Chapter 2. Acquiring second language vocabulary through the use of images and words

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CHAPTER 2

Acquiring second language vocabulary through the use of images and words

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Two experiments explored the relative benefits of learning vocabulary in a second language by varying the learning formats both within and between participants. English monolingual speakers were taught vocabulary words in Spanish by pairing those words with their English translations, black-and-white pictures, or color pictures. Testing of those newly acquired words occurred via the use of a Lexical Decision Task (LDT) wherein participants were shown letter strings and were asked to identify them as either real words or nonwords in English (i.e., a word priming procedure). Letter strings were paired with either their correct Spanish translations or an unrelated Spanish word. In Experiment 1, all three learning conditions produced significant priming effects indicating that all the methods used to teach these words yielded similar success in their retrieval. Additionally, the black-and-white picture condition speeded up responses, as compared to the color picture condition. Experiment 2 presented the three learning conditions within subjects and revealed significant priming in the word-word condition and the black-and-white image condition. However, response times were significantly faster in the word-word condition overall supporting the notion of transfer appropriate processing. Results are discussed with regards to this theory of processing.

Introduction

One of the many challenges teachers of a second language (L2) face is devising methods that can efficiently and effectively assist a learner in acquiring knowledge of a new language. Additionally, learning an L2 poses even greater challenges to students with learning disabilities and those with less-developed native language abilities (e.g., see Ganschow, Sparks & Schneider 1995; Krug, Shafer, Dardick, Magalis & Parenté 2002). Yet, to date, there is no preferred “best practice” or common set of best methods for teaching an L2. Perhaps it is unrealistic to expect that
a single method will render an optimal situation for learning an L2 by an individual who already knows a given language or languages. This may not be a case of “one size fits all.” Rather, the key to successfully devising a means through which a new language or symbol set is acquired is to first understand the levels at which a given language is processed. How those levels operate independently or interact, and the ways in which those levels might best be acquired, developmentally, would also be important points of inquiry. For example, if methods emphasize the semantic or meaning-based attributes of a new language over form, at first, would they necessarily lead to, say, stronger conversational skills? Or, if methods emphasize the physical nature of a language that perhaps is not phonetic, one that has no clear grapheