-speaking and English-speaking children. Predicted errors were consistent with

Table 3

Three of the Seven Error Categories from Cronnell (1985)

Error type	Phoneme		Error
Spanish spelling			
	/i/ (clean)	→	i (clin)
	/ɑ/ (rock)	→	æ (rack)
	/eɪ/ (making)	→	e (mekin)
	/s/ (once)	→	s (ones)
Pronunciation-consonants			
	Final clusters (bust)		nonexistent (bus)
	/tʃ/ (watch)	↔	/ʃ/ (wash)
	/ð/ (they)	↔	/d/ (dey)
	/s/ (price)	↔	/z/ (prize)
	/ŋ/ (going)	→	/in/ (goin)
Pronunciation-vowels			
	/ɛ/ (tell)	→	/ɑ/ (tall)
	/ə/ (up)	→	/a/ (op)
	/ər/ (were)	→	/ar/ (war)

the correct use of orthographic and phonological rules in Spanish and nonpredicted errors were other possible errors. There were eight categories of predicted errors. These errors are described in Table 4. It is important to note that while it appears that Spanish spelling possibilities are greater than the English ones, this is actually not so. Many of these phonemes do not actually exist in Spanish; therefore, the spelling possibilities, or errors, are increased to make up for these nonexistent phonemes. For example, the "all" cluster in English can be mistakenly represented by *al, o, ol,* or *oll.* These errors are actually a combination of English and Spanish orthographies, which is evidenced by the fact that /l/ is only spelled with an *l* in Spanish. Based on these two types of errors, Spanish students committed more predicted errors than the English speaking students. In other words, they applied Spanish spelling rules to the English words. Using error category 2 as an example, a Spanish-speaking child would spell the English word "hand" as *jand.* The results of Fashola and colleagues' (1996) study indicate that Spanish-speaking students make consistent errors in their English spelling and that these errors are based on Spanish phonological and orthographic rules. However, because no information was provided on the Spanish-speaking children's prior literacy experience in Spanish, we cannot assume that the errors were due to an influence of Spanish orthography. For Study 2, I identified the children who attended school in a Spanish-speaking country prior to their arrival in the United States, thereby exploring the effect of native language (L1) orthographic knowledge.

Another study investigating the spelling errors in English words by Spanish-speaking children was conducted by Rolla San Francisco et al. (2006). This study examined the relation of language of instruction and vocabulary knowledge on Spanish-

Table 4

Possible Spellings as Delineated in Fashola et al. (1996)

Category	Allophone	Expected spellings in English	Expected spellings for Spanish speakers*
1	/k/	ck, cc	c, k, qu
2	/h/	h	j
3	/sk/	sk	sc, squ
4	/b/	b	b, v
5	“all” cluster	al, all	al, o, ol, oll
6	/e/	a	ey, ei, ell
7	/u/ and /U/	oo	u
8	/i/	ee, ea	i

* Note that these spelling possibilities combine English and Spanish orthographic rules

influenced spelling errors. Like Fashola et al. (1996), this study also examined errors with the vowels /e/ and /i/, whereas Fashola et al.’s (1996) study examined /e/, /i/, and /u/. Table 5 presents the phonemes examined by Rolla San Francisco et al. (2006) and examples from the study.

Rolla San Francisco et al.’s (2006) study included first graders in a low-SES school. The bilingual children were divided into two groups: one receiving English-only instruction and one receiving bilingual instruction. All of the bilingual children spoke Spanish as well as, or better than, English, upon entering school. Therefore, the effect of

Spanish phonology on English spelling could be examined. However, if students had received prior instruction in Spanish reading and writing (i.e. very recent immigrants) the

Table 5

Vowel Phonemes Examined by Rolla San Francisco et al., (2006)

Phoneme	Example	English spelling	Spanish spelling
/e/	nade	nade, naid	neid, neyd
/i/	kipe	kipe	kaip, kayp

effect of orthography, obtained through this prior instruction, would also have to be taken into account. For example, a Spanish-speaking child in a Spanish language school, would learn that the /i/ sound is written with an *i.* Therefore, not only would the child have to distinguish between English and Spanish phonology, but also between their orthographic rules.

Results from this study indicated that both language of instruction and vocabulary knowledge have a significant effect on Spanish-influenced spelling. Only bilingual students receiving instruction in both English and Spanish demonstrated Spanish-influenced spelling. Spanish-speaking students receiving English-only instruction did not demonstrate any spelling errors attributable to Spanish orthography or phonology. In addition, Spanish vocabulary knowledge was a strong predictor of Spanish-influenced spelling; English vocabulary knowledge predicted English-influenced spelling. Rolla San Francisco and her colleagues concluded that Spanish-speaking children receiving even brief instruction in only English “blocked” negative transfer from Spanish, even for those children whose Spanish oral proficiency was stronger than their English proficiency.

These results suggest that for Spanish-English bilingual children, English-only instruction would eliminate Spanish-influenced spelling errors. However, like Fashola et al.'s (1996) study, Rolla San Francisco et al.'s study does not discuss any possible influence of Spanish literacy instruction, including specific instruction and intense exposure to Spanish orthography. Children who have received reading and writing instruction in Spanish may not be as able to impede negative transfer with brief exposure to English literacy instruction.

The current study will address the influence of both Spanish phonology and orthography on English word reading and spelling. In addition, I will examine the English vowel spelling errors of Spanish-speaking children who have received literacy instruction in their native language. All of the students in the current study receive English-only instruction; therefore, it will be interesting to determine whether the Spanish-speaking children continue to make Spanish-influenced errors in their English spelling.

No studies to date have examined the vowel sounds /e/, /i/, /aI/, and /u/ together. The /o/ is not included because it is pronounced and spelled similarly in both languages. Of the ten vowel phonemes shared by English and Spanish (monophthongs /a/, /ɛ/, /ɪ/, /o/, /u/; diphthongs /aI/, /e/, /aʊ/, /ju/, /ɔɪ/), I focused on four of them that are spelled differently in the two languages. Three of the phonemes are monophthongs (/e/, /i/, /u/) and one is a diphthong (/aI/). These four phonemes are traditionally referred to as "long vowel sounds" in English. In English, these vowel phonemes can be represented by avariety of graphemes and grapheme combinations. For example, the /e/ sound can be

Table 6

Possible Spellings for Vowel Sounds in English and Spanish

Phoneme	English spellings	Spanish spellings
/e/	*ai* (maid)	*ei*
	ay (day)	*ey*
	a-e (gate)	
	ey (grey)	
	eigh (weigh)	
	ei (rein)	
	ea (break)	
/i/	*ee* (seed)	*i*
	ea (meat)	
	ie (believe)	
	e-e (impede)	
	ei-e (caffeine)	
	ei (ceiling)	
/u/	*oo* (food)	*u*
	ue (blue)	
	u-e (rude)	
	ough (through)	
/aI/	*ie* (pie)	*ai*
	ye (bye)	*ay*
	y (my)	
	i-e (ride)	
	ei (seismic)	

spelled as *ai* in *maid*, *ay* in *day*, and *a-e* in *gate*, etc. The /i/ sound can be spelled *ee* as in *seed, ea* as in *meat, ie* as in *believe,* etc. The /u/ sound can be spelled as *oo* as in *food, ue* as in *due, u-e* as in *rude,* etc. Finally, the /aɪ/ sound can be spelled as *ie* as in *pie, ye* as in *bye, i-e* as in *ride,* etc. In Spanish, however, the phoneme /e/ can only be spelled *ei* or *ey;* the phoneme /i/ can only be spelled with an *i;* the phoneme /aɪ/ can be spelled *ai* or *ay;* and the phoneme /u/ can only be spelled with a *u.* Table 5 presents all possible spellings for the four vowel sounds in both languages.

Age of Acquisition and its Effect on Cross-Language Transfer

In addition to phonology and orthography, the age at which a language is acquired affects proficiency in any given language. People are able to learn their native languages with ease, because it is the language they have heard since birth and learned to speak early. However, in terms of learning an L2, age of acquisition plays a crucial role. In discussing L2 acquisition, it is important to review studies on age of acquisition, age of arrival, and age of exposure. These three terms are often used interchangeably, although they have distinct definitions. Age of acquisition refers to the age at which a child begins learning a second language. This term often encompasses the other two. Age of arrival refers specifically to the age at which the individual arrives in the country where the L2 is spoken. However, what if an individual arrives in the L2 country, stays for a year or two, returns to his or her country of origin, and later "arrives" again ten years later? Finally, age of exposure generally refers to the time at which a child is first exposed to the language, which could occur in a formal school setting or through living in the country where the L2 is spoken. These two scenarios are quite different levels of language exposure. When addressing age of acquisition, the majority of studies mention the Critical Period Hypothesis or the Sensitivity Period Hypothesis.

The Critical Period Hypothesis (CPH) plays a large role in second language acquisition (Flege, Yeni-Komshian, & Liu, 1999; Silverberg & Samuel, 2004). However, there is quite a bit of controversy about the age at which the critical period for learning an L2 ends. Hakuta, Bialystok, and Wiley (2003) cited several studies in their article arguing that the critical period ends anywhere from 5 to 15 years of age. Hakuta et al. (2003) suggest that there exist several factors, other than age of acquisition, that affect second-language learning. These factors include social and educational factors, as well as cognitive aging, which can impede the ability to learn new knowledge.

Due to the controversy surrounding the offset of the critical period, the Sensitivity Period Hypothesis (SPH) was proposed and is now generally used interchangeably with the CPH. While the CPH is based upon stringent offset, the SPH asserts a more gradual offset. Instead of the period for L2 learning ending abruptly at a certain age, the SPH emphasizes a slow decline in learning ability (Flege et al., 1999; Hakuta et al., 2003). Several studies have examined these hypotheses and found support in favor of the SPH (Flege et al., 1999; Hakuta et al., 2003).

Through an examination of census data, Hakuta et al. (2003) analyzed information from both Spanish and Chinese native speakers. The census asked participants to describe their English ability using five categories: “not at all,” “not well,” “well,” “very well,” and “speak only English.” Hakuta et al. (1999) also calculated age of acquisition for each participant. While results indicated a steady decline in language proficiency was correlated with increased age of acquisition, there was no evidence for an abrupt ending of L2 learning. Therefore, the results supported the notion of the SPH. The use of census data allows for an extremely large sample (2 million Spanish speakers and over 300,000 Chinese speakers (Hakuta et al., 1999)). This study, however, used self-report and no measures for actual oral or written proficiency, so it is difficult to be certain of the validity of the findings. One important measure of language proficiency is foreign accent, which was not measured. Flege et al. (1999) found that as age of arrival increased, foreign accents became more prominent.

Although the CPH and the SPH provide theoretical guidelines for ability to learn an L2, it has been shown that a simple measure of age of exposure cannot be used to predict L2 acquisition rate. When simply measuring age of exposure, several confounding variables may affect L2 learning and performance (Flege et al., 1999). Examples of confounding variables would include how often the L2 was used, years of residence in the foreign country, and whether the language was learned before arriving in the country. Motivation also plays a large role in how quickly and accurately the L2 is learned. An individual completely immersed in an environment where learning the L2 is necessary for everyday living would certainly learn more quickly than another individual who lived and worked in a community where the community members all spoke the L1. In other words, the extent to which the L2 was used, the amount or type of exposure to the language would certainly play more salient roles in language learning than when a person became exposed to the language (McDonald, 1987). Amount and type of exposure to a language can also be considered “level of proficiency.” Regardless of the age of acquisition or age of exposure, we are now looking at quality of language exposure, rather than simply quantity.

Study 1 does not distinguish between different levels of English exposure. The children in this study were reportedly native Spanish-speaking children who predominantly spoke Spanish at home, but were learning to read and spell in English at school. Study 2, however, examined only children who had arrived in the United States after receiving some formal schooling in their home country. While age of arrival varies for the participants, all of the children fall well within the accepted Sensitive Period for learning language.

In summary, the literature on the relation between phonological processing skills and reading is extensive. Less extensive is the research on orthographic knowledge and spelling. However, both phonological processing skills and orthographic knowledge have been shown to benefit reading and spelling in both English and Spanish. In fact, orthographic knowledge has been shown to contribute to word reading ability, independently of phonological processing skills. Good reading skills can enhance spelling, and learning to spell correctly can reciprocally enhance reading proficiency. Based on the Orthographic Depth Hypothesis and the Psycholinguistic Grain Size Hypothesis, it is believed that a Spanish speaking child would face difficulties in learning to read and spell in English. Word reading and spelling in Spanish, a relatively shallow and consistent orthography, requires knowledge of letter sounds and phonemic awareness. Conversely, reading in English is more complex. Uniformly, Spanish speaking children perform better on word reading tasks in Spanish than English speaking children do in English, in part due to English's deep orthography.

Based on the previous research conducted on the cross-language transfer of L1 phonological and orthographic processing skills in L2 learners, I offer several hypotheses for the current studies. The first study aimed to examine whether Spanish phonological and orthographic processing skills contribute a unique amount of variance to English word reading and spelling, after taking into consideration English phonological and orthographic processing skills. If a child is highly knowledgeable about Spanish phonological and orthographic rules, will this knowledge transfer to English word reading and spelling? The hypotheses for Study 1 are:

1. Spanish phonological processing skills will explain a significant amount of variance to English word reading and spelling in second and third grade Spanish speakers who are learning English, after English phonological and orthographic processing skills have been taken into consideration.
2. Spanish orthographic processing skills will explain a significant amount of variance to English word reading and spelling in second and third grade Spanish speakers who are learning English, after English phonological and orthographic processing skills and Spanish phonological processing skills have been taken into consideration.

The second study investigated whether Spanish-speaking children, who have received literacy instruction in Spanish, learning English make consistent errors in their spelling of English vowel sounds. What are these errors and are they consistent with Spanish phonological and orthographic rules? I hypothesize that:

3. Spanish-speaking children learning English will produce significantly more spelling errors on vowels that are spelled differently in English and Spanish, than will their English speaking counterparts. These errors will be consistent with

Spanish orthography, thus demonstrating backwards transfer, or L1 influence on L2 spelling.

CHAPTER 3: STUDY 1 - CROSS-LANGUAGE PHONOLOGICAL AND ORTHOGRAPHIC TRANSFER

Overview

Study 1 examined the cross-language transfer of phonological and orthographic processing skills of Spanish-speaking (L1) children who are learning to read and spell in English (L2). I was interested in determining whether a) Spanish phonological processing skills contribute a unique amount of variance to English word reading and spelling, over and above that due to English phonological and orthographic processing skills and whether b) Spanish orthographic processing skills account for a unique amount of variance in English word reading and spelling, after taking English phonological and orthographic processing skills into account. Participants were tested using phonological, orthographic, reading, and spelling tasks, in both English and Spanish. Measures included an oral language proficiency measure, onset and rhyme detection, phoneme deletion, orthographic choice, homophone choice, real word and pseudoword reading, and real and pseudoword spelling tasks. A demographic information survey was also completed. A native English-speaking control group was also tested to serve as a comparison for performance on the English language tasks.

Method

Participants

Eighty-nine native Spanish-speaking children who are learning English (39 boys and 50 girls) and 53 native English-speaking children (27 boys and 26 girls) were recruited from five public elementary schools in the suburbs of a large city. The participants in the English group were in Grade 2 (n = 32, mean age: 7.74, SD = .40) and

Grade 3 (n = 21, mean age: 8.39, SD = .49) and the participants for the Spanish group were also in Grade 2 (n = 42, mean age: 7.82, SD = .55) and Grade 3 (n = 47, mean age: 8.54, SD = .68). Due to the demographic nature of the schools that participated in the study, the native English-speaking comparison group consisted of 92% African-American, 2% Caucasian, and 6% Asian American. While I attempted to obtain a sample that was ethnically diverse, the population of the schools did not provide that opportunity—our sample is representative of the schools' population (51% Hispanic, 46% African-American, 1.3% Caucasian, and 2.2% Asian American).

Parents of the children in the Spanish-speaking group were asked to fill out a Demographic Survey Form that asked for information on language use, including language spoken at home and parents' English proficiency (see Appendix C). The Spanish-speaking children in this population typically speak Spanish at home, but are learning English at school; Spanish was the first language learned. Almost 30% of these participants were born in Spanish-speaking countries, while the majority was born in the United States. Most of the children speak both English and Spanish at home, and in many cases, the parents of the Spanish-speaking children speak little English.

English Tasks

Oral Language Proficiency

Children's English oral language proficiency was measured by a modified version of the Peabody Picture Vocabulary Test – Third Edition (PPVT-III; Dunn & Dunn, 1997). Twenty items were chosen from the PPVT-III for this study. Items were chosen from various levels of difficulty. Two words were chosen from the word list appropriate for ages 6-7, four words were chosen from the list appropriate for ages 8-9. Eight words were chosen from the list appropriate for ages 10-11, and finally, six words were chosen from the word list for ages 12-16. This task was similar to the task used in Wang et al. (2006). Pilot testing indicated that a few of the items used in Wang et al. (2006) may have been too difficult for the population of children in the current study; therefore, the two most difficult items (ages 17 +) were replaced with two items from the word list appropriate for ages 6-7. (See Appendix D for a list of items.)

Experimental Phonological Tasks

These experimental tasks were designed for testing English phonological skills. The tasks include onset detection, rhyme detection, and phoneme deletion. The English tasks are the same as those used by Wang, Perfetti, and Liu (2005) and Wang, Park, and Lee (2006). These phonological tasks were found to be both reliable and valid (Wang et al., 2006). Both the onset and rhyme detection tasks presented participants with three one-syllable nonwords in a verbal format. The nonwords ranged from 3-5 letters in length. Items from both tasks are listed in Appendix D. Items from the onset and rhyme tasks were similar to those used by Bradley and Bryant (1983), Stanovich, Cunningham, and Cramer (1984), and Gottardo (2002). Items from the phoneme deletion task were similar to those used by Wade-Woolley (1999) and Gottardo, Yan, Siegel, and Wade-Woolley (2001). A native English speaker recorded the stimuli via a digital voice recorder, with a time interval of three seconds between the three words in each item. There was an interval of seven seconds between each of the items to allow children sufficient time to respond. For all of the tasks, children were tested individually in quiet rooms. Children listened to the tasks on a laptop computer via a set of headphones, to reduce the risk of distraction and outside noise. Three practice items were given for each task. If the participants answered incorrectly on practice items, the researcher simply repeated the task instructions and helped the child choose the correct answer. No help or feedback was given on the actual tasks. Performance on the three tasks, rhyme-detection, onset-detection, and phoneme deletion were significantly correlated to one another (all *r*s $> .27$, $p < .01$), thereby demonstrating construct validity among the phonological awareness tasks.

Rhyme-detection task. This task examined children's ability to detect the item that has a different rhyme in spoken English words. Of the 15 items that were used, 4 of the items had consonant clusters as onsets, while the remainder contained a single consonant as the onset. Three cards with the numbers "1," "2," and "3" were placed on the desk in front of the participant to reduce the memory load from listening to and remembering the three words in each task item. The instructions for the task were, "Now listen carefully. You will hear 3 words that are not real words. The first word will correspond to the '1' sign on your desk. The second word will correspond to the '2' sign. And the third word will correspond to the '3' sign. Two of these words end with the same sound. They rhyme. One of the words doesn't rhyme with the other words. Please tell me which one doesn't rhyme by pointing to one of the numbers on your desk. Let's practice." For example, the child heard "bap," "dap," "sler," and was asked to point to the number that corresponded to the word that did not rhyme with the other two words.

Onset-detection task. This task examined children's ability to differentiate between English words with different initial phonemes, or onsets. The procedure used for the rhyme-detection task was used. Fifteen items were used in this task. For each of the items, the onset consisted of a single consonant. The instructions for this task were, "Now listen carefully. Remember the rhyming words? Well, this time, I am going to say 3 words. Two of these words start with the same sound. One of the words starts with a different sound than the other two words. Please tell me which one doesn't start with the same sound by pointing to one of the numbers on your desk. Let's practice." For example, the child heard "bap," "bam," "gonk," and was asked to point to the number that corresponded to the word that did not begin with the same sound as the other two words.

Phoneme deletion task. The purpose of this phonological processing task was to assess children's ability to manipulate phonemes. Nonwords were used in this task to control for lexicality effects. A native English speaker recorded the stimuli and these words were presented via laptop computer. The child heard a word first and was asked to repeat it. Then the child was asked to remove a sound from the word. The child heard, for example, "Say *mab.* Now say it again but don't say /b/." The recording paused for 5 seconds, allowing the child to repeat the word. There was a 10-second interval between each item. This task consisted of 20 items. The position of the phoneme to be deleted was varied in order to test the difficulty level associated with phoneme positions. There were two items each for beginning and ending consonants, four items each for the first phoneme of a beginning consonant cluster, the second phoneme of a beginning consonant cluster, the first phoneme of a final consonant cluster, and the second phoneme of a final consonant cluster.

Children's responses were recorded via a digital voice recorder and scored as follows: correct (1) if the target word was repeated correctly and the target phoneme was deleted accurately or if the target word was repeated incorrectly but the target phoneme was deleted accurately; incorrect (0) if the target phoneme was not deleted accurately, regardless of the accuracy of the repeated word. For example, if the child was asked to repeat the target word *mab* without the /b/ and the child said, *nab…na*, it would be scored as correct (1) because the /b/ was deleted correctly.

Experimental Orthographic Tasks

Orthographic choice task. The purpose of this task was to examine children's sensitivity to orthographic patterns. The child was presented with a pair of nonwords on a card. The child was asked to point to the one that looked more like a real word. An example of a pair of nonwords is "beff" and "ffeb." In this case, the first word, "beff," looks more like a real word. The items in this task, which were the same as those used in Wang et al. (2006), were similar to those used by Treiman (1993) and Siegel, Share, and Geva (1995). The original task consisted of 28 items. However, to ensure that the task was assessing pure orthographic knowledge, based on Wang et al.'s (2005) technique, I eliminated items that were phonologically illegitimate (i.e., not pronounceable.) Wang et al. (2005) asked 14 native English-speaking undergraduate students to rate the phonological legitimacy of the items. Students rated the original 28 pairs of words on a 3-point scale: 1 for items that were phonologically legitimate and occurred frequently; 2 for items that were phonologically legitimate but occurred rarely; and 3 for items that were phonologically illegitimate. Following Wang et al. (2005), I deleted the ten items that received ratings of 2.5 or higher. This resulted in a remainder of 18 items.

Cronbach's Internal Consistency Reliability alpha was relatively low for the original task, so I further conducted a criterion test on the 18 items to make sure that in each pair, one of the words did in fact look more like a real word. Fifty English-speaking undergraduate students rated a list of 80 nonwords. They were asked to check the words that looked like real English words. Words that were considered to look like English words by at least 70% of the students were used as the target correct answers. Words receiving less than 20% of the students' vote were considered as the incorrect choices. The results of this process left only 13 of the original words; therefore, I included five more pairs, based on the results of the criterion test for a total of 18 items. These five pairs of words fit the criterion that one of the items in each pair was more like a real word. The words from the criterion test that were added are phonologically legitimate (i.e. pronounceable), receiving a phonological legitimacy rating of below 2.5. Eleven undergraduate students rated the words for their phonological legitimacy, following Wang et al.'s (2005) procedure (see Appendix E.) A list of the items included in the criterion test, the ratings for each item, and the final list of items used is found in Appendix F. Two practice items were given.

Homophone choice task. The homophone choice task (Olson, Kliegl, Davidson, & Foltz, 1985; Cunningham et al., 2002) was used to assess children's orthographic knowledge, while controlling for phonology. Twenty-three pairs of phonologically similar letter-strings were presented to the participants. Each pair of words was presented on a separate card. Each pair contains one real word and one pseudohomophone. In other words, both words are pronounced the same, but only one is spelled correctly (e.g., *brain* and *brane*). The participants were asked to point to the word that was spelled correctly. Two practice items were given. Performance on the homophone choice task was significantly correlated with the orthographic choice task, $r = .62$, $p < .01$; the two orthographic awareness tasks are strongly correlated, providing evidence of construct validity.

Reading Tasks

Real word reading. The purpose of this task was to examine word recognition skill. The child was shown one or two words at a time on a card. The child was then asked to read the word aloud. The materials consisted of 35 words from the word recognition subtest of the Wide Range Achievement Test-Revised (WRAT-R; Jastak & Jastak, 1984). Five practice items were given and responses were recorded via a digital voice recorder. Only pronunciations that included all phonemes were accepted as correct (1 = correct; 0 = incorrect). After five consecutive incorrect responses, testing for this particular task was stopped. As evidence of construct validity between the two reading tasks, performance on the real word reading task was significantly correlated with performance on the pseudoword reading task, $r = .76$, $p < .01$.

Pseudoword reading. The child was shown one or two items at a time on a card and was asked to sound out the letter string aloud. Five practice items and 40 test items were given. Materials were from the Word Attack subtest of the Woodcock Reading Mastery Test-Revised (Woodcock, 1987). Responses were recorded via a digital voice recorder. Only pronunciations including all phonemes were scored as correct. As with the real word reading task, after five consecutive incorrect responses, testing was stopped.

Spelling Tasks

Real word spelling. The purpose of the spelling task was to investigate whether Spanish phonological and orthographic processing skills contributed to performance on English spelling. The task consisted of 48 words that varied in length from two to six letters. One word contained two letters; five words consisted of three letters; 32 words consisted of four letters; and nine words consisted of five letters. A native English female voice read the target spelling word, used it in a sentence, and repeated the word again. Children were given approximately ten seconds to write the word. The words were rated for familiarity and difficulty by six second and third grade teachers. This method was used in previous research with bilingual populations when designing comparable tasks in languages other than English (e.g., Wang et al., 2006). Three of the teachers taught in the same school district in which the research is being conducted. The other three were from a neighboring school district. Teachers were asked to rate the words based on the following five-point scale: 1 = known - I think every student (including ESL) knows this word and can use it productively; 2 = very familiar - I think most students (including ESL) (roughly 80% and more) are familiar with this word; 3 = familiar – I think many students (including ESL) (roughly 60% - 80%) are familiar with this word; 4 = not likely familiar – I think many students (including ESL) are not familiar with this word; and 5 = not at all familiar – I don't think most students (including ESL) have seen this word before. The final list of words had an average familiarity rating of 2.29. Familiarity ratings for each spelling item and the range of ratings are presented in Appendix D.

Pseudoword spelling. An English pseudoword spelling task was used to control for the possibility of children spelling words based on whole word knowledge. In spelling real words, children can use lexical information, as well as sight word knowledge, to correctly spell words. Therefore, by using pseudowords, the children had to use spelling rules to spell the words. By incorporating a pseudoword spelling task that examined the same vowel sounds as in the real word spelling task, I was better able to determine whether children had internalized English orthographic rules. Of the 48 items, three words consisted of three letters, 35 words consisted of four letters, and ten words consisted of five letters. Items for all of the English language spelling tasks are presented in Appendix D. A native English female voice read the target word twice. Children were given approximately ten seconds to write the word. The two spelling tasks were also significantly correlated, $r = .83$, $p < .01$.

The spelling task was coded via the coding scheme incorporated by Wang and Geva (2003a), which was the same scheme used in Liberman, Rubin, Duques, and Carlisle (1985) and Mann, Tobin, and Wilson (1987). The coding scale is described in Table 7, using the word "brick" as an example:

Table 7
Spelling Error Coding Scheme

Score	Description	Example
0	Random letter, or random string of letters	d
1	Consonant or vowel, but not initial one	ik
2	Includes initial consonant and other segments, but not segments listed in categories 3, 4, or 5	brc
3	All salient phonemes or phonetic segments; must include a vowel	brek
4	Transitional-vowel combination attempted, silent letters employed; errors on doubling letters; all phonemes represented	brik
5	Correct spelling	brick

Spanish Tasks

Oral Language Proficiency

Spanish-speaking children's oral language proficiency in Spanish was also assessed using the Test de Vocabulario En Imágenes Peabody (TVIP; Dunn, Lugo, Padilla, & Dunn, 1997), the Spanish language version of the PPVT-III. A total of 20 words were chosen from the TVIP to create this task. Two words were chosen from the word list appropriate for ages 6-7. Four words were chosen from the word list appropriate for ages 8-9, eight words were chosen from the list for ages 10-11, five were chosen from the list for ages 12-13, and one was chosen from list for ages 14-adult. The words chosen for this task are comparable to the words used in the English version. Items were taken from word lists appropriate for the same age groups in both language versions. (See Appendix G for a list of all items).

Experimental Phonological Tasks

These experimental tasks were designed for testing Spanish phonological skills. The tasks included onset detection, rhyme detection, and phoneme deletion. The Spanish tasks were designed to be parallel to the English tasks. Specifically, the number of task items and the time interval between words and items were the same as in the English tasks. Procedures for these tasks were the same as for the English version. The instructions were also the same; however, they were provided in Spanish. The instructions and task items were recorded by a native Spanish-speaking female. Items from both tasks are listed in Appendix G. As with the English phonological awareness tasks, performance on the three Spanish tasks, rhyme-detection, onset-detection, and phoneme deletion were significantly correlated to one another (all rs > .25, $p < .05$), thereby demonstrating construct validity among the Spnaish phonological awareness tasks.

Rhyme-detection task. This task consisted of 15 items. To tap into phonological processing skills in Spanish, approximately half of the items (7) contained unique

Spanish phonemes. Of these seven items containing phonemes that have unique spellings in Spanish, six contained unique vowel sounds (/uɛ/, /ua/, /iɛ/, /i/, /eɪ/) and one contained a unique consonant (/ɹ/). About half of the items (8) contained phonemes shared by both Spanish and English. Only one of the items had a consonant cluster as the onset (trat, blim, clat) while the remainder contained a single consonant as the onset. The nonwords were derived so they could not represent real words in English or in Spanish.

Onset-detection task. Fifteen items were used in this task. I attempted to create nonwords with onsets that were unique in Spanish; however, this was too difficult since most beginning consonants exist and are pronounced similarly in both English and Spanish. Therefore, the onsets of the words in each item were shared by both English and Spanish (e.g. /m/, /p/, /l/). For each of the items, the onset consisted of a single consonant. I also aimed to derive nonwords that were also nonwords in English. Therefore, the nonword could not be easily mistaken for a real English word.

Phoneme deletion task. Nonwords were used in this task to control for lexicality effects. A native Spanish speaker recorded the stimuli and these words were presented via a laptop computer. The child heard a word first and was asked to repeat it. Then the child was asked to remove a sound from the word. The child heard, for example, "Di *nip.* Ahora, dila otra vez, pero no di el /n/." As with the English version, the child was given 5 seconds to repeat the target word. There was a 10-second interval between each item. This task consisted of 20 items. The position of the phoneme to be deleted was varied in order to test the difficulty level associated with phoneme positions. To ensure comparability between the two language versions, the variation of phoneme positions followed the same pattern as the English version. There were two items each for beginning and ending consonants, four items each for the first phoneme of a beginning consonant cluster, the second phoneme of a beginning consonant cluster, the first phoneme of a final consonant cluster, and the second phoneme of a final consonant cluster. Children's responses were recorded via a digital voice recorder and scored as correct (1) or incorrect (0) (see coding description for English phoneme deletion for a more detailed description).

Experimental orthographic tasks

Orthographic choice task. The child was presented with a pair of nonwords on a card. The child was asked to point to the one that looked more like a real word. The task consisted of 18 items. Seven of the words contained the following letters, unique to Spanish orthography: rr, ll, and ñ. Eleven of the words contained letters used in both English and Spanish orthography. The placement of the letters within each word for each item determined whether the word followed Spanish orthographic rules. The consonant doublet, *rr,* cannot appear at the beginning of a word and must appear between two vowels. Therefore, in the word pair "rron" and "arro," the second word follows Spanish orthographic rules. In the word pair "quin" and "quan," the first word follows Spanish orthographic rules because the consonant cluster *qu* can not appear before an *a,* only before *e* and *i.* Two practice items were given.

Upon conducting statistical analyses, I found that Cronbach's reliability alpha for the Spanish orthographic processing task was -0.03. The negative alpha indicates that the items may not form a useful single scale because they do not measure the same thing (Nichols, 1999). In addition, performance on the orthographic choice task was not significantly correlated with the homophone choice task, demonstrating a lack of construct validity. The purpose of the Spanish orthographic choice task was to determine native Spanish-speaking children's ability to identify a non-word that utilized correct Spanish orthographic rules. However, while the children in this sample spoke Spanish as their native language, only some of them could read and write it (26 out of 89; 29%). Therefore, we also cannot assume native Spanish-speaking children possess enough orthographic knowledge to perform well in a task such as the orthographic choice task utilized in this study.

In fact, the native Spanish-speaking children's performance on Spanish orthographic choice task yielded only 57.12% correct answers, while their performance on the English orthographic choice task resulted in 77.59% correct. In studying reading and spelling in English speakers, it is argued that tasks designed to tap into orthographic processing skills are not independent of reading experience (see Burt, 1996). Of the common orthographic processing tasks (e.g. orthographic choice, homophone choice, spelling recognition, word finding) orthographic choice can be considered the most difficult. Burt (1996) describes this task as requiring memory for word-specific orthography, which demands the most reliance on reading experiences. Assuming that this is true of native English-speaking children reading and spelling in English, I suggest that a Spanish orthographic choice task, as originally created for the current study, would be even more difficult for native Spanish-speaking children than an English task for native English speakers. The majority of their exposure to print would be in English. Therefore, I ultimately decided to delete this measure and focus on the Spanish homophone choice task as a possible predictor of English word reading and spelling.

Homophone choice task. The Spanish version of the homophone choice task was designed to contain comparable items to the English version. The pairs of words and nonwords were chosen because they are phonologically similar, but orthographically different. For example, the word *cinco* (/sinko/) was paired with the phonologically similar letter string cinko. In this pair, the target phoneme is the second *c*, which is pronounced /k/. The items contain the following phonologically similar phonemes: *c, k,* and *qu* for /k/; *c, s,* and *z* for /s/; *i* and *y* for /i/; *ll ,* and *y i* for /i/; and *ñ* and *ni* for /ñ/. Children were asked to point to the word that was spelled correctly. As with the English version, two practice items were given.

Reading Tasks

The purpose of the Spanish real word and psuedoword reading tasks was to serve as comparisons for performance on the English versions. The scores were used to examine correlations between performance in the two languages. Performance on the two Spanish reading tasks were strongly correlated, $r = .96$, $p < .01$.

Real word reading. The child was shown one word at a time on a card. The child was then asked to read the word aloud. The materials consisted of 35 words. In order to ensure that the words were varied in levels of difficulty, three second and third grade Spanish teachers were asked to rate the difficulty level of each of the words. The real word item list was created to include ten words judged as “easy,” 15 as “moderate,” and ten as “difficult.” The teachers rated the words on a scale of 1 (known) to 5 (not at all familiar). The mean ratings for the categories were: easy words = 1.1; moderate words = 2.23; and difficult = 3.85. As the level of difficulty increased, words increased in length from one syllable to four and five syllables. The criterion for stopping both word reading tasks was the same as for the English version. Testing was discontinued after five consecutive incorrect responses.

Pseudoword reading. The child was shown two items at a time on a card and was asked to sound out the letter string aloud. Five practice items and 40 test items were given. Pseudowords were created by the researcher. Each of the words is phonologically and orthographically legitimate; therefore, each word can be read and pronounced. Responses were recorded via a digital voice recorder and, like the English pseudoword reading task, only pronunciations including all phonemes were scored as correct.

Spelling Tasks

As with the word reading tasks, scores from the Spanish real word and pseudoword spelling tasks were used to examine correlations between performance in the two languages. As with the Spanish reading tasks, performance on the two Spanish spelling tasks was strongly correlated, $r = .94$, $p < .01$.

Real word spelling. The real word spelling task consisted of 48 Spanish words. Items were rated by three 2nd and 3rd grade Spanish teachers using the same rating scale as for the English task. Item difficulty ratings were averaged; difficulty ratings were comparable to the words in the English spelling task, at 2.31. However, more of the Spanish items contained two syllables, whereas all of the English items had only one syllable. The Spanish language contains fewer single syllable words than English (Ferreiro, 1990). The Spanish spelling task consisted of 13 one-syllable words, 34 two-syllable words, and one three-syllable word. The 20 filler items contained Spanish semi-vowels (y as in *yes,* and w as in *well)* and diphthongs (/ia/, /oi/, /ui/, and /au/). A native

Spanish female voice read the target spelling word, used it in a sentence, and repeated the word again. Children were given approximately ten seconds to write the word.

Pseudoword spelling. The words followed Spanish orthographic rules and were comparable to the items used in the English version. The pseudoword spelling task consisted of 48 nonwords. The items included 18 one-syllable words, 29 two-syllable words, and one three-syllable word. This task, as with the English pseudoword spelling task, should minimize the occurrence of spelling words through memorization. Items for all Spanish language tasks are presented in Appendix G.

Procedure

Classroom teachers and reading specialists at each of the elementary schools aided in distributing parental consent forms to the students. Teachers were given a stipend for their time and effort. After parental consent forms were collected, I began the data collection. Four trained research assistants (three bilingual Spanish-English speakers and one native English-speaker), as well as the Spanish-English bilingual researcher, administered the tasks to all of the participants. A bilingual Spanish-speaking research assistant called each of the parents on the telephone to obtain the information requested on the Demographic Information Survey.

Each child was tested individually in a quiet room located in their school. The English speaking group was tested in one 1-hour session. The Spanish-speaking group was tested in two separate 1-hour sessions. One session was devoted to English tasks and the other, to Spanish tasks. The order of the two sessions, English and Spanish versions, as well as the tasks within each session, were counterbalanced among the Spanish-speaking children. However, within the phonological awareness tasks, the three tasks were not counterbalanced. These items were administered in a fixed order: rhyme detection, onset detection, and phoneme deletion. Due to the relative difficulty of phoneme deletion in relation to onset and rime detection, I preferred that children did not perform this task first. The two sessions for Spanish-speaking children were spread over a period of at least 3 days. Children were given a 5-minute break in the middle of each testing session. They were also given school-related gifts of appreciation for their participation in the study at the end of each testing session, such as pencils, stickers, and markers.

Data Coding

The researcher and one trained research assistant coded all of the spelling tasks. The research assistant was trained and then coded the spelling tasks of 26 participants independently – 18% of the total number of spelling tasks. The mean interrater reliability for real word spelling and pseudoword spelling was 94.1% and 93.0%, respectively. All disagreements were resolved by conferencing.

Results

Means and standard deviations of percentages of correct answers for the English and Spanish tasks by language group and grade are shown in Table 7. Scoring for the spelling tasks was on a scale of 0 (random string of letters) to 5 (correct); therefore, the average scores based on this 5-point scale are presented. Overall, English language and word reading skills tended to improve from Grade 2 to Grade 3. Native English-speaking children in Grade 3 performed significantly better on English tasks than in Grade 2 on real word reading, $t(51) = 2.90$, $p < .01$. Native Spanish-speaking children

Table 8

Means and Standard Deviations of Percentages of Correct Answers for All English and Spanish Tasks by Language Group

	Reliability (Cronbach's Alpha)	Spanish-English Bilingual Grade 2	Spanish-English Bilingual Grade 3	English Grade 2	English Grade 3
English					
PPVT	.59	46.79 (14.05)	51.49 (19.41)	54.69 (13.26)	60.24 (10.89)
Rhyme Detection	.68	68.89 (19.24)	71.35 (15.53)	69.58 (16.67)	77.78 (17.43)
Onset Detection	.64	61.43 (15.83)	64.26 (21.33)	61.04 (21.16)	61.27 (17.84)
Phoneme Deletion	.77	30.71 (17.59)	33.83 (22.37)	38.75 (17.83)	37.86 (20.41)
Orthographic Choice	.63	73.68 (14.57)	80.61 (12.79)	76.91 (15.59)	84.39 (9.23)
Homophone Choice	.82	77.74 (18.38)	89.73 (12.14)	87.09 (12.47)	92.34 (10.46)
Real Word Reading	.88	30.54 (11.30)	44.26 (15.88)	34.82 (10.55)	43.81 (11.76)
Pseudoword Reading	.95	32.74 (23.65)	46.44 (24.99)	35.70 (22.38)	43.81 (24.91)
Real Word Spelling*	.97	3.78 (.96)	4.15 (.87)	4.09 (.72)	4.39 (.56)
Pseudoword Spelling*	.96	3.10 (.89)	3.40 (.89)	3.46 (.82)	3.42 (.95)
Spanish					
TVIP	.49	32.86 (12.20)	42.13 (13.70)		
Rhyme Detection	.81	70.16 (22.10)	74.61 (23.41)		
Onset Detection	.67	61.43 (18.89)	63.40 (20.71)		
Phoneme Deletion	.84	26.31 (18.74)	41.28 (25.33)		
Orthographic Choice	-.03	56.22 (11.97)	57.92 (9.39)		
Homophone Choice	.60	62.42 (12.73)	75.21 (12.75)		
Real Word Reading	.98	45.71 (37.33)	76.60 (27.82)		
Pseudoword Reading	.98	42.22 (40.36)	67.36 (30.59)		
Real Word Spelling*	.99	3.46 (1.01)	4.15 (1.23)		
Pseudoword Spelling*	.98	2.95 (1.06)	3.45 (1.13)		

* Spelling scores are reported as averages, based on a scale of 0 (random string of letters) to 5 (correct).

also performed significantly better in Grade 3 than in Grade 2 on several Spanish tasks including oral vocabulary $t(87) = 3.35$, $p < .001$, phoneme deletion, $t(87) = 3.14$, $p < .01$, homophone choice, $t(87) = 4.73$, $p < .001$, and real word reading, $t(23) = 2.36$, $p < .05$. Native Spanish-speaking children's performance on English tasks was significantly better in Grade 3 than Grade 2 on the orthographic choice task, $t(87) = 2.39$, $p < .05$, the homophone choice task, $t(87) = 3.67$, $p < .001$, real word reading, $t(87) = 4.64$, $p < .001$, and pseudoword reading, $t(87) = 2.65$, $p < .01$. While both language groups showed improvement in all tasks from Grade 2 to Grade 3, with the exception of phoneme deletion for English speakers, not all of the changes reached statistical significance. To increase the number of participants for the correlations and regression analyses, I combined the children from both grade levels.

Correlations Among the Variables

Within Language

Correlations among all of the English and Spanish tasks are shown in Table 8. Within English language tasks, I observed many significant correlations. English rhyme detection, phoneme deletion, orthographic choice, and homophone choice were all very strongly correlated with English real word and pseudoword reading and English real word and pseudoword spelling (all *r*s > .4, $p < .01$). English onset detection was also significantly correlated ($r = .31$, $p < .05$) with real word reading. All of the English phonological and orthographic tasks were statistically correlated with English pseudoword reading, real word and pseudoword spelling (all *r*s > .35, $p < .01$).

For the Spanish tasks, phoneme deletion was significantly correlated with real word reading ($r = .53$, $p < .01$), pseudoword reading ($r = .46$, $p < .05$), real word spelling

($r = .65$, $p < .01$), and pseudoword spelling ($r = .59$, $p < .01$). Homophone choice was significantly correlated with both real word and pseudoword reading and spelling (all rs > .65, $p < .01$).

Across Languages

Examining correlations across languages, I found that Spanish rhyme detection and phoneme deletion were significantly correlated with English real word reading (all rs > .39, $p < .01$). Spanish homophone choice was also significantly correlated with English real word reading ($r = .56$, $p < .01$). Spanish rhyme and onset detection and phoneme deletion were significantly correlated with English pseudoword reading (all rs > .27, $p < .01$). Spanish homophone choice was also significantly correlated with English pseudoword reading ($r = .47$, $p < .01$). For Spanish phonological and orthographic processing tasks and English spelling tasks, I found that Spanish rhyme and onset detection, and phoneme deletion were significantly correlated with English real word spelling (all rs ≥ .29, $p < .01$) and Spanish homophone choice was also significantly correlated with English real word spelling ($r = .38$, $p < .01$). Spanish rhyme and onset detection, and phoneme deletion were also significantly correlated with English pseudoword spelling (all rs ≥ .41, $p < .01$) and finally, Spanish homophone choice was significantly correlated with English pseudoword spelling ($r = .35$, $p < .01$).

Regression Analyses

The purpose of Study 1 was two-fold: 1) to examine whether Spanish phonological processing skills predicted English word reading and spelling, after English phonological and orthographic processing skills were taken into consideration and 2) to examine whether Spanish orthographic processing skills predicted English word reading

Table 9

Correlations Among Spanish and English Variables for Spanish speakers, Including Age

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
								English tasks											
1. Age	---																		
2. PPVT	.208*	---																	
3. Rhyme detection	.070	.342**	---																
4. Onset detection	.233**	.268**	.456**	---															
5. Phoneme deletion	.052	.285**	.434**	.361**	---														
6. Orthographic choice	.150	.266**	.469**	.326**	.304**	---													
7. Homophone choice	.246**	.386**	.498**	.362**	.237**	617**	---												
8. Real word reading	.277**	.313*	.417**	.309*	.520**	.480**	.580**	---											
9. Pseudoword reading	.137	.202*	.571**	.371**	.482**	.493**	.524**	.762**	---										
10. Real word spelling	.094	.380**	.520**	.359**	.464**	.546**	.720**	.694**	.688**	---									
11. Pseudoword spelling	.010	.380**	.540**	.378**	.597**	.505**	.520**	.659**	.717**	.832**	---								

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
								Spanish tasks												
12. TVIP	.377**	.120	-.003	.190	.159	-.110	.089	.228*	.143	.026	.058	---								
13. Rhyme detection	.098	.327**	.620**	.352**	.374**	.381**	.277**	.396**	.481**	.375**	.506**	.224*	---							
14. Onset detection	.038	.284**	.371**	.360**	.195	.317**	.284**	.318	.277**	.285**	.407**	.110	.509**	----						
15. Phoneme deletion	.267*	.232*	.443**	.368* *	.611**	.263*	.385**	.617**	.589**	.501**	.583**	.316**	.478**	.246*	---					
16. Orthographic choice	.055	.088	.088	.082	.112	-.024	-.055	.178	.188	-.082	-.052	.125	.028	.041	.207	---				
17. Homophone choice	.264*	.181	.098	.212*	.071	.235*	.409**	.560**	.469**	.383**	.353**	361**	.197	.059	.376**	.093	---			
18. Real word reading	.321	.022	-.153	-299	.112	.144	.199	.674**	.457*	.378	.343	.390	.117	.076	.527**	-.117	.732**	---		
19. Pseudoword reading	.305	-.078	-.221	.257	.072	.072	.075	.571**	.330	.236	.202	.373	.039	.115	.460*	-.060	.655**	.966**	---	
20. Real word spelling	.153	.220	.074	.396*	.284	.270	.342	.644**	.572**	.604**	.688**	.197	.159	.166	.648**	-.065	.848**	.813**	.784**	---
21. Pseudoword spelling	.061	-.020	.025	.274	.199	.161	.157	.582**	.474**	.477*	.473**	.217	.182	.211	.593**	-.070	.726**	.853**	.841**	.942**

* $p < .05$. ** $p < .01$. *** $p < .001$

and spelling, over and above the contribution made by English phonological and orthographic processing skills and by Spanish phonological processing skills. In order to investigate this cross-language phonology and orthography prediction from Spanish to English word reading and spelling, I conducted a set of four hierarchical regression analyses. For each of the four analyses, age was entered first and English oral vocabulary knowledge was entered second in order to control for their effects.

The dependent variables for the four regression analyses were: English real word reading, English pseudoword reading, English real word spelling, and English pseudoword spelling. For each of the analyses, the predictors were entered in the following order: age, English PPVT, English phonological processing, English orthographic processing, Spanish phonological processing, and Spanish orthographic processing. Spanish tasks were entered after English tasks to examine their unique contribution to English reading and spelling, over and above that of the English tasks. Orthographic tasks were entered after phonological tasks to examine the unique variance explained by orthographic tasks after taking phonological tasks into account. For phonological processing, rhyme detection, onset detection, and phoneme deletion were entered into one block and analyzed using the stepwise regression method. By using this method, I was able to determine which of the three tasks contributed significantly to the dependent variable. The results of the hierarchical regression analyses on English reading and spelling are displayed in Table 10 and Table 1, respectively. Age only contributed a significant amount of variance to English real word reading. English oral vocabulary (PPVT) contributed significantly to real word reading, real word and pseudoword spelling when entered first.

Cross-Language Transfer Prediction

In support of our first hypothesis, Spanish phonological processing skills, specifically phoneme deletion, predicted a significant amount of variance of fEnglish real word and pseudoword reading and English real word and pseudoword spelling, over and above English phonological and orthographic processing skills (r^2 change = .06, .07, .02, and .04, respectively). Spanish rhyme detection was also a significant predictor of English pseudoword spelling (r^2 change = .02). With regard to our second hypothesis, Spanish orthographic processing, namely, homophone choice, predicted English real word and pseudoword reading (r^2 change = .09 and .06, respectively), after taking English phonological and orthographic processing skills and Spanish phonological processing skills into consideration. However, orthographic processing skills in Spanish did not predict a significant amount of variance in either English real word or pseudoword spelling. In other words, Spanish orthographic processing skill transferred to English reading, but not to English spelling.

Within Language Prediction

Within English language tasks, I found that phonological and orthographic processing skills predicted a significant amount of unique variance in both real word and pseudoword reading and spelling. Specifically, for real word reading, phoneme deletion and homophone choice emerged as significant predictors (r^2 change = .20 and .16, respectively). For pseudoword reading, significant predictors were rhyme detection, phoneme deletion, and homophone choice (r^2 change = .24, .06, and .10, respectively). With regards to spelling, rhyme detection, phoneme deletion, and homophone choice significantly predicted real word spelling performance (r^2 change = .13, .05, and .28,

Table 10
Hierarchical Regression Analyses Predicting English Word Reading Using English and Spanish Tasks

Variable	Mult. R	Mult. R^2	ΔR^2	ΔF	Final β
Predicting English real word reading					
Step 1: Age	.29	.08	.08	7.92**	.01
Step 2: PPVT	.39	.15	.07	6.69*	.02
Step 3: English phoneme deletion	.59	.35	.20	25.40***	.30***
Step 4: English homophone choice	.71	.51	.16	27.37***	.30***
Step 5: Spanish phoneme deletion	.75	.56	.06	10.47**	.18
Step 6: Spanish homophone choice	.80	.65	.09	19.80***	.34***
Predicting English pseudoword reading					
Step 1: Age	.11	.01	.01	1.15	-.12
Step 2: PPVT	.24	.06	.04	3.90	-.07
Step 3: English rhyme detection	.55	.30	.24	29.66***	.25**
English phoneme deletion	.60	.36	.06	7.21**	.15
Step 5: English homophone choice	.68	.46	.10	16.01***	.26**
Step 6: Spanish phoneme deletion	.72	.53	.07	11.23***	.23*
Step 7: Spanish homophone choice	.76	.58	.06	11.24***	.29***

*p < .05 ** p < .01 *** p < .001

Table 11
Hierarchical Regression Analyses Predicting English Word Spelling Using English and Spanish Tasks

Variable	Mult. R	Mult. R^2	ΔR^2	ΔF	Final β
Predicting English real word spelling					
Step 1: Age	.02	.02	.02	1.28	-.20
Step 2: PPVT	.42	.17	.16	16.51***	.10
Step 3: English rhyme detection	.55	.30	.13	15.27***	.01
English phoneme deletion	.60	.35	.05	7.06**	.19*
Step 5: English homophone choice	.79	.63	.28	61.68***	.61***
Step 6: Spanish phoneme deletion	.81	.65	.02	4.30*	.14
Step 7: Spanish homophone choice	.81	.66	.01	1.71	.10
Predicting English pseudoword spelling					
Step 1: Age	.02	.00	.00	.03	-.33***
Step 2: PPVT	.46	.22	.22	23.55***	.12*
Step 3: English phoneme deletion	.68	.46	.25	39.22***	.32***
English rhyme detection	.72	.51	.05	8.32**	-.02
Step 5: English homophone choice	.78	.61	.10	21.92***	.34***
Step 6: Spanish phoneme deletion	.81	.66	.04	10.26**	.18
Step 7: Spanish rhyme detection	.82	.67	.02	4.32*	.16
Step 8: Spanish homophone choice	.83	.69	.02	3.84	.15

*$p < .05$ ** $p < .01$ *** $p < .001$

respectively). Phoneme deletion, rhyme detection, and homophone choice emerged as the significant predictors of pseudoword spelling (r^2 change = .25, .05, and .10, respectively).

Discussion

Cross-Language Transfer Prediction

The results from Study 1 support previous findings on the role of phonological processing skills in learning to read and spell in alphabetic languages. This study investigated the unique contribution of Spanish phonological and orthographic processing skills to English real word and pseudoword reading and spelling. General findings indicated that Spanish phonological processing did, indeed, predict English real word and pseudoword reading and spelling. Spanish orthographic processing also predicted English word reading; however, Spanish orthographic processing did not emerge as a significant predictor of English spelling.

Of particular interest was that Spanish phonological processing skills contributed a significant amount of unique variance to English real word and pseudoword reading and spelling, over and above the contribution of English phonological and orthographic processing skills. This finding supports our first hypothesis that Spanish phonological processing skills would contribute unique variance to English reading and suggests that L1 phonological processing skills assist in L2 real word and pseudoword reading and spelling. Given that Spanish and English share the alphabetic principle and many similar phonemes and graphemes, these results are consistent with previous work conducted with Spanish-speaking children learning to read in English (Durgonoglu et al., 1993; Gottardo, 2002; Manis et al, 2004), as well as with other bilingual populations, such as Italian-

English (e.g., D'Angiulli et al., 2001), French-English (e.g., Comeau et al., 1999), and Korean-English (Wang et al., 2006).

In addition, during the stepwise regression process that included three Spanish phonological processing tasks, Spanish phoneme deletion consistently emerged as the, or one of the, strongest predictors of English word reading and spelling. While there is a debate regarding which of the phonological units (e.g., onset-rime, phoneme) best predicts reading, researchers have argued for the strong predictive power of phoneme deletion in an L1 to reading in an L2. Our study complements findings from other studies of Spanish-English bilingual children (Durgunoglu et al., 1993), supporting the argument that phonemic awareness in an L1 is a very strong predictor of reading in an L2. Phoneme deletion has also been found to be the strongest predictor of reading within alphabetic languages (e.g., in Dutch, Patel et al., 2004; in English, Nation & Hulme, 1997, Hulme et al., 2002; in Spanish, Manrique & Signorini, 1994).

Even more importantly, in response to our second hypothesis, our study demonstrated that Spanish orthographic processing skills predicted English real word and pseudoword reading, after taking English phonological and orthographic processing and Spanish phonological processing into consideration. I would suggest that the similarities between English and Spanish orthographies facilitated Spanish-speaking children's performance on English real word and pseudoword reading, even though Spanish orthography is more transparent. Our results contrast those from studies involving orthographies differing in transparency and visual forms, such as English and Korean, where limited orthographic transfer was found, suggesting that these differences may have restricted the transfer (see Wang et al., 2005; 2006).

However, Spanish is more similar to English than is Korean, in that Spanish and English not only share the alphabetic principle, but are also based on the Roman alphabet. The current study demonstrates that orthographic learning in Spanish is important for native Spanish-speaking children learning to read in English. As posited by the Linguistic Interdependence Hypothesis, an individual with strong L1 skills will be better able to develop strong skills in the L2. Results from the current study support the view that there is an interaction between L1 and L2 competence levels; orthographic processing skills in Spanish facilitate reading in English. Even for children with relatively transparent L1s, exposure to reading in that L1 benefits learning in the L2 (e.g., D'Angiulli et al., 2001). D'Angiulli et al. (2001) found that exposure to Italian, a language with a fairly consistent grapheme-phoneme correspondence, helped Italian-English bilingual children to perform better on English phonological tasks.

Addressing our second hypothesis, an interesting finding emerged. After taking into account English phonological and orthographic processing, and Spanish phonological processing, I found a limited, non-significant amount of orthographic transfer from Spanish orthographic processing to English real word and pseudoword spelling. Therefore, I would argue that the orthographic skills between the L1 and L2 are independent in spelling. If orthographic patterns are language specific, as suggested by Durgunoglu (2002), orthographic knowledge in an L1 may not benefit spelling in an L2. According to Durgunoglu (2002), orthographic processing skills in an L1 cannot be transferred to the L2 unless the two languages share similar alphabetic structures. While Spanish and English share the alphabetic principle, knowledge of the spelling patterns in

Spanish, a highly transparent orthography, may not be beneficial when spelling in English, a relatively deep orthography.

An important question that arose with the finding that Spanish orthographic processing predicted word reading, but not spelling, was why this difference occurred? One plausible explanation is that spelling in English is more difficult than reading in English due to their asymmetrical relation (see Kessler & Treiman, 2001). Kessler and Treiman (2001) conducted an extensive investigation of English reading and spelling consistency by examining the influence that each of the three parts of a syllable (onset, vowel, and coda) has on the other two parts. They found that the reading consistency of the onset, coda, and vowel was higher than that of the spelling consistency. In addition, research with Dutch-English bilinguals has found that L2 learners have more difficulty spelling words in the L2 than reading them (Verhoeven, 2000).

Within Language Prediction

Within the English language tasks, results from our hierarchical regression analyses in English and Spanish echo previous research findings. Not only do phonological processing skills predict word reading and spelling, but orthographic processing skills account for a significant amount of unique variance in reading, independent of phonological processing skills (Cunningham & Stanovich, 1989).

In general, both native Spanish-speaking children and native English-speaking children performed better on the real word spelling tasks than the pseudoword spelling tasks, in both languages. Performance on a pseudoword spelling task is a better indicator of phonological and orthographic knowledge than performance on a real word spelling task. With spelling real English words, children, including native Spanish speakers, can rely on lexical information and memorization to spell the words correctly. Many of the words included in the task are currently, or have recently been, on the students' spelling word lists. However, the English pseudoword spelling task, which utilized words conforming to English orthographic rules, tapped students' true orthographic knowledge. Pseudoword spelling may be more sensitive to orthographic processing skills.

CHAPTER 4: STUDY 2 - SPELLING PHONEMES REPRESENTED BY DIFFERENT GRAPHEMES IN ENGLISH AND SPANISH

Overview

Study 2 aimed to address whether Spanish-speaking children learning English make systematic errors in their spelling of English vowel sounds and whether these errors are consistent with Spanish orthographic rules. Previous literature has shown some evidence of the difficulties that Spanish-speaking children encounter in spelling English phonemes, including consonants and vowels (e.g., Fashola et al., 1996; Rolla San Francisco et al., 2006). Our study targeted the vowels that are spelled differently in English and Spanish (i.e., contrastive vowels). English and Spanish vowels differ drastically in their transparency in terms of letter-sound correspondences. Vowels in Spanish have a direct one-to-one mapping, whereas in English each vowel phoneme corresponds to various graphemes. Therefore, I expect Spanish-speaking children who are transitioning to English literacy acquisition to exhibit difficulty in spelling vowels. I was also careful to recruit participants who had arrived in the United States within the past two to three years; their age of arrival lead me to presume that they had received L1 literacy instruction. We also tested their L1 literacy knowledge prior to study participation. I hypothesize that these Spanish-speaking children, who received prior literacy instruction in Spanish, will use their knowledge of Spanish orthography to spell these contrastive vowels.

Method

Participants

The participants for Study 2 were part of the sample utilized in the first study. Of the 90 native Spanish-speaking children, I identified 26 who had received, on average, 2.2 years of schooling in their native language. The Demographic Information Surveys completed by parents, suggested that these children had received reading and spelling instruction in Spanish, specifically instruction in Spanish grapheme-phoneme correspondences. Therefore, students who immigrated to the US prior to kindergarten were not included in this sample. In general, children who had been in US schooling for two years or fewer were included in Study 2. No additional tasks were administered for Study 2, however, in-depth error analyses were conducted on the spelling responses for the English real word and pseudoword spelling tasks.

English Tasks

Real Word Spelling

The purpose of the spelling task was to tap into how Spanish speaking children spell English phonemes that either do not exist, or are spelled differently in Spanish. For each spelling task, there were 14 items with contrastive vowels (/eɪ/, /i/, /aɪ/, /u/), and 14 with non-contrastive vowels (/ɛ/, /æ/, /o/). The contrastive items were words that contained vowels or vowel sounds that are represented by letter combinations not used in Spanish, such as *same, tool*, and *meet.* Spanish speakers might spell the words as *seim, tul,* and *mit.* The noncontrastive items were words that contained vowels that are pronounced similarly in English and Spanish. For example, the vowels in the words *fast, lend*, and *sell* are pronounced the same in both languages. The fillers were created by using vowel sounds that were neither clearly contrastive nor non-contrastive. The /ɪ/, /ɑ/, /ʌ/, and /ɝ/ sounds do not have corresponding sounds or spellings in Spanish. In other words, there is no correct way to represent these English vowel phonemes with Spanish graphemes, but there are close approximations. For example, the word "trim" could be spelled "trem."

The familiarity ratings (described in Study 1) by all teachers were averaged for each word (see Appendix D for item ratings and range of ratings). This rating scale was used to ensure that contrastive and noncontrastive item groups contained words with similar levels of familiarity. I also controlled for number of letters, phonemes, and consonant clusters in each group. Therefore, any significant differences found between the words cannot be attributed to a difference between the two groups of words, other than the fact that they were contrastive or noncontrastive. The means for level of familiarity for contrastive and noncontrastive items are 2.07 and 2.10, respectively. A native English female voice read the target spelling word, used it in a sentence, and repeated the word again. Children were given approximately ten seconds to write the word.

Pseudoword Spelling

An English pseudoword spelling task was used to control for the possibility of children spelling words based on whole word knowledge. In spelling real words, children can use lexical information, as well as sight word knowledge, to correctly spell words. In other words, the children do not need to use spelling rules to spell the words. By incorporating a pseudoword spelling task that examined the same vowel sounds as in the real word spelling task, I was better able to determine whether or not Spanish speaking children incorporated Spanish orthographic rules in spelling English phonemes. Items for all of the English language tasks are presented in Appendix D.

Data Coding

For specific vowel spelling, I designed a coding scheme that would account for errors consistent with English spelling rules as well as Spanish spelling rules. The scheme is described in Table 12, using the word "meat" as an example:

Table 12
Vowel-specific Spelling Coding Scheme

Spelling Code	**Description**	**Example**
1	Incorrect; phonologically inappropriate *and* orthographically illegitimate in English and Spanish	maat
2	Incorrect; either phonologically inappropriate *or* orthographically illegitimate in English or Spanish	mat, meate
3	Incorrect; phonologically appropriate and orthographically legitimate in English	meet
4	Incorrect; phonologically appropriate and orthographically legitimate in Spanish	mit

If a word is phonologically appropriate, it means that it is pronounced the same way as the target spelling word. If it is orthographically legitimate, it means the spelling is of an actual real word. Because the current study focuses on the spelling of vowels, words spelled incorrectly were coded for vowel spellings only. Study 1 examined spelling performance based on whole words; Study 2 focuses on vowels. Spelling codes 1 - 4 refer to words spelled incorrectly. Code 1 errors refer to words spelled with vowels that are phonologically inappropriate *and* orthographically illegitimate in English and

Spanish. Code 2 errors are words containing vowels that are either phonologically inappropriate *or* orthographically illegitimate in English or Spanish.

Note that there are three possible spelling errors that fall into this category: errors that are phonologically appropriate but orthographically illegitimate in English; errors that are phonologically inappropriate but orthographically legitimate in English; and errors that are phonologically inappropriate but orthographically legitimate in Spanish. The third type of error occurred very rarely. Vowel errors that are phonologically appropriate in Spanish are, by default, also orthographically legitimate in Spanish, due to the direct mapping of vowel phonemes to graphemes in Spanish orthography. Code 3 errors refer to words that are phonologically appropriate and orthographically legitimate in English, and Code 4 errors are words that are phonologically appropriate, and therefore, the vowel spellings are orthographically legitimate, in Spanish. Therefore, with the example "meate," this word would be pronounced the same as the target spelling word "meat," but it does not exist in English orthography. Meanwhile, with the example "mat", the vowel is not pronounced the same as in the target spelling word, but the word does exist in English orthography. These errors would be Code 2 errors. Note that Code 4 errors are the critical errors of interest, because they reflect the influence of Spanish orthography. If the target word *meate* was spelled as *mit* /mit/, it would be given a score of '4' because the *i* is pronounced as /i/ in Spanish.

For coding vowel spellings in pseudowords, the same coding scheme was utilized. However, the possibility of spelling errors was smaller. For example, /blin/ could be correctly spelled in various ways, such as *blean, bleen,* or *blene.* The spelling *blin* would be coded as a 4, as the *i* is pronounced as /i/ in Spanish. *Blean* and *bleen* would be coded as 2–phonologically appropriate, but orthographically illegitimate in English.

For each group (English Grade 2, English Grade 3, Spanish Grade 2, and Spanish Grade 3), I calculated percentages of error (Codes 1, 2, 3, and 4) by determining the number of times each type of error was made. I then divided the total number of errors committed by the number of errors for each error code. To provide a comprehensive picture of children's spelling, I also tabulated frequencies of consonant spelling errors in both the initial and final word positions.

The researcher coded all of the spelling tasks. The bilingual research assistant was trained and then coded the spelling tasks of 14 participants independently—17% of the total number of spelling tasks. The mean interrater reliability for real word spelling and pseudoword spelling was 93.9% and 95.3%, respectively. All disagreements were resolved by conferencing.

Procedure

The procedure for Study 2 was the same as for Study 1, since the participants were pulled from the larger sample of the first study. In addition to sending home and collecting parental consent forms, reading specialists aided in identifying native Spanish-speaking children who have been in U.S. schools fewer than two years and are learning English. This information, as well as the demographic information provided by parents, allowed us to ascertain which students had received some reading and writing instruction in Spanish.

Results

The purpose of Study 2 was to examine whether native Spanish-speaking children, who are learning to read and spell in English, make more spelling errors on contrastive vowels in English than their native English-speaking counterparts. I also investigated whether the vowel errors are consistent with Spanish orthography. In order to address our research questions, an analysis of the errors was conducted. Frequencies of the occurrences, in percentages, for spelling errors on both contrastive vowels and consonants on the English Real Word spelling task and English Pseudoword spelling task are displayed in Table 11 and Table 12, respectively. I predicted, in general, that the native Spanish-speaking children in our sample would perform more poorly on English vowels that are spelled differently in Spanish and English.

Analyses will be presented in the following order. Attending to our main research question for the current study, I first examined Code 4 errors on the contrastive vowels. These are errors consistent with Spanish orthography (e.g. spelling *meat* as *mit*). I hypothesized that native Spanish-speaking children would make significantly more Code 4 errors than the native English-speaking children. In other words, their spelling of words with contrastive vowels would be influenced by their knowledge of Spanish orthography. I then compared the two language groups on the other three error codes, with respect to contrastive and non-contrastive words. I predicted that the two language groups would perform similarly with regards to these three error codes, and that there would be no significant differences between the contrastive and non-contrastive vowels. Finally, to provide a more comprehensive view of children's spelling errors, I examined initial consonant and final consonant spelling errors. Overall, for both language groups, the error pattern within each error code for Grade 2 and Grade 3 was similar. Additionally, independent samples *t*-tests were conducted to examine whether amount of errors differed significantly between Grade 2 and Grade 3. No significant differences were found for Code 4 errors between grades. For the real word spelling tasks, no significant differences were found between grades for contrastive items; however, there were significant differences in performance for error code 1 ($t = 2.27$, $p = .26$) and error code 2 ($t = 2.58$, $p = .12$) on control items. For the pseudoword spelling tasks, no significant differences were found between grades for control items, and the only significant difference for contrastive items was for Code 1 errors ($t = 2.24$, $p < .05$). Since the difference between grades for Code 4 errors was not significant, and only few significant differences were found between grades, the two grade levels were collapsed for the following analyses to increase sample size and therefore, statistical power of our analyses.

Comparison between Native English-Speaking and Native Spanish-Speaking Children on Code 4 Errors

Our research question focuses on spelling errors that are consistent with Spanish orthography (Code 4 errors). I predicted that native Spanish-speaking children would make significantly more Code 4 errors than native English-speaking children on contrastive items due to an influence from the native Spanish speakers' L1. Therefore, to examine the differences in Code 4 errors between native Spanish-speaking children and native English-speaking children on contrastive words, two separate independent samples t-tests were conducted: one for the real word spelling task and one for the pseudoword spelling task. For real word spelling, an independent samples t-test determined that native

Spanish-speaking children made significantly more Code 4 errors than native English-speaking children, $t(77) = 4.67$, $p < .001$. For pseudoword spelling, results were similar, revealing that native Spanish-speaking children made significantly more Code 4 errors than their English-speaking counterparts, $t(77) = 7.67$, $p < .001$.

I was also interested in whether children's performance differed on real words and pseudowords. Pseudoword spelling requires pure knowledge of phoneme-grapheme correspondences, unlike real word spelling, which can be aided by lexical knowledge. Therefore, pseudowords provide us with children's true spelling ability by controlling for the use of whole-word memorization. To investigate whether children made more Code 4 errors on real words or pseudowords, I conducted a 2 (language group) x 2 (word type) Repeated Measures ANOVA, which demonstrated an interaction between word type and language group, $F(1, 77) = 13.82$, $p < .001$. The main effect of language group, $F(1, 77) = 43.67$, $p < .001$ and word type (real word vs. pseudoword), $F(1, 77) = 51.67$, $p < .001$. Native Spanish-speaking children made significantly more Code 4 errors with pseudowords ($M = 3.12$, $SD = 2.36$) than with real words ($M = 1.69$, $SD = 2.62$), $t(25) = 4.33$, $p < .001$, as did the native English speakers (see Figure 1). These results are not surprising since children can use whole word knowledge to spell real words, whereas they cannot for pseudowords. Therefore, children made more Code 4 spelling errors on pseudowords. The spelling of pseudowords is a better indicator of children's knowledge of phoneme-grapheme correspondences.

Comparison between Native English-Speaking and Native Spanish-Speaking Children on the Other Error Categories

I also examined the other three error codes to see whether native Spanish-speaking children differ from native English-speaking children in the types of errors made on contrastive and non-contrastive words. The other three errors codes are: Code 1, phonologically inappropriate and orthographically illegitimate in English and Spanish (excludes Code 4 errors); Code 2, phonologically inappropriate OR orthographically illegitimate in English or Spanish; and Code 3, phonologically appropriate and orthographically legitimate in English. A 2 (language group) x 2 (contrastiveness) x 3 (error code) Repeated Measures ANOVA was conducted for real words and for pseudowords.

Real Word Spelling

There was a three-way interaction between contrastiveness, error code, and language, F (2, 77) = 9.36, $p < .001$. There was a significant two-way interaction between contrastiveness and error code, F (2, 77) = 27.38, $p < .001$. For contrastive items, no significant differences were found in the number of errors per error code, all ts < .69, all ps > .05. For the non-contrastive items, children made more Code 1 errors (M = 3.5, SD = .33) than Code 2 errors (M = 1.9, SD = .19), $t(77) = 3.87$, $p < .001$, and more Code 2 errors than Code 3 errors (M = 1.2, SD = .11), $t(77) = 2.91$, $p = .005$ (see Figure 2). In other words, most of the errors children made with non-contrastive items were phonologically inappropriate and orthographically illegitimate. Main effects were found for contrastiveness, F (1, 77) = 19.24, $p < .001$, and error code, F (2, 77) = 11.63, $p < .001$. Post hoc analyses indicated that, overall, children made significantly more Code 1 errors (M = 2.65, SD = .26) than Code 2 (M = 1.84, SD = .17) or Code 3 (M = 1.47, SD = .10) errors on contrastive and non-contrastive items, combined. There were no significant interactions between contrastiveness and language group or between error code and language group.

There was no significant main effect of language group, indicating that the two language groups committed a similar amount of Code 1, Code 2, and Code 3 errors, overall. There was no significant difference between Code 2 and Code 3 errors. These results are in line with my expectations, as I did not expect the two language groups to differ in the proportion of these types of errors made between contrastive and non-contrastive items. In addition, I did not expect a difference in the types of errors committed between native Spanish-speaking children and native English-speaking children.

Pseudoword Spelling

The pattern of errors for pseudoword spelling was very similar to that of real word spelling.There was no significant three-way interaction. A significant two-way interaction was found between contrastiveness and error code, F (2, 77) = 6.37, p = .002. Children made significantly more Code 2 errors with non-contrastive than contrastive items (see Figure 3). Results revealed no significant two-way interactions between contrastiveness and language group, or between error code and language group. As expected, the two language groups did not differ significantly in proportion of error, or type of error, for contrastive and non-contrastive items. No main effect was found for language group. Main effects were found for contrastiveness, F (1, 77) = 10.29, p = .002, and error code, F (2, 77) = 117.23, p < .001.

Comparison between Native English-Speaking and Native Spanish-Speaking Children on Consonant Errors

I also examined the spelling errors committed on the initial consonant(s) and final consonant(s), to provide a more complete picture of native Spanish-speaking children's spelling performance, as it relates to native English-speaking children. A 2 (language group) x 2 (consonant location) Repeated Measures ANOVA was conducted. The within-subjects variable of consonant location refers to the position of the consonant in the word (initial vs. consonant). Figure 4 represents final vs. initial consonant errors with real-words and pseudowords, combined.

Real Word Spelling

A two-way interaction between consonant location and language group was found, F (1, 77) = 7.29, p = .01. Post hoc analyses provided the additional information that native Spanish-speaking children made significantly more final consonant errors than the native English-speaking children, t(77) = 2.56, p = .01, but that their errors were not significantly different in spelling initial consonants.

A main effect of language group revealed that native Spanish-speaking children made more consonant spelling errors than native English-speaking children, F (1, 77) = 4.97, p = .03. A main effect of consonant location was found, F (1, 77) = 21.51, p < .001, indicating that the children in our study made significantly more errors with final consonants than initial consonants.

Pseudoword Spelling

The pattern of consonant errors for pseudowords was similar to that of real words, except that no two-way interaction between consonant location and language group ws found, *F* (1, 77) < 1. Both language groups made significantly more final consonant than initial consonant errors. Also, no main effect of language group was found. I suggest that the language groups did not differ on their consonant errors because neither group had the advantage of using lexical knowledge to spell, as they would with real words. A main effect of consonant location was found, *F* (1, 77) = 152.74, *p* < .001. Children made more final consonant errors (*M* = 9.33, *SD* = .62) than initial consonant errors (*M* = 4.50, *SD* = .45).

Discussion

Study 2 was designed to investigate whether native Spanish-speaking children make more spelling errors on contrastive vowels in English than native English-speaking children, and in particular, if these errors are influenced by Spanish orthography. Contrastive vowels refer to vowel phonemes that are represented by different graphemes between English and Spanish.

Upon comparing the two groups on their spelling errors, I found that the native Spanish-speaking children made significantly more Code 4 errors, which are influenced by Spanish orthography, than the native English-speaking children. In addition, the two language groups did not differ on the other types of errors. These results indicate that the Code 4 errors made by native Spanish-speaking children were indeed influenced by their L1. These findings complement the results of previous studies that suggest that native Spanish-speaking children spell English vowels according to Spanish orthographic rules (Fashola et al., 1996; Rolla San Francisco et al., 2006).
Research with other bilingual populations also found L1 influence on L2 spelling (Wang & Geva, 2003a). In their 2003 study with Cantonese-speaking children learning English,

Wang and Geva (2003a) investigated whether the Cantonese-speaking children had difficulty spelling English phonemes that did not exist in Cantonese phonology. Results suggested that young Cantonese speakers did indeed have difficulty spelling two novel English phonemes that do not exist in Cantonese (/θ/ and /ʃ/), although this difficulty decreased with time. Geva, Wade-Woolley and Shany (1993) also examined L1 influence on L2 spelling with English-speaking children learning to read and spell in Hebrew, finding that one particular phoneme, /ts/, caused spelling difficulties for the English

Table 13

Frequency of Occurrences (in percentages) for Spelling Errors of Vowels and Consonants in ***Real Words***

	Spanish-English Bilingual n = 26		English n = 53	
	Contrastive	non-Contrastive	Contrastive	non-Contrastive
IC Initial Consonant(s)	7.42	16.21	4.99	10.51
FC Final Consonant(s)	14.84	23.08	6.47	12.53
1 Incorrect (m**aa**t) Phonologically Illegitimate Orthographically Illegitimate	25.87	61.34	31.92	42.57
2 Incorrect (m**ite,** m**eete**) Phonologically Illegitimate OR Orthographically Illegitimate	32.84	25.26	27.31	33.33
3 Incorrect (m**ee**t) Phonologically Legitimate Orthographically Legitimate	19.40	13.40	40.38	24.09
4 Incorrect (m**i**t) Phonologically Legitimate IN SPANISH	21.89	0	0.38	0
5 Correct (m**ea**t)	46.15	46.70	64.82	59.30

Note: Percentages for IC, FC, and Category 5 were calculated by dividing the error count by the total number of words. Percentages for Category 1-4 were calculated by dividing the errors for each category by the total number of errors committed.

Table 14

Frequency of Occurrences (in percentages) for Spelling Errors of Vowels and Consonants in ***Pseudowords***

		Spanish-English Bilingual n = 26		English n = 53	
		Contrastive	non-Contrastive	Contrastive	non-Contrastive
IC	Initial Consonant(s)	16.21	20.33	11.99	18.06
FC	Final Consonant(s)	36.81	35.99	27.49	27.22
1	Incorrect (l**o**f) Phonologically Illegitimate Orthographically Illegitimate	46.76	58.47	55.83	55.73
2	Incorrect (l**oa**f, l**u**m**e**) Phonologically Illegitimate OR Orthographically Illegitimate	15.83	30.51	25.63	35.02
3	Incorrect (l**oo**se) Phonologically Legitimate Orthographically Legitimate	8.27	11.02	13.33	9.47
4	Incorrect (l**u**f) Phonologically Legitimate IN SPANISH	29.14	0	5.21	0
5	Correct (l**oo**f)	23.90	35.16	35.31	38.68

Note: Percentages for IC, FC, and Category 5 were calculated by dividing the error count by the total number of words. Percentages for Category 1-4 were calculated by dividing the errors for each category by the total number of errors committed.

Figure Captions

Figure 1. Code 4 spelling errors on real word vs. pseudoword items by language group.

Figure 2. Percentage of error per error codes 1, 2, and 3 for contrastive vs. non-contrastive real words.

Figure 3. Percentage of error per error codes 1, 2, and 3 for contrastive vs. non-contrastive pseudowords.

Figure 4. Percentage of error for consonant location by language group.

Figure 1

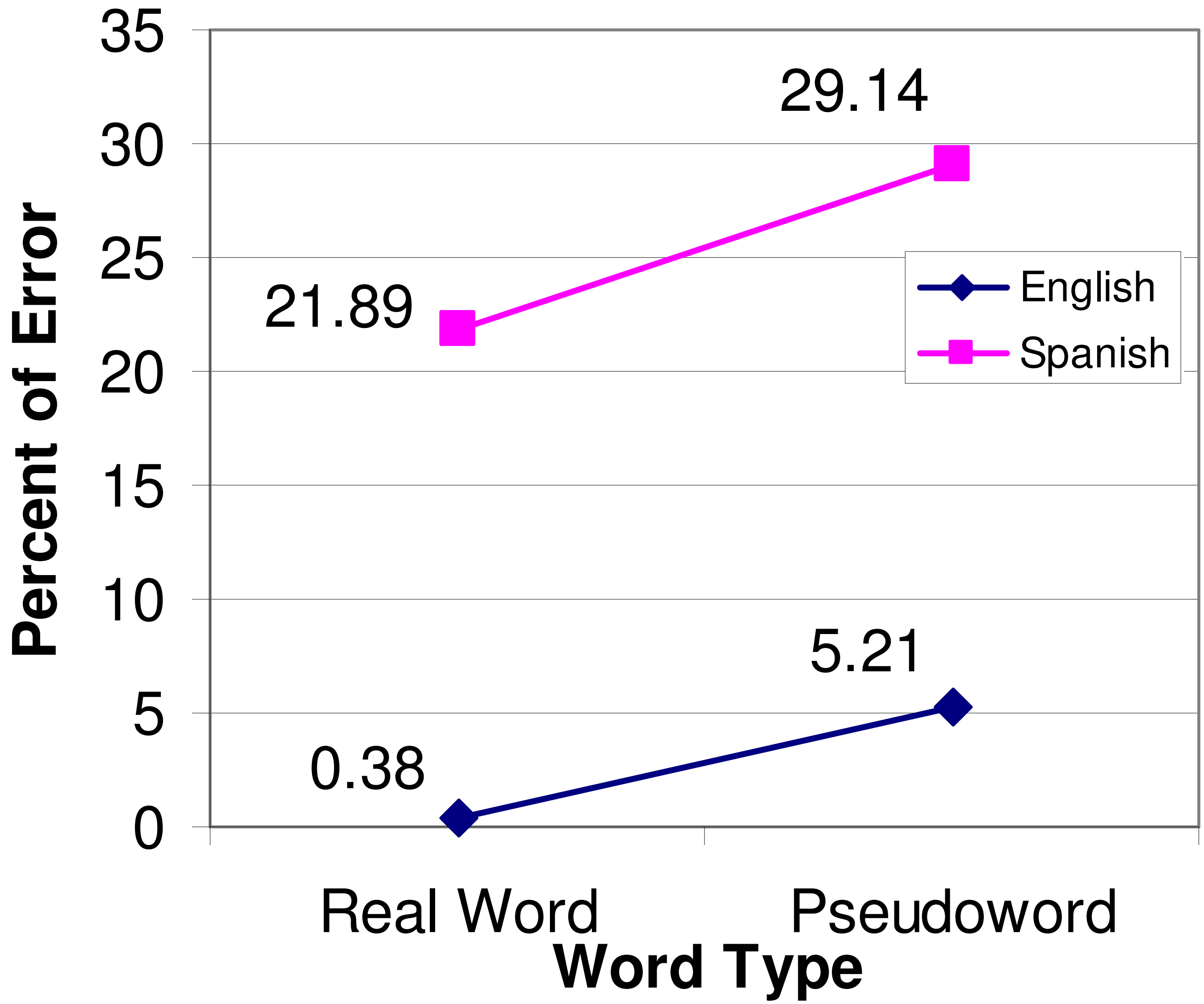

35
30
25
20
15
10
5
0
Percent of Error
29.14
21.89
5.21
0.38
English
Spanish
Real Word
Pseudoword
Word Type

Figure 2

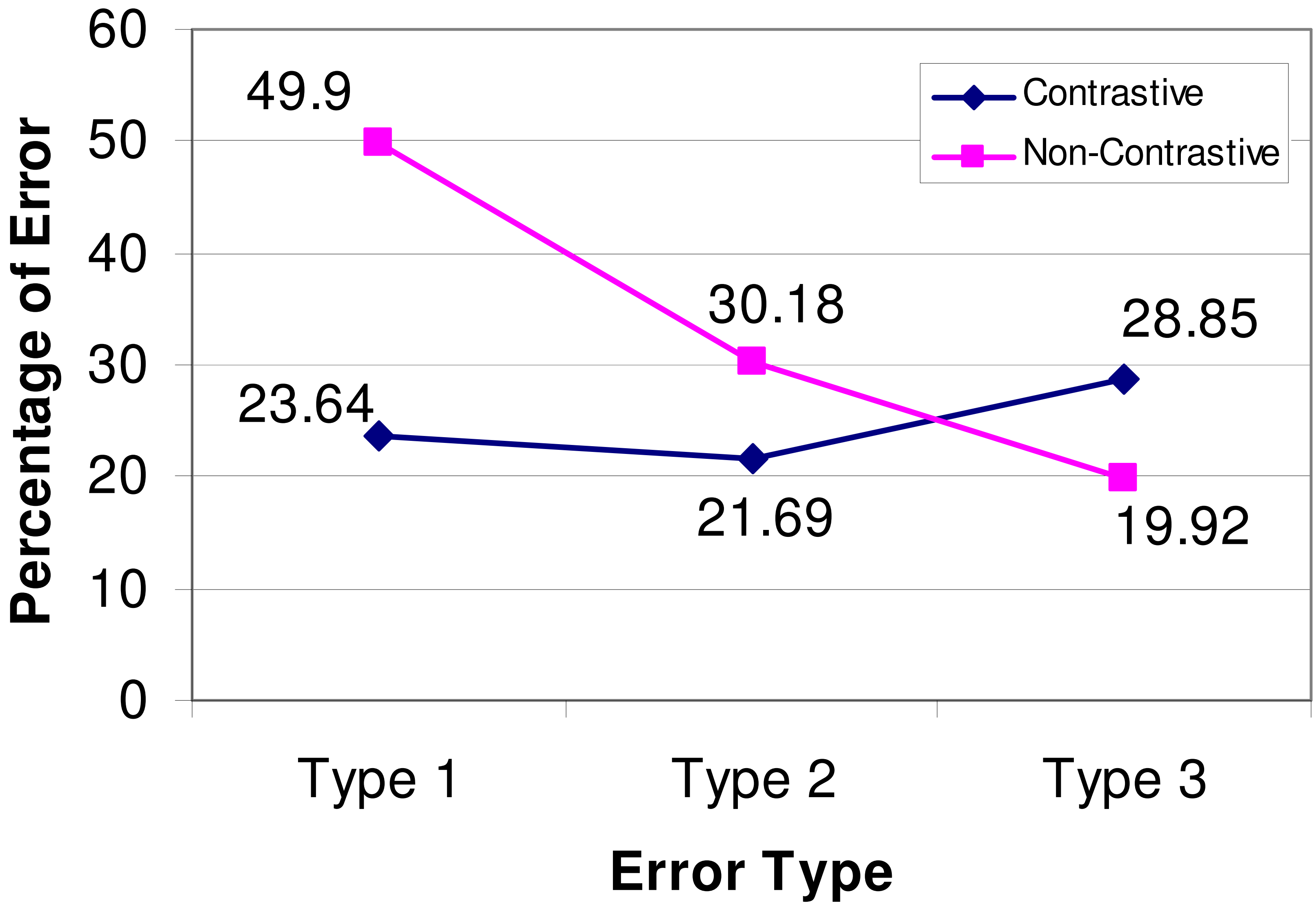

Percentage of Error
60
50
40
30
20
10
0
49.9
30.18
28.85
23.64
21.69
19.92
Contrastive
Non-Contrastive
Type 1
Type 2
Type 3
Error Type

Figure 3

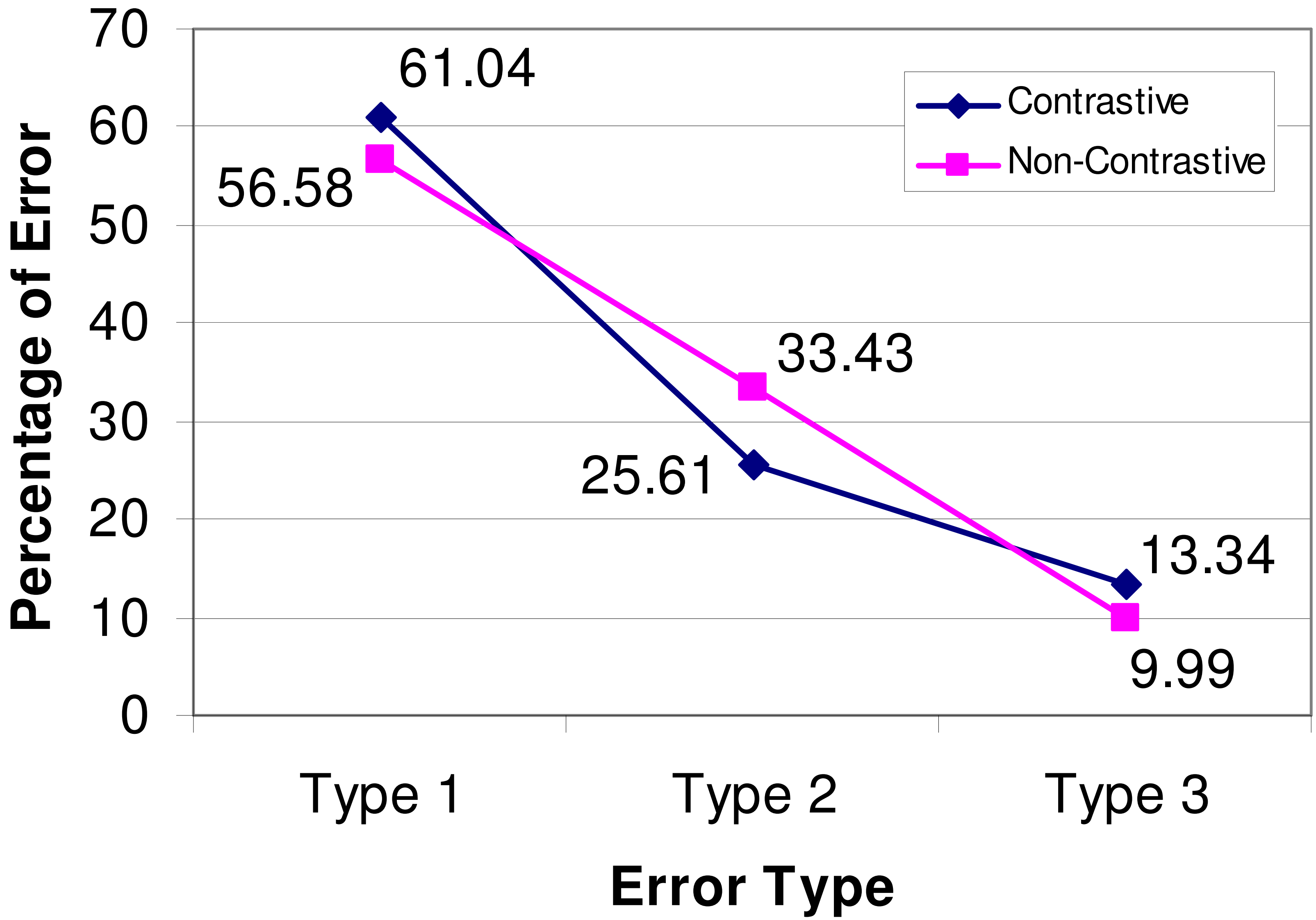
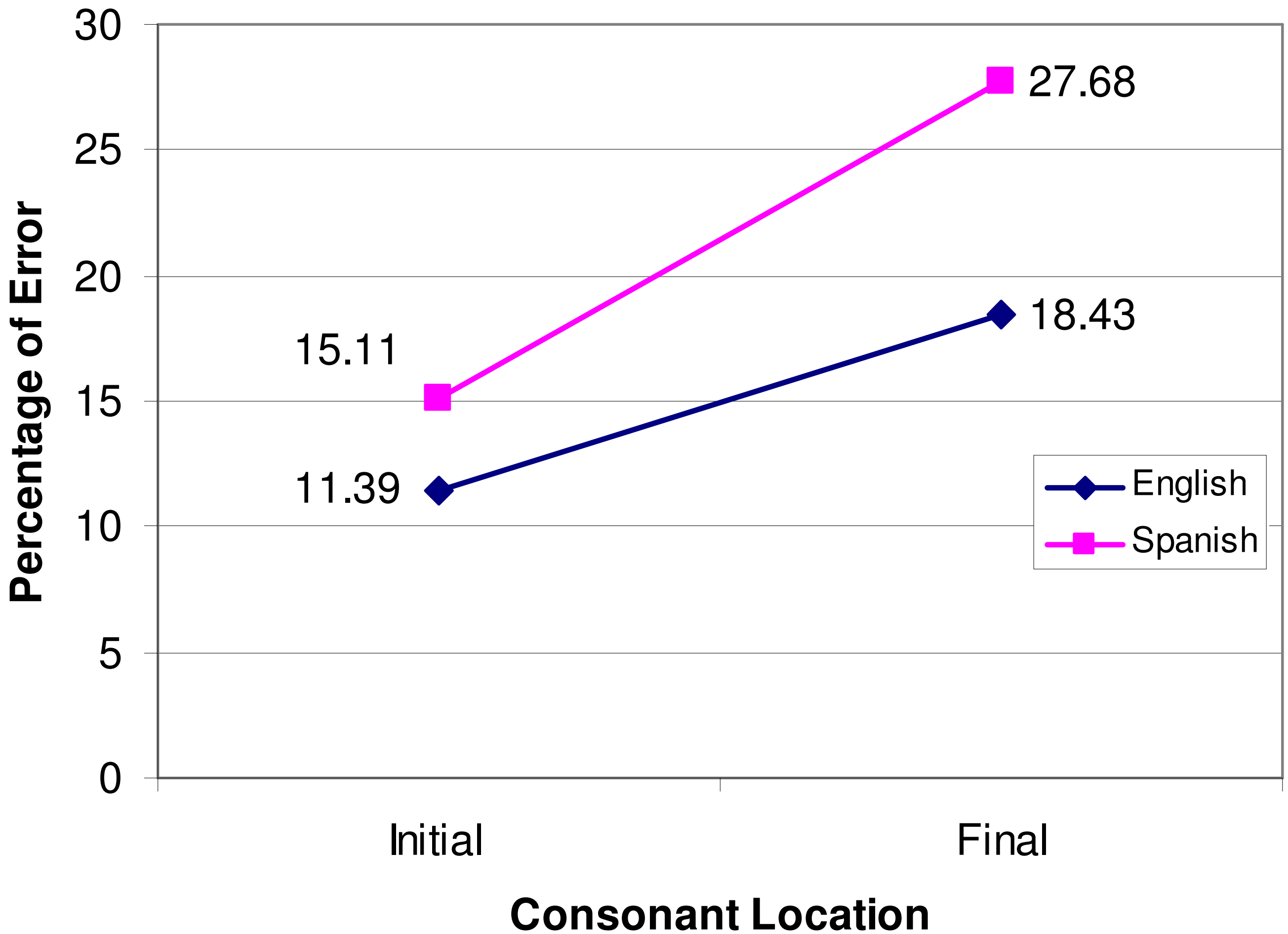

70
60
50
40
30
20
10
0
Percentage of Error
61.04
56.58
33.43
25.61
13.34
9.99
Contrastive
Non-Contrastive
Type 1
Type 2
Type 3
Error Type

Figure 4


30
25
20
15
10
5
0
Percentage of Error
27.68
18.43
15.11
11.39
English
Spanish
Initial
Final
Consonant Location

speakers when spelling in Hebrew. In English, /ts/ cannot appear at the beginning of a word. In Hebrew, however, not only can it can appear at the beginning of a word, but it is distinct from /s/, a similar phoneme. In addition, /ts/, at the end of a word, is spelled differently in Hebrew. These orthographic differences between the two languages caused difficulties for English-speaking children learning to spell in Hebrew.

In addition, in the current study, more of these Code 4 errors occurred with pseudowords. Previous research also utilized pseudowords as their spelling task items. Whole word knowledge can be used to spell real words, but not pseudowords. Pseudoword spelling is a better indicator of knowledge of phoneme-grapheme correspondences.

In our study, I also found that native English-speaking children made Code 4 errors. One could, therefore, argue that all of the Code 4 errors were *not* due to the influence of Spanish orthography. However, because the number of Code 4 errors made by this group was so minimal, in comparison to the number of Code 4 errors made by native Spanish speakers, I confidently believe that Spanish speakers committed this type of error due to their L1 influence. I acknowledge that a small proportion of Code 4 errors could have been due to poor general spelling ability; however, the native Spanish-speaking children made significantly more of these errors. Based on the analyses of the other types of errors, I found that there was no difference between language groups.

Recall that the other three error types are: Code 1, both phonologically inappropriate and orthographically illegitimate in English and Spanish; Code 2, either phonologically inappropriate or orthographically illegitimate in English; and Code 3, both phonologically appropriate and orthographically legitimate in English. For Code 1, Code 2, and Code 3 errors, I found no significant difference between language groups for contrastive versus non-contrastive real words or pseudowords. As mentioned earlier, because both groups performed similarly with regard to Code 1, 2, and 3 errors, I reiterate that the only errors for which performance differed between language groups was for Code 4.

For both real words and pseudowords, children made Code 1 errors the most. This indicates that children made errors that had no phonological or orthographic basis. It is somewhat surprising to see that both native English and native Spanish-speaking children made so many Code 1 errors, suggesting that these young children are, in general, still developing their basic spelling skills. I found that the difference between Code 2 and Code 3 errors was significant for pseudowords, but not for real words. I suggest that this difference can partially be attributed to the fact there were fewer possible Code 3 errors in the pseudoword spelling task. Code 3 errors are phonologically appropriate and orthographically legitimate, meaning that they are homophones (e.g. spelling *meat* as *meet*), but for pseudowords, these homophones would be coded as correct. For example, each of the following spellings for the target word /pif/ would be coded as correct: *peef, peaf, peif, pief,* and *pefe.*

Upon further examination of Code 1, 2, and 3 errors for real words, results revealed that there was no significant difference between the error types for contrastive items, but that there was a significant difference for non-contrastive items. The difference in the distribution of error types between contrastive and non-contrastive can possibly be explained by the different number of homophones in each word type. There were four possible homophones in the contrastive items (*meat, scene, main, tune*) and only two possible homophones in the non-contrastive items (*wrap, sell*). Three of the contrastive homophones were commonly used words (e.g. *meat* could have been spelled *meet, scene* could have been spelled *seen*, *tune* could have been spelled *toon*, which, while not an actual word, is commonly used to mean *cartoon*), whereas of the two non-contrastive homophones, only one seemed to cause errors for the children (*wrap* spelled as *rap*). Therefore, the potential for making a Code 3 error was greater for contrastive items than contrastive items, thus, possibly narrowing the gap between Code 2 and Code 3 for contrastive items, making the difference not significant. Future research should either eliminate homophones or match them between the contrastive and non-contrastive items to control for this confound.

Finally, for consonant errors, children made more final consonant errors than initial consonant errors for both real and pseudowords. Our findings that consonants in the word-final position are more difficult to spell than those in the word-initial position are in line with previous research findings (Stage & Wagner, 1992; Treiman, 1993; Treiman, Berch, & Weatherston, 1993). Treiman and her colleagues, in particular, found that consonants at the ends of syllables caused more spelling errors than consonants at the beginnings of syllables. For real words, native Spanish-speaking children made more consonant errors, both in the initial and final positions, than native English-speaking children. I know that children have more difficulty spelling consonant clusters than single consonants (in English, Treiman, Zukowski & Richmond-Welty, 1995; in Spanish, Manrique & Signorini, 1994) , but out of the 28 spelling items, there was an equal number of initial and final consonant clusters (3 each). However, Spanish orthography lacks final consonant clusters, therefore, the native Spanish-speaking children would naturally have more difficulty spelling these. As for errors with single consonants, native Spanish-speakers were also more likely to make errors. Justicia et al.'s (1999) study of Spanish speakers' patterns of spelling errors suggested that many of the errors were influenced by speech. This conclusion is in line with suggestions put forth by Ehri, Nunes, Willow, Schuster, Yaghoub-Zadeh, and Shanahan (2001) in their meta-analysis of research conducted on phonemic awareness instruction. Ehri et al. (2001) claim that the difference in pronunciation of English phonemes for speakers with different L1s (e.g. Spanish, Chinese, Japanese) could potentially cause English language learners to misunderstand English phonemes. Therefore, when native Spanish-speaking children are asked to spell dictated English words, they may process the target phonemes differently, leading to spelling errors. For pseudowords, however, there was no difference between language groups. One possible explanation for this lack of difference between language groups could be that both groups have equally poor general spelling skills, but that the native English-speaking group really utilized whole word knowledge to spell real words. For pseudowords, neither language group had the advantage of whole word memorization and this may be why both groups performed poorly.

CHAPTER 5: GENERAL DISCUSSION

Major Issues of Cross-Language Transfer

Both Study 1 and Study 2 aimed to address how young children acquire biliteracy skills. Specifically, I examined the influence of Spanish L1 on English L2 reading and spelling acquisition. Study 1 investigated the facilitation from L1 to L2 – whether phonological and orthographic processing skills in Spanish predicted reading and spelling performance in English. This study was designed to provide a more general view of L1's influence on L2 reading and spelling. Study 2, however, focused on specific linguistic units – the contrastive vowels /e/, /aI/, /i/, and /u/. Error analyses presented a much more in-depth examination on how L1 orthographic knowledge influences L2 vowel spelling. The two studies incorporated different levels of analysis in order to better explain the effect of cross-language transfer on L2 reading and spelling acquisition.

Results from Study 1 indicate that phonological processing skills in Spanish predicted performance on English reading and spelling tasks, both with real words and pseudowords. Also, orthographic processing skills in Spanish predicted performance on English real word and pseudoword reading tasks. In other words, our study confirmed the strong link between L1 phonological and orthographic skills and L2 reading. Pursuant to the theoretical framework outlined in the literature review, results from this study support and provide converging evidence for the Linguistic Interdependence Hypothesis; strong L1 skills facilitated strong L2 skills. The findings enhance the theoretical framework by providing evidence of this interdependence, even in two languages that differ in their orthographic depth. It seems fair to conclude that native Spanish-speaking children with strong phonological and orthographic processing skills in their L1 are likely to show strong performance on word reading tasks in their L2.

Our findings that phonological processing skills in an L1 facilitate reading in an L2 complement previous research findings on biliteracy acquisition in various bilingual groups, including Spanish-English (Durgunolgu et al., 19923), Italian-English (D'Angiulli et al., 2001), French-English (Comeau et al., 1999), and Korean-English (Wang et al., 2006). For this reason, our findings strengthen the claim that universal phonological processes, across all alphabetic languages, play a pivotal role in facilitating bilingual reading acquisition.

One very interesting finding was that Spanish orthographic processing skill did not predict performance on English spelling tasks after taking into account the within-language predictors and Spanish phonological processing skill. One reason for this finding could be that, in English, spelling is more inconsistent, hence more difficult, than reading. For example, in reading, the letters *f* and *ph* are always pronounced /f/. In spelling, however, the phoneme /f/ can be spelled *f* or *ph* (Kessler & Treiman, 2003). Ziegler, Stone, and Jacobs (1997) conducted a statistical analysis to determine the feedback and feedforward inconsistencies of 2,694 monosyllabic English words. Feedforward consistency refers to the consistency in reading processes; graphemes that can be pronounced in multiple ways are considered feedforward inconsistent (e.g., *g* is pronounced /g/ as in *good* and /dʒ/ as in *giraffe).* Feedback consistency, on the other hand, refers to consistency in spelling processes; phonemes that can be spelled in various ways are considered feedback inconsistent (e.g., /s/ can be spelled as *s* in *see,* as *c* in *city,* as *ss* in *pass,* etc.). In Ziegler et al.'s (1997) study, rather than examining individual grapheme-phoneme correspondences, they presented correspondences for rimes. For example, the *-int* in *pint* and *hint* is inconsistent because it can be pronounced in multiple ways, but *–uck* as in *duck* and *luck* is considered consistent because it has only one pronunciation. Results of their analyses demonstrated that spelling is much more inconsistent than reading. Of the words used in the analysis, 72.3% were feedback inconsistent, compared to only 30.7% that were feedforward inconsistent (see Ziegler et al., 1997, for complete mappings of feedforward and feedback inconsistencies). Therefore, the more drastic discrepancy between English and Spanish orthographies may explain why Spanish orthographic processing has limited predictive power on English spelling.

Another potential cause of the limited L1 orthographic transfer to L2 spelling is that orthographic skills may be language-specific, particularly when the languages in question do not share similar alphabetic structures (Durgunoglu, 2002). Based on our findings, I found that even with languages sharing a similar alphabetic structure, such as English and Spanish, orthographic processing skills in one language do not facilitate spelling in the other. I suggest that this limited transfer could be attributed to the different levels of orthographic transparency between English and Spanish. Study 2 further addressed this discrepancy by investigating spelling errors of four vowel sounds that are spelled differently in the two languages.

Findings from Study 2 support the Orthographic Depth Hypothesis; specifically, different levels of transparency effect spelling acquisition. English orthography has an indirect phoneme to grapheme correspondence, causing spelling to be relatively difficult. Spanish, on the other hand, has a shallow orthography, with very direct mapping between sounds to letters. In particular, for vowels, the phoneme-grapheme correspondence is one-to-one. Therefore, native Spanish-speaking children who are learning to spell vowel sounds in English are faced with, and demonstrate, a difficulty with correctly spelling English vowels that are spelled differently in English and Spanish. This finding echoes previous research involving children acquiring spelling skills in two orthographies simultaneously. Wang and Geva (2003) studied Cantonese-speaking children's acquisition of two novel English phonemes (/θ/ and /ʃ/), finding that the Cantonese-speaking children had difficulty spelling these two sounds that do not exist in Cantonese. Geva, Wade-Woolley, and Shany (1993) investigated the spelling performance of English L1 children learning to read and spell in Hebrew L2. They found that one particular novel phoneme, /ts/, which does not exist in English, caused spelling difficulties for English-speaking children learning to spell in Hebrew.

Sources of difficulties impacting spelling errors include novel phonemes (Geva et al., 1993; Wang and Geva, 2003) and phonemes that are spelled differently in the two languages, for example in Spanish and English (Fashola et al., 1996; Rolla San Francisco et al., 2006). In learning to write in an L2, children will always encounter new spellings. In addition, the different levels of transparency between the two languages being learned are often the sources of spelling errors for L2 learners. The basis of the Orthographic Depth Hypothesis is that languages differ in their orthographic depth. Findings from the current study support that premise and provide additional empirical evidence that transfer from a shallow to a deeper orthography may prove difficult for young children learning to read and spell in the L2. The direction of the transfer (i.e., from shallow to deep or from deep to shallow) may play a role in how easily a child transitions from L1 to L2.

Limitations

While the results of these two studies certainly add important pieces of evidence to the existing literature on the influence of L1 knowledge on L2 learning, it is important to acknowledge the limitations of the current research, as well as suggestions for improvement. In Study 1, Cronbach's reliability analysis on the Spanish orthographic choice task yielded an extremely low alpha. Additional investigation into why this occurred and how to effectively measure Spanish orthographic awareness via an orthographic choice task is needed. Also, the English and Spanish real word spelling tasks were not matched in number of syllables because Spanish contains much fewer one-syllable words than does English. Replicating this study with only two-syllable words would control for both word length and word structure, similar to the measures utilized by Pollo et al. (2005) in their study with English-Portuguese bilingual children. Pollo et al. (2005) also controlled for syllable stress, by using only words with stress on the first syllable, the most common stress pattern in both English and Portuguese. Also, for consonant spelling errors, the English spelling task items contained final consonant clusters, which may have confounded the results – Spanish lacks final consonant clusters. In an effort to control for word length (i.e., number of letters) between the contrastive and non-contrastive vowel items, I added phonemes to the non-contrastive items. For example, with contrastive vowels (i.e. long vowels) the vowel phonemes were represented by at least two graphemes (e.g. *meat, time, bake*). For non-contrastive vowels, only one grapheme was needed in most of the items (e.g. *shed, fast, mold*). The presence of final consonant clusters potentially presented difficulty for the native

Spanish-speaking children. Final consonant clusters should be eliminated altogether in order to get a clearer comparison of spelling errors between the two language groups.

Future Directions for Research

It is evident that there is a need to continue in this line of investigation. Language minority children tend to have difficulty in school, as evidenced by their academic underachievement (Gottardo, 2002; Verhoeven, 2000). Future research should examine whether backward transfer exists from English to Spanish. An interesting question would be whether the opaque L2 had a negative effect on spelling in the transparent L1, or if, due to its transparency, the L1 was not affected at all? Incorporating a larger sample size for the native Spanish-speaking group would allow us to perform hierarchical regression analyses in the L2-L1 direction. Another variable to be taken into account is parental literacy. While parental language use is of importance, whether the parents demonstrate reading and writing in the home might also play a role in the child's literacy development. Finally, while the findings from Study 2 suggest that native Spanish-speaking children with a minimum of one year of literacy instruction in Spanish (in their native country) exhibit spelling errors that are influenced by Spanish orthography, a longitudinal study would provide additional insight regarding how many years *after* arrival to the United States does the Spanish-influenced spelling fade away. The participants in our study were in Grades 2 and 3. A longitudinal study would help address at what age these children stop making Spanish-influenced spelling errors or whether the types of errors change over time. Upon examining the Spanish-influenced vowel spelling errors by phoneme, two of the phonemes, /i/ and /u/, seemed to cause the most difficulty for native Spanish-speaking children at this age. Would this change over time? A study focusing on these two phonemes could also potentially address why these two phonemes, in particular, caused the most spelling errors.

Educational Implications

Finally, there are several educational implications that emerge from our findings. Most importantly, results from the two studies can aid in informing future research on teaching strategies. It is important for classroom teachers to be aware of, and even understand, that their native Spanish-speaking children's strong L1 skills can be transferred to their L2 word reading and spelling development. Also, if a native Spanish-speaking student is not making gains in English reading, and his Spanish phonological and orthographic processing skills prove to be poor, the instructional approaches may have to be altered. In many cases, native Spanish-speaking children who are not performing well in English reading, are placed in English as a Second Language (ESL) programs, with the assumption that the reading difficulties are due to language barriers, rather than fundamental deficiencies in phonological awareness. Furthermore, this dissertation provides evidence that if teachers of Spanish-speaking children do have some knowledge of Spanish orthography, they may be better equipped to understand why a child might misspell vowels that are spelled differently in English and Spanish. Practically speaking, future research aimed at expanding this knowledge may help in the development and implementation of teaching strategies to target these specific phonemes.

In conclusion, our results are consistent with previous research findings in the area of cross-language transfer of phonological and orthographic processing skill. Phonological processing skills in Spanish did predict English reading and spelling, but orthographic processing skills only predicted English reading, indicating an independence of orthographic processing as it relates to spelling. In addition, there is a strong L1 influence when spelling vowels in the L2 (English) that are represented by different graphemes in the two languages.

Appendix A: Spanish graphemes and phonemes

Graphemes	Phonemes	Pronunciation according to the sounds underlined in the following English words
a	/ ɑ/	"rock"
b	/b/	"bed"
c	/k/ /s/	"cat" "city"
ch	/tʃ/	"cheese"
d	/d/	"dog"
e	/ɛ/	"tell"
f	/f/	"for"
g	/g/ /h/	"good" "hello"
h	---	
i	/i/	"clean"
j	/h/	"hello"
k	/k/	"cat"
l	/l/	"low"
ll	/y/	"yes"
m	/m/	"mat"
n	/n/	"no"
ñ	/ñ/	"nya"
o	/o/	"ball"
p	/p/	"pet"
q	/k/	"cat"
r	/r/	"red"
s	/s/	"sit"
t	/t/	"toy"
u	/u/	"food"
v	/b/	"bed"
w	/w/	"want"
x	/s/ /ks/	"sit" "exit"
y	/i/ /y/	"clean" "yes"
z	/s/	"sit"

Appendix B: International Phonetic Alphabetic

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

CONSONANTS (PULMONIC)

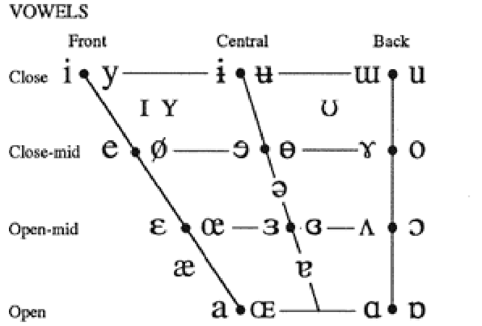
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

Clicks		Voiced implosives		Ejectives	
ʘ	Bilabial	ɓ	Bilabial	ʼ	as in:
ǀ	Dental	ɗ	Dental/alveolar	pʼ	Bilabial
ǃ	(Post)alveolar	ʄ	Palatal	tʼ	Dental/alveolar
ǂ	Palatoalveolar	ɠ	Velar	kʼ	Velar
ǁ	Alveolar lateral	ʛ	Uvular	sʼ	Alveolar fricative

VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

OTHER SYMBOLS

- ʍ Voiceless labial-velar fricative
- w Voiced labial-velar approximant
- ɥ Voiced labial-palatal approximant
- ʜ Voiceless epiglottal fricative
- ʢ Voiced epiglottal fricative
- ʡ Epiglottal plosive
- ɕ ʑ Alveolo-palatal fricatives
- ɺ Alveolar lateral flap
- ɧ Simultaneous ʃ and x

Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.

k͡p t͡s

SUPRASEGMENTALS

- ˈ Primary stress
- ˌ Secondary stress — ˌfoʊnəˈtɪʃən
- ː Long — eː
- ˑ Half-long — eˑ
- ̆ Extra-short — ĕ
- . Syllable break — ɹi.ækt
- | Minor (foot) group
- ‖ Major (intonation) group
- ‿ Linking (absence of a break)

TONES & WORD ACCENTS

LEVEL		CONTOUR	
e̋ or ˥	Extra high	ě or ˩˥	Rising
é ˦	High	ê ˥˩	Falling
ē ˧	Mid	e᷄ ˧˥	High rising
è ˨	Low	e᷅ ˩˨	Low rising
ȅ ˩	Extra low	e᷈ ˧˦˧	Rising-falling
↓	Downstep	↗	Global rise
↑	Upstep	↘	Global fall

etc.

DIACRITICS

Diacritics may be placed above a symbol with a descender, e.g. ŋ̊

̥ Voiceless n̥ d̥	̤ Breathy voiced b̤ a̤	̪ Dental t̪ d̪
̬ Voiced s̬ t̬	̰ Creaky voiced b̰ a̰	̺ Apical t̺ d̺
ʰ Aspirated tʰ dʰ	̼ Linguolabial t̼ d̼	̻ Laminal t̻ d̻
̹ More rounded ɔ̹	ʷ Labialized tʷ dʷ	̃ Nasalized ẽ
̜ Less rounded ɔ̜	ʲ Palatalized tʲ dʲ	ⁿ Nasal release dⁿ
̟ Advanced u̟	ˠ Velarized tˠ dˠ	ˡ Lateral release dˡ
̠ Retracted i̠	ˤ Pharyngealized tˤ dˤ	̚ No audible release d̚
̈ Centralized ë	~ Velarized or pharyngealized ɫ	
̽ Mid-centralized e̽	̝ Raised e̝ (ɹ̝ = voiced alveolar fricative)	
̩ Syllabic ɹ̩	̞ Lowered e̞ (β̞ = voiced bilabial approximant)	
̯ Non-syllabic e̯	̘ Advanced Tongue Root e̘	
˞ Rhoticity ə˞	̙ Retracted Tongue Root e̙	

Appendix C: Demographic Information Survey (English)

Demographic Information Survey

Date ___________________ Child's Name ______________________________

1. Date of birth ________mm _________dd _________yy

2. Gender: Male Female

3. Grade level: ________________

4. Country of Birth ___________________

5. Date of arrival to USA ______________

6. Language spoken at home

by child:	English	Spanish	English and Spanish
by mother:	English	Spanish	English and Spanish
by father:	English	Spanish	English and Spanish

7. Mother speaks some English Yes No

8. Father speaks some English Yes No

9. Parental education (university degree): father_________mother______________

10. What was the first language this child learned? ________________________

Demographic Information Survey (Spanish)

Cuestionario de Informácion Demográfica

Fecha __________________ Nombre de Hijo/a ____________________________

1. Fecha de nacimiento: _______ ________ _________
   día mes año

2. Sexo Masculino Femenino

3. Grado: _______________

4. País de nacimiento: _________________

5. Fecha de llegada a USA: ______________

6. Idioma principal usado en la casa:

del hijo/a:	Inglés	Español	Inglés y Español
de la madre:	Inglés	Español	Inglés y Español
del padre:	Inglés	Español	Inglés y Español

7. Madre habla por lo menos un poco de Inglés Sí No

8. Padre habla por lo menos un poco de Inglés Sí No

9. Educación (título de Universidad) de: padre______________madre_____________

10. Cual fue el primer idioma aprendido por este hijo/a? ______________________

Appendix D: English Tasks

Oral Language Proficiency

Items by Age Group

Ages 6-7

- parachute
- vegetable

Ages 8-9

- gigantic
- nostril
- vase
- island

Ages 10-11

- flamingo
- palm
- clarinet
- exhausted
- pitcher
- vine
- inhaling
- demolishing

Ages 12-16

- microscope
- archery
- adapter
- coast
- consuming
- colt

Rhyme Detection

1.	dap	fap	**smar**
2.	**flem**	snock	bock
3.	**seck**	lork	gork
4.	**noing**	bronk	lonk
5.	sond	hond	**jad**
6.	kep	**ghed**	sep
7.	zob	stob	**brab**
8.	bisk	**rint**	kisk
9.	fenk	**fesk**	menk
10.	fench	dench	**sarn**
11.	merl	**bisp**	derl
12.	pilt	nilt	**prem**
13.	**misk**	bant	tant
14.	trast	**blim**	clast
15.	nade	kade	**zeep**

Onset Detection

1.	bep	bap	**gonk**
2.	sisk	**bork**	sonk
3.	**mork**	rem	rond
4.	menk	monk	**fesk**
5.	**zep**	pob	ponk
6.	fep	**stob**	fisk
7.	tisk	**zep**	tant
8.	**ghen**	lench	lisk
9.	**jast**	dod	dant
10.	bant	**milt**	bast
11.	**gade**	kenck	kade
12.	tade	**daw**	terl
13.	gheck	gaw	**kass**
14.	**pode**	naw	noke
15.	susk	seck	**kem**

Note: Correct choices are indicated in bold.

Phoneme Deletion Task

1.	neep	→	(n) eep
2.	zipe	→	(z) ipe
3.	toof	→	(f) too
4.	sen	→	(n) se
5.	skeak	→	(s) keak
6.	sisp	→	(p) sis
7.	snize	→	(s) nize
8.	fask	→	(s) fak
9.	bift	→	(t) bif
10.	stob	→	(s) tob
11.	spap	→	(s) pap
12.	basp	→	(s) bap
13.	sneck	→	(n) seck
14.	yift	→	(f) yit
15.	skaff	→	(k) saff
16.	stoam	→	(t) soam
17.	kesk	→	(s) kek
18.	smool	→	(m) sool
19.	dapt	→	(p) dat
20.	tect	→	(c) tet

Orthographic Choice Task

1.	ffeb	**beff**
2.	**dalled**	ddaled
3.	**vadding**	vayying
4.	**bey**	bei
5.	dau	**daw**
6.	**chim**	chym
7.	**miln**	milg
8.	visn	**vism**
9.	**vost**	vosst
10.	sckap	**skap**
11.	qoast	**quoast**
12.	**phim**	ffim
13.	**moil**	moyl
14.	**camb**	camt
15.	**shud**	suhd
16.	**reat**	raet
17.	**lase**	lasq
18.	zayl	**zail**

Note: Correct choices are indicated in bold.

Homophone Choice Task

1.	**take**	taik
2.	gote	**goat**
3.	sleap	**sleep**
4.	**hole**	hoal
5.	rume	**room**
6.	snoe	**snow**
7.	**face**	fase
8.	hert	**hurt**
9.	**sheep**	sheap
10.	smoak	**smoke**
11.	**bowl**	boal
12.	cloun	**clown**
13.	**word**	wurd
14.	cote	**coat**
15.	**rain**	rane
16.	stoar	**store**
17.	lurn	**learn**
18.	**nice**	nise
19.	scair	**scare**
20.	**skate**	skait
21.	**true**	trew
22.	streem	**stream**
23.	wize	**wise**

Note: Correct choices are indicated in bold.

