LEARNING WORDS IN A NEW LANGUAGE: THE EFFECT OF LANGUAGE EXPERIENCE ON VOCABULARY ACQUISITION AND INHIBITORY CONTROL

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Abstract

Although bilinguals have been shown to possess superior abilities in the domain of executive function and inhibitory control (e.g., Bialystok et al., 2004; Colzato et al., 2008; Costa et al., 2008), there is evidence for a bilingual disadvantage in the realm of vocabulary size and speed of lexical access (e.g., Bialystok, 2005; Gollan et al., 2008). The few previous studies that have investigated vocabulary learning in monolinguals vs. bilinguals have reported a clear advantage for bilinguals (e.g., Kaushanskaya, 2007; van Hell & Mahn, 1997), a result that is somewhat at odds with the conclusion that lexical knowledge and retrieval is compromised in the presence of more than a single language.

The current study examined this apparent paradox in a group of adults learning new vocabulary that was equally unfamiliar to monolingual and bilingual participants. Sixty-four Dutch words were taught to three groups of participants with different language backgrounds: native English speakers who were functionally monolingual, native English speakers who had learned Spanish as their second language (L2), and Mandarin Chinese speakers who had learned English as their second language (L2). The words were either Dutch-English cognates (hotel in Dutch means "hotel" in English), Dutch-English false cognates (room in Dutch means "cream" in English), or unambiguous Dutch control words with no overt orthographic or phonological relationship to English. In the first session, participants studied the Dutch words twice and were subsequently given tests of translation recognition. In a second session several days later, participants studied the training set a third time, and were given a Dutch lexical decision task in which they had to respond 'yes' if the item was a Dutch word. Participants then came in for a third and final session several weeks later to repeat this same test of Dutch lexical decision. Results from the tests of translation recognition—which were administered just after the training phase—demonstrated that native language (i.e., English) was a better predictor of faster and more accurate performance than bilingualism. This suggests that for initial tests in foreign-language learning, learning of the unfamiliar language via one’s L1 rather than one’s L2 predicts success. In the first test of Dutch lexical decision, few differences existed between the groups in terms of accuracy, although the cognates were the most accurate word type for all participants, and speed only differed for the Chinese-English bilinguals, who were slower overall. At the second test of Dutch lexical decision, however, both bilingual groups demonstrated an advantage in retention of the words, which was reflected in their accuracy performance. These results provide additional support for the notion that bilinguals as experienced language learners have an advantage over monolinguals when learning new words in an unfamiliar language. The implications of these findings for claims about the advantages and disadvantages of bilingualism for lexical performance are discussed, as well as the possibility of both a general and a specific bilingual advantage in foreign-language learning, depending on the time of test.
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Background and Introduction

Although more people are bilingual than monolingual worldwide, most research on language and thought has focused on monolingual English speakers. Recently, this situation has changed, with an expansion in work examining the consequences of bilingualism for language processing and for cognition more generally (e.g., Kroll & de Groot, 2005). Of the many issues to consider and examine, one of the most hotly debated is what, if any, cognitive processing differences exist between bilingual and monolingual individuals, and if such differences exist, whether bilinguals are advantaged or disadvantaged when compared to monolinguals.

Within the realm of language processing, evidence for differences between multilingual and monolingual individuals has suggested some processing disadvantages for multilinguals (Bialystok, 1988; Gollan, Montoya, Fennema-Notestine, & Morris, 2005; Gollan, Montoya, & Werner, 2002; Rosenblum & Pinker, 1983; Rosselli et al., 2000; Umbel, Pearson, Fernández, & Oller, 1992). However, bilinguals have often been found to outperform their monolingual counterparts on non-linguistic tests of general cognitive ability (Bialystok, 1999; Bialystok, Craik, & Freedman, 2007; Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok & Martin, 2004; Bialystok, Martin, & Viswanathan, 2005; Costa, Hernández, & Sebastián-Gallés, 2008). This apparent paradox begs several questions about the nature of these advantages and disadvantages. If such differences exist in some cognitive capacities, what are the underlying causes for these differences? And are the differences related, due to the same or similar mechanisms?

The present study aimed to further investigate the nature of these differences within the same experimental paradigm, with the possibility that bilinguals might have advantages over monolinguals in some aspects of the paradigm, and disadvantages in others.
Specifically, the current experiment asked whether experience with multiple languages bestows a "language-learning" benefit on bilinguals over monolinguals, and if specific types of words are more easily learned by individuals from different language backgrounds. Additionally, the current study also whether, if such advantages did exist, these advantages exist for all bilinguals, regardless of which combination of languages they speak.

The main hypothesis being investigated is whether bilinguals are better foreign-language learners because of their experience with multiple languages, while monolinguals, with no foreign-language learning experience, are not as skilled in this respect. Before outlining the present study in detail, a review of the nature of cognitive advantages and disadvantages, both linguistic and non-linguistic, will be presented. Additionally, a review of the research that has examined how cognates and false cognates are processed by bilinguals is presented. And finally, an overview of several theories that attempt to explain processing differences between bilinguals and monolinguals is presented.

1. Bilingual advantages and disadvantages

Some evidence has suggested that bilinguals exhibit several general cognitive advantages. Specifically, several studies have found greater attentional control in bilinguals than in monolinguals. For instance, (Bialystok, 1999) found that bilingual preschool-aged children performed better on two tasks of attentional control (the moving word task and the dimensional card sort task) than monolingual children matched for age, English proficiency, and memory span. In the moving word task, children saw two familiar objects and an experimenter placed a card with one of the object's names underneath the corresponding object and told the child what the card said. The child was then asked what the card said. Then the card would "accidentally" be moved underneath the other object when the experimenter wasn't looking, and the child was asked again what the card said. This task was
designed to test the notion of symbolic invariability between words and objects. On a second task—the dimensional card sort task—children were given a stack of cards and asked to place them in piles based on a perceptual feature (for example, shape). Then the experimenter would retrieve the cards, shuffle them, and ask the child to sort the cards into piles based on a different perceptual feature (for example, color). Both of these tasks required children to attend to one feature of a stimulus or set of stimuli, while ignoring another feature, and perform an action based on the attended feature. Across both tasks, bilingual children were less likely to be distracted by the non-salient features of the stimuli than their monolingual counterparts. After some concern over the difficult representational demands placed on the children in this study, these results were replicated with reduced representational demands, while maintaining the same amount of distracting information as the previous study (Bialystok & Martin, 2004; Bialystok et al., 2004). They also found that the bilingual advantage for attending to only the salient features of the stimuli was only present when the task demanded attention to perceptual cues, not for semantic (i.e., meaningful) cues. The authors suggest that this is because perceptual cues are inherently more salient, and are thus more difficult to ignore when a task requires it. Hence the argument follows that when distractor cues are particularly salient, children generally have a difficult time ignoring them, but bilingual children seem to develop this skill of inhibiting irrelevant information at an earlier age than do monolingual children.

Research has also suggested that the general cognitive advantages that accompany bilingualism are not restricted to children. Studies have shown that elderly bilingual individuals demonstrate faster and more accurate responses in the Simon task, in which participants are instructed to make responses based solely on the color of a stimulus while ignoring the salience of the stimulus position (Bialystok et al., 2004). The authors interpreted
this finding as evidence for a bilingual advantage in attentional control and executive function in an elderly population. Other studies have reported that the onset of dementia in older bilingual individuals is four years later than in older monolingual individuals (Bialystok et al., 2007). While this research is controversial and cannot control for many extraneous factors that could contribute to the results, there is at least a suggestion that bilingualism may have some beneficial very long-term cognitive consequences.

Within the bilingual-advantage literature, a great deal of evidence has been found for a general cognitive advantage in both bilingual children and older bilinguals. However, the evidence from bilingual young adults is not as compelling. For example, on the Simon task, where elderly bilinguals reliably outperform monolingual age-matched controls, bilingual college-aged students perform identically to monolingual college-aged students (Bialystok et al., 2005). Bialystok et al. argue that this could be due to ceiling effects because reaction times to visually-presented stimuli are as fast as they will ever be for this age group, and thus any advantages that may exist are more difficult to detect because of this (but see Costa et al., 2008, for recent evidence of a cognitive advantage in the attentional network task for young adult bilinguals).

Another camp of researchers has focused not on the processing advantages that are reliably found in certain bilingual populations, but rather on some of the disadvantages that have been observed for bilinguals relative to monolinguals. These disadvantages are often found within the domain of language processing, particularly in speed of processing. For instance, bilingual children have been observed to score reliably lower than monolingual children on receptive vocabulary tests (Rosenblum & Pinker, 1983; Umbel et al., 1992), when tested in either their L1 or their L2 (Bialystok, 1988). However, such tests have been shown to provide an underestimation of a bilingual's vocabulary because they test their
knowledge in only one of their languages, and portions of bilingual's vocabularies in two languages often do not overlap (Umbel et al., 1992). Nevertheless, given the current climate of the educational system in this country and the unilingual nature of the system as well as the tests children take, lower performance on receptive vocabulary tests may be a serious disadvantage.

Other disadvantages have been reported for bilingual adults. On a verbal fluency task, for example, one study showed that bilingual young adults could recall fewer category exemplars in their non-native language than age-matched monolinguals (Gollan et al., 2002), and that this effect was greater for semantic category (e.g., words that are animals, fruits, colors, etc.) than for lexical category (e.g., words that start with A, M, R, etc.). Perhaps even more surprisingly, the same effect emerged when bilinguals were given instructions in both of their languages and were allowed to produce exemplars from either language. Similar results from the verbal fluency task have been found in older bilingual adults when compared to age-matched monolingual controls (Rosselli et al., 2000). Furthermore, another study demonstrated that bilinguals are slower to name pictures in their dominant language than monolinguals (Gollan et al., 2005). Gollan and her colleagues argue that these results provide evidence for a cross-language interference account (also known as the weaker links hypothesis or the relative frequency account), which proposes that processing delays in bilinguals are due to relatively decreased use of both languages (compared to monolinguals' use of one), rendering bilinguals slower to activate language-specific items than monolinguals. This account explains the results of the Gollan et al. (2002) study and the Gollan et al. (2005) study by suggesting that lexical access for a bilingual is more difficult than for a monolingual because there are more stored lexical items, and accessing them via
activation at the conceptual level is a slower process for bilinguals because there are so many more items to be examined, activated, and selected.

Gollan and her colleagues argue that bilingualism is akin to having an entire lexicon full of low-frequency words that are more effortful to retrieve. The argument stems from the notion that if a bilingual has two words that he or she could use to describe something (say, a dog—*dog* and *perro*), neither lexical item appropriate to convey the concept of "dog" get as much usage as would the lexical item *dog* for a monolingual English speaker, who must use the English word *dog* every time that he or she wants to describe the concept of "dog." If monolinguals and bilinguals refer to the concept "dog" equally often, a Spanish-English bilingual will never use *dog* or *perro* as frequently as a monolingual English-speaker will use the word *dog*, because the monolinguals will only ever use one word to refer to the concept of "dog," whereas the bilinguals will use either *dog* or *perro*. Hence, the idea is that both *dog* and *perro* are both more weakly connected to the concept of "dog" for a Spanish-English bilingual than *dog* is connected to the concept of "dog" for a monolingual English-speaker.

Another model that has been invoked to explain these findings is the inhibitory control model (Green, 1998). The inhibitory control model suggests that the increased time required for bilinguals to generate category exemplars is due to increased cross-language activation that delays processing. This is because cross-language activation appears to be non-selective (de Groot, Delmaar, & Lupker, 2000; Dijkstra, Timmermans, & Schriefers, 2000; Dijkstra, van Jaarsveld, & Ten Brinke, 1998), and words in the unintended language are often activated and must be suppressed in order for the bilingual to produce in the intended language. This active and frequent manipulation of languages slows processing overall. But this model is compatible with the prediction that bilinguals will experience cognitive benefits because of the need to resolve cross-language competition. This is due to a
lifetime of attending to salient cues (which cue the language a bilingual is intending to speak) while shutting out irrelevant ones (that activate a bilingual's unintended language). This could lead, in turn, to greater attentional control and overall benefits to executive function.

These two models, the inhibitory control model and the cross-language interference account, encapsulate the central issue in the ongoing debate about the degree to which bilingual and monolingual processing differs. However, the two are not mutually exclusive, and elements of both accounts may both be at work. There is certainly agreement, however, that there are indeed cognitive consequences for learning, knowing, and using multiple languages, and that a bilingual is not merely the conglomeration of two monolingual speakers of two separate languages, but rather a different entity entirely—one in which two languages interact with one another (Grosjean, 1982). The predictions that can be made from the inhibitory control model are that a lifetime of learning to select the intended language in the face of cross-language competition requires attention to salient information and suppression of irrelevant information, with the consequence that attentional control and executive function benefit over time. The cross-language interference account also maintains that a bilingual's two languages are inextricably connected, but that having two active languages is detrimental to immediate processing. The argument set forth by this account is that managing two active languages slows overall processing, rendering a bilingual disadvantaged, not advantaged.

The inhibitory control model and the cross-language interference account raise some probing questions about the nature of bilingualism and its cognitive consequences. How is it that bilinguals seem to be advantaged in some respects, but disadvantaged in others? Although a satisfying answer at this point is not apparent, the present study will make an attempt to examine this issue within a single experimental framework.
2. Implications for language learners

Thus far, some general cognitive advantages for bilinguals of different ages, as well as some language processing disadvantages, have been discussed. Perhaps unsurprisingly, some language processing advantages have been found in bilingual populations relative to monolingual populations, but thus far, the differences that have been examined often depend on the specific bilingual language combinations selected for study. For instance, in a study of phonological awareness, Spanish-English bilingual children outperformed English monolingual children, but both groups outperformed Chinese-English bilingual children (Bialystok, Majumder, & Martin, 2003). In this task, children were asked to use the sound from one word (such as the initial sound in *cat*) and use it as a sound in another word (for example, as the initial sound for the word *mop*). The authors argued that the observed advantage for Spanish-English bilinguals could be due to the knowledge of two phonologically similar languages, or because Spanish itself is a phonologically transparent language that enables phonological awareness to emerge earlier than for children who speak other languages. This issue of a bilingual’s particular language combinations is an important and tricky one, and it will be further discussed in Chapter 2.

One potentially interesting language processing difference that may exist between monolingual and bilingual individuals, and the one this study further investigates, does not stem from a bilingual's ability to speak two languages per se, but rather from a bilingual's experience learning and acquiring languages. Vocabulary acquisition is an essential aspect of foreign-language learning, and allows for tests that provide a window into language processing at various stages of language proficiency. Identifying the factors that influence vocabulary acquisition in an unfamiliar language is essential for understanding the role of learner characteristics. The hypothesis that bilinguals are more experienced language-
learners, and would be better able to learn vocabulary words in a foreign language than would monolinguals, has not yet received much attention in empirical research. To date, only a few studies have examined this issue (Kaushanskaya, 2007; Kaushanskaya & Marian, 2009; Papagno & Vallar, 1995; van Hell & Mahn, 1997), and all have been performed using early bilinguals (i.e., bilinguals who acquired their non-native language approximately before the age of twelve). Hence, any advantages or disadvantages that have been observed for bilinguals cannot yet be generalized to all bilinguals at all ages of acquisition of the second language. Be this as it may, the results that have been observed thus far are suggestive of a bilingual advantage in foreign-language learning.

Papagno and Vallar (1995) administered both a phonological short-term memory test as well as a foreign-word learning task to monolingual and bilingual participants. They taught Russian words to all of their participants via Italian translations, which was the native language of both the monolingual and the bilingual participants. They found that bilinguals outperformed monolinguals on both tasks. Although some methodological shortcomings (i.e., small sample size and variability in the languages spoken by participants) cast some doubt on the interpretability of these results, these findings at least suggest that the experience of learning more than one language puts bilinguals at an advantage when learning a new, unfamiliar language.

Another study on vocabulary acquisition supports the Papagno and Vallar (1995) results. van Hell and Mahn (1997) taught Spanish vocabulary words to Dutch-English bilinguals and English monolinguals. All participants were unfamiliar with the target language, Spanish. Critically, however, the Dutch-English bilinguals learned the unfamiliar Spanish vocabulary via Dutch translations (their native language), while the English monolingual participants learned the unfamiliar Spanish vocabulary via English translations.
(their native language). Half of the participants were instructed to memorize the words by repeating the word silently (i.e., rote rehearsal) and the other half were instructed to associate each Spanish word with an orthographically- and phonologically-related word in their native language and imagine an interaction between the meaning of the Spanish word and the meaning of the associated word in their native language (the so-called "keyword method"). Regardless of the learning method condition, the Dutch-English bilinguals recalled the definition of the Spanish words more frequently, and were faster to do so than the English monolingual participants. The only effect that learning method seemed to have was that Dutch-English bilinguals recalled fewer words and were slower to do so for the keyword method condition than the rote rehearsal condition, but still outperformed both learning-method groups of monolinguals. These results suggest that not only do bilinguals outperform monolinguals on vocabulary acquisition tasks when the target language is unfamiliar to both groups, but the way in which they learn seems also to be both qualitatively different than that of monolinguals. These findings also have implications for the bilingual/monolingual advantage/disadvantage debate by suggesting that bilinguals are better at vocabulary learning than monolinguals, which further suggests that there are general cognitive differences driving these differences in language-learning.

An interesting question to ask about van Hell and Mahn’s (1997) results is what other differences between the two groups tested could be behind the observed differences found in previous research. An important distinction may be the specific languages involved. There is no evidence to suggest that all bilinguals, regardless of which two languages they speak, perform the same on the kinds of tasks that have been previously presented here. Languages vary in many respects, including phonology, orthography, syntax, grammatical gender, and script, not to mention others. A more recent study (Kaushanskaya, 2007; Kaushanskaya &
Marian, 2009) has reexamined the issue of vocabulary acquisition and learning differences by testing English monolinguals, English-Spanish bilinguals, and English-Mandarin bilinguals. The reasoning behind such a comparison is that English and Mandarin Chinese do not share orthography, whereas English and Spanish do. A series of predictions can be made based on this feature of the languages. For example, because English and Spanish share orthography, a proficient English-Spanish bilingual must have learned more phoneme-to-letter mappings, often with multiple phonemes mapped to the same letter, than English monolingual speakers. Likewise, bilingual speakers of both Mandarin, a logographic system, and English, an alphabetic system, do not have to undergo such laborious phoneme-to-letter mapping. One could predict, then, that English-Spanish bilinguals (a same-script bilingual) would be better equipped to learn a new language that shared the orthography of English (and, likewise, Spanish) than would English-Mandarin bilinguals (different-script bilinguals) because they would have less experience with orthographic overlap, and would not be able to learn the new language as efficiently as English-Spanish bilinguals. However, previous studies have shown that there are observable cross-linguistic priming effects between languages of different scripts, suggesting that even if the orthography of a bilingual’s two languages are wholly disparate, some of the representations overlap in such a way that activation of an item in one language can trigger the activation of a related item in the other language (Gollan, Forster, & Frost, 1997; Hoshino & Kroll, 2008; Jiang, 1999).

Likewise, any bilingual advantages (or even disadvantages) that exist within the realm of foreign-language learning could be dependent on whether the bilingual learned the unfamiliar language via the native language or a second language. Thus far, all studies examining language-learning comparisons between bilinguals and monolinguals have taught unfamiliar vocabulary to all subjects via their native language. One issue that this experiment
aims to address is not only whether particular language combinations can influence language-learning differences in bilinguals relative to monolingual controls, but also whether bilingual advantages (or disadvantages) exist for all bilinguals, regardless of whether new vocabulary was learned via the native language or a second language (henceforth, a *general bilingual advantage*), or whether advantages and disadvantages rely on whether the unfamiliar language is taught via the native language or a second language (henceforth, a *specific bilingual advantage*).

The results of Kaushanskaya’s (2007) study replicated those of van Hell and Mahn’s (1997) study to a certain extent: both groups of bilingual participants learned more words from an artificial foreign language presented at study than did monolingual participants. However, in Kaushanskaya’s study, bilinguals did not seem to exhibit an advantage in processing efficiency over monolinguals, as the reaction times across groups did not differ significantly. This difference across studies is likely due to the kind of test utilized by each study to examine how well the new foreign words had been learned. In the van Hell and Mahn study, learners were cued by the Spanish word and asked to recall its definition. In the Kaushanskaya study, learners performed a translation recognition task, which requires participants to attest to the accuracy of a translation paired with a foreign-language word that they previously studied, and a production task, in which they were asked to say aloud the correct translation from a set of alternatives. These results suggest that the bilingual advantage in the context of language-learning is perhaps exhibited for particular types of tests, but not for all tests.

In addition to the differences in the tests utilized by the two studies, the study phases differed as well. Unlike the van Hell and Mahn (1997) study, which posed the keyword method against the rote rehearsal method for vocabulary learning, the Kaushanskaya (2007)
study trained participants on the vocabulary words either auditorily (*unimodal* presentation) or simultaneously auditorily and visually (*bimodal* presentation). The results of the Kaushanskaya study showed that all language groups were slower and less accurate for tests of both recognition and production when words were presented bimodally at study. This effect was observed for both bilingual groups tested, as well as the monolingual group. This suggests that being both visually and auditorily presented with a word in a foreign language is more difficult when phoneme-to-letter mappings to not overlap with an individual’s known language or languages.

In terms of the observed differences between the tested groups, there were several results of note. First, English-Spanish bilinguals were more accurate at acquiring the artificial foreign language than the English monolinguals, but only when words had been studied under the more difficult bimodal presentation. This advantage was only present for immediate testing and not subsequent testing one week later. English-Mandarin bilinguals, on the other hand, not only outperformed monolinguals in the accuracy of responses whether words had been studied bimodally or unimodally, but this advantage was observed consistently both for immediate and delayed testing. However, the caveat to this observation is that while English-Mandarin bilinguals consistently outperformed both English monolinguals and English-Spanish monolinguals on tests of production and recognition, their performance was best when stimuli had been presented unimodally at study, and seemed to suffer slightly when stimuli had been presented bimodally at study. The performance of the English-Spanish bilinguals, on the other hand, was relatively consistent across both the unimodal and bimodal study conditions.

Due to the differential performance of the two bilingual groups, it seems unlikely that a general bilingual language-learning advantage exists, and can be accounted for with a
general cognitive explanation. It seems, at least for these particular tests, one must take into account the similarity of a bilingual's two languages. Previous research has suggested that if a bilingual speaks two languages that share a script, that reading in one language can activate the phonology of the other language (Jared & Kroll, 2001). Kaushanskaya (2007) argues that because English-Spanish bilinguals have been experiencing such inadvertent cross-language activation over a lifetime, same-script bilinguals are better equipped when learning words in an unfamiliar same-script language because they will be less resistant to map new phonology to familiar orthography. This argument would also explain why English-Mandarin bilinguals performed better when they studied foreign words in the auditory-only modality than when they studied them in the auditory and visual modality. When presented with a word in a foreign language that shares orthography with English visually and auditorily, the incongruity of any letter-to-phoneme mapping may hinder memory for the word and impair performance.

Kaushanskaya (2007) further argues that the seat of such phonology-orthography mapping may be at the episodic buffer, within the context of Baddeley's (Baddeley, 1986; Baddeley, 2000) model of working memory. In the revised model (Baddeley, 2000), there exist four components: a central executive component, involved in the coordination of the other components; a phonological loops, responsible for managing and maintaining auditory information; a visuo-spatial sketchpad, responsible for managing and maintaining visual and spatial information; and the episodic buffer, which can integrate information from the other components and is also thought to integrate information between long-term memory and short-term memory. Kaushanskaya argues that, because English-Spanish bilinguals had experience in processing an orthographic unit when it activated more than one phoneme, they had a developed system in long-term memory that frequently processed such incongruities in
short-term memory, strengthening their ability to interpret orthography with the correct phonology, depending on the context, via the episodic buffer. Without such a system in place, the English-Mandarin bilinguals did not perform optimally when they had to simultaneously incorporate orthography and phonology.

All of this evidence suggests that there is parallel processing for a bilingual's two languages. The existence of such parallel processing would predict that even when performing a task in only one of a bilingual's two languages, activation of the non-target language would still occur, whether to the detriment or benefit of the bilingual individual. As evidenced in Kaushanskaya's study, English-Spanish bilinguals seem to be utilizing some knowledge of their non-target language that is causing a difference in performance between them and the English-Mandarin bilinguals.

Interestingly, the bilingual advantage in vocabulary-learning would appear to contradict the observation that bilinguals have reduced verbal fluency relative to monolinguals, as per the cross-language interference account. If bilinguals have reduced verbal fluency, then learning and recognizing words in a new language should be more difficult for them than for monolinguals, because the bilinguals would be increasing the size of their already burdened mental lexicon (i.e., the number of words they can retrieve/recognize). Hence, vocabulary acquisition in an unfamiliar language seems to be a task particularly well-suited to examining the controversy concerning the observed advantages and disadvantages between bilinguals and monolinguals.

All of the vocabulary-acquisition studies that compared performance between monolinguals and bilinguals (Kaushanskaya, 2007; Kaushanskaya & Marian, 2009; Papagno & Vallar, 1995; van Hell & Mahn, 1997) suggest that there some type of a bilingual advantage in terms of foreign-language learning. The proposed study attempts to examine
this issue within the context of semantic overlap or non-overlap between the foreign language and one of the bilingual's known languages by utilizing Dutch-English cognates, false cognates, and Dutch words that bear no resemblance to words in English.

3. Cognate effects within the context of foreign-language learning

A cognate, defined within the psycholinguistic context, is a word that shares both meaning and form across two languages. Cognates can share sounds, although many times, cognates are pronounced differently in different languages. For example, the Spanish word teléfono bears a resemblance to the English word telephone, and both words mean "telephone." The two words sound similar, but they are pronounced slightly differently, and the Spanish version has an additional syllable. There also exist identical cognates, such as the Dutch word hotel, which means "hotel" in English. These two words are not only spelled exactly the same, but their pronunciation in both languages is very similar. The effect of cognate status has been heavily investigated in the psycholinguistic literature, in a wide variety of tasks, such as cross-language activation as measured through translation priming (Gollan et al., 1997), phonological recognition (Dijkstra, Grainger, & van Heuven, 1999) facility of translation (de Groot & Poot, 1997) and foreign-language learning (de Groot & Keijzer, 2000). The basic idea in using cognates in bilingual research is that they reveal the level of cross-language activation, because the semantic, orthographic, and sometimes phonological information is shared across languages. In terms of foreign-language learning, it is also generally thought that learning cognates (teléfono in Spanish means "telephone" or hotel in Dutch means "hotel") is easier than learning other kinds of words. In a study by de Groot and Keijzer (2000), they found that cognates, constructed in an artificial foreign language to be similar to Dutch, were not only easier to learn, but were also more likely to be remembered when tested one week later.
By the same token, false cognates pose an interesting challenge to bilingual speakers and foreign-language learners. A false cognate (also called a "false friend" or an "interlingual homograph") is a word that shares form and/or sounds across languages, but has a different meaning in either language. For example, the Spanish word *fábrica* is similar in orthography to the English word *fabric*, but *fábrica* in Spanish means "factory" in English. As is the case with cognates, some false cognates are orthographically identical to a word in another language, but, unlike cognates, this word has no semantic relationship to the false cognates, as is the case with the Dutch word *room*, which means "cream" in English. The underlying assumption regarding false cognates is that they are difficult to process. For example, if a Dutch-English bilingual reads the word *hotel* in an English context, the negative consequence of inadvertently activating the Dutch word that shares the orthography with this English word is minimal, because both words share the same meaning. However, if a Dutch speaker reads *room* in an English context and activates the Dutch word *room*, meaning "cream," this can cause a delay in processing, if not total confusion.

Likewise, learning false cognates is thought to be a more labor-intensive process than learning either cognates or words that bear no resemblance whatsoever to any word the learner has already stored in memory. This is because the learner must resist activating the meaning he or she has most frequently associated with this form and map a new meaning onto it. This is a difficult process, as anyone who has ever learned a foreign language can attest.

The effects of processing cognates and false cognates have been investigated within the context of bilingual language processing. For example, one study found that when processing cognates in a task that required Dutch-English bilinguals to decide whether or not a presented word was an English word or not, responses were faster for cognates than for
control items (i.e., words that were form-unique to one language), but false cognates were processed at about the same speed as these controls (Dijkstra et al., 1998). However, when the task required participants to respond YES to an item when it was a valid English word, and NO when the item was either a nonsense word or a Dutch word, bilingual participants were much slower to respond to false cognates than to unambiguous English words. In a final experiment, Dijkstra et al. found that false cognates could facilitate reaction times when the task required participants to answer YES if a presented item was a word in either English or Dutch, and NO only for items that were not words in either language. These results suggest that the effect of processing false cognates depends on the nature of the given task. Because the authors did not include Dutch-English cognates among their materials in their second and third experiments, it is impossible to know for certain what effect task has on processing cognates. One can hypothesize, however, that there would be an effect of facilitation for processing cognates in the context of the third experiment, because a Dutch-English cognate read by a Dutch-English bilingual could be identified as either a Dutch word or an English word and still be able to respond accurately, without needing to activate the word in the other language. In the second experiment, however, there would likely be a delay in response to the cognate because the participants would need to inhibit the Dutch interpretation of the word and recognize whether the word was a valid English word or not, regardless of its similarity to Dutch.

Goals for the present study

The proposed study set out to compare how well and easily different groups of bilinguals and a group of English monolinguals (none of whom know any Dutch or German), learn Dutch-English cognates, false cognates, and unambiguous Dutch words that serve as a control (henceforth, unambiguous controls). The goal of the current study was to further
investigate the apparent contradiction between the observed bilingual advantages and
disadvantages in language processing in the literature, and to better understand the way in
which language processing is influenced by bilingualism. Furthermore, this study also set out
to investigate the conditions under which bilingualism may confer more general
consequences for cognition. Additionally, the current experiment aimed to replicate the
previous findings that have found foreign-language learning advantages for experienced
language (Kaushanskaya, 2007; Kaushanskaya & Marian, 2009; Papagno & Vallar, 1995;
vан Hell & Mahn, 1997), and, following Kaushanskaya, to investigate the possible
differences that existed in different bilingual populations. The purpose of comparing the
bilingual groups to the monolingual group, was to determine whether knowledge of any other
language benefits vocabulary acquisition in an unfamiliar language. That is, whether a
bilingual advantage would be general or specific. Finally, the purpose of including language-
ambiguous stimuli (i.e., cognates and false cognates) was to investigate if the learning of
these types of words differed between the bilingual groups and the monolinguals.

Participants were first given an opportunity to study a set of Dutch words paired with
their correct English translations, and were then given an immediate translation recognition
task to assess their learning of these words.¹ In the first session of the experiment they
repeated the learning and test conditions once, for a total of two exposures at study and two
tests of translation recognition. In a second experimental session, participants repeated the
training and test sequence, and then performed a Dutch lexical decision task, in which they
had to make a decision regarding each item about whether letter strings presented on a screen
were Dutch words that they previously studied or not; this was the study’s primary measure
of how well the Dutch words were learned over the two sessions. In addition to the

¹ A schematic of the experiment can be found in Table 2.2 on p. 31.
vocabulary-learning tasks, participants also performed a set of general cognitive tasks to assess individual differences in memory resources and executive control. In the last task of the second session, participants were administered an English lexical decision task, in which they had to decide if the items presented were valid English words or not. The English words for this task were derived from the English translations previously presented, as well as from the Dutch-English false cognates. Finally, participants returned for a third session that took place 13 to 47 days after the second session. In this third and final session, participants were administered a second test of Dutch lexical decision that served as a test of long-term retention of the Dutch vocabulary.

In the following chapter, an outline of the experiment is provided, as well as the rationale for administering each particular task. Additionally, the goals and predictions for the current experiment are outlined.
General Directions and Methodologies

The main goal of the current study was to assess whether experienced language-learners (i.e., bilinguals) are better at learning a new, unfamiliar language than inexperienced language-learners (i.e., monolinguals). In order to investigate this issue, participants studied a set of sixty-four Dutch words on three different occasions over two study sessions separated by one to four days. Participants' learning was evaluated at different intervals with different types of tests, so that learning could be more accurately parsed into different types of learning: initial accuracy and speed of response in a test of recognition of word and translation, the rate of learning between performance on the initial and second test of recognition, initial accuracy and speed of response in a test of word recognition, and the rate of forgetting between initial word recognition and word recognition weeks later. Because these participants had such limited exposure to these words, both the tests of translation recognition and the test of Dutch lexical decision were, in a sense, simple recognition memory tests. Hence, both tests could be tapping into more domain general processes than language-specific processes.

A second goal of the study was to determine whether differences obtained for bilingual vs. monolingual learners could be attributed to language experience per se (a general bilingual advantage), or if such differences relied upon the process of acquiring new vocabulary via the first or second language (a specific bilingual advantage). In this study, all participants learned vocabulary in a new, unfamiliar language via English translations. For monolinguals, the acquisition of these new words in a second language will necessarily take place with respect to the first language, English. For bilinguals, depending on whether their native language is English or another language, the new words in the third language will be
learned either with respect to their first or second language. In the present study, the possibility of both a general and a specific bilingual advantage is considered.

A third goal of the study was to replicate the finding first reported by Gollan, Montoya, Fennema-Notestine, and Morris (2005), in which bilinguals name pictures in their dominant language more slowly than do monolinguals. This picture-naming latency discrepancy has not yet been observed in this particular bilingual population (i.e., English-Spanish bilinguals who are not heritage speakers of Spanish), so a replication of this effect in this particular population would be valuable in extending this effect to bilinguals with a different language-learning trajectory. Alternatively, finding no discrepancy between the two groups would suggest that the effect observed by Gollan et al. (2005) was specific to a particular population. In that study, bilingual participants were described as having “learned both languages at an early age and in natural settings (usually at home)…[and] being English dominant or speaking both English and Spanish as well as ‘a native speaker.’” Bilinguals from this population are often termed “heritage speakers,” and as yet, it is not known if bilinguals from other populations (e.g., late-learners or bilinguals whose language dominance has been consistent throughout their lives) would demonstrate this same pattern of results for picture naming. In order to test this, an English picture-naming task, both to replicate the picture-naming latency discrepancy and to assess English language proficiency using an online measure in addition to self-assessed ratings.

The current chapter provides an overview of the experimental procedures and the rationale for using each task, as well as a description of the norming of the word stimuli conducted beforehand. The design was crafted to allow sufficient study time for the words to be learned, as well as multiple testing opportunities, both to examine early foreign-language vocabulary learning in this abbreviated time course, and to allow participants sufficient time
and opportunity for learning to occur. The experimental materials were selected on the basis of their relationship to similar words in English, and that similarity was evaluated with a translation elicitation paradigm (Kroll & Stewart, 1994) administered before testing occurred.

Translation Elicitation

Using the translation elicitation method (Kroll & Stewart, 2004), sixty-four Dutch words were selected for use in the experiment. In translation elicitation, monolingual speakers of the known language (e.g., English) are instructed to provide their best guess for the correct translation for a word in an unknown language (e.g., Dutch). For these stimuli, words were presented in Dutch to monolingual speakers of English. Words that were guessed correctly by approximately half of the participants were identified as cognates between the known and unknown languages (i.e., Dutch and English). Words that received the same incorrect guess by approximately half of the participants were identified as false cognates. Words that had less than one-third of the consensus of guesses from participants were identified as unambiguous controls.

Thirty-two of these Dutch words shared orthography (i.e., spelling) with an English word, and thirty-two of these Dutch words were orthographically dissimilar from any existing words in English. Sixteen of the form-similar words were Dutch-English cognates, selected for their orthographic and semantic overlap with a word in English (e.g., the Dutch word hotel is similar in orthography to the English word hotel, and both words share the same meaning). The remaining sixteen of the form-similar words were Dutch-English false cognates, selected for their orthographic overlap with a word in English and their dissimilarity in meaning (e.g., the Dutch word room is similar in orthography to the English word room, but the Dutch word room means "cream" in English). The remaining thirty-two Dutch words were form-unique, and were identified as unambiguous controls. Each
unambiguous control word was matched for word frequency (both in the Dutch frequency of the word and the English frequency of its translation) and length to a form-similar Dutch word via a stimulus matching program (van Casteren & Davis, 2007).

The stimuli were administered via paper and pencil in one of three unique presentation orders created via a stimulus mixing program (van Casteren & Davis, 2006) to 24 monolingual speakers of English. These were the same unique presentation orders used in the training task of the experiment proper. Participants were instructed to provide their best guess at an English translation for each Dutch word that appeared on the page. The words appeared in such a way that no more than three words of any particular type (i.e., cognates, false cognates, and control words) appeared consecutively. Participants were paid five dollars for their participation. Data from three participants were excluded for failure to follow instructions.

The results from the translation elicitation task can be found in Table 2.1. The proportion of the guess that was offered most frequently by participants is marked in parentheses in the "Most Freq Guess" column.
<table>
<thead>
<tr>
<th>Dutch False Cognate Targets</th>
<th>Correct English Translation</th>
<th>Most Freq Guess</th>
<th>Matched Dutch Controls</th>
<th>Correct English Translation</th>
<th>Most Freq Guess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ramp</td>
<td>disaster</td>
<td>ramp (.57)</td>
<td>33 grap</td>
<td>joke</td>
<td>grab (.24)</td>
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<td>fire</td>
<td>brand (.52)</td>
<td>34 steun</td>
<td>support</td>
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<td>strand (.52)</td>
<td>35 vijand</td>
<td>enemy</td>
<td>land, hand (.10)</td>
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<td>back</td>
<td>rug (.71)</td>
<td>36 tijd</td>
<td>time</td>
<td>tide (.14)</td>
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<td>passage</td>
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<td>37 boer</td>
<td>farmer</td>
<td>beer (.19)</td>
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<td>38 paard</td>
<td>horse</td>
<td>pardon (.19)</td>
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<td>rope</td>
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<td>slang (.62)</td>
<td>40 druif</td>
<td>grape</td>
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<td>shark</td>
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<td>jeep (.19)</td>
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<td>hurt (.14)</td>
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<td>mist (.67)</td>
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<td>arena (.29)</td>
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<tr>
<td>30 piraat</td>
<td>pirate</td>
<td>pirate (.76)</td>
<td>62 perzik</td>
<td>peach</td>
<td>person (.19)</td>
</tr>
<tr>
<td>31 tiger</td>
<td>tiger</td>
<td>tiger (.95)</td>
<td>63 biecht</td>
<td>confession</td>
<td>beach (.24)</td>
</tr>
<tr>
<td>32 panieik</td>
<td>panic</td>
<td>panic (.71)</td>
<td>64 herfst</td>
<td>autumn</td>
<td>first, hurt (.14)</td>
</tr>
</tbody>
</table>

\(2\) The Dutch item *haai* (meaning "shark" in English) was replaced with the Dutch word *korf* meaning "basket" in English.

\(3\) The Dutch item *wens* (meaning "wish" in English) was replaced with the Dutch word *vrede* meaning "peace" in English.

\(4\) The Dutch item *aarde* (meaning "earth in English) was replaced with the Dutch word *beurt* meaning "turn" in English. This item was replaced because a more suitably matched a form-similar item that was itself a replacement.

\(5\) The Dutch item *midden* (meaning "middle" in English) was replaced with the Dutch word *vriend*, meaning friend in English.

\(6\) The Dutch item *manier* (meaning "manner" in English) was replaced with the Dutch word *kapitein*, meaning captain in English.

\(7\) The Dutch item *kracht* (meaning "strength" in English) was replaced with the Dutch word *vrijheid*, meaning "freedom" in English.

\(8\) The Dutch item *ark* (meaning "ark" in English) was replaced with the Dutch word *fruit*, meaning "fruit" in English. As *fruit* was already one of the items, *fruit* was replaced with the Dutch word *hand*, meaning "hand" in English.

\(9\) The Dutch item *erwt* (meaning "pea" in English) was replaced with the Dutch word *vrouw* meaning "woman" in English. This item was replace because a more suitably matched a form-similar item that was itself a replacement.
Table 2.0.1. Results from translation elicitation task.

The results demonstrated that of the sixteen Dutch-English cognates, twelve elicited the correct response more than 48% of the time. The four items that did not elicit the correct response more than 48% of the time were replaced with different Dutch-English cognates judged by the experimenter and several research assistants to elicit the correct translation. All sixteen of the Dutch-English false cognates were incorrectly guessed by participants, but the most common incorrect guess provided by the participants was the English word that looked identical to the false cognate (e.g., 57% of participants guessed that the Dutch word *ramp* meant "ramp" in English, even though *ramp* actually means "disaster"). For all sixteen of these false cognates, the expected incorrect guess was provided by at least 48% of the participants. None of the thirty-two unambiguous controls were correctly guessed correctly by more than 5% of the participants, and none of the control items elicited a uniform incorrect response among the participants (participants conformed to an incorrect response between 1% of the time and 33% of the time). Three of the unambiguous controls were guessed correctly by one out of the 24 participants, and no other correct guesses were made for any of the other 29 unambiguous controls. After replacing the four Dutch-English cognates, the items within the stimulus set were judged as reliably resembling a predictable English word for the false cognates and for the cognates, and not reliably resembling any particular English word for the unambiguous controls.

*General Method and Rationale*

10 Initially, 50% had been set as the cutoff, but one false cognate (*breed*) was correctly guessed 48% of the time. This item would have made the initial cutoff of 50% with one more correct guess, so the cutoff was adjusted to 48% correct and retain the item rather than replace it.
In addition to evaluating foreign-language learning between participants groups in a broad sense, another goal was to test whether an unfamiliar word's superficial similarity to a word in a known language would differentially influence learning among participants of different language backgrounds. Cross-language ambiguity provides a tool both for determining the degree to which there is transfer from a known language to the new language and also for examining the hypothesized advantage that bilinguals are thought to possess in ignoring irrelevant information. A key question was whether bilinguals would be less affected by surface form resemblance than monolinguals. Specifically, the stimuli for the experiment consisted of both Dutch-English cognates (i.e., words that look the same and have similar meaning across two languages) and Dutch-English false cognates (i.e., words that look the same but have different meanings across two languages). Comparing performance on these language ambiguous words relative to unambiguous controls provided a further test of the effects of bilingualism in vocabulary learning.

The experiment was composed of eleven tasks distributed across three sessions. A schematic of the experiment can be found in Table 2.2.

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training (1 of 3)</td>
<td>Training (3 of 3)</td>
<td>Dutch Lexical Decision (2)</td>
</tr>
<tr>
<td>Translation Recognition (1 of 2)</td>
<td>Dutch Lexical Decision (1 of 2)</td>
<td>Operation Span</td>
</tr>
<tr>
<td>Training (2 of 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Translation Recognition (2 of 3)</td>
<td></td>
<td>Simon</td>
</tr>
<tr>
<td>Picture-Naming in English</td>
<td></td>
<td>English Lexical Decision</td>
</tr>
</tbody>
</table>

Table 2.0.2. Schematic representation of each of the three sessions in the experiment. If the task is presented more than once, the number of the task in its sequence of presentation is presented in parentheses, alongside the total number of times participants viewed the task.

In the first session, participants studied the set of sixty-four Dutch words, which were presented alongside their English translations, and were then given a test of translation recognition immediately following the study phase. Participants were then asked to study the
words a second time using the same study paradigm, and again, a test of translation recognition immediately followed. The final task in the first session was simple picture naming in English. In the second session, participants were given a third and final opportunity to study the Dutch words using the same procedure as in the first session. In Session 2, participants were then given a test of Dutch lexical decision, which was followed by the Simon and Operation-Span tasks. The final task administered in the second session was a test of English lexical decision. For the participants who returned for the third and final session, there was no additional study opportunity—only a second test of Dutch lexical decision that was used a measure of long-term retention.

All tasks except for a language history questionnaire, which was administered at the end of the first session of the experiment, were administered on a Dell PC in an isolated room. All items were presented in black Courier font on a white background using E-Prime software. Vocal responses were collected for all three training phases for each participant, as well as for the picture-naming task. For these tasks, the preceding trial concluded when the recording software detected an auditory response, and reaction times were measured per trial. Tasks that required button presses (i.e., the translation recognition task, lexical decision tasks, the Simon task, and the Operation-Span task) used either an E-Prime button box or the computer keyboard. for these tasks, both reaction times for each button press as well as accuracy per trial were collected.

Training Task

The training portion of the experiment consisted of each of the sixty-four Dutch words presented on the left side of the computer screen in isolation for two seconds, followed by the presentation of the English translation of the Dutch word on the right side of the computer screen. Both the Dutch word and the English translation appeared side by side on
the computer screen for a maximum of five seconds, or until the voice trigger was activated. Participants were asked to study the Dutch word and its English translation for as long as they wanted within the five-second window, and when they were ready to proceed with the next item, they were asked to read aloud the English translation on the screen.

Three versions of the training task were created using the same items in each version, but presenting them in a unique presentation order created via a stimulus mixing program (van Casteren & Davis, 2006). Every participant saw all three versions, but not in the same sequential order. The items were pseudo-randomized to create each of the three versions, with the constraint that no more than two words of any particular type (i.e., cognate, false cognate, or unambiguous control) would appear consecutively.

The motivation for using this paradigm was to allow participants a sufficient, but constrained, amount of time in which to study the stimuli. Providing the relatively long maximum study time also allowed for the use of voice latency onset as an indicator of necessary study time. Asking participants to read the English translation aloud not only provided a latency measure as an indicator of required study time, but also guaranteed that participants had paid attention on each trial. Participants were never asked to read the Dutch items aloud because these participants were unfamiliar with Dutch, and had no way of knowing how to pronounce Dutch words. Also, asking participants to pronounce words in an unfamiliar language would have less accurately reflected necessary study time. Participants were told that they would never be asked to pronounce Dutch words or recognize spoken Dutch words, only to recognize them visually.

Translation Recognition Task

The translation recognition task consisted of the same sixty-four Dutch words and English translations presented during training, and was administered after each of the first
two training tasks. Each translation recognition trial was similar to a training trial, in that a Dutch item appeared on the left side of the screen for two seconds, and was then followed by the appearance of an English translation on the right side of the screen across from the Dutch word. However, unlike the training trials, half of the trials consisted of Dutch words correctly paired with their English translations, while the other half of the trials consisted of Dutch words incorrectly paired with another word’s English translation. Similar to the creation of the presentation lists for the training task, two versions of the translation recognition task were created. Each participant saw both versions, but half of the participants saw version A before version B, and the other half saw the reverse. Both versions were created via a pseudo-randomization process (van Casteren & Davis, 2006) that permitted no more than two consecutive trials of any particular Dutch word type, and no more than three consecutive trials that required the same response (i.e., either YES for correct translations or NO for incorrect translations). Both versions included 32 correct and 32 incorrect trials.

Additionally, half of the items of each word type appeared alongside their correct translation in version A, while the other half of the items of each word type appeared alongside an incorrect translation. For version B, the correct half of the items of each word type in version A now composed the incorrect trials, and the incorrect trials of each word type from version A now composed the correct trials. All items appeared alongside their correct translation in one version, and alongside an incorrect translation in another version.

Incorrect trials were created by re-pairing Dutch items and translations among the set of incorrect items. Because of the larger number of unambiguous controls, and to limit variability in the pairings of different word types, every incorrect trial that featured a Dutch cognate was paired with an English translation drawn from one of the unambiguous control words, and every Dutch false cognate feature on an incorrect trial was also paired with an
English translation drawn from one of the unambiguous control words. Half of the unambiguous control words featured on incorrect trials were paired with English translations drawn from the cognates, and the other half were paired with English translations drawn from the false cognates.

Translation recognition tasks are not only commonly used to assess foreign-language vocabulary, but in the current experiment, a translation recognition task also allows for a testing situation that was virtually identical to the learning situation. That is, participants in the current experiment saw a Dutch word paired with an English translation at both learning and test. Maintaining similarity between learning and test was important because of the limited experience participants had had with these words, and because the most sensitive behavioral measure possible was desired, in order to evaluate learning at this early stage. Using the same task twice, (once after one instance of training, and again after two) allows for the assessment of the rate of learning that took place for every word type for every participant from the first test to the second, within the same experimental session. This provides an additional measure to compare between groups, in addition to overall accuracy for items of each word type. A visual representation of a trial from the translation recognition task can be found in Figure 2.1.
In the self-paced picture naming task, participants were asked to name 60 black and white pictures in English as quickly and as accurately as possible. Their spoken responses activated a voice relay. Each spoken response initiated the next trial. The picture naming task was administered to all participants following the second translation recognition task during the first experimental session, just before the written language history questionnaire was administered.

The motivation for using a picture naming task was two-fold. First, each participant's accuracy on the task could be used as an indicator of English proficiency, since not all participants were native speakers of English. Second, previous research (Gollan et al., 2005) has found that bilingual individuals are slower to name pictures in their dominant language than are monolingual individuals. This finding has been presented as evidence for the weaker links hypothesis (Gollan et al., 2005; Gollan, Fennema-Notestine, Montoya, & Jernigan, 2007; Gollan, Montoya, Cera, & Sandoval, 2008), and, in particular for this study, evidence
in support of the idea that bilingual individuals may be disadvantaged in regard to speed of lexical access within the dominant language. Hence, including the picture naming task provided an opportunity to test the weaker links hypothesis with a group of late bilinguals who were not heritage speakers and for whom English was the native language. For the two bilingual groups who were non-native speakers of English, the picture naming task provided a measure of L2 proficiency.

*Dutch lexical decision*

A Dutch lexical decision task was administered to all participants during the second session, following the third and final training trials. A fixation point was presented for 2000 milliseconds, followed by a single letter string presented in lower case Courier font in the center of the computer screen. Participants were asked to judge as quickly and accurately as possible whether the item presented on the screen was a real Dutch word that they had studied (YES) or not (NO). Because the Dutch items presented were constrained to the set of 64 Dutch words that the participants had studied, this task may have had elements of a simple recognition memory task. However, differential performance between groups and/or between word types would still allow for some potentially interesting insights into how newly acquired vocabulary in a previously unfamiliar language interacts with a known language.

Six types of items were presented in the Dutch lexical decision task. The three types of Dutch words that required a YES response were cognates, false cognates, and the unambiguous controls that had been previously studied. The three types of items that required a NO response were Dutch-like nonwords, English semantic neighbors (each semantically related to a particular Dutch word that participants had studied), and English orthographic or lexical neighbors (each orthographically related to a particular Dutch word...
that participants had studied; henceforth, English lexical neighbors). Examples of the Dutch lexical decision stimuli can be found in Table 2.3.

<table>
<thead>
<tr>
<th>YES Trial Word Types</th>
<th>Example (Dutch - English)</th>
<th>NO Trial Word Types</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>False Cognates</td>
<td>room - cream</td>
<td>Dutch-Like Nonwords</td>
<td>trang</td>
</tr>
<tr>
<td>Cognates</td>
<td>hotel - hotel</td>
<td>English Lexical Neighbors</td>
<td>twin (derived from tuin)</td>
</tr>
<tr>
<td>Unambiguous Controls</td>
<td>tuin - garden</td>
<td>English Semantic Neighbors</td>
<td>summer (derived from herfst)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>herfst - autumn</td>
</tr>
</tbody>
</table>

Table 2.0.3. Sample stimuli for each of six word types in the Dutch lexical decision task.

The task consisted of a total of 128 items, 64 of which were the previously studied Dutch items (requiring a YES response), and 64 of which were Dutch-like nonwords or English words (requiring a NO response). The 64 items that required a YES response were the same items that participants had previously studied: 16 Dutch-English cognates, 16 Dutch-English false cognates, and 32 Dutch unambiguous controls. Of the 64 items that required a NO response, 48 were Dutch-like nonwords, 8 were English semantic neighbors (to eight of the Dutch items), and 8 were English lexical neighbors (to eight of the Dutch items). Of the 8 English semantic neighbors, four were neighbors of a Dutch control word, two were neighbors of a Dutch-English cognate, and two were neighbors of a Dutch-English false cognate. Of the 8 English lexical neighbors, again, four were neighbors of a Dutch control word, two were neighbors of a Dutch-English cognate, and two were neighbors of a Dutch-English false cognate. Two versions of the task were created via a stimulus mixing program (van Casteren & Davis, 2006), such that no more than any two items of the same word type appeared consecutively in either version, and no more than any three items that required the same response (either YES or NO) appeared consecutively in either version.

The Dutch-like nonwords were created via the Pseudo program (van Heuven, 2003) and were matched for length, bigram, and trigram frequencies, as well as consonant-vowel structure with the 64 real Dutch words. The nonwords were examined by two native speakers of Dutch, who confirmed that they were, in fact, not real Dutch. The English semantic
neighbors were items that were similar in meaning to one of the target Dutch items that the participants had studied. These items were selected using the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 1998). When possible, the most frequently associated item for the matched English translation was selected as the English semantic neighbor. Criteria for exclusion included synonyms, opposites, words that were not the same parts of speech as the matched English translation, words that were judged by a native speaker of Dutch to have the same Dutch translation for both the matched English translation the English semantic neighbor, and words that were judged by a native speaker of Dutch to be valid Dutch words. The English lexical neighbors were items that were similar in spelling to some of the target Dutch items that the participants had studied. These items were selected by replacing a single letter for a Dutch word that had already been studied, such that the result was a valid word in English.

Approximately sixty-five percent of the participants elected to participate in a voluntary third session, which consisted solely of the same Dutch lexical decision task two to seven weeks later. Two versions of this task were created, so that every participant who took part in the voluntary third session saw both versions of the task, with different versions for each session.

This task was motivated in part by a desire to have more than one measure of learning to compare between and within participants, but also to add the manipulation of participants being unable to predict whether a stimulus would be an English word or a Dutch word, so that if any cross-language interference were present, it may be more likely to be revealed than in the translation recognition task. In addition, the Dutch lexical decision task allowed for the manipulation of difference types of incorrect responses that were more or less similar
to the critical stimuli in various ways, which allowed for further examination of cross-language interference.

*Operation-Span task*

The Operation-Span (O-Span) task (Turner & Engle, 1989) followed the Dutch lexical decision task in the second experimental session, and asked participants to evaluate whether a particular arithmetic equation (e.g., \((2*2) - 1 = 3\)) was correct (requiring a YES response) or incorrect (requiring a NO response), while simultaneously asking them to memorize single words and recall them at particular intervals. This particular iteration of the task was administered in such a way that a word was presented on the computer screen after participants had hit either YES or NO in regard to an arithmetic equation. Blocks of equations followed by words began with two equations and two words to be recalled, and increased to a maximum of six equations and six words to be recalled. When the word RECALL appeared on the screen, it was immediately followed by a black box in which participants could type their responses (this was true for all participants except for some of the Chinese-English participants, see below).

Due to the different populations from which this experiment was sampling, bilingual participants were allowed to perform the O-Span task in either of their known languages. Hence, three versions of the O-Span task were used in this experiment: an English version, a Spanish version, and a Mandarin Chinese version. For all three versions, equations were presented in standard Arabic numerals from left to right. However, the word that followed each equation was presented in English for the English version, Spanish for the Spanish version, and in traditional Chinese characters for the Mandarin Chinese version. Both the English and Spanish versions of the O-Span task were performed entirely on the computer using an American keyboard, and Spanish participants were told that they did not need to
worry about replicating Spanish accents when they made their responses. For the Mandarin Chinese version, participants were asked to make their responses with pencil and paper.

The O-Span task was administered as one of two individual difference measures that could be used to match or exclude participants, as well as an independent measure that could demonstrate existing differences between the different populations tested.

Simon task

The Simon task (Simon & Rudell, 1967) was the second of the two tasks used in this experiment to measure individual differences, and followed the O-Span task in sequence. This iteration of the Simon task consisted of red and blue boxes that were presented on either the left, right, or center of the screen. Participants were asked to simply press a marked blue key if the presented box were blue in color, and a marked red key if the presented box were red in color. Critically, the blue key was always on the left side of the computer keyboard (the TAB key), and the red key was always on the right side of the computer keyboard (the \ key). This manipulation creates "congruent" and "incongruent" trials, in which the correct response is either on the same side (congruent) of the keyboard as the stimulus is presented on the computer screen, or on the opposite side (incongruent). Central trials occur when the stimulus is presented in the center of the screen.

The Simon task is widely known as a task that measures attentional control, or the ability to attend to critical information and ignore irrelevant cues or stimuli. Previous research has robustly demonstrated that participants are faster on congruent trials than on incongruent trials of the Simon task (Brebner, Shephard, & Cairney, 1972). Frequently, a measure called the Simon score is calculated by subtracting participants' average reaction time on congruent trials from their average reaction time on incongruent trials. The lower a participant's Simon score is, the better their attentional control is assumed to be. Bilingual
research in particular has demonstrated that bilinguals’ Simon scores are lower on average relative to monolinguals (Bialystok et al., 2004). This effect may only be observable in older bilinguals (relative to older monolinguals), but the inclusion of the task here allowed for yet another examination of this comparison with several different groups of bilinguals.

*English lexical decision*

An English lexical decision task was the final task of the second experimental session. This task asked participants to decide, as quickly and accurately as possible, whether or not an item presented on the screen was a real word in English. Unlike the Dutch lexical decision task, participants were told that any real English words would require a YES response, not just the ones presented in the study (as translations, cognates, or false cognates). The task consisted of 160 items, 80 of which required a YES response, and 80 of which required a NO response. The 80 items that required a NO response were all English-like nonwords created via the Pseudo program (van Heuven, 2003) and were matched for length, bigram, and trigram frequencies, as well as consonant-vowel structure with the 80 items that required a YES response. Of those 80 words that required a YES response, 32 were the English translations of the Dutch control words the participants had previously studied, 16 were the English translations of the Dutch-English cognates the participants had previously studied (some of which were also Dutch-English cognates, due to exact orthographic overlap of half of the Dutch-English cognates), 16 were the English translations of the Dutch-English false cognates the participants had previously studied, and 16 of which were the Dutch-English false cognates themselves that the participants had studied. The task was created via a stimulus mixing program (van Casteren & Davis, 2006) so that no more than any two items of the same word type appeared consecutively, and no more than any three items that required the same response (either YES or NO) appeared consecutively.
This task was used to evaluate how much interference from learning form-similar Dutch words would manifest in participants with different language backgrounds. One might hypothesize that participants who performed better on the tasks that measured learning of the Dutch items (i.e., the translation recognition and Dutch lexical decision tasks) might demonstrate more impaired performance (likely manifested in slower reaction times) on this task, particularly for the Dutch-English cognate translations (which were either identical or nearly identical to the Dutch-English cognates) and the Dutch-English false cognates. Accuracy on this task was expected to be at ceiling for most participants, but reaction times were predicted to be slowest for the Dutch-English cognate translations and the Dutch-English false cognates.

All participants completed the tasks presented to them in two sessions, separated by one to four days. (Three out of the total 88 participants failed to return for the second session within four days, hence data will only be reported for 85 participants.) Of the 85 participants who completed the first two sessions, 55 returned for the third and final session (approximately 65%). A one-way analysis of variance (ANOVA) using language group as the independent variable (English monolingual, English-Spanish bilingual, or Chinese-English bilingual) and whether the participants returned as the dependent variable revealed no significant differences in the proportion of participants who returned for the third session between the language groups ($F = 0.36, p = .70$). Another one-way ANOVA using language group as a the independent variable and the number of days between the second session and the third session as the dependent variable revealed no significant differences in the number of days between sessions two and three between the language groups ($F = 2.03, p = .15$).

**Participant Demographics**
In order to test whether foreign-language learning differences exist between bilingual and monolingual individuals, groups with different language backgrounds were compared. These groups included both a bilingual group of native English speakers who had learned Spanish as a second language, henceforth English-Spanish bilinguals, and a functionally monolingual group of native English speakers who had little to no second language experience (henceforth English monolinguals). This is an ideal comparison because both groups of participants share a native language, and, since virtually all of the participants tested from these two groups were from the United States, are assumed to share similar culture and vocabulary.

Furthermore, data were collected from two additional bilingual groups: native Spanish speakers who had learned English as a second language (henceforth Spanish-English bilinguals), and native Mandarin Chinese speakers who had learned English as a second language (henceforth Chinese-English bilinguals). These two non-native English speaking bilingual groups were included to discern if any differential performance in the English-Spanish bilingual group, relative to the English monolingual group, would also be observed in bilingual participants whose native language was not English (i.e., whether any observed bilingual advantages would be general or specific). That is, these two additional groups would be learning vocabulary from a third, unfamiliar language, via their second language (L2), rather than learning from a third, unfamiliar language via their first language (L1), as the English-Spanish bilinguals would. However, data thus far collected from the Spanish-English bilinguals represents an older segment of the population than either of the three additional language groups, and these participants were demonstrating slower reaction times (henceforth, RTs) and lower O-Span scores than either of the other three groups. For this
reason, their data will be excluded from the analyses presented in Chapter 4, and from the
general discussion in Chapter 5.

Language history, proficiency, and dominance were assessed by a language history
questionnaire. The demographic data (including age, days studied abroad, and L1 and L2 self
ratings), as well as O-Span and Simon scores are presented in Table 2.4.

<table>
<thead>
<tr>
<th></th>
<th>Age (in years)</th>
<th>Days Studied Abroad</th>
<th>L2 Self Rating (1-10)</th>
<th>L1 Self Rating (1-10)</th>
<th>Simon Difference Score</th>
<th>O-Span (# of items recalled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English monolinguals</td>
<td>20.43</td>
<td>18.17</td>
<td>3.81</td>
<td>9.55</td>
<td>33.30</td>
<td>43.95</td>
</tr>
<tr>
<td>English-Spanish bilinguals</td>
<td>23.23</td>
<td>570.32</td>
<td>7.96</td>
<td>9.75</td>
<td>27.14</td>
<td>50.82</td>
</tr>
<tr>
<td>Chinese-English bilinguals</td>
<td>24.53</td>
<td>441.63</td>
<td>7.41</td>
<td>9.42</td>
<td>33.31</td>
<td>51.84</td>
</tr>
</tbody>
</table>

Table 2.0.4. Mean age, number of days studied abroad, L1 and L2 self ratings, O-Span scores, and Simon scores for all participant groups.

A one-way analysis of variance (ANOVA) was performed using language group as the independent variable and age as a dependent variable. This analysis revealed that the English monolinguals were significantly younger than either bilingual group ($F = 9.54, p < .001$; for English monolinguals and English-Spanish bilinguals, $t = 3.01, p < .01$; for English monolinguals and Chinese-English bilinguals, $t = 4.24, p < .001$). The two bilingual groups revealed no significant difference in age between each other ($t = 1.36, p = .37$). Another one-way ANOVA was performed using language group as the independent variable and days studied abroad as the dependent variable. No significant differences were observed, due to the high variability amongst the participants ($F = 0.39, p = .68$). Because so few English monolinguals had studied abroad (only 3 out of twenty-one participants), and because both bilingual groups demonstrated such high variability in the number of days studied abroad (standard deviation for the number of days studied abroad for the English-Spanish bilinguals: 1476 days; for Chinese-English bilinguals: 841 days), these data will not be further analyzed or discussed.
Two additional one-way ANOVAs using language group again as the independent variable and L1 self-ratings and L2 self-ratings as dependent variables revealed no significant difference in L1 self-ratings ($F = 1.50, p = .23$), but a predictable difference in L2 self-ratings ($F = 68.73, p < .001$). Post-hoc tests revealed that the English monolingual group rated themselves lower in their L2 proficiency than either the English-Spanish bilingual group ($t = 13.37, p < .001$) or the Chinese-English bilingual group ($t = 9.11, p < .001$), thus supporting their categorization as functionally monolingual. The two bilingual groups did not differ in their L2 proficiency self-ratings ($t = 1.41, p = .34$).

For the Simon difference scores (i.e., mean RT for incongruent trials minus the mean RT for congruent trials), another one-way ANOVA was conducted using language group as the independent variable and the Simon difference scores as the dependent variable. No significant difference was observed ($F = 0.50, p = .61$). This is unsurprising, as the bilingual advantage has been difficult to replicate among young adult populations (Bialystok et al., 2005). A final one-way ANOVA was performed using language group as the independent variable and O-Span score (i.e., the number of items recalled) as the dependent variable. This revealed a difference between groups ($F = 8.54, p < .01$). Post-hoc tests revealed that this difference was significant between the English monolinguals and the English-Spanish bilinguals ($t = 3.38, p < .01$) and between the English monolinguals and the Chinese-English bilinguals ($t = 3.74, p < .01$), as the English monolinguals demonstrated lower O-Span scores than both the English-Spanish and the Chinese-English bilinguals. There was no significant difference, however, between the English-Spanish bilinguals and the Chinese-English bilinguals ($t = 0.49, p = .88$). This replicates result from previous research, in which a bilingual advantage on a reading span task was observed relative to learners (Kroll, Michael, Tokowicz, & Dufour, 2002).
Predictions

It is possible that bilinguals would be advantaged for some aspects of the experimental paradigm, while disadvantaged in others. The prediction was that bilinguals would outperform monolinguals in both speed and accuracy of performance on the vocabulary-learning tests. This prediction was motivated by two factors. First, bilinguals have many years of experience learning multiple languages, so their performance on the vocabulary-learning tasks in this experiment could be enhanced due to that experience. Second, bilinguals may outperform monolinguals on these tasks because of their enhanced inhibitory control, due to a lifetime of negotiating two languages. This enhanced inhibitory control could manifest itself in particular for the Dutch-English false cognates, which were predicted to be the most difficult word type for the bilinguals as well as for the monolinguals, but the prediction held that bilinguals would be much faster and more accurate for the false cognates than would the monolinguals, despite their overall difficulty. This could be due both to the fact that bilinguals have experience with words that share orthography in two languages, but do not share meaning, as well as their enhanced inhibitory control that would allow them to better inhibit the unintended meaning.

Secondly, in general terms regarding the language-ambiguous items (i.e., Dutch-English false cognates and cognates), false cognates were predicted to be more difficult to learn, while cognates would be much easier. As for disadvantages, bilinguals were predicted to be slower than monolinguals for cognates, but still be faster on cognates than any other word type. The rationale here was that if bilinguals demonstrated enhanced inhibitory control, they would be less inclined to assume that shared orthography would necessarily equate with shared meaning. By that same logic, bilinguals would be predicted to be slower for the cognates than monolinguals for the same reason that bilinguals would be faster for the
false cognates than the monolinguals: a lifetime of experience with and awareness of
inglanguage-ambiguous words.

Additionally, for the English picture-naming task, bilinguals were predicted to exhibit
a similar pattern relative to monolinguals as was found in Gollan et al. (2005): bilinguals
would be slower to name pictures in their dominant language than would monolinguals.
Again, this prediction was founded on the weaker links hypothesis, which explains that
words in a bilingual’s dominant language are functionally less frequent in their vocabulary
relative to monolinguals because bilinguals are not speaking in either of their two languages
as often as monolinguals speak in their one language.
Native English-speaking Monolinguals Learning Dutch

Data from the English monolinguals will be presented in this chapter, with the data from both the Chinese-English and English-Spanish bilinguals following in Chapter 4. Given the complexity of the design, the goal of arranging the results in this way is to allow the reader to first understand the findings across the sequence of tasks and then to later compare the critical data for monolinguals vs. bilinguals.

Data from two English monolingual participants were discarded due to either failing to meet a minimum Operation-Span score, or falling outside the desired age range (18-40), resulting in a total of 21 English monolingual participants.

Training Task

Each participant trained on the sixty-four Dutch words alongside their English translations on three separate occasions. The first training task immediately followed the completion of the consent form in Session 1, the second followed the first test of translation recognition, and the third began the second session, which took place one to four days following the first session (see p. 28 for a review of the training task). During the training, participants viewed the Dutch word in isolation for two seconds, followed by the Dutch word alongside its English translation for a maximum of five seconds. After the English translation appeared on the screen, participants were encouraged to study the Dutch word alongside its English translation, and to speak the English translation into the microphone when they felt ready. However, participants were also told that study time should not exceed five seconds.

The participants in the English monolingual group correctly produced the target (i.e., the English translation presented on the screen) into the microphone on 97.5% of trials presented. The remaining 2.5% of the trials were either technical errors (0.6% of trials, which consisted of computer malfunctions or microphone malfunctions), or trials in which
participants waited longer than 3000 ms to name the English translation (1.7% of trials; this was done to remove outlier trials). Due to the high accuracy on this task, accuracy data will not be analyzed further.

Reaction time (RT) data for the time to name the English translations of the Dutch words are presented in Figure 3.1.

![Figure 3.1](image)

**Figure 3.0.1.** Mean naming latencies for English translations in the training task for English monolinguals.

A 3 (Time 1 vs. Time 2 vs. Time 3) × 3 (false cognates vs. cognates vs. unambiguous controls) repeated measures analysis of variance (ANOVA), showed a main effect of time ($F = 7.15, p < .01$), and a main effect of word type ($F = 21.47, p < .001$), with no significant interactions. To test if the difference between the false cognates and unambiguous controls at Time was significant, a pairwise comparison was conducted, but this difference was not significant ($F = 3.24, p = .09$).

**Discussion.** The English translation naming latencies are a coarse measure of how much time participants felt they required to study the Dutch words and their English translations. Hence, it is, perhaps, unsurprising that naming latencies declined as participants had more training.
opportunities and their knowledge of the Dutch words and their English translations improved. Additionally, it is also unremarkable that Dutch-English cognates (e.g., hotel, meaning “hotel” in English) were studied for less time than either the Dutch-English false cognates (e.g., room, meaning “cream” in English) or the unambiguous controls at all three training opportunities. This pattern was consistent among the English monolinguals for all three training opportunities. However, the English monolinguals studied the false cognates and the unambiguous controls for about the same length of time, which was somewhat contrary to the initial predictions that all participants (and English monolinguals in particular) would have more difficulty with false cognates relative to the unambiguous controls. This would have predicted that the English monolinguals would have spent more time studying the false cognates than the unambiguous controls. This prediction was not upheld.

Translation Recognition Task

Each participant completed the translation recognition task twice: once following the initial training task, and once following the second training task (see p. 29 for a review of the translation recognition task). In translation recognition, participants viewed one of the sixty-four Dutch words they had previously studied, alongside an English translation. Half of the trials were YES trials, in which the correct English translation was paired with the presented Dutch word, and half of the trials were NO trials, in which an incorrect English translation was paired with the presented Dutch word. Both tests of translation recognition were administered in Session 1. Hence, data from translation recognition are interpreted to be a measure of initial learning, and not of long-term retention. Furthermore, because participants had studied the 64 Dutch items that they were being tested on only once or twice (for translation recognition Time 1, and translation recognition Time 2, respectively), the data from these particular tests of translation recognition should not be interpreted to reflect
native- or near-native-language processing. Rather, these are tests of recognition memory for items recently studied in an unfamiliar language.

For the tests of translation recognition, two 2 (Time 1 vs. Time 2) × 3 (false cognates vs. cognates vs. unambiguous controls) ANOVAs were carried out for both RTs and accuracy, separately for YES and NO responses. Thus the results of four analyses will be reported.

Overall, participants responded to 72.9% of the trials in the tests of translation recognition correctly, and 19% incorrectly. The remaining 8.1% of the trials were outliers, either above or below pre-set cut-off points (below 300 ms or above 3000 ms), or 2.5 standard deviations above or below the mean for each participant, per time, per YES or NO trial. Data regarded as outliers were not included in the RT analyses, but were counted as errors for accuracy analyses.

Translation Recognition: Accuracy. Accuracy data from the translation recognition task for the English monolinguals can be found in Figures 3.2 and 3.3.

![Figure 3.0.2](Image) Mean accuracy percentages for English monolinguals on tests translation recognition for NO trials.
Figure 3.0.3. Mean accuracy percentages for English monolinguals on tests translation recognition for YES trials.

For both the NO and YES trials, separate 2 (Time 1 vs. Time 2) × 3 (false cognate vs. cognate vs. unambiguous control) repeated measures analyses of variance revealed main effects of time (for NO trials, \(F = 67.62, p < .001\); for YES trials, \(F = 12.71, p < .01\)) and of word type (for NO trials, \(F = 32.59, p < .001\); for YES trials, \(F = 33.13, p < .001\)). Only for the NO trials was there a time × word type interaction (\(F = 3.37, p < .05\); YES trials, \(F = 0.49, p = .62\)). However, based on the observation that accuracy performance on cognates approached ceiling, arcsine transformations were conducted. The same analyses performed on arcsine transformations on the accuracy data still revealed main effects of time (for NO trials, \(F = 67.14, p < .001\); for YES trials, \(F = 16.63, p < .01\)) and of word type (for NO trials, \(F = 36.12, p < .001\); for YES trials, \(F = 36.48, p < .001\)) for both NO and YES trials.

However, no time × word type interaction was observed for either the NO or the YES trials (for NO trials, \(F = 0.50, p = .61\); for YES trials, \(F = 0.50, p = .61\)).

Translation Recognition: RT. Response time data from the translation recognition task for the English monolinguals can be found in Figures 3.4 and 3.5.
Figure 3.0.4. Mean RTs for English monolinguals on tests of translation recognition for NO trials.

Figure 3.0.5. Mean RTs for English monolinguals on tests of translation recognition for YES trials.

As in the accuracy analyses, separate 2 (Time 1 vs. Time 2) × 3 (false cognate vs. cognate vs. unambiguous control) repeated measures analyses of variance revealed main effects of time (for NO trials, $F = 42.42, p < .001$; for YES trials, $F = 5.85, p < .05$) and of word type (for NO trials, $F = 17.23, p < .001$; for YES trials, $F = 73.37, p < .001$). However,
Unlike the accuracy data, no time × word type interaction was revealed for either the NO trials or the YES trials.

**Discussion.** Like the results for the training task, performance on the translation recognition task for the English monolinguals showed that not only were participants improving in their accuracy from Time 1 to Time 2, but they were also getting faster at making responses from Time 1 to Time 2. The main effect of word type for the accuracy data suggests that not all types of new words (i.e., false cognates, cognates, and controls) were as easy to learn, even at immediate tests. The descriptive statistics suggest that this effect was driven entirely by the cognates, while the false cognates and unambiguous control words were generally processed similarly. This finding replicates previous results (de Groot & Keijzer, 2000; Lotto & de Groot, 1998), in which cognates were both easier for participants to learn and more likely to be remembered upon testing.

While the interaction of time × word type for the raw accuracy data for NO trials might have suggested that this difference in the learning of particular word types changed from the first test of translation recognition to the second, analyses performed on arcsine transformed data suggest that this is due to learning of the cognates approaching ceiling for the NO trials, compared to the dramatic improvement of the false cognates and unambiguous control items from Time 1 to Time 2 for the NO trials. This explanation is further evidenced by the lack of a time × word type interaction for the RT data, in which the more dramatic speeding of the NO trials parallels the dramatic improvement in accuracy of the false cognate and unambiguous control NO trials. However, for the cognate RT data, as accuracy performance approached ceiling at Time 2, participants were still speeding up their responses.
The pattern of RT data for translation recognition suggests that performance depended on whether or not the trials required a YES or a NO response. Some part of the difference for each response may be attributable to the nature of the cognate trials in the YES condition. YES trials for cognates were always identical or nearly-identical pairs (e.g., hotel – hotel, or gitaar – guitar). For the NO trials, the cognates were paired with an incorrect translation and therefore perceptually distinct. It is important to note that the fact there was still facilitation in the NO condition in the absence of a high degree of perceptual similarity, suggests that there is a genuine benefit for learning the cognates.

Overall, the results demonstrated that English monolingual participants were able to learn Dutch words to some degree with only a few exposures. They were faster and more accurate after two training sessions than after only one. Dutch-English cognates were the easiest type of word to learn: English monolingual participants were both faster and more accurate on cognate trials than on false cognate or unambiguous control trials. In fact, cognate accuracy approached ceiling after only two training sessions. Perhaps the most dramatic finding, however, is that performance for false cognates was only slightly different than performance for language unambiguous words. There was a hint at Time 1 that the conflict in meaning between the new Dutch word and its English translation was problematic, but by Time 2 that conflict appeared to be resolved. The fact that these items were not more difficult than the unambiguous controls in both the accuracy data and the RT data is surprising, and runs contrary to the predictions outlined in Chapter 2. Like the evidence from the training task, the data here suggest that English monolinguals are more likely to learn cognates than unambiguous controls (which was predicted), but not less likely to learn false cognates relative to unambiguous controls (which was not predicted).
**Picture Naming Task**

The picture naming task concluded the computer-based portion of the first session, and was administered to the English monolingual participants as a baseline measure with which to compare the bilingual participants (see p. 32 for a review of the picture-naming task). According to a liberal estimate of the naming performance (e.g., counting “desk” as a correct response when the target was “table,” or “bunny” as a correct response for “rabbit”; this estimate is intended to remedy the unintended problems created by certain ambiguous stimuli, as well as take into account pictures that might have had more than one correct label), they named 99.8% ($SE = 0.13\%$) of the pictures correctly, with a mean naming latency of 775 ms ($SE = 28.28$). According to a very strict estimate of their performance (i.e., naming only the targets intended by the experimenter when selecting the pictures for inclusion), they named 92.9% ($SE = 0.99\%$) of the pictures correctly, with a mean naming latency of 766 ms ($SE = 26.03$).

**Dutch Lexical Decision Task**

The Dutch lexical decision task was administered twice: once during Session 2 following the third training task, and again during Session 3 as the only task in that session (see p. 33 for a review of the Dutch lexical decision task). It must be noted once again that not all participants returned for Session 3. Fifteen of the 21 English monolingual participants returned for Session 3. In Dutch lexical decision, participants saw a letter string in the middle of the screen and were asked to decide as quickly and accurately as possible whether the item was a Dutch word that they had studied or not. It must be noted that, since these participants’ knowledge of Dutch was limited to the vocabulary on which they were trained, this task is not a traditional test of lexical decision, but rather a test of recognition of their recently studied vocabulary in Dutch. The judgment was not entirely an OLD/NEW judgment,
however, since some of the NO items in the Dutch lexical decision task were valid English words. Recall from the description of the task in Chapter 2 that the YES trials were composed of the three types of Dutch words that participants had been studying throughout the experiment (i.e., false cognates, cognates, and unambiguous controls), and the NO trials were either Dutch-like nonwords, English lexical neighbors (similar in orthography to one of the studied Dutch words), and English semantic neighbors (similar in meaning to one of the studied Dutch words).

Like the translation recognition task, the Dutch lexical decision task was administered twice to participants. However, unlike the translation recognition task, both tests of Dutch lexical decision were administered in different sessions (one test of Dutch lexical decision in Session 2 and one in Session 3; both tests of translation recognition within Session 2). Additionally, while the time between the two tests of translation recognition was relatively constant for all participants (the second training task separated the two), the time between the two tests of Dutch lexical decision varied considerably between participants (mean = 25.07 days, standard deviation = 7.73 days). This, when compounded with the additional word types in Dutch lexical decision, is the rational for reporting the two tests of Dutch lexical decision in separate analyses first, before analyzing them together.

In the first test of Dutch lexical decision, 84.3% of the trials were scored as correct, and these trials were the only trials included for the RT analyses. Additionally, 12.1% of trials were incorrect, with 0.6% of the trials falling outside of a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds), and 3.0% of the data fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials (if the trial were a YES trial) or for NO trials (if the trial were a NO trial). All trials not regarded as correct were counted as errors in the accuracy analyses.
In the second test of Dutch lexical decision, 65.0% of the trials were scored as correct, and again these trials were the only trials included for the RT analyses. Additionally, 29.6% of trials were incorrect, with 0.5% of the trials falling outside of a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds), and 5.0% of the data falling outside 2.5 standard deviations above or below each participant’s mean RT for YES trials (if the trial were a YES trial) or for NO trials (if the trial were a NO trial). Again, all trials not regarded as correct were counted as errors in accuracy analyses.

**Dutch lexical decision: Time 1 accuracy.** Accuracy data from the English monolingual participants at the first test of Dutch lexical decision in Session 2 are presented in Figures 3.6 and 3.7.

![Figure 3.0.6](image_url)

*Figure 3.0.6.* Mean accuracy scores for English monolinguals on the first test of Dutch lexical decision (during Session 2) for YES trials.
Figure 3.0.7. Mean accuracy scores for English monolinguals on the first test of Dutch lexical decision (during Session 2) for NO trials.

Separate one-way repeated measures ANOVAs, using word type as the independent variable, were carried out for YES and NO trials for the accuracy data. For the YES trials, the ANOVA revealed a main effect of word type ($F = 28.63, p < .001$), and for the NO trials, a separate ANOVA also revealed a main effect of word type ($F = 40.75, p < .001$).

Follow-up pairwise comparisons with the Bonferroni correction were performed separately for YES and NO trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. For the YES trials, the main effect of word type was driven by the cognates, on which the English monolinguals were more accurate than both the false cognates ($F = 24.02, p < .001$) and the unambiguous controls ($F = 69.42, p < .001$). The difference in accuracy performance between the false cognates and the unambiguous controls was not significant ($F = 2.94, p = .10$). For the NO trials, all comparisons reached significance. That is, English monolingual performance for the English semantic neighbors was more accurate than their performance on Dutch-like nonwords ($F = 43.11, p < .001$), and their performance on English lexical
neighbors \( (F = 64.51, \ p < .001) \), and performance on Dutch-like nonwords was more accurate than their performance on English lexical neighbors \( (F = 20.70, \ p < .001) \).

**Dutch lexical decision: Time 1 RT.** RT data from the English monolingual participants at the first test of Dutch lexical decision in Session 2 are presented in Figures 3.8 and 3.9.

![Bar chart](image)

**Figure 3.0.8.** Mean RT scores for English monolinguals on tests of the first test of Dutch lexical decision (during Session 2) for YES trials.
Figure 3.0.9. Mean RT scores for English monolinguals on tests of the first test of Dutch lexical decision (during Session 2) for NO trials.

Separate repeated measures ANOVAs, using word type as the independent variable, were carried out for YES and NO trials for the RT data. For the YES trials, a repeated measures ANOVA revealed a main effect of word type for the YES trials \((F = 19.31, p < .001)\), and a separate repeated measures ANOVA revealed a main effect of word type for the NO trials \((F = 7.36, p < .01)\).

Follow-up pairwise comparisons with the Bonferroni correction were performed separately for YES and NO trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. For the YES trials, the main effect of word type was, like the results from the accuracy data, driven by the cognates. The English monolinguals were faster to respond on cognates trials than on either false cognates trials \((F = 42.91, p < .001)\) or unambiguous control trials \((F = 27.22, p < .001)\). The difference in mean RT between false cognate trials and unambiguous control trials was not significant \((F = 0.32, p = .58)\). For the NO trials, the main effect of word type was driven by the English lexical neighbors. The English monolinguals were slower to respond
on English lexical neighbor trials than on either Dutch-like nonwords trials \((F = 9.58, p < .01)\) or English semantic neighbor trials \((F = 8.87, p < .01)\). The difference in meant RT between Dutch-like nonwords trials and English semantic neighbor trials was not significant \((F = 2.57, p = .13)\).

**Discussion.** Data from the first test of Dutch lexical decision for the monolingual participants resembled the pattern found in both the training and translation recognition tasks: cognates were the easiest type of word to learn, both in terms of accuracy and speed. The Dutch lexical decision data also resembled the training and translation recognition results in that performance for the false cognates and unambiguous controls was similar. Contrary to the initial predictions that monolinguals would find false cognates difficult to learn because they would have difficulty inhibiting the conflicting meaning in their L1, there was little evidence beyond the very first session that false cognates and unambiguous words were processed differently.

Data from the NO trials suggests that English lexical neighbors were particularly difficult for monolinguals to reject: they were both less accurate and slower to respond to English lexical neighbors than Dutch-like nonwords (although the RT comparison did not quite reach significance). This suggests that the newly-learned Dutch words are residually activating orthographically similar items in English, which provides support for non-selective activation of multiple languages. Further support for this idea comes from the English semantic neighbors, which were more accurate than Dutch-like nonwords (though no faster than Dutch-like nonwords), suggesting that there is something particular about form-ambiguity that causes difficulty for learning, because no such difficulty seems to exist for meaning-ambiguity. This result replicates a finding from other L2 learning studies (Ferre, Sanchez-Casas, & Guasch, 2006; Talamas, Kroll, & Dufour, 1999), in which less proficient
bilinguals experienced more interference from form-similar distractor translations than from meaning-similar distractor translations.

*Dutch lexical decision: Time 2 accuracy*. Accuracy data for the monolingual participants at the second test of Dutch lexical decision in Session 3 are presented in Figures 3.10 and 3.11.

![Figure 3.0.10](image)

*Figure 3.0.10.* Mean accuracy scores for English monolinguals on the second test of Dutch lexical decision (during Session 3) for YES trials.
Figure 3.0.11. Mean accuracy scores for English monolinguals on the second test of Dutch lexical decision (during Session 3) for NO trials.

Separate repeated measures ANOVAs, using word type as the independent variable, were carried out on YES and NO trials for the accuracy data. For the YES trials, a repeated measures ANOVA revealed a main effect of word type ($F = 22.46, p < .001$). For the NO Trials, a separate repeated measures ANOVA also revealed a main effect of word type ($F = 5.05, p < .05$).

Follow-up pairwise comparisons with the Bonferroni correction were performed separately for YES and NO trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. For the YES trials, the main effect of word type was, like the accuracy data at Time 1, driven by the cognates. English monolingual performance on the cognate trials at Time 2 was more accuracy than the false cognate trials ($F = 29.28, p < .001$) and the unambiguous control trials ($F = 24.51, p < .001$). There was no significant difference in accuracy performance between the false cognate trials and the unambiguous control trials ($F = 0.01, p = .92$). For the NO trials, the main effect of word type was driven by the English lexical neighbors.
English monolingual performance at Time 2 for the English lexical neighbor trials was less accurate than English semantic neighbor trials \((F = 7.98, p < .017)\), and marginally less accurate than Dutch-like nonwords \((F = 6.34, p = .03)\). The difference in accuracy performance between the Dutch-like nonwords and the English semantic neighbors was not significant \((F = 0.04, p = .84)\).

*Dutch lexical decision: Time 2 RT.* RT data from the monolingual participants at the second test of Dutch lexical decision in Session 3 are presented in Figures 3.12 and 3.13.

![Graph](image)

**Figure 3.0.12.** Mean RT scores for English monolinguals on the second test of Dutch lexical decision (during Session 3) for YES trials.
Figure 3.0.13. Mean RT scores for English monolinguals on the second test of Dutch lexical decision (during Session 3) for NO trials.

Separate repeated measures ANOVAs, using word type as the independent variable, were carried out for YES and NO trials for the accuracy data. For the YES trials, a repeated measures ANOVA revealed a main effect of word type ($F = 5.28, p < .05$). For the NO Trials, a separate repeated measures ANOVA also revealed a main effect of word type ($F = 3.56, p < .05$).

Follow-up pairwise comparisons with the Bonferroni correction were performed separately for YES and NO trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. For the YES trials, the main effect of word type was driven by the cognates. English monolingual RT performance on cognate trials at Time 2 was faster than false cognate trials at Time 2 ($F = 9.73, p < .01$) and marginally significantly faster than unambiguous control trials at Time 2 ($F = 6.33, p = .03$). No significant difference was observed in RT performance between the false cognate trials and the unambiguous control trials ($F = 0.77, p = .40$). For the NO trials, the main effect of word type was driven by the Dutch-like nonwords. English monolingual
RT performance on Dutch-like nonwords trials was faster than English lexical neighbor trials \((F = 10.05, p < .01)\), and marginally significantly faster than English semantic neighbor trials \((F = 5.47, p = .04)\). No significant difference was observed in RT performance between the English lexical neighbor trials and the English semantic neighbor trials \((F = 0.17, p = .69)\).

**Discussion.** Data from the second test of lexical decision that took place between 15 and 46 days after the first test of lexical decision with no intervening study opportunities revealed that English monolingual participants retained very little knowledge of the Dutch words they had studied (give the average percentage), save for the cognates. They performed at chance levels at for both false cognates and unambiguous controls. They also responded more quickly to the cognates than to the false cognates or unambiguous controls, even at this delayed testing interval. And finally, although English monolinguals at the first test of Dutch lexical decision appeared to show no semantic interference, their performance at Time 2, Session 3 suggests that, while they have forgotten some of the words, semantically-related distracters are causing interference. This suggests that, while the English monolingual participants seemed to have made significant gains in learning these previously unfamiliar Dutch words during Sessions 1 and 2, little evidence of that learning remains at Session 3 for the YES trials, save for performance on the cognates. This replicates previous work done on the learning of cognates (de Groot & Keijzer, 2000), supporting the idea that vocabulary items that are easier to learn are harder to forget. However, evidence from the English semantic neighbors suggests that the English monolingual processing at Time 2, Session 3 (as opposed to at Time 1, Session 2) more closely resembles performance from low-proficiency bilinguals in other studies (Linck, Kroll, & Sunderman, 2005; Sunderman & Kroll, 2006; Talamas et al., 1999). That is, they experience interference from semantically-related distractor items.
The data from the NO trials suggests that English monolingual participants continue to experience difficulty with the English lexical neighbors in the Dutch lexical decision task. The participants were, once again, least accurate for this type of NO trial, while demonstrating no significant differences in accuracy performance between the Dutch-like nonwords and the English semantic neighbors. For the NO trial RT data, English semantic neighbors were the slowest type of NO trial (although English lexical neighbors were similarly slow), and were significantly slower than the Dutch-like nonwords. This result can be explained in one of two ways. First, it might suggest that the encoding that seemed to be present at the first test of lexical decision that was activating only lexically similar English words and not semantically similar English words was no longer as strong, and the semantically similar English words that had once allowed for very accurate and fast performance had become difficult at Time 2 as a consequence of poor encoding or decay. However, another possibility is that, although English monolingual participants remembered fewer items on the NO trials overall, in tests of long-term retention, the English semantic neighbors were better encoded and were now causing more interference relative to Dutch-like nonwords. This interpretation would support results from Sunderman and Kroll (2006), which demonstrated that bilinguals at all levels of proficiency experience interference from words similar in form to the target, as well as words similar in meaning to the target. These results also replicate the findings from Linck et al. (2005) for Linck et al.’s classroom learners, who experienced interference from both form-related distractors and meaning-related distractors.

Overall, these data suggest that the English monolingual participants were able to retain only their cognate vocabulary and none of their false cognate or unambiguous control vocabulary over an extended period of time. This is slightly contrary to the initial study
predictions, which had predicted that English monolinguals would demonstrate their best performance for cognates, but did not predict that the false cognates and unambiguous controls would be similarly difficult. However, despite poorer performance at Time 2, Session 3, the English monolinguals appeared to be experiencing semantic interference (but, interestingly, not at Time 1, Session 2), paralleling interference patterns from lower proficiency bilingual groups in previous studies (Linck et al., 2005; Sunderman & Kroll, 2006; Talamas et al., 1999). This result suggests that even with limited exposure to an L2, English monolinguals can begin to display some patterns that are similar to those of lower-proficiency bilinguals.

_Dutch lexical decision: Times 1 and 2 accuracy comparison._ Accuracy data from the monolingual participants at the second test of Dutch lexical decision at Time 1 (Session 2) and Time 2 (Session 3) are presented in Figures 3.14 and 3.15.

![Figure 3.0.14](image)

**Figure 3.0.14.** Comparison of mean accuracy scores for English monolinguals for Dutch lexical decision YES trials, at Time 1 (Session 2) and Time 2 (Session 3).
Two separate 2 (Time 1 vs. Time 2) × 3 (false cognates vs. cognates vs. unambiguous controls) repeated measures ANOVAs were conducted, one for YES trials and one for NO trials. The 2 (Time 1 vs. Time 2) × 3 (false cognate vs. cognate vs. unambiguous control) repeated measures ANOVA for YES trials revealed a main effect of time ($F = 43.54, p < .001$) and a main effect of word type ($F = 31.72, p < .001$). It also revealed a time × word type interaction ($F = 4.36, p < .05$). A separate 2 (Time 1, Time 2) × 3 (Dutch-like nonword vs. English lexical neighbor vs. English semantic neighbor) repeated measures ANOVA for NO trials revealed a main effect of word type ($F = 18.91, p < .001$), but no main effect of time ($F = 2.48, p = .14$). It also revealed a time by word type interaction ($F = 5.16, p < .05$).

Follow-up pairwise comparisons with the Bonferroni correction were performed for only the YES trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. These tests revealed that the main effect of word type found for the YES trials was driven by the cognate trials, which exhibited, overall, more accurate performance by the English monolinguals than
either the false cognate trials \( F = 36.26, p < .001 \) or the unambiguous control trials \( F = 39.38, p < .001 \). There was no significant difference in accuracy performance between the false cognate trials and the unambiguous control trials \( F = 1.60, p = .23 \).

Dutch lexical decision: Times 1 and 2 RT comparison. RT data from the English monolingual participants at the second test of Dutch lexical decision in Session 3 are presented in Figures 3.16 and 3.17.

![Figure 3.16. Comparison of mean RTs for English monolinguals for Dutch lexical decision YES trials at Time 1 (Session 2) and Time 2 (Session 3).](image)
Two separate 2 (Time 1 vs. Time 2) × 3 (false cognates vs. cognates vs. unambiguous controls) repeated measures ANOVAs were conducted, one for YES trials and one for NO trials. The 2 (Time 1 vs. Time 2) × 3 (false cognates vs. cognates vs. unambiguous controls) repeated measures ANOVA for YES trials examining RT data, revealed a main effect of time ($F = 22.20, p < .001$) and a main effect of word type ($F = 16.65, p < .001$), but no time × word type interaction ($F = 0.32, p = .73$). The 2 (Time 1 vs. Time 2) × 3 (Dutch-like nonwords vs. English lexical neighbor vs. English semantic neighbor) repeated measures ANOVA for NO trials, examining RT data, revealed a main effect of word type ($F = 3.37, p < .05$), but no main effect of time ($F = 0.39, p = .55$). It also revealed a time × word type interaction ($F = 9.78, p < .001$).

Follow-up pairwise comparisons with the Bonferroni correction were performed separately for YES and NO trials (setting alpha at .017, dividing .05 by three for three word type comparisons) in order to determine which word types differed from each other. For the YES trials, the main effect of word type was driven by, again, by the cognate trials, which
were, overall, faster than either the false cognate trials ($F = 21.45, p < .001$) or the unambiguous control trials ($F = 27.45, p < .001$). No significant difference was observed between the false cognate trials and the unambiguous control trials ($F = 0.83, p = .38$). For the NO trials, the only comparison that exhibited a significant difference was that the Dutch-like nonwords trials were faster than the English lexical neighbor trials ($F = 11.32, p < .01$). There was no overall difference in RT performance between the Dutch-like nonwords and the English semantic neighbors ($F = 0.25, p = .63$) or the English lexical neighbors and the English semantic neighbors ($F = 2.49, p = .14$).

**Discussion.** These results further support the results from the analyses performed on the data from the second test of Dutch lexical decision in isolation: English monolingual participants were both slower and less accurate on a test of Dutch lexical decision after a time delay between 15 and 46 days since their last exposure to the Dutch words. The only caveat to this general trend comes with the cognates, which were initially learned by the English monolingual participants better than either the false cognates or the unambiguous controls, but they were also the only word type on which the English monolingual participants performed above chance levels in the test of retention (i.e., Dutch lexical decision after a delay of many days). For the NO trials, English lexical neighbors were the most difficult word type to reject in Dutch lexical decision immediately after learning and after a delay. However, the relative ease of rejecting the English semantic neighbors existed only for tests immediately following learning. The increased sensitivity to the semantic distractors at the time of the later tests suggests that there was indeed representation of the meaning of at least some of the newly learned words.

**English lexical decision task.** The English lexical decision task was administered once at the end of the second session (see p. 38 for a review of the English lexical decision task).
Recall that the English lexical decision task contained an equal number of YES and NO trials, and that the YES trials were either unambiguous control English translations, Dutch-English cognates (using the English spelling when applicable), Dutch-English false cognates, or Dutch-English false cognate English translations. NO trials were all English-like nonwords, and will not be analyzed.

The purpose of administering the English lexical decision task was to determine whether limited exposure and knowledge of a small set of Dutch words will impact native language performance for English monolinguals in any way. In the Dutch lexical decision task, the results suggested that L1 knowledge both benefited and interfered with Dutch (“L2”) processing, but it is unclear if “L2” processing would affect L1 processing for these “very early bilingual” participants. Because all of the items that required a YES response in the English lexical decision task were translations of Dutch items that the participants had previously studied, it is possible that participants experienced repetition priming for these items. However, since all items were viewed by the participants an equal number of times (except for identical cognates, although half of the exposures were to a Dutch word that happened to be identical to its English translation), so no word type (other than perhaps the identical cognates) would benefit from repetition priming more than any other, and comparisons between the different word types is still relevant. It should also be noted that the only Dutch words that appeared in the English lexical decision task were also English words (i.e., cognates or false cognates), and no exclusively Dutch words appeared, in contrast to the Dutch lexical decision task. Hence, if English monolinguals are able to effectively “turn off” their newly acquired Dutch knowledge, whether or not an English word was also a Dutch word should not have changed the participants’ performance.
For the English monolingual participants, 95.6% of all of the trials were scored as correct. These were the trials used to analyze RT data. The remaining data were either incorrect trials (0.8%), fell outside a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds—0.1%), or fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials or for NO trials (3.5%). All trials not regarded as correct were counted as errors in accuracy analyses.

*English lexical decision: Accuracy.* Accuracy data from the English lexical decision task are presented in Figure 3.18.

As can be seen from Figure 3.18, English monolingual participants were very accurate at performing the English lexical decision task, and a one-way ANOVA using word type as the independent variable revealed no main effect of word type ($F = 0.34, p = .54$).

*English lexical decision: RT.* RT data from the English lexical decision task are presented in Figure 3.19.
A one-way ANOVA using word type as the independent variable revealed a main effect of word type ($F = 5.82, p < .001$). Follow-up one-way ANOVAs revealed that false cognate trials were slower than unambiguous control translation trials ($F = 7.10, p < .05$), but no other RT differences between unambiguous control translations and any other word types (for cognates, $F = 0.54, p = .47$; for unambiguous control translations $F = 0.00, p = .997$). A significant difference also existed between RTs for false cognate translations and false cognates ($F = 7.23, p < .05$), and for false cognates and cognates ($F = 8.22, p < .01$), as false cognates were significantly slower than either of these word types. However, no significant differences existed between RTs for false cognate translations and cognates ($F = 1.17, p = .29$).

A follow-up one-way ANOVA using word type as the independent variable and English word frequency as the dependent variable was conducted. This analysis showed no systematic differences in word frequency between the four word types ($F = 0.55, p = .65$). Because no real control group exists (i.e., an English monolingual group who did not study the Dutch items), the stimuli were uploaded to the English Lexicon Project database (Balota...
et al., 2007), in order to obtain normed RTs and accuracy for these items. The data retrieved from the database were analyzed in a one-way ANOVA using word type as the independent variable and mean lexical decision RT, mean lexical decision accuracy, mean naming RT, and mean naming accuracy as dependent variables. No significant differences were observed ($F = 0.71, p = .55$ for mean lexical decision RT; $F = 1.08, p = .36$ for mean lexical decision accuracy; $F = 0.54, p = .66$ for mean naming RT; and $F = 1.47, p = .23$ for mean naming accuracy). Hence, it is unlikely that the main effect of word type is due to an inherent property of the words themselves.

Discussion. These results demonstrate that three training exposures to these English monolingual participants does not induce a forgetting of the original English words that must now be mapped to a Dutch word with a different meaning (i.e., the false cognates). This learning does, however, cause a processing delay for these words relative to all other types of English words tested—even ones that have been learned as Dutch words with the same meaning and spelling as an English word (i.e., cognates). This suggests that the learning of false cognates, even for people with little to no language learning experience, can alter their processing of their native language.

Discussion of English Monolingual Results

Results from the English monolingual data demonstrated that English monolinguals were able to learn a set of 64 Dutch words over the course of 3 exposures and several tests (two of translation recognition and two of lexical decision). However, they were unlikely to retain knowledge of any of those words for the test of long-term retention, save for the cognates. The results also replicate previous findings regarding cognates being both easier to learn and more likely to be remembered at test (de Groot & Keijzer, 2000; Lotto & de Groot, 1998). The results from the second test of Dutch lexical decision parallel those from studies
that examined performance from lower-proficiency bilinguals (Linck et al., 2005; Sunderman & Kroll, 2006; Talamas et al., 1999), in that semantic and lexical/form distractors both caused a degree of interference for the English monolinguals (who became early L2 learners). In order to examine the rest of the predictions laid out in Chapter 2, side-by-side comparisons between monolingual performance and bilingual performance will be presented in Chapter 4.
Data from the English-Spanish bilinguals and the Chinese-English bilinguals will now be presented, alongside the data from the English monolinguals that were presented in Chapter 3. As a reminder, the English monolingual group is not a control group per se, since all three groups were exposed to the same experimental paradigm. Rather, the English monolinguals serve as a comparison group for data from two different types of bilinguals. If bilinguals are advantaged in vocabulary learning as a consequence of their language experience per se, then both bilingual groups might be expected to outperform the monolinguals. However, if success in learning new vocabulary depends on how new learning is mapped to existing language knowledge, then the two bilingual groups may differ from one another.

The profile of the participants in the two bilingual groups was given in Chapter 2 (see p. 21). Data from one English-Spanish bilingual participant were discarded due to failing to meet a minimum Operation-Span score. All Chinese-English participants were included. This resulted in a total of 22 English-Spanish bilingual participants, and 19 Chinese-English participants.

Training Task

For a review of the procedure for the training task, please see the Training Task section in Chapter 2 (p. 28). The English-Spanish participants correctly produced the target (i.e., the English translation presented on the screen) into the microphone on 96.9% of trials presented. The remaining 3.1% of the trials were either technical errors (2.2% of trials, which consisted of computer malfunctions or microphone malfunctions), or trials in which participants waited longer than 3000 ms to name the English translation (0.9% of trials; these were considered outlier trials). No trials from the English-Spanish bilingual group contained
production errors. The Chinese-English participants correctly produced the target into the microphone on 95.1% of trials presented. The remaining 4.9% of the trials were either technical errors (1.2% of trials, which consisted of computer malfunctions or microphone malfunctions), trials in which participants waited longer than 3000 ms to name the English translation (2.5% of trials), trials in which participants named the Dutch word instead of the English translation (0.1% of trials), or incorrect productions (1.1% of trials). Due to the high accuracy on this task, accuracy data will not be analyzed further.

RT data for the time to name the English translations of the Dutch words are presented in Figure 4.1.

Figure 4.1. English translation naming latencies (in milliseconds) during all three training tasks by all three groups.

A 3 (language group) by 3 (time) by 3 (word type) mixed-factors ANOVA, with repeated measures on the second and third factors, showed a main effect language group \( (F = 9.64, p < .001) \), a main effect of time \( (F = 29.95, p < .001) \), and a main effect of word type \( (F \)
It also revealed a language group × word type interaction ($F = 8.99, p < .001$), a time × word type interaction ($F = 2.92, p < .05$), and a 3-way language group × time × word type interaction ($F = 3.24, p < .01$).

Tukey’s HSD follow-up tests revealed that the main effect of language group was driven by the longer RTs for the English-Spanish bilinguals, which were significantly longer than the RTs for either the English monolinguals ($t = 3.95, p < .01$) or the Chinese-English bilinguals ($t = 3.58, p < .01$). There was no significant difference in RT between the English monolinguals and the Chinese-English bilinguals ($t = 0.22, p = .97$).

Follow-up tests were performed in order to compare Time 1 to Time 2 and Time 2 to Time 3 within word type, using a Bonferroni corrected alpha level of .008 (for each of six comparisons). These tests demonstrated that responding to the false cognates became significantly faster from Time 1 to Time 2 ($F = 13.20, p < .008$), and from Time 2 to Time 3 ($F = 23.34, p < .008$), and that cognates were significantly faster from Time 1 to Time 2 ($F = 35.46, p < .008$), and from Time 2 to Time 3 ($F = 21.19, p < .008$). Unambiguous controls, however, were significantly faster from Time 2 to Time 3 ($F = 20.31, p < .008$), but not from Time 1 to Time 2 ($F = 4.72, p = .03$). Additional post-hoc tests compared word types with each Time were conducted, using a Bonferroni corrected alpha level of .006 (for each of nine comparisons). At Time 1, cognates were significantly faster than either false cognates ($F = 25.22, p < .008$) or unambiguous controls ($F = 24.08, p < .008$), but RTs for false cognates and unambiguous controls were not significantly different from one another ($F = 5.15, p = .03$) at the conservative post-test alpha level. At Time 2, cognates were again faster than either false cognates ($F = 51.10, p < .008$) or unambiguous controls ($F = 43.26, p < .008$), and RTs for false cognates and unambiguous controls were, again, not significantly different from one another ($F = 3.05, p = .09$). And finally, at Time 2, cognates were still faster than
either the false cognates ($F = 82.06, p < .001$) or the unambiguous controls ($F = 64.28, p < .008$), and RTs for false cognates and unambiguous controls remained not significantly different from one another ($F = 2.42 p = .13$).

**Discussion**

It is clear from these results that the English-Spanish bilinguals adopted a different strategy during the training task than either the English monolinguals or the Chinese-English bilinguals. While all three groups demonstrate essentially the same pattern (i.e., progressively faster RTs overall across time and faster RTs for cognates at each point in time), the English-Spanish bilinguals waited much longer to name the English translations, particularly for the false cognates and the unambiguous controls, but also to a certain extent for the cognates.

Perhaps the most surprising result from the between-groups comparison is how very similar the RT performance in the training task at all three points in time was for English monolinguals and Chinese-English bilinguals. Aside from the Chinese-English bilinguals’ performance on the cognates at Time 1 (which is driving the 3-way language group × time × word type interaction), the two groups are virtually indistinguishable. This is especially surprising given that both groups trained on these Dutch items via English translations, and English was the non-native language for the Chinese-English bilinguals and the native language for the English monolinguals.

Note that the Chinese-English bilinguals were the only group of participants learning the Dutch words via their L2, and would not have benefited from the automaticity associated with native-language reading. One might then have expected that the Chinese-English bilinguals would have demonstrated much slower naming latencies, due to increased reading times. However, this was not the case. Hence, the similar naming latencies for the Chinese-English bilinguals and the English monolinguals actually may suggest that the Chinese-
English bilinguals are utilizing a different strategy that allows them to name the English translations faster than English monolinguals can, given the lack of a native-language naming benefit to the Chinese-English bilinguals. If this were so, the data demonstrate that the two bilingual groups are adopting completely different strategies during the training phase: the English-Spanish bilinguals wait a relatively long time before naming, while the Chinese-English bilinguals name very quickly, and the English monolinguals wait some intermediate amount of time to name the translations. This issue of the Chinese-English bilinguals’ similarity to the English monolinguals’ performance is further addressed in the translation recognition discussion section (see p. 80) and in the picture-naming discussion section (see p. 90).

Translation Recognition Task

For a review of the procedure for the training task, please see the Translation Recognition Task section in Chapter 2 (p. 29). For the tests of translation recognition, two 3 (language group) × 2 (time) × 3 (word type) analyses of variance were carried out for both RTs and accuracy, separately for YES and NO responses. Thus the results of four analyses are reported.

Overall, English-Spanish bilinguals responded to 78.1% of the trials in the tests of translation recognition correctly, and 11.2% incorrectly. The remaining 10.7% of the trials were outliers, either above or below pre-set cut-off points (below 300 ms or above 3000 ms), or 2.5 standard deviations above or below the mean for each participant, per time, per YES or NO trial. The Chinese-English bilinguals responded to 70.7% of the trials in the tests of translation recognition correctly, and 22.9% incorrectly. The remaining 6.4% of the trials were outliers, defined as for the English-Spanish bilinguals. Data regarded as outliers were not included in the RT analyses but were counted as errors for accuracy analyses.
Translation Recognition all-group comparison: Accuracy. Accuracy data from the translation recognition task for all three groups can be found in Figures 4.2 and 4.3.

![Figure 4.2](image1.png)  
**Figure 4.2.** Mean percent accuracy for all groups on tests translation recognition for NO trials.

![Figure 4.3](image2.png)  
**Figure 4.3.** Mean accuracy percentages for all groups on tests translation recognition for YES trials.

For both the NO and YES trials, separate 3 (English monolingual vs. English-Spanish bilingual vs. Chinese-English bilingual) × 2 (Time 1 vs. Time 2) × 3 (false cognate vs. cognate vs. unambiguous control) mixed-factor ANOVAs, with repeated measures on the
second and third factors, revealed main effects of time (for NO trials, $F = 125.67, p < .001$; for YES trials, $F = 44.80, p < .001$), of word type (for NO trials, $F = 47.39, p < .001$; for YES trials, $F = 89.02, p < .001$), and of language group (for NO trials, $F = 3.51, p < .05$; YES trials, $F = 6.49, p < .01$). Tukey’s HSD follow-up tests on the NO trial accuracy data revealed that the only significant difference between language groups was that the English-Spanish bilinguals were more accurate than the Chinese-English bilinguals ($t = 2.84, p < .05$). Tukey’s HSD follow-up tests on the YES trial accuracy data revealed that the English-Spanish bilinguals were more accurate than both the English monolinguals ($t = 2.94, p < .05$) and the Chinese-English bilinguals ($t = 3.23, p < .01$). No other post-hoc comparisons between language groups reached significance.

For both the NO and YES trials, an interaction between word type and language group emerged (for NO trials, $F = 2.73, p < .05$; YES trials, $F = 5.71, p < .001$). However, only for the NO trials was there a time × word type interaction ($F = 7.69, p < .01$; YES trials, $F = 2.14, p = .12$). No other interactions reached significance.

Based on the observation that accuracy performance on cognates approached ceiling, the accuracy data were subjected to arcsine transformations. The same analyses performed on arcsine transformations on the accuracy data still revealed main effects of time (for NO trials, $F = 202.75, p < .001$; for YES trials, $F = 48.86, p < .001$), of word type (for NO trials, $F = 50.36, p < .001$; for YES trials, $F = 104.71, p < .001$), and of language group (for NO trials, $F = 5.01, p < .05$; for YES trials, $F = 4.63, p < .05$) for both NO and YES trials. Tukey’s HSD follow-up tests on the NO trial arcsine transformed accuracy data revealed, again, that the only significant difference between language groups was that the English-Spanish bilinguals were more accurate than the Chinese-English bilinguals ($t = 3.17, p < .01$). However, Tukey’s HSD follow-up tests on the YES trial accuracy data revealed that the only
difference between groups in accuracy performance was that the English-Spanish bilinguals were more accurate than the Chinese-English bilinguals ($t = 2.84, p < .05$), and marginally significantly more accurate than the English monolinguals ($t = 2.34, p = .06$). No other post-hoc comparisons between language groups reached significance. Additionally, the word type × language group interaction was still present for both NO and YES trials (for NO trials, $F = 3.22, p < .05$; for YES trials, $F = 2.76, p < .05$). However, no time × word type interaction was observed for either the NO or the YES trials (for NO trials, $F = 1.51, p = .23$; for YES trials, $F = 0.89, p = .42$). The time × language group interaction, however, did reach significance under the arcsine transformed data, but only for the NO trials (for NO trials $F = 3.08, p < .05$; for YES trials, $F = 0.22, p = .81$).

Six follow-up 2 (Time 1 vs. Time 2) × 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) mixed-factor ANOVAs, with repeated measures on the second factor, were carried out on the raw data for each word type, for YES and NO trials. These tests revealed a marginally significant effect of language group for false cognates for NO trials ($F = 3.04, p = .06$), but a significant effect of language group for false cognates for YES trials ($F = 13.01, p < .001$). Post-hoc tests further revealed that, for false cognate YES trials, English-Spanish bilinguals were more accurate than either the Chinese-English bilinguals or the English monolinguals, but no other differences between groups for false cognate performance. No time × language group interactions were present for false cognates (for NO trials, $F = 1.13, p = .33$; for YES trials, $F = 0.25, p = .78$). There was also an effect of language group for cognates for NO trials ($F = 4.79, p < .05$), but not for YES trials ($F = 0.08, p = .93$). No time × language group interactions were presented for cognates (for NO trials, $F = 0.26, p = .77$; for YES trials, $F = 0.95, p = .40$). There were no language group effects for accuracy performance on unambiguous controls for either NO or YES trials.
(for NO trials, $F = 1.45, p = .24$; for YES trials, $F = 2.13, p = .13$). No time $\times$ language group interactions were presented for unambiguous controls (for NO trials, $F = 1.99, p = .15$; for YES trials, $F = 0.61, p = .55$).

Discussion. The translation recognition accuracy data for the English demonstrate that all three groups learned all three word types from the first test of translation recognition to the second. The data also demonstrated that, overall, the English-Spanish bilinguals outperformed both the English monolinguals and the Chinese-English bilinguals. The exception to this rule was the cognate NO trials, on which the Chinese-English bilinguals were less accurate than either the English monolinguals or the English-Spanish bilinguals.

Translation Recognition all group comparison: RT. Response time data from the translation recognition task for all three groups can be found in Figures 4.4 and 4.5.

**Figure 4.4.** Mean RTs (in milliseconds) for all three groups on tests of translation recognition for NO trials.
Figure 4.5. Mean RTs (in milliseconds) for all three groups on tests of translation recognition for YES trials.

As in the accuracy analyses, separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 2 (Time 1 vs. Time 2) × 3 (false cognate vs. cognate vs. unambiguous control) mixed-factor ANOVAs, with repeated measures on the second and third factors, revealed main effects of time (for NO trials, $F = 125.28, p < .001$; for YES trials, $F = 49.82, p < .001$), of word type (for NO trials, $F = 54.81, p < .001$; for YES trials, $F = 295.02, p < .001$), and of language group (for NO trials, $F = 7.64, p < .01$; for YES trials, $F = 5.64, p < .01$). Post-hoc tests revealed that, for the YES trials, the main effect of language group was driven by the English-Spanish bilingual group performing much faster than the Chinese-English group ($t = 3.33, p < .01$). For the NO trials, both English-Spanish bilinguals and the English monolinguals were significantly faster than the Chinese-English bilinguals ($t = 3.87, p < .01$ for English-Spanish/Chinese-English difference; $t = 2.53, p < .05$ for English monolingual/Chinese-English difference). However, unlike the accuracy data, no significant interactions were revealed for the NO trials, but several interactions were revealed for the YES trials: a word type × language group interaction ($F = 2.52, p < .05$), a time × word type interaction ($F = 6.31, p < .01$), a 3-way time × word type × language group
interaction ($F = 3.07, p < .05$), and a marginally significant time × language group interaction ($F = 2.75, p = .07$).

Six follow-up 2 (Time 1 vs. Time 2) × 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) mixed-factor ANOVAs, with repeated measures on the first factor were carried out for each word type, for YES and NO trials. These tests revealed that, for RTs on NO and YES trials for the false cognates, there was a main effect of language group (for NO trials, $F = 5.68, p < .01$; for YES trials, $F = 5.15, p < .01$). But only for YES trial RTs for the false cognates was there a time × language group interaction (for NO trials, $F = 1.01, p = .37$; for YES trials, $F = 3.46, p < .05$). For cognates, there was also a main effect of language group for both NO and YES trials (for NO trials, $F = 7.53, p < .01$; for YES trials, $F = 3.99, p < .05$), but there were no time × language group interactions for either the NO trials ($F = .084, p = .44$) or the YES trials ($F = 0.01, p = .99$). For the unambiguous controls, the pattern was similar to that of the false cognates: main effect of language group for both NO ($F = 7.82, p < .01$) and YES trials ($F = 5.50, p < .01$), but only a time × language group interaction for YES trials (for NO trials, $F = 1.72, p = .19$; for YES trials, $F = 4.75, p < .05$).

Discussion. In general, what is clear from the results of the translation recognition task is that participants from all three language groups get faster and more accurate from Time 1 to Time 2. However, how much faster and how much more accurate depends on the word type, the language group, and whether or not the trial required a YES or NO response.

Overall, the English-Spanish bilinguals were faster and more accurate than the Chinese-English bilinguals and the English monolinguals, but this difference was only significant for NO trials. For YES trials, both native-English groups were faster and more accurate than the Chinese-English bilinguals. This suggests that the English monolinguals
were able to utilize a strategy that benefited them on YES trials, but not on NO trials. A particular property of the cognate YES trials in translation recognition is that all YES trials for cognates presented orthographically identical or very similar items side by side. None of the NO trials paired orthographically similar items. Therefore, participants could have adopted a strategy of immediately pressing YES when the word on the right (the English translation) matched the word on the left (the Dutch word). This seems to have been the case, as YES trials for cognates were highly accurate, even at Time 1 after only one exposure to the words, and were much faster than either of the other word types.

It is also important to once again note that the Chinese-English bilinguals were the only group learning the Dutch words via their L2. Hence, some automaticity associated with reading words in the L1 might have benefited both the English monolinguals and the English-Spanish bilinguals. That said, it is particularly interesting that no large RT differences were observed between the English monolinguals and the Chinese-English bilinguals. It is possible that the Chinese-English bilinguals are actually advantaged relative to the English monolinguals because their performance is so similar. In order to further test this hypothesis, an additional Chinese-English bilingual group who would learn Dutch via their L1 (i.e., Mandarin Chinese) would need to be compared to the present sample. This issue will be further addressed in the picture-naming discussion (see p. 90).

For the RT data, a time × language group interaction was observed for YES trials for both the false cognates and the unambiguous controls, but not the cognates. The data suggest that this is because both bilingual groups got much faster from Time 1 to Time 2 for these word types, but the English monolinguals, although they did get faster from Time 1 to Time 2, did not experience such dramatic improvement. This pattern may have been masked by a floor effect for the cognate YES trials, meaning that the items were so easy for participants
from all groups that the effect could not be observed. It could also mean that English monolinguals were, as predicted, somewhat insulated from a language-learning deficit for the cognate items. That is, the items on which the English monolinguals were predicted to outperform the bilingual groups were the only items on which the English monolinguals did not differ from the bilingual groups. However, this pattern only held for RT YES trial data, so the story is clearly more complicated than that.

Another factor that might have been contributing to the complexity of the translation recognition data is that the different groups may have differentially biased to respond YES or NO. (Across all trials, 50% were YES trials and 50% were NO trials.) This would explain several of the differences observed between NO and YES trials, both for accuracy and for RTs. The English monolinguals demonstrated a NO bias, with 51.7% of trials resulting in a response of NO; the English-Spanish bilinguals demonstrated a NO bias, with 50.44% of trials resulting in a response of NO; and the Chinese-English bilinguals demonstrated a YES bias, with 48.82% of trials resulting in a response of NO. Treated as groups, z-tests to compare these percentages demonstrated that the English monolinguals were more likely to respond NO than the Chinese-English bilinguals (z = 1.97), but no other group was more biased toward a YES or NO response than any other.

What these results suggest is that, preliminarily, two factors matter when learning vocabulary in an unfamiliar language: language-learning experience, and whether the unfamiliar language is taught in one’s native language. The English-Spanish bilingual group has both: they are native English speakers learning Dutch via English, and they have previous language-learning experience. The English monolinguals have the native language advantage, but not the language-learning experience, whereas the Chinese-English bilinguals have the opposite: language-learning experience, but not learning the new language via their
native language. However, this hypothesis cannot be confirmed or rejected, due to several aspects of the samples. First, the English-Spanish bilinguals clearly adopted a different strategy during the training task, which may be the only factor truly driving their performance for both accuracy and RT results. Second, the Chinese-English bilinguals likely also adopted a different strategy, since during training, they named English translations as fast as English monolinguals, even though they named in their L2. Hence, the root of the Chinese-English bilinguals’ somewhat impaired performance in translation recognition might have been due to their study strategy during the training task, or it may have been caused by a lack of sensitivity to form similarity between two languages that do not share a script with their native language. It is yet unclear if the differences observed between these groups are due, in fact, to learning a new language via one’s native language, or whether it has to do with the new language sharing the same script as one’s native language. This latter hypothesis would be testable with an additional bilingual group whose native language is not English, but shares a script with English (e.g., Spanish-English bilinguals). This comparison would allow for testing these two hypotheses.

For the purposes of summarizing the translation recognition data in terms of the predictions laid out in Chapter 2, it appears that there may be a bilingual advantage in immediate tests of foreign-vocabulary learning, but that these advantages are specific, and may be limited depending on one’s native language and the language through which the new language is being taught, as well as whether the task involves recognizing new words or rejecting distractors. Cross-language cognates will be the easiest type of word to learn for anyone, and false cognates will likely be the most difficult. However, false cognates, as predicted, may be more difficult for monolinguals to learn than for bilinguals, but this may only be true for bilinguals learning the new language via their native language, or, perhaps,
via a language that at least shares a script with one’s native language. English monolinguals did not outperform both bilingual groups for the cognates as was predicted, but they did not demonstrate any disadvantages for them, either in accuracy or RTs, suggesting that the lack of experience with cross-linguistic ambiguity insulated them from disadvantages in cognate performance.

The results from the Dutch lexical decision task presented on page 93 will further address some of these issues regarding bilingual advantages.

*Picture Naming Task*

For a review of the picture-naming task procedure, please refer to page 32 in Chapter 2. The accuracy performance results from the picture-naming task can be found in Figure 4.6, and the RT performance results can be found in Figure 4.7.

![Figure 4.6](image-url)  
*Figure 4.6. Liberal and strict judgments of accuracy performance for all three groups in English picture-naming.*
According to a liberal estimate of the accuracy in English picture-naming, the English-Spanish bilinguals named 99.4% ($SE = 0.41\%$) of the pictures correctly and Chinese-English bilinguals named 92.51% ($SE = 1.4\%$) of the pictures correctly. According to a very strict estimate of their performance, the English-Spanish bilinguals named 94.37% ($SE = 0.62\%$) of the pictures correctly and Chinese-English bilinguals named 79.28% ($SE = 2.08\%$) of the pictures correctly. A one-way ANOVA revealed that there was a main effect of language group on naming accuracy (for liberal estimate, $F = 27.18, p < .001$; for strict estimate, $F = 39.36, p < .001$). Post-hoc tests revealed this effect was driven by the Chinese-English bilinguals, who were less accurate to name pictures in English, both according to the liberal accuracy estimate ($t = 6.58, p < .001$ for the Chinese-English bilingual/English monolingual comparison; $t = 6.31, p < .001$ for the Chinese-English bilingual/English-Spanish bilingual comparison), and a strict accuracy estimate ($t = 7.30, p < .001$ for the Chinese-English bilingual/English monolingual comparison; $t = 8.15, p < .001$) and a strict
accuracy estimate. The difference in accuracy performance between English-Spanish bilinguals and English monolinguals was not significant \((t = 0.35, p = .93\) for liberal estimate; \(t = 0.79, p = .71\) for strict estimate).

Including only those trials scored as correct by a liberal estimate in English picture-naming, English-Spanish bilinguals had a mean naming latency of 765 ms \((SE = 28.28)\) and Chinese-English bilinguals had a mean naming latency of 1061 \((SE = 26.79)\). A one-way ANOVA revealed that there was a main effect of language group on naming latencies, both according to a liberal estimate \((F = 37.88, p < .001)\) and a strict estimate \((F = 38.41, p < .001)\). Post-hoc tests revealed that this effect was, like the accuracy data, driven entirely by the Chinese-English bilinguals, who were slower to name pictures in English than either the English-Spanish bilinguals \((t = 7.78, p < .001)\) for the Chinese-English bilingual/English-Spanish bilingual liberal comparison; \(t = 7.79, p < .001\) for the Chinese-English bilingual/English-Spanish bilingual strict comparison) or the English monolinguals \((t = 7.44, p < .001)\) for the Chinese-English bilingual/English monolingual liberal estimate comparison; \(t = 7.55, p < .001\) for the Chinese-English bilingual/English monolingual strict estimate comparison). The difference in naming latencies between English-Spanish bilinguals and English monolinguals was not significant \((t = 0.26, p = .97)\) for the liberal estimate, \(t = 0.16, p = .99\) for the strict estimate).

**Discussion.** It is unsurprising that the Chinese-English bilinguals were both slower and less accurate to name pictures in English, since English was the second language for all of these participants. Unlike previous studies (Gollan et al., 2005), however, no bilingual disadvantage was found for naming pictures in the bilinguals’ dominant language. This was a surprising result, but it suggests that not all bilingual groups may be disadvantaged in the same way as the bilinguals tested by Gollan et al. 2005.
Dutch Lexical Decision Task

For a review of the Dutch lexical decision task procedure, please refer back to page 33.

In order to determine if the time elapsed between the two tests of Dutch lexical decision was significantly different between participant groups, a one-way ANOVA was conducted using language group as the independent variable and the number of days between Session 2 and Session 3 as the dependent variable. The English monolinguals averaged 25.07 days ($SE = 2.00$ days) between sessions, the English-Spanish bilinguals averaged 28.54 days ($SE = 3.73$ days) between sessions, and the Chinese-English bilinguals averaged 20.92 days ($SE = 1.50$ days) between sessions. The analysis revealed no significant difference between groups ($F = 2.03, p = .15$) in the number of days between sessions. An additional one-way ANOVA was conducted using language group as the independent variable and the number of participants who returned (represented as 0s and 1s) as a dependent variable. The descriptive statistics revealed that 71.43% of English monolinguals returned for Session 3, 59.09% of English-Spanish bilinguals returned, and 63.16% of Chinese-English bilinguals returned. The analysis revealed that the difference in the number of participants who returned for Session 3 did not differ significantly between the language groups ($F = 0.36, p = .70$).

In the first test of Dutch lexical decision, 84.3% of the trials from English monolinguals were scored as correct, 89.0% of the trials from English-Spanish bilinguals were scored as correct, and 80.4% of the trials from the Chinese-English bilinguals were score as correct. Only these trials were included for the RT analyses. Additionally, 12.1% of trials from English monolinguals, 7.2% of trials from English-Spanish bilinguals, and 16.1% of trials from Chinese-English bilinguals were scored as incorrect. An additional 0.6% of the trials from English monolinguals, 0.6% of the trials from English-Spanish bilinguals, and
0.5% of Chinese-English bilinguals fell outside of a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds). And finally, 3.0% of the data from English monolinguals, 3.2% of the data from English-Spanish bilinguals, and 3.0% of the data from Chinese-English bilinguals fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials or for NO trials. All trials not regarded as correct were counted as errors in accuracy analyses.

In the second test of Dutch lexical decision, 65.0% of the trials from English monolinguals, 75.7% of the trials from English-Spanish bilinguals, and 66.3% of trials from Chinese-English bilinguals were scored as correct, and again these trials were the only trials included for the RT analyses. Additionally, 29.6% of trials from English monolinguals, 18.4% of trials from English-Spanish bilinguals, and 28.1% of trials from Chinese-English bilinguals were scored as incorrect. An additional 0.5% of the trials from English monolinguals, 0.5% of the trials from English-Spanish bilinguals, and 2.1% of trials from Chinese-English bilinguals fell outside of a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds). And finally, 5.0% of the data from English monolinguals, 5.3% of the data from English-Spanish bilinguals, and 3.5% of the data from Chinese-English bilinguals fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials or for NO trials. Again, all trials not regarded as correct were counted as errors in accuracy analyses.

*Dutch lexical decision all group comparison: Time 1 accuracy.* Accuracy data from all three participant groups at the first test of Dutch lexical decision in Session 2 are presented in Figures 4.8 and 4.9.
Figure 4.8. Mean accuracy performance for all three groups on the first test of Dutch lexical decision for YES trials.

Figure 4.9. Mean accuracy performance for all three groups at the first test of Dutch lexical decision for NO trials.
Separate $3 \times 3$ (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second factor, were carried out for YES and NO trials for the accuracy data. For both the YES and NO trials, the ANOVA revealed a main effect of word type (for YES trials, $F = 44.66, p < .001$; for NO trials, $F = 137.68, p < .001$). Only for the NO trials, however, was there a main effect of language group (for YES trials, $F = 0.93, p = .40$; for NO trials, $F = 22.00, p < .001$). Post-hoc tests revealed that this difference was driven by the Chinese-English bilinguals demonstrated slower performance than either the English-Spanish bilinguals ($t = 6.49, p < .001$) or the English monolinguals ($t = 4.60, p < .001$). No significant differences between the English-Spanish bilingual group and the English monolingual group were observed ($t = 1.89, p = .19$). There were also no word type × language group interactions, either for YES trials ($F = 2.00, p = .10$) or for NO trials, ($F = 1.41, p = .24$).

Follow-up pairwise comparisons with the Bonferroni correction (setting alpha at .017) were performed separately for YES trials and NO trials to determine which word types differed from each other. These tests revealed that all three types of YES trials were significantly different from one another (false cognates vs. cognates, $F = 35.26, p < .001$; false cognates vs. unambiguous controls, $F = 9.38, p < .01$; cognates vs. unambiguous controls, $F = 98.29, p < .001$). They also revealed that all three types of NO trials were significantly different from one another (Dutch-like nonwords vs. English lexical neighbors, $F = 100.55, p < .001$; Dutch-like nonwords vs. English semantic neighbors, $F = 52.45, p < .001$; English lexical neighbors vs. English semantic neighbors, $F = 200.51, p < .001$).
Discussion. The accuracy data from the first test of Dutch lexical decision suggest that, contrary to the initial hypothesis that bilinguals would outperform monolinguals on tests of retention, English monolinguals and English-Spanish bilinguals performed similarly, while the Chinese-English bilinguals exhibited less accurate performance for all word types. As observed for the English monolinguals, both bilingual groups were most accurate for the cognates and least accurate for the unambiguous controls in the YES trials, and most accurate for English semantic neighbors and least accurate for the English lexical neighbors in the NO trials, suggesting that language experience in recognition tests in short-term retention provide bilinguals with no advantage or disadvantage, as long as the new language was learned via the L1. These results suggest that the only advantage in accuracy performance in foreign-language learning comes from learning the unfamiliar language via one’s native language, completely independent of language-learning experience.

Dutch lexical decision all group comparison: Time 1 RT. RT data from all three participant groups at the first test of Dutch lexical decision in Session 2 are presented in Figures 4.10 and 4.11.
Figure 4.10. Mean RT performance for all three groups for the first test of Dutch lexical decision for YES trials.

Figure 4.11. Mean RT performance for all three groups for the first test of Dutch lexical decision for NO trials.

Separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second factor, were carried out for YES and
For both the YES and NO trials, the ANOVA revealed a main effect of word type (for YES trials, $F = 28.42, p < .001$; for NO trials, $F = 8.56, p < .001$). Again, only for the NO trials was there a main effect of language group (for YES trials, $F = .97, p = .39$; for NO trials, $F = 7.68, p < .01$). Post-hoc tests revealed that this difference was driven by the Chinese-English bilinguals, who demonstrated slower performance than either the English-Spanish bilinguals ($t = 3.73, p < .01$) or the English monolinguals ($t = 3.01, p < .05$). No significant differences between the English-Spanish bilingual group and the English monolingual group were observed ($t = 0.70, p = .19$). There were also no word type \times language group interactions, either for YES trials ($F = 0.79, p = .53$) or for NO trials, ($F = 2.16, p = .08$), although the interaction for NO trials was marginally significant.

Follow-up pairwise comparisons with the Bonferroni correction (setting alpha at .017) were performed separately for YES trials and NO trials to determine which word types differed from each other. These tests revealed that, for the YES trials, the cognates were significantly faster than both the false cognates ($F = 38.68, p < .001$) and the unambiguous controls ($F = 43.37, p < .001$). The false cognates and unambiguous controls, however, were not significantly different from each other ($F = 0.70, p = .41$). The follow-up tests also revealed that, for the NO trials, the English lexical neighbors were significantly slower than both the Dutch-like nonwords ($F = 8.52, p < .01$) and the English semantic neighbors ($F = 12.17, p < .01$). The Dutch-like nonwords and the English semantic neighbors were not significantly different from each other ($F = 2.40, p = .13$).

**Discussion.** The results from the RT analyses from the first test of Dutch lexical decision suggest that, for all groups, regardless of language experience, cognates are easier to respond to than either false cognates or unambiguous controls; and English lexical neighbors are more difficult than either Dutch-like nonwords or English semantic neighbors. Like the
accuracy results, data from the RT analyses suggest that there is no bilingual advantage in speed of response for short-term tests of retention in foreign-vocabulary learning. Again, what seems to matter most is that the unfamiliar language was learned via the participants’ native language.

It is also interesting to note that, although the effect did not quite reach significance, the Chinese-English bilinguals seem to experience less interference from the English lexical neighbors than either the English-Spanish bilinguals or the English monolinguals. This could be because L2 interference is not as powerful as L1 interference (e.g., Ehri & Bouchard-Ryan, 1980; Meuter & Allport, 1999), and consequently the Chinese-English bilinguals were better able to ignore distractors from their non-native language. There is also the issue of script-differences, because Chinese-English bilinguals are learning a new language that shares a script with their second language, but not their first. Looking at Figure 4.10, it appears that the Chinese-English bilinguals responded to all NO trials at approximately the same speed, regardless of word type, whereas both native-English groups were slightly slower for English lexical neighbors and slightly faster for English semantic neighbors. The heavy exposure of these two groups to a language that shared a script with the new language may have advantaged them for the English semantic neighbors and disadvantaged them for the English lexical neighbors, whereas the Chinese-English bilinguals remained relatively constant. Again, the addition of a Spanish-English bilingual group would help to disentangle these two possibilities.

*Dutch lexical decision all group comparison: Time 2 accuracy.* Accuracy data from all three participant groups at the second test of Dutch lexical decision are presented in Figures 4.12 and 4.13.
Figure 4.12. Mean accuracy performance by all three groups for YES trials on the second test of Dutch lexical decision.

Figure 4.13. Mean accuracy performance by all three groups for NO trials on the second test of Dutch lexical decision.

Separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second factor, were carried out for YES and
NO trials for the accuracy data. For both the YES and NO trials, the ANOVA revealed a main effect of word type (for YES trials, $F = 45.70, p < .001$; for NO trials, $F = 11.93, p < .001$) and a main effect of language group (for YES trials, $F = 3.57, p < .05$; for NO trials, $F = 9.84, p < .001$). Post-hoc tests revealed that, for YES trials, none of the three language group comparisons reached significance, despite the main effect of language group. Two of the three comparisons, however, were marginally significant: the English monolingual group was less accurate than both the English-Spanish bilingual group ($t = 2.32, p = .07$) and the Chinese-English bilingual group ($t = 2.23, p = .08$). For post-hoc tests on the NO trials, the Chinese-English bilingual group was less accurate than both the English-Spanish bilingual group ($t = 4.39, p < .001$) and the English monolingual group ($t = 2.92, p < .05$). There was not a significant word type × language group interaction for either the YES trials ($F = 1.82, p = .13$) or the NO trials ($F = 1.68, p = .16$).

Follow-up pairwise comparisons with the Bonferroni correction (setting alpha at .017) were performed separately for YES trials and NO trials to determine which word types differed from each other. These tests revealed that all three types of YES trials were significantly different from one another (false cognates were less accurate than cognates, $F = 52.28, p < .001$; unambiguous controls were responded to less accurately than false cognates, $F = 5.77, p < .05$; cognates were responded to more accurately than unambiguous controls, $F = 73.94, p < .001$). They also revealed that the English lexical neighbors were responded to significantly less accurately than both the Dutch-like nonwords ($F = 22.35, p < .001$) and English semantic neighbors ($F = 15.77, p < .001$). The difference between Dutch-like nonwords and English semantic neighbors was not significant ($F = 0.23, p = .63$).

**Discussion.** The accuracy data from the second test of Dutch lexical decision suggest that, in contrast to the first test of Dutch lexical decision that took place closer in time to the
training phase of the experiment, bilinguals, regardless of their native language were more accurate on YES trials than the English monolinguals. That is, even though the Chinese-English bilinguals had, at Time 1, less accurate performance than either the English monolinguals or the English-Spanish bilinguals, they forgot fewer words at Time 2 after an extended delay than did the English monolinguals. This difference in the number of words forgotten was large enough that at Time 2, English monolinguals demonstrated worse performance than the Chinese-English bilinguals, not just similar performance. This suggests that there is a bilingual advantage in vocabulary-learning for long-term tests of retention. That is, during the learning phase, whether the unfamiliar language is being learned via the participants’ native language or not is a better predictor of their performance (i.e., more accurate if via the L1) than whether or not they are bilingual or monolingual. However, the performance from these same participants at Time 2 suggests that, in contrast to Time 1, after a delay, the language through which the unfamiliar language was learned is now less important, and participants’ bilingual status is a better predictor of more accurate performance (i.e., more accurate if bilingual). This trend seemed to hold for all three YES trial word types (e.g., false cognates, cognates, and unambiguous controls), contradicting the prediction that English monolinguals would exhibit better performance on cognates relative to the bilinguals. However, there is a suggestion in the data here that the generally impaired accuracy performance of English monolinguals at Time 2 of Dutch lexical decision was somewhat lessened for cognates relative to false cognates and unambiguous controls. That is, forgetting was somewhat insulated for English monolinguals on the cognates, but not entirely spared.

The data from the NO trials reflects a different pattern. For the NO trials, the group with the most impaired accuracy performance relative to other groups was the Chinese-
English bilinguals. This was the same pattern in the first test of Dutch lexical decision as well, suggesting that, despite better performance by the Chinese-English bilingual group relative to English monolinguals, the Chinese-English bilingual group experienced greater interference from distractor items than did either native-English group. This was true not just for the English distractor items, but also the Dutch-like nonwords. Whether this effect was due to the bilingual group learning Dutch via their second language, or whether it was an issue of the unfamiliar language not sharing a script with their native language, is impossible to say at this point without the addition of the Spanish-English bilingual group.

*Dutch lexical decision all group comparison: Time 2 RT.* RT data from all three participant groups at the second test of Dutch lexical decision are presented in Figures 4.14 and 4.15.

![Figure 4.14](image_url)  
*Figure 4.14. Mean RT performance by all three groups for YES trials on the second test of Dutch lexical decision.*
Figure 4.15. Mean RT performance by all three groups for YES trials on the second test of Dutch lexical decision.

Separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second factor, were carried out for YES and NO trials for the RT data. For both the YES and NO trials, the ANOVA revealed a main effect of word type (for YES trials, $F = 10.84, p < .001$; for NO trials, $F = 8.02, p < .01$). Only for the NO trials, however, was there a main effect of language group (for YES trials, $F = 0.11, p = .90$; for NO trials, $F = 3.83, p < .05$). Post-hoc tests revealed that this difference was driven by the Chinese-English bilinguals exhibiting slower performance than the English monolinguals ($t = 2.69, p < .05$). No other group comparisons reached significance. There were also no significant word type × language group interactions, either for YES trials ($F = 0.24, p = .92$) or for NO trials, ($F = 0.80, p = .53$).

Follow-up pairwise comparisons with the Bonferroni correction (setting alpha at .017) were performed separately for YES trials and NO trials to determine which word types
differed from each other. These tests revealed that, for the YES trials, the cognates were significantly faster than both the false cognates \((F = 16.00, p < .001)\) and the unambiguous controls \((F = 15.37, p < .001)\). The false cognates and unambiguous controls, however, were not significantly different from each other \((F = 0.21, p = .65)\). The follow-up tests also revealed that, for the NO trials, the Dutch-like nonwords were significantly slower than both the English lexical neighbors \((F = 16.53, p < .001)\) and the English semantic neighbors \((F = 7.96, p < .01)\). However, the English lexical neighbors and the English semantic neighbors were not significantly different from each other \((F = 0.56, p = .46)\).

**Discussion.** It is important to bear in mind that a variable number of days per participant separated the most recent training phase and this second test of Dutch lexical decision, and for this reason, they may not be as meaningful as the RT results from the first test of Dutch lexical decision. Nevertheless, the results from the RT analyses from the second test of Dutch lexical decision suggest that, for all groups, regardless of language experience, cognates are easier to respond to than either false cognates or unambiguous controls. RT performance for all three groups was surprisingly similar at Time 2, given RT performance at Time 1. It appears that whatever advantages or disadvantages exist between these groups, they do not manifest themselves in speed at long-term tests of retention.

The NO trial data are more complicated than the YES trial data for Time 2. All three groups found both the English lexical and semantic neighbors more difficult to reject (i.e., exhibited slower performance) relative to Dutch-like nonwords at Time 2. Also, in contrast to the accuracy data, the Chinese-English participants exhibited at Time 2 the most impaired performance relative to the other groups. Clearly, the bilingual advantage in tests of foreign-vocabulary retention does not extend into speed of response.
After examining the data from the second test of Dutch lexical decision, it is now crucial to examine the first test to the second within a statistical analysis in order to examine whether the rate of forgetting between the groups differed, and whether such differences depended on the type of words being forgotten.

**Dutch lexical decision all group comparison: Times 1 and 2 comparison for accuracy.**

Accuracy data from all three participant groups comparing performance on the Dutch lexical decision at Time 1 (Session 2) and Time 2 (Session 3) are presented in Figures 4.16 and 4.17.

![Graph](image)

**Figure 4.16.** Mean accuracy performance on YES trials for all three groups from the first test of Dutch lexical decision to the second.
Figure 4.17. Mean accuracy performance on NO trials for all three groups from the first test of Dutch lexical decision to the second.

Separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 2 (Time 1 vs. Time 2) × 3 (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second and third factor, were carried out for YES and NO trials for the accuracy data. For the YES trials, main effects of time ($F = 76.26, p < .001$) and word type ($F = 50.41, p < .001$) were observed, with a marginally significant effect of language group ($F = 2.98, p = .06$). Additionally, a time × language group interaction ($F = 3.35, p < .05$), a time × word type interaction ($F = 10.60, p < .001$), and a word type × language group interaction ($F = 2.53, p < .05$) were observed. The three-way time × word type × language group interaction was not significant ($F = 0.69, p = .60$).

For the NO trials, main effects of time ($F = 12.11, p < .01$), word type ($F = 57.07, p < .001$), and language group ($F = 19.91, p < .001$) were observed. Post-hoc tests revealed that the main effect of language group was driven by the Chinese-English bilinguals exhibiting less accurate performance than either the English monolinguals ($t = 4.39, p < .001$) or the
English-Spanish bilinguals ($t = 6.18, p < .001$). The difference in accuracy between the English monolinguals and the English-Spanish bilinguals was not significant ($t = 2.04, p = .12$). Additionally, a time × word type interaction was observed ($F = 9.39, p < .001$). The time × language group interaction ($F = 0.96, p = .39$), the word type × language group interaction ($F = 1.76, p = .15$), and the three-way time × word type × language group interaction ($F = 1.80, p = .14$) were all non-significant.

Using a Bonferroni corrected alpha level of .017 (.05 divided by three comparisons), follow-up tests revealed that all word types for the YES trials differed in the mean accuracy level: false cognates vs. cognates ($F = 46.63, p < .001$), false cognates vs. unambiguous controls ($F = 12.40, p < .001$), and cognates vs. unambiguous controls ($F = 86.54, p < .001$). That is, cognates were the most accurate word type, followed by false cognates, followed by the unambiguous controls. Using the same Bonferroni corrected alpha level of .017, follow-up tests were again conducted for the NO trial word types. These analyses revealed that the main effect of word type for the NO trials was driven by the English lexical neighbors, which were less accurate than both the Dutch-like nonwords ($F = 65.34, p < .001$) and the English semantic neighbors ($F = 96.97, p < .001$). No mean accuracy difference was found for the Dutch-like nonwords and the English semantic neighbors was not significant ($F = 1.48, p = .23$).

*Dutch lexical decision all group comparison: Times 1 and 2 comparison for RT*. RT data from all three participant groups comparing performance on the Dutch lexical decision at Time 1 (Session 2) and Time 2 (Session 3) are presented in Figures 4.18 and 4.19.
Figure 4.18. Mean RT performance on YES trials for all three groups from the first test of Dutch lexical decision to the second.

Figure 4.19. Mean RT performance on NO trials for all three groups from the first test of Dutch lexical decision to the second.

Separate 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 2 (Time 1 vs. Time 2) × 3 (YES trials: false cognates vs. cognates vs. unambiguous controls; NO trials: Dutch-like nonwords vs. English lexical neighbors vs. English semantic neighbors) mixed-factor ANOVAs, with repeated measures on the second and third factors, were carried out for YES and NO trials for the accuracy data. For both the YES and NO trials, main effects of time (for YES trials, $F = 31.59, p < .001$; for NO trials, $F$
= 4.12, \( p < .05 \)) and of word type (for YES trials, \( F = 21.14, \ p < .001 \); for NO trials, \( F = 6.91, \ p < .01 \)) were observed. For the YES trials, no other significant main effects or interactions were present. For the NO trials, there was also a main effect of language group (\( F = 6.98, \ p < .01 \)). Post-hoc tests revealed that the main effect of language group was driven by the Chinese-English bilinguals exhibiting slower performance than both the English monolinguals (\( t = 3.35, \ p < .01 \)) and the English-Spanish bilinguals (\( t = 3.18, \ p < .01 \)). The difference in RT performance between the English monolinguals and the English-Spanish bilinguals was not significant (\( t = 0.11, \ p = .99 \)). Additionally, for the NO trials, there was also a time × word type interaction (\( F = 6.95, \ p < .01 \)). No other interactions were significant.

Using a Bonferroni corrected alpha level of .017 (.05 divided by three comparisons), follow-up tests revealed that the main effect of word type for the YES trials was driven by the cognates, which were slower than both the false cognates (\( F = 27.21, \ p < .001 \)) and the unambiguous controls (\( F = 26.14, \ p < .001 \)). The difference between the false cognates and the unambiguous controls was not significant (\( F = 0.20, \ p = .65 \)). Using the same Bonferroni correct alpha level of .017 for the NO trials, follow-up tests revealed that the main effect of word type for the NO trials was driven by the English lexical neighbors, which received slower responses than the nonwords (\( F = 18.25, \ p < .001 \)), and were marginally significantly slower than the English semantic neighbors (\( F = 5.82, \ p = .02 \)). No significant difference existed between the speed of response for the nonwords and the semantic neighbors (\( F = 1.05, \ p = .31 \)).

Discussion. The combined results from both tests of Dutch lexical decision between all three language groups clearly suggests that there exists a bilingual advantage in foreign-language vocabulary learning. This is manifest in the accuracy data, where the English monolinguals forget more words from each word type from the first test of Dutch lexical
decision to the second, though the effect is strongest for the false cognates and the unambiguous controls. In the RT data, there appears to be no evidence for a bilingual advantage, and the differences observed in these analyses are likely due to the Chinese-English bilinguals having learned their L3 via their L2 and not their L1.

It is especially surprising that both bilingual groups outperformed the English monolingual group in terms of accuracy from the first test of Dutch lexical decision to the second, both due to the different strategies adopted by the two bilingual groups during the training task, and due to the lack of a general bilingual advantage found during the tests of translation recognition. This suggests that a general bilingual advantage (i.e., one that may exist for all bilinguals, regardless of which languages they speak) may exist for long-term retention in recognition of learned vocabulary, but that a specific bilingual advantage (i.e., one that depends on the languages already learned and being learned) may exist for more immediate recognition tests.

It also seems to be the case that the Chinese-English bilinguals experience more interference from the English semantic neighbors at Time 2 of Dutch lexical decision relative to Time 1, further supporting the notion that, over time, form-similarity between the learned Dutch words and their English translations affects the Chinese-English bilinguals’ processing. This is in contrast to the Chinese-English bilinguals’ performance during translation recognition, which suggested less sensitivity to cognates than either native-English group.

It should be noted that with the current data set, it is not possible to be sure that participants did not study these words on their own time between Session 2 and 3. Many participants were scheduled for their third session after completing Session 2, so they knew they would likely be tested again. It has been suggested by Green (personal communication,
July 9, 2009) that part of this bilingual advantage in foreign-vocabulary learning may be due to self-selection. That is, bilinguals may be people who enjoy learning languages. However, if this were the case, it would be surprising to observe such similar results in the accuracy data for both the English-Spanish bilinguals (from the United States) and the Chinese-English bilinguals (from China): two groups who come from very different cultural backgrounds and likely have differed motivations for learning an L2. However, this cannot be determined in the current data set, so it is an important point to keep in mind.

Despite predictions that the English monolinguals would demonstrate enhanced performance on the cognates relative to the bilingual groups, it appears that the English monolinguals are somewhat insulated from the difficulty of learning words in an unfamiliar language for these form- and meaning-similar words, but they are by no means better than either bilingual group. If anything, both bilingual groups trend toward outperforming the English monolingual group.

These data overall suggest that for performance on a delayed test of Dutch lexical decision relative to a more immediate test of Dutch lexical decision, bilinguals were advantaged relative to monolinguals. And while cognates were the least forgotten word type for the English monolinguals, as well as the easiest to process and respond to, the monolinguals did not outperform either bilingual group. Hence, the data here provide support for the idea of a bilingual advantage in foreign-vocabulary learning for tests of long-term retention.

*English Lexical Decision Task*

For a review of the Dutch lexical decision task procedure, please refer back to page 38.
For the English-Spanish bilinguals, 96.2% of all of the trials were scored as correct, and for the Chinese-English bilinguals, 91.3% of all of the trials were scored as correct. These were the trials used to analyze RT data. For the English-Spanish bilinguals, the remaining data were either incorrect trials (1.1%), fell outside a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds—0.1%), or fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials or for NO trials (2.6%). For the Chinese-English bilinguals, the remaining data were either incorrect trials (5.7%), fell outside a pre-specified RT cut-offs (below 300 milliseconds or above 3000 milliseconds—0.2%), or fell outside 2.5 standard deviations above or below each participant’s mean RT for YES trials or for NO trials (2.7%). All trials not regarded as correct were counted as errors in accuracy analyses.

**English lexical decision all groups: Accuracy.** Accuracy data from all three participant groups for the test of English lexical decision can be found in Figure 4.19.

![Figure 4.20](image_url)

**Figure 4.20.** Mean accuracy performance for four word types in the English lexical decision task for all three language groups.
A 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 4 (unambiguous control translations vs. false cognates vs. cognates vs. false cognate translations) mixed-factor ANOVA, with repeated measures on word type, was conducted for the English lexical decision accuracy data. This analysis revealed a main effect of word type \( (F = 7.48, p < .001) \) and a main effect of language group \( (F = 4.11, p < .05) \). It also revealed a word type × language group interaction \( (F = 4.00, p < .05) \). Tukey’s HSD follow-up tests revealed that the main effect of language group was driven by the less accurate performance from the Chinese-English bilinguals, which was significantly less accurate than the English-Spanish bilinguals’ performance \( (t = 2.73, p < .05) \), and marginally significantly less accurate than the English monolinguals’ performance \( (t = 2.19, p = .08) \).

There was no significant difference between the English monolinguals and the English-Spanish bilinguals in terms of their accuracy \( (t = 0.54, p = .85) \).

Four separate one-way ANOVAs (i.e., simple effects tests) were conducted for each word type in order to determine which word type(s) were driving the word type × language group interaction. Only the ANOVAs for unambiguous control translations \( (F = 3.49, p < .05) \) and false cognates \( (F = 5.74, p < .01) \) reached significance (for cognates, \( F = 0.70, p = .50 \); for false cognate translations, \( F = 0.61, p = .55 \)). Tukey’s HSD follow-up tests revealed that, for the effect of language group for the unambiguous control translations, the only difference in accuracy performance between the groups was that the Chinese-English bilinguals were less accurate than the English-Spanish bilinguals \( (t = 2.51, p < .05) \). No other comparisons reached significance. Tukey’s HSD follow-up tests for the effect of language group for the false cognates revealed that the Chinese-English bilinguals were significantly less accurate than both the English-Spanish bilinguals \( (t = 2.93, p < .05) \) and the English monolinguals \( (t = 3.00, p < .05) \).
English lexical decision all groups: RT. RT data from all three participant groups for the test of English lexical decision can be found in Figure 4.21.

![Graph showing RT performance for four word types in the English lexical decision task for all three language groups.](image)

**Figure 4.21.** Mean RT performance for four word types in the English lexical decision task for all three language groups.

A 3 (English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 4 (unambiguous control translations vs. false cognates vs. cognates vs. false cognate translations) mixed-factor ANOVA, with repeated measures on word type, was conducted for the English lexical decision RT data. This analysis revealed a main effect of word type ($F = 6.29, p < .001$) and a main effect of language group ($F = 12.16, p < .001$). No word type × language group interaction was observed ($F = 0.39, p = .68$). Tukey’s HSD follow-up tests revealed that the main effect of language group was driven by the Chinese-English bilinguals, who were slower to respond than both the English-Spanish bilinguals ($t = 4.70, p < .001$) and the English monolinguals ($t = 3.77, p < .01$). No significant difference in RT performance was observed between the English-Spanish bilinguals and the English monolinguals ($t = 0.91, p = .64$).
To determine which word types differed from one another, follow-up Bonferroni corrected follow-up tests were conducted, setting the critical alpha level at .008 (.05 divided by six for six paired comparisons). This analysis revealed that no comparisons reached the corrected critical alpha level, but the three comparisons involved the false cognates approached significance (false cognates vs. unambiguous control translations, $F = 6.72, p = .01$; false cognates vs. cognates, $F = 7.08, p = .01$; false cognates vs. false cognate translations, $F = 6.59, p = .01$). No other comparisons reached significance.

Discussion. The results from the English lexical decision task demonstrate that, quite unsurprisingly, the Chinese-English bilinguals were less accurate and slower to make lexical decisions about words in their L2 than were English monolinguals and English-Spanish bilinguals who were making lexical decisions about words in their L1.

For the RT data, the English-Spanish bilinguals trended toward faster lexical decisions than the English monolinguals for all word types, but this difference did not reach significance. Hence, it appears that no group experienced more or less interference from their newly acquired Dutch knowledge than any other group. However, all groups had more difficulty recognizing the false cognates (e.g., accepting the letter string room as an English word, after studying room as a Dutch word meaning “cream” in English) in terms of accuracy. This was also the trend in the RT data, though this did not reach significance. This pattern was certainly not the case in either the accuracy or the RT data for the cognates, which suggests that the learning of the false cognates caused more interference than the cognates.
General Discussion

In order to summarize the findings from the experiment, discussion will be divided into sections based on the predictions made in Chapter 2.

Prediction 1: Bilinguals will outperform monolinguals in both speed and accuracy of performance on the vocabulary-learning tests.

The general prediction that bilinguals will outperform monolinguals in vocabulary learning was upheld, most strikingly for accuracy performance in the tests of long-term retention. For these tests, a general bilingual advantage was observed, in that regardless of native language, bilinguals were more accurate than monolinguals. However, in intermediate tests that occurred immediately following training, a specific bilingual advantage was observed. Here, only the bilingual group (i.e., the English-Spanish group) whose L1 was English (i.e., the language through which the Dutch words were being taught) demonstrated an advantage.

Although there has been a great deal of research within the realm of vocabulary learning, very few previous studies have compared bilingual and monolingual performance in this context. The current experiment contributed to this body of research, and replicated, to an extent, previous studies that demonstrated that bilinguals were better at learning foreign-language vocabulary than monolinguals (Kaushanskaya, 2007; Kaushanskaya & Marian, 2009; van Hell & Mahn, 1997). Additionally, this finding, in terms of accuracy performance after a delay, was extended to a new bilingual population: bilinguals learning an L3 via an L2, rather than their L1.

In this experiment, for tests of long-term retention, a general bilingual advantage was observed; that is, both bilingual groups, regardless of having English as their L1 and regardless of speaking another language that had the same script as English, outperformed
the English monolinguals. This suggests that, for tests of long-term retention, bilinguals are advantaged relative to monolinguals in their accuracy performance, no matter which languages they speak, or through which language the learned language was taught. The evidence for this type of advantage is consistent with the hypothesis that bilinguals may be advantaged in the realm of foreign-language learning due to a lifetime of experience with language-learning. However, such an explanation cannot account for all of the differences observed between groups. For example, in the RT performance, the factor that seemed to predict faster performance on tests of vocabulary learning, both for immediate and delayed tests, was native language; that is, the English monolinguals and the English-Spanish bilinguals were faster than the Chinese-English bilinguals. This is likely due to the fact that the Chinese-English bilinguals learned the Dutch words via their L2 rather than their L1, but it is also possible that it is due to the fact that the Chinese-English bilinguals were learning a language that did not share a script with their native language, which made the learning task and tests more difficult. These two possibilities may be disentangled with the addition of another bilingual group, such as a Spanish-English group, whose native language is not English, but whose native language does share a script with the language to be learned.

For immediate tests, however, a specific bilingual advantage emerged. When learning Dutch via English translations, general performance on immediate tests of learning was better if the participant’s native language was English, both in terms of accuracy and RT. However, when comparing only native-language English groups, bilinguals outperformed monolinguals, suggesting that, for immediate tests of learning, there is a specific bilingual advantage: one observes a bilingual advantage, but only if the bilinguals are learning their new L3 via their L1.
Prediction 2: This bilingual advantage in foreign-vocabulary learning will be related to bilinguals’ enhanced inhibitory control, wherein bilinguals will be faster and more accurate than monolinguals for false cognates, but slower and less accurate than monolinguals for cognates.

First, no support for enhanced inhibitory control in the bilingual groups emerged in these data. For the Simon task, which was administered to all participants, all participants exhibited the standard Simon effect (i.e., slower RTs for incongruent trials as opposed to congruent trials), this effect was approximately the same size for all three groups (although a difference in working memory did emerge between bilingual and monolingual groups, see p. 124). This lack of an effect has been found in young adult samples before (e.g., Bialystok et al., 2005), but more recent work has also demonstrated that a bilingual advantage in other tasks that tap into inhibitory control processes can be observed (Costa et al., 2008; Costa et al., 2008; Prior & MacWhinney, in press).

For an effect of bilingual enhanced inhibitory control processes to have emerged, bilinguals would have had to demonstrate faster RTs for false cognates and slower RTs for cognates relative to monolinguals. This was not the case for either the tests of translation recognition or the tests of Dutch lexical decision. All groups demonstrated the same general pattern: cognates were the fastest type of trial, while false cognates were slower than cognates, but not different from unambiguous controls. This pattern in results was generally predicted for all participant groups, which supported previous findings that suggested that cognates are both easier to learn and more likely to be remembered (de Groot & Keijzer, 2000). Indeed, cognates were faster and more accurate than unambiguous controls for all tests at all points in time. Cognates also required less study time. However, the predictions regarding the language-ambiguous stimuli were not entirely upheld because of the
performance observed on the false cognates. The false cognates were no more difficult to learn than the unambiguous controls, suggesting that there is no relative difficulty in learning false cognates.

Although no group seemed to be significantly advantaged over the other with regard to any particular word type, it should be noted that not all groups demonstrated exactly the same pattern for all word types. In fact, there is some evidence in these data to suggest that monolinguals rely more exclusively on a cognate strategy, as cognates were the only word type that the monolinguals seemed to remember at the test of long-term retention (see p. 123 for further discussion of participants’ use or lack of use of a cognate strategy). Additionally, there is a suggestion that, during the first training phase, the Chinese-English bilinguals were initially not able to take advantage of any type of cognate strategy, but later this strategy became more available.

**Prediction 3: Bilinguals will be disadvantaged relative to monolinguals when naming pictures in their dominant language.**

This prediction did not find support in these data. In the picture-naming task, English monolinguals and English-Spanish bilinguals named pictures in English equally fast. Gollan (personal communication, July 10, 2009) suggested that one possible explanation for this finding is that the pictures to be named in the picture-naming task in the current study were of higher frequency than those in prior research (Gollan et al., 2008), and that the bilingual disadvantage is only found for relatively lower frequency items. To test this hypothesis, the 60 pictures presented in the picture-naming task were divided into high- and low-frequency groups. This was done according to the same CELEX database ranges (in English frequencies per million) specified in a previous experiment that had demonstrated this effect (Gollan et al., 2008). This yielded 22 items in the low-frequency group (Gollan et al.’s low-
frequency groups also consisted of 22 items), and 25 items in the high-frequency group (Gollan et al.’s high-frequency groups consisted of 22 items). This yielded 13 items that were not included in the frequency analysis. The mean of the low-frequency items was 8.50 per million and a standard deviation of 4.52 (Gollan et al. used three lists, each with high- and low-frequency items; the low-frequency items had means of 8.1, 8.7, and 8.1 per million, with standard deviations of 5.0, 6.5, and 7.9), and the mean of the high-frequency items was 95.68 per million and a standard deviation of 74.17 (Gollan et al.’s high-frequency items had means of 125.1, 117.5, and 184.3 per million, with standard deviations of 143.1, 133.3, and 146.1). Although the current study’s higher frequency items were slightly lower in frequency on average than Gollan et al.’s high-frequency items, the lower frequency items matched more closely, and were of greater interest, since these items are where the bilingual disadvantage has been observed. The results of this analysis can be found in Table 5.1.

<table>
<thead>
<tr>
<th></th>
<th>Low Frequency</th>
<th>High Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>English monolinguals</strong></td>
<td>789.85 (131.69)</td>
<td>779.20 (153.64)</td>
</tr>
<tr>
<td><strong>English-Spanish bilinguals</strong></td>
<td>782.21 (143.46)</td>
<td>783.60 (127.80)</td>
</tr>
</tbody>
</table>

**Table 5.1.** Mean RT (standard deviation) in picture-naming for low- and high-frequency items.

A 2 (English monolinguals vs. English-Spanish bilinguals) × 2 (low-frequency vs. high-frequency) mixed-factor ANOVA, with repeated measures on frequency, revealed no main effect of frequency ($F = 0.13, p = .72$), and no language group × frequency interaction ($F = 0.23, p = .64$). Hence, no support was found for the weaker links/reduced frequency hypothesis in the picture-naming data in this experiment.

One possible explanation for the effect that disadvantages observed for bilinguals in picture-naming in their dominant language (Gollan et al., 2005; Gollan et al., 2008) is the
particular population from which these studies have sampled. The participants in these experiments have all been heritage speakers; that is, these participants are individuals who grew up in Spanish-speaking homes in the United States, but were educated in English and report English dominance. The bilinguals in the current experiment are native English speakers who grew up in English-speaking homes and learned Spanish as a second language. The lack of any effect in these data suggests that the effect that has previously been observed may be a result of dominance switching. This effect may also be influenced by other factors that may also have differed between the samples, such as the frequency of language switches and the reliability of contexts as language cues. Whatever the case may be, the data presented here suggest that bilinguals naming pictures in their native and dominant language name high- and low-frequency pictures just as quickly as monolinguals. The data also do not support a weaker links/reduced frequency account that proposes that bilinguals suffer from reduced use of both languages relative to monolinguals’ use of one language.

*Prediction 4: Monolinguals will exploit a cognate strategy, whereas bilinguals will make less use of such a strategy in order to reduce interference from false cognates.*

The data demonstrated that monolinguals did make use of a cognate strategy, in that from the very first training session until the second test of Dutch lexical decision at Time 3, they were faster and more accurate for cognates. However, the second part of the prediction did not find support: bilinguals took advantage of a cognate strategy and, depending on the test, performed as well as if not better than the English monolinguals. This was true for all tests comparing the English-Spanish bilinguals and the English monolinguals. The data from the Chinese-English bilinguals reflected this same general pattern, but, for the first training task, they appeared to not take advantage of this strategy, but by the second training task, they had adopted this same strategy as both native-English groups. Additionally, on some
tests (particularly for translation recognition), the Chinese-English bilinguals were much slower and less accurate than either of the native English groups. This is, of course, likely due to the fact that the Chinese-English bilinguals were learning Dutch words via their non-native language, or possibly also due to the fact that Dutch and Chinese (their L1) do not overlap in script. In any case, even though the Chinese-English bilinguals demonstrated less accurate performance and slower RTs on initial tests, by the second test of Dutch lexical decision at Time 3, both the Chinese-English bilinguals and the English-Spanish bilinguals were outperforming the English monolinguals in terms of accuracy, despite slower performance from the Chinese-English bilinguals.

*Other considerations*

Perhaps the most interesting observation in the training data is that all three groups approached the task of learning vocabulary in an unfamiliar language in different ways. The English-Spanish bilinguals opted to study the Dutch words next to their English translations for much longer than either the Chinese-English bilinguals or the English monolinguals. The Chinese-English bilinguals named the English translations about as fast as the English monolinguals did, but since they were naming in their L2 (and their performance during picture-naming suggests that they are slower in naming tasks in English), they were likely naming very quickly, relative to how fast they can reasonably name words in their L2. And finally, the English monolinguals fell somewhere in between the two bilingual groups: not waiting as long as the English-Spanish bilinguals to name the translation (and not studying as long), but also not naming at a rate as fast as the Chinese-English bilinguals named (relative to their naming speed capability for L2 word naming). At this point, it is difficult to determine what effect each of these strategies has on foreign-vocabulary learning, since study strategy is also confounded with language group. It may be part of the explanation for why
the English-Spanish bilinguals outperformed the English monolinguals, who outperformed the Chinese-English bilinguals during translation recognition, both in terms of accuracy and RT in general, although the patterns become less clear when dividing YES and NO trials. However, because the Chinese-English bilinguals were still performing all tasks in their L2 (to learn their L3), it cannot be distinguished which factor is responsible. It is especially interesting, then, that the retention tests for Dutch lexical decision show a very similar advantage for both bilingual groups, regardless of their study strategy or their L1. This suggests something very fundamental about bilingualism and the foreign-language learning benefit it may incur.

It is also interesting to note that both bilingual groups outperformed the English monolingual group on the O-Span task. An interesting analysis to pursue is whether the higher span English monolinguals more closely resemble the bilinguals in their foreign-vocabulary learning. In order to test this hypothesis, a median split assigned 11 English monolinguals to the lower span monolingual group (O-Span scores ranged from 30 to 45) and 10 English monolinguals to the higher span monolingual group (O-Span scores ranged from 48 to 58). These two monolingual groups were compared to the two bilingual groups in the training task and the second test of Dutch lexical decision (for this task, both accuracy and RT analyses). The results of these two analyses can be found in Figures 5.1, 5.2, and 5.3.
Figure 5.1. Mean naming latencies during each of the three training tasks, with the English monolingual group split into those with higher O-Span and those with lower O-Span.

Figure 5.2. Mean percentage correct for YES trials on the second test of Dutch lexical decision (Session 3, Time 2), with the English monolingual group split into those with higher O-Span and those with lower O-Span.
Figure 5.3. Mean RT for YES trials on the second test of Dutch lexical decision (Session 3, Time 2), with the English monolingual group split into those with higher O-Span and those with lower O-Span.

For the training task, a 4 (high-span English monolinguals vs. low-span English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (Time 1 vs. Time 2 vs. Time 3) × 3 (false cognates vs. cognates vs. unambiguous controls) mixed-factor ANOVA, with repeated measures on the second and third factors, was conducted.

Unsurprisingly, this analysis revealed main effects of time ($F = 25.73, p < .001$), word type ($F = 39.83, p < .001$), and language group ($F = 6.43, p < .01$), as well as a word type × language group interaction ($F = 6.02, p < .01$), and a three-way time × word type × language group interaction ($F = 2.59, p < .01$). However, Tukey’s HSD follow-up tests revealed that the high- and low-span English monolinguals did not differ significantly from one another ($t = 0.52, p = .96$). It does appear that the low-span English monolinguals do not study as long as high-span English monolinguals, particularly during the initial training phase. Indeed, a 2 (high-span English monolinguals vs. low-span English monolinguals) × 3 (Time 1 vs. Time 2 vs. Time 3) × 3 (false cognates vs. cognates vs. unambiguous controls)
mixed-factor ANOVA (ignoring both bilingual groups), with repeated measures on the second and third factors, revealed a word type × language group interaction. This pattern in the high-span English monolinguals more closely resembles that of the English-Spanish bilinguals. This suggests that English monolinguals with a higher working memory span may fundamentally differ from English monolinguals with a lower working memory span in the context of language learning. Specifically, higher-span monolinguals may demonstrate more “bilingual-like” strategies when studying foreign-vocabulary words.

For the accuracy data on the second test of Dutch lexical decision (administered during Session 3), a 4 (high-span English monolinguals vs. low-span English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (false cognates vs. cognates vs. unambiguous controls) mixed-factor ANOVA, with repeated measures on word type, was conducted. This revealed a main effect of word type ($F = 33.47, p < .001$) and a word type × language group interaction ($F = 2.89, p < .05$), as well as a marginally significant effect of language group ($F = 2.44, p = .08$). A follow-up 2 (high-span English monolinguals vs. low-span English monolinguals) × 3 (false cognates vs. cognates vs. unambiguous controls) mixed-factor ANOVA, with repeated measures on word type, also revealed a main effect of word type ($F = 31.59, p < .001$), but not main effect of language group ($F = 0.27, p = .61$). It did, however, reveal a word type × language group interaction ($F = 4.78, p < .05$).

The data here suggest that the low-span English monolinguals are more likely to adopt a cognate strategy that allows them to have more accurate performance for cognates, but impairs their performance on the false cognates. The high-span English monolinguals, however, demonstrated a pattern much more similar to that of the two bilingual groups. However, though the pattern is similar, the high-span English monolingual are not as
accurate as either bilingual group. This pattern is reminiscent of the Kroll et al., (2002) study, in which low-span learners were faster to translate cognates than high-span learners, but slower to translate noncognates than high-span learners. Though those data consist of RTs, the pattern is strikingly similar. This suggests that, as was predicted in Chapter 2, English monolinguals do adopt a strategy that enables them to be very accurate for cognates, but much less accurate than false cognates, but this is only true for English monolinguals with lower working memory span.

Finally, a 4 (high-span English monolinguals vs. low-span English monolinguals vs. English-Spanish bilinguals vs. Chinese-English bilinguals) × 3 (false cognates vs. cognates vs. unambiguous controls) mixed-factor ANOVA, with repeated measures on word type, was conducted for the RT data from the second test of Dutch lexical decision (during Session 3). This analysis revealed a main effect of word type ($F = 101.4, p < .001$), but no main effect of language group and no word type × language group interaction. Hence, unlike the Kroll et al. (2002) data and the accuracy data for this task, the low-span English monolinguals were not faster to recognize cognates than the high-span English monolinguals. This may be due to these particular items not being learned well enough to produce this pattern, since the same analysis for RT performance at the first test of Dutch lexical decision also revealed the same pattern (i.e., the low-span English monolinguals were slower than the high-span English monolinguals for all word types).

**Summary of findings**

The data here suggest that there is a bilingual advantage in vocabulary learning, and that this advantage exists for bilinguals who have learned an L3 via their native language, and for bilinguals who have learned an L3 via their non-native language. However, this general bilingual advantage exists only for accuracy (i.e., memory) during tests of long-term
retention, and not in speed of retrieval or for immediate tests. Evidence for a specific bilingual advantage was also found: bilinguals who learn an L3 via their L1 are generally faster and more accurate during immediate tests. However, this effect depends on a variety of factors about the test trials (e.g., whether the trial demands a YES or NO response), and is stronger for a second test rather than the initial test following a single study phase. Cognates are easiest for both bilinguals and monolinguals to learn relative to unambiguous controls, and false cognates are more difficult than cognates to learn for both bilinguals and monolinguals, although no more difficult than unambiguous controls. English monolinguals, though they are less likely to remember newly acquired words in an unfamiliar language than bilinguals, are somewhat more likely to remember cognates than either false cognates or unambiguous controls, but not as likely as bilinguals. Some of these differences between groups may be due to working memory, as further analyses revealed that English monolinguals with higher working memory span demonstrated patterns more similar to the bilinguals than to the low-span monolinguals (i.e., less likely to adopt a cognate strategy that would leave them susceptible to interference from false cognates), although this working memory account does not appear to be the whole story, since neither the low- nor the high-span English monolingual group performed as well as either bilingual group during a test of long-term retention. For the high-span English monolinguals, who had demonstrated more “bilingual-like” performance during the training phase, their accuracy performance for the retention test was more similar to the two bilingual groups’ performance, but their performance on both language-ambiguous word types (i.e., false cognates and cognates) was less accurate. This replicates previous research (Kaushanskaya, 2007; Kaushanskaya & Marian, 2009; Kaushanskaya, van Hecke, & Hinrichsen, 2009) to some extent, demonstrating
that working memory is certainly related to the bilingual advantage observed in foreign-language learning.

Future directions

This experiment raises several questions that should be addressed by future research. One that has been mentioned throughout the document is to determine whether some of the differences observed between the two bilingual groups reported here are due to one group having English as a second language rather than a native language (and then learning Dutch words via English), or whether this is something specific to having Chinese (a language with a very different script from either English or Dutch) as a native language. The addition of a Spanish-English bilingual group would allow these two possibilities to be teased apart, and hopefully this group will be added in the near future. Due to geographical constraints, however, collecting data from this particular group in this particular region of the United States such that it is matched to the three groups for which data have already been collected may be a challenge. Hence, data from this group may need to be collected at another university in another region of the country or the world.

Another interesting question that can be asked is how general this advantaged language-learning mechanism is, and whether an advantage of language-learning should be considered a cognitive consequence of bilingualism. To date, foreign-language learning has not yet entered the discourse of the cognitive consequences of bilingualism. However, the data here suggest that there exists a general bilingual advantage in vocabulary learning that is independent of particular language combinations. That said, what is not yet known is which particular characteristics of bilinguals cause such advantages. Previous research (Luk, 2008) has suggested not all bilinguals demonstrate advantages over monolinguals, but that high proficiency in English (which was may have been the dominant or non-dominant language
for these participants) and the balanced use of a bilingual’s two languages predict bilingual advantages in executive function. However, data from the current experiment suggest that a bilingual advantage in vocabulary retention may exist for different types of bilinguals, regardless of their proficiency in English. The current experiment did not collect data on multiple language use, and so this hypothesis cannot be further explored using the current sample.

If the language-learning mechanism that appears to be enhanced for bilinguals but not for monolinguals is, indeed, a general cognitive consequence that is independent of language combinations, then one interesting follow-up to consider is teaching a language that differs dramatically from a bilingual’s L1 or L2. In the current experiment, the Chinese-English bilinguals were learning an L3 that was very different from their L1, but not from their L2. A follow-up experiment that is currently being designed is to teach American Sign Language (ASL) vocabulary to English-Spanish bilinguals and English monolinguals. ASL is a language that differs in modality, since it employs the use of the hands rather than the vocal tract in order to communicate. The purpose of doing such a follow-up would allow for the exploration of how general the language-learning mechanism is that appears to be enhanced in bilingual populations. If English-Spanish bilinguals still outperform English monolinguals when learning ASL, which is a language that not only be unfamiliar to both groups, but would also employ a modality that would be linguistically completely foreign to both groups, then the generality of this language-learning mechanism and advantage may be further confirmed.

A further experiment is planned, inspired by the results of the current experiment together with previous work done by McLaughlin, Osterhout, and Kim (2004). What McLaughlin et al. found was that classroom learners of a second language demonstrated
neural activity that indicated language-learning before behavioral measures registered that any learning had taken place. Other studies have found that certain aspects of L2 knowledge may be known implicitly, and can be detected via brain activity measures but not behaviorally (Tokowicz & MacWhinney, 2005). What this follow-up proposes is to teach bilinguals and monolinguals an unfamiliar language and measure the electrical activity in their brains using event-related potentials, as McLaughlin et al., 2004 did with monolinguals. While the scope of the project has yet to be determined, the interest question that this follow-up study can address is whether the implicit learning (i.e., activation in the brain) that seems to come online in learners’ brains before explicit learning (i.e., behavioral measures) is similar, both in time course and in activation patterns, for both bilinguals and monolinguals. If the factor that drives the bilingual advantage in foreign-language learning has to do with enhanced metalinguistic awareness in bilinguals, then one would predict to see no significant differences in implicit learning (i.e., time course and activation patterns) between bilinguals and monolinguals. However, it is also possible that there may be something about keeping a language-learning mechanism “alive” that would manifest an advantage in implicit learning for bilinguals over monolinguals. Or, it is possible that differences in implicit language-learning may have more to do with strategy or other characteristics of particular bilinguals (e.g., particular language pairs and their similarity to the language being taught, how balanced bilinguals are, how often they switch languages, how early or late they learned their L2, etc.) that may affect implicit learning in ways that are similar or different to the ways they may affect explicit learning. That is, it is possible that there may be a general bilingual advantage in explicit learning, but a specific bilingual advantage in implicit learning. Such a study would, then, not only add to the literature on the cognitive consequences of bilingualism, but would also add to the literature on general language-learning.
Conclusions

The data from the current experiment suggest that there is a bilingual advantage in foreign-language learning. The evidence suggests that this advantage may extend to all bilinguals, regardless of their particular language pairs, and independent of the language through which the unfamiliar language is taught. These data strongly support the idea that this advantage in foreign-language learning should be added to the repertoire of the cognitive consequences of bilingualism. Additionally, within the current experiment, no evidence was found for a bilingual disadvantage, even for a similar paradigm that had previously been associated with a bilingual disadvantage (i.e., picture naming in one’s dominant language). Hence, although the experiment began with the motivation to better understand an apparent paradox, no evidence was found for such a paradox. In fact, only evidence for advantages were found. It should be noted that such results do not necessarily support the idea that no disadvantages exist for bilinguals at all. This is almost certainly not the case. Many costs associated with bilingualism are in tasks under circumstances that put multiple languages in competition with one another (e.g., Meuter & Allport, 1999). Hence, the very same samples in this study likely would exhibit some disadvantages in other, untested tasks as a result of the very mechanisms that provided such an advantage in the tasks of language-learning. One possible hint of such a disadvantage or cost for these advantaged bilinguals comes from the English-Spanish bilinguals, who were often the fastest and most accurate group for all word types. They were much, much slower than the other two groups during training at Time 1, Time 2, and Time 2. Is this a “cost” of a greater language-learning ability? Should such data be considered evidence in support of a specific bilingual disadvantage for native English bilinguals in this study? The issue is complicated, and not one likely to be resolved very soon. However, it does seem to be the case that for this particular set of tasks, the cost of
knowing multiple languages, particularly when learning the new language via one’s native language, was relatively minimal.

These data suggest that the observed general bilingual advantage in retention of language-learning could likely be extended to other bilingual populations, regardless of which languages they may know. This may be due to the continued use of a language-learning mechanism that has not been actively maintained in monolingual populations. The data further suggest that learning a new language will be easiest for those who have learned a language before. Within that population of bilinguals, however, those bilinguals learning a new language are predicted to have greater success if they learn this new language via their native language. This suggests that bilinguals with a common native language but different L2s will learn an unfamiliar language equally well if that language is taught via their native language. In addition to the particular type of bilingual, additional factors that may interact with these various groups are how the new language is taught and when the tests are taken. Further investigation will either confirm or disconfirm such hypotheses and interactions of groups, teaching, and time of testing. However, the results of the current study are highly suggestive of an advantage within the realm bilingual cognitive consequences, and provide ample future possibilities for continued research.
References