Reading Tasks

Real Word	Pseudoword
in	dee
cat	ap
book	ift
tree	raff
how	bim
animal	nan
even	fay
spell	gat
finger	roo
size	oss
felt	pog
split	plip
lame	dud’s
stretch	shab
bulk	whie
abuse	vunhip
contemporary	nigh
collapse	bufty
contagious	sy
triumph	straced
alcove	chad
bibliography	than’t
horizon	tadding
municipal	twem
unanimous	laip
benign	adjex
discretionary	gouch
stratagem	yeng
seismograph	zirdn’t
heresy	gaked
itinerary	knoink
usurp	cigbet
irascible	mancingful
pseudonym	wrey
oligarchy	bafmotbem
	translibsodge
	monglustamer
	vauge
	gnouthe
	quiles

Real Word Spelling Task

Contrastive Vowels		Non-Contrastive Vowels		Fillers	
/i/	green	/ɛ/	sell	/ɪ/	trim
	meat		check		kiss
	scene		shed		brick
/eI/	bake		red		wind
	same		get		lips
	lane	/æ/	wrap		inch
	main		drag	/ɑ/	clock
/aI/	like		fast		blonde
	shine		mask		nod
	my	/o/	blow		frog
	time		mold		pond
/u/	moon		bowl	/ ʌ/	club
	tune		show		truck
	tool		cone		run
					gum
					shut
				/ɝ/	bird
					word
					shirt
					burn

Check	The teacher will check my work.	Check
Scene	My sister made a scene at the store	Scene
Blonde	My neighbor has blonde hair.	Blonde
Get	Did you get a new book?	Get
Bake	My grandmother likes to bake cookies.	Bake
Show	I will show you how to play the game.	Show
Mask	He wore a scary mask for Halloween.	Mask
Wrap	My mom will wrap the present.	Wrap
Tune	That song has a nice tune.	Tune
Truck	The man drove a pick-up truck.	Truck
Bird	That bird lives in a nest.	Bird
Trim	Just trim my hair – don’t cut it too short!	Trim
Kiss	I gave my mom a good-night kiss.	Kiss
Frog	The frog in the pond jumps high.	Frog
Green	In the summer, the grass is green.	Green.
Mold	Mold was growing on the bread.	Mold
Main	The main office is down the hall	Main
Gum	We cannot chew gum in school.	Gum
Clock	We start school at 8 o’clock.	Clock

Lane	Drive in the right lane!	Lane
Lips	Read my lips!	Lips
Time	What time is it?	Time
Moon	The moon is big and round.	Moon
Brick	The house is made of brick.	Brick
Cone	Can I have an ice cream cone?	Cone
Tool	A hammer is a tool.	Tool
Fast	She is driving too fast.	Fast
Pond	There are fish in the pond.	Pond
Meat	Do you like to eat meat?	Meat
Wind	The wind is blowing hard!	Wind
Same	We live on the same street.	Same
Shine	The sun will shine in the morning.	Shine
My	My friend is coming.	My
Sell	We're trying to sell our car.	Sell
Inch	This book is an inch thick!	Inch
Nod	Nod your head if you understand.	Nod
Word	What does this word mean?	Word
Drag	Don't drag your jacket on the ground.	Drag
Shed	The lawnmower is in the shed.	Shed
Like	We really like going to school	Like
Shut	Don't forget to shut the door!	Shut
Blow	I'll blow out the candles.	Blow
Burn	Fire can burn you.	Burn
Club	The soccer club meets after school.	Club
Red	Some apples are red.	Red
Shirt	His shirt is dirty.	Shirt
Bowl	I drank a bowl of soup.	Bowl
Run	He likes to run down the hallway.	Run

Familiarity Ratings for Real Word Spelling Task Items

Item	Overall Rating	Range
green	1.00	1-1
meat	2.33	1-3
scene	2.67	2-3
bake	2.67	2-3
same	2.00	1-3
lane	4.00	3-5
main	2.67	1-4
like	1.00	1-1
shine	3.00	2-4
my	1.33	1-2
time	1.33	1-2
moon	1.33	1-2
tune	4.00	3-5
tool	3.00	3-3
sell	2.00	2-2
check	2.67	2-4
shed	3.67	2-5
red	1.00	1-1
get	1.33	1-2
wrap	3.33	3-4
drag	3.33	3-4
fast	1.00	1-1
mask	3.00	2-4
blow	2.67	2-3
mold	4.00	2-5
bowl	1.33	1-2
show	2.33	2-3
cone	3.33	3-4
trim	4.67	4-5
kiss	1.00	1-1
brick	2.33	2-3
wind	2.67	2-4
lips	1.67	1-2
inch	3.00	2-4
clock	1.67	1-2
blonde	3.67	3-4
nod	2.67	1-5
frog	1.33	1-2
pond	2.00	1-3
club	2.67	2-3
truck	1.00	1-1
run	1.00	1-1
gum	2.33	1-3
shut	2.00	1-3
bird	1.00	1-1
word	1.00	1-1
shirt	1.00	1-1
burn	2.67	2-3

Pseudoword Spelling Task

Contrastive Vowels		Non-Contrastive Vowels		Fillers	
/i/	peef	/ɛ/	mell	/ɪ/	blist
	treeb		frep		prip
	blean		pech		wib
/eI/	paim		beld		tris
	paig		wect		gist
	gake	/æ/	trad		kint
	lape		saft	/ɑ/	trob
/aI/	shile		bast		shont
	ribe		plash		blop
	wike	/o/	pode		pron
	fie		crote		crot
/u/	roop		wolb	/ʌ/	brud
	goom		voln		funt
	loof		shobe		pruck
					lund
					tum
				/ɝ/	lurd
					herk
					nirt
					gurnd

Appendix E. Phonological Legitimacy Ratings for 5 added items

Item	Average Rating
camb	1.55
reat	1.18
zayl	1.91
lasq	2.18
suhd	2.45
raet	2.09
camt	1.91
zail	1.27
shud	1.18
lase	1.36

Appendix F. Criterion Test for Orthographic Choice Task

Items	Rating (%)	Items	Rating (%)	**Final Word Pair List**	
ffeb	0	bey	86.7	Ex. **nuck**	**ckun**
yikk	22.2	daw	84.4	Ex. **fage**	**fayj**
dalled	100	chym	17.8	**reat**	**raet**
vadd	28.9	lund	75.6	**chim**	**chym**
dau	15.6	cdil	0	**daw**	**dau**
gry	73.3	vism	73.3	**shud**	**suhd**
moil	93.3	drin	68.9	**phim**	**ffim**
cnif	2.2	shud	82.2	**lase**	**lasq**
blad	93.3	fojy	2.2	**camb**	**camt**
beff	71.1	nuck	84.4	**bey**	**bei**
togn	2.2	hifl	0	**skap**	**sckap**
skap	88.9	clid	71.1	**vost**	**vosst**
dorw	8.9	vadding	71.1	**moil**	**moyl**
zail	88.9	quas	15.6	**vadding**	**vayying**
lign	26.7	fong	80.0	**dore**	**dorw**
lasq	2.2	radn	6.7	**dalled**	**ddaled**
miln	82.2	hibs	60.0	**vism**	**visn**
vosst	8.9	zayl	8.9	**beff**	**ffeb**
ckun	4.4	raet	8.9	**zail**	**zayl**
hift	73.3	dore	97.8	**miln**	**milg**
chim	86.7	bnad	0		
sckap	6.7	nilt	66.7		
dlun	4.4	vayying	17.8		
fage	93.3	milg	17.8		
naor	6.7	pong	48.9		
jofy	46.7	phim	71.1		
visn	6.7	lase	86.7		
ffim	2.2	vost	75.6		
suhd	8.9	lidn	2.2		
thak	64.4	yinn	22.2		
quoast	37.8	dacker	95.6		
fowg	44.4	moyl	17.8		
camb	91.1	noar	51.1		
ddaled	2.2	hihs	2.2		
munn	53.3	qas	20.0		
nitl	2.2	camt	17.8		
bei	17.8	pone	97.8		
muun	8.9	reat	77.8		
fayj	0	rdin	0		
crif	62.2	htak	0		

Appendix G: Spanish Tasks

Oral Language Proficiency

Items by Age Group

Ages 6-7
- vacío
- construcción

Ages 8-9
- bosque
- iluminación
- cooperación
- gotear

Ages 10-11
- carpintero
- cuarteto
- binocular
- roer
- morsa
- confiar
- terno

Ages 12-13
- portátil
- clasificar
- carroña
- brujula
- felino

Ages 14+
- fragíl

Rhyme Detection

1.	nue	/nuɛ/	sue	/suɛ/	**bab**	**/bɑb/**
2.	**san**	**/san/**	pual	/pual/	fual	/fuɑl/
3.	miez	/miɛs/	**dat**	**/dat/**	fiez	/fiɛs/
4.	sor	/sʊɹ/	dor	/dʊɹ/	**buk**	**/buk/**
5.	trat	/trat/	**blim**	**/blim/**	clat	/klat/
6.	**mik**	**/mik/**	dien	/diɛn/	fien	/fiɛn/
7.	pik	/pik/	nik	/nik/	**pem**	**/pem/**
8.	dap	/dap/	fap	/fap/	**sar**	**/sar/**
9.	fen	/fɛn/	**fes**	**/fɛs/**	men	/mɛn/
10.	**lem**	**/lɛm/**	bok	/bɑk/	jok	/hɑk/
11.	**neg**	**/nɛg/**	bonc	/bɑnk/	ronc	/rɑnk/
12.	kep	/kɛp/	**min**	**/min/**	sep	/sep/
13.	mel	/mɛl/	**bis**	**/vis/**	pel	/pɛl/
14.	neid	/neɪd/	queid	/keɪd/	**sip**	**/sip/**
15.	**com**	**/com/**	nup	/nup/	lup	/lup/

Note: Correct choices are indicated in bold.

Onset Detection

1.	**sip**	**/sip/**	dat	/dɑt/	due	/duɛ/
2.	keit	/keɪt/	ken	/kɛn/	**beib**	**/veɪb/**
3.	nip	/nip/	**pud**	**/pud/**	nul	/nul/
4.	suk	/suk/	sec	/sɛk/	**kem**	**/kɛm/**
5.	**ban**	**/vɑn/**	nie	/niɛ/	nop	/nop/
6.	tual	/tuɑl/	**bok**	**/vok/**	tat	/tat/
7.	sup	/sup/	sem	/sem/	**bap**	**/vɑp/**
8.	**nas**	**/nɑs/**	gak	/hɛk/	gol	/hol/
9.	til	/til/	**din**	**/din/**	tad	/tad/
10.	lek	/lɛk/	**gen**	**/hɛn/**	lis	/lis/
11.	**mor**	**/mor/**	rem	/rɛm/	rud	/rud/
12.	mek	/mɛk/	mon	/mon/	**fes**	**/fɛs/**
13.	fep	/fɛp/	**ton**	**/ton/**	fis	/fis/
14.	**nas**	**/nɑs/**	dap	/dɑp/	dam	/dɑm/
15.	bep	/vɛp/	bam	/vɑm/	**nok**	**/nok/**

Note: Correct choices are indicated in bold.

Phoneme Deletion Task

1.	plas	→	(p) las	/plɑs/	→	/lɑs/
2.	blot	→	(l) bot	/blot/	→	/bot/
3.	mart	→	(r) mat	/mɑrt/	→	/mɑt/
4.	romp	→	(p) rom	/romp/	→	/rom/
5.	nip	→	(n) ip	/nip/	→	/ip/
6.	gras	→	(g) ras	/grɑs/	→	/rɑs/
7.	bont	→	(t) bon	/vont/	→	/von/
8.	crut	→	(c) rut	/krut/	→	/rut/
9.	kit	→	(t) ki	/kit/	→	/ki/
10.	pelt	→	(l) pet	/pɛlt/	→	/pɛt/
11.	plon	→	(l) pon	/plon/	→	/pon/
12.	lun	→	(n) un	/lun/	→	/un/
13.	fask	→	(s) fak	/fɑsk/	→	/fɑk/
14.	duat	→	(t) dua	/duɑt/	→	/duɑ/
15.	stor	→	(s) tor	/stor/	→	/tor/
16.	bord	→	(r) bod	/bord/	→	/bod/
17.	lisc	→	(c) lis	/lisk/	→	/lis/
18.	blit	→	(b) lit	/blit/	→	/lit/
19.	sint	→	(t) sin	/sint/	→	/sin/
20.	clab	→	(c) lab	/klɑb/	→	/lɑb/

Orthographic Choice Task

1.	slu	**sul**
2.	aqu	**iqu**
3.	**sop**	spo
4.	**quet**	quat
5.	rin	**iña**
6.	**quin**	quan
7.	bell	**lleb**
8.	**equ**	oqu
9.	traan	**tran**
10.	seet	**set**
11.	guup	**gup**
12.	**llun**	nell
13.	grou	**groi**
14.	**set**	seet
15.	**gup**	guup
16.	ñob	**oñe**
17.	loñ	**lon**
18.	rrit	**irre**

Note: Correct choices are indicated in bold.

Homophone Choice Task

1.	**como**	komo
2.	**cerrar**	serrar
3.	mui	**muy**
4.	**cinco**	cinko
5.	**bella**	beia
6.	yamo	**llamo**
7.	**niño**	ninio
8.	rubyo	**rubio**
9.	**playa**	plaia
10.	kon	**con**
11.	sierto	**cierto**
12.	**queso**	keso
13.	**mayor**	mallor
14.	braso	**brazo**
15.	**carne**	karne
16.	**año**	anio
17.	**aquí**	akí
18.	siya	**silla**
19.	**día**	dilla
20.	odyo	**odio**
21.	**paso**	pazo
22.	**zapato**	sapato
23.	kince	**quince**

Note: Correct choices are indicated in bold.

Reading Tasks

Real Word	Pseudoword
tío	mos
pie	des
pez	leis
luz	telesot
pan	millo
ropa	satro
foto	zaño
libro	fejo
helado	tarro
planta	nibro
conejo	dorra
romper	tuz
biblioteca	luedas
caja	jacar
abrir	pieve
primo	lludi
izquierda	firado
paraguas	derve
arena	conello
aprender	nescrotinio
camión	warcafloren
rubio	nágino
peligro	fabilla
tierra	lentaspuomo
mencionar	lotozón
aún	firmcontapético
algódon	norrato
significado	ellopmentan
iluminado	dorteñazo
naturaleza	lodeazgo
obligado	michupán
atardecer	olifuerta
proporcionar	camileteso
emparentado	achedientis
neurasthenia	munaroción
	lirtefactuo
	ambineche
	toridades
	borrallaje

Real Word Spelling Task

Contrastive Vowels		Non-Contrastive Vowels		Filler Items	
/i/	sin	/ɛ/	pez	/ie/	tiene
	lista		tren		bien
	gris		lejos		siete
/eI/	leiste		medio		hielo
	seis		negro		nieva
	peine	/æ/	gato		cielo
	reino		vaca		diez
/aI/	aire		blanco	/ue/	abuelo
	pais		plan		agua
	bailar	/o/	dos		huevo
	traigo		toque		fuente
/u/	luna		pronto		buena
	gusta		toro		hueso
	mucho		loca	/ia/	tias
					piano
					mia
				/oi/	soy
					voy
				/ui/	fuimos
				/au/	causa

Negro	Su pelo es negro.	Negro
Sin	Yo como pollo sin arroz	Sin
Soy	Soy la hermana mayor.	Soy.
Peine	Mi mama usa un peine en su cabello	Peine
Gusta	No me gusta comerlo.	Gusta
Loca	Mi vecina está loca.	Loca
Buena	Buena suerte!	Buena
Siete	El tiene siete años.	Siete
Causa	El sol causa calor.	Causa
Traigo	Traigo mi mochila al escuela.	Traigo
Gato	El gato duerme aquí	Gato
Dos	Tenemos dos manos	Dos
Lista	Ya estás lista para salir?	Lista
Bien	Haz la tarea bien.	Bien
Aire	El aire está fresco.	Aire
Piano	Mi madre toca el piano.	Piano
Abuelo	Voy a la casa de mi abuelo.	Abuelo
Diez	Tengo diez dedos.	Diez
Tren	El viaja en un tren.	Tren
Leiste	Cuantos libros leiste?	Leiste

Toro	El toro está enojado.	Toro
Voy	Voy al médico mañana.	Voy
Hueso	Me rompí un hueso jugando fútbol.	Hueso
Nieva	Nieva en el invierno.	Nieva
Lejos	Está muy lejos de mi casa.	Lejos
Pais	Los Estados Unidos es un pais grande.	Pais
Pronto	El correo llega pronto.	Pronto
Agua	Bebo aqua cuando tengo sed.	Agua.
Cielo	El cielo es azul	Cielo
Tiene	Cuantos años tiene?	Tiene
Gris	El elefante es gris.	Gris
Reino	La princesa vive en un reino	Reino
Mia	La bicicleta es mia.	Mia
Seis	Cuesta seis dolares.	Seis
Huevo	El huevo es blanco.	Huevo
Pez	Veo un pez en el lago.	Pez
Mucho	Te quiero mucho.	Mucho
Blanco	El conejo es blanco.	Blanco
Bailar	Me gusta bailar	Bailar
Vaca	La vaca dice “moo”	Vaca
Tias	Mis tias son bonitas	Tias
Toque	Dile que toque la guitarra	Toque
Plan	Tengo un plan de escape.	Plan
Hielo	El hielo está frio!	Hielo
Fuimos	Fuimos de vacaciones	Fuimos
Medio	Sientate en el medio.	Medio
Luna	La luna aparece por la noche.	Luna
Fuente	Hay agua en la fuente	Fuente

Pseudoword Spelling Task

Contrastive Vowels		Non-Contrastive Vowels		Filler Items	
/i/	plisa	/ɛ/	tepa	/ie/	miete
	rito		chem.		Tiesa
	pimu		leb		biela
/eI/	deip		qued		crien
	creit		selt		diepe
	teib	/æ/	banti		fielo
	leila		rask		piente
/aI/	traite		pamo	/ue/	buepe
	shain		tral		tuete
	maipa	/o/	gombo		gruem
	chaib		plonto		puelo
/u/	fumi		bot		natuepo
	plunt		blopa		bluen
	ruma		lonu	/ia/	diante
					tiaro
					miapo
				/oi/	groi
					ploim
				/ui/	liupe
				/au/	fauso

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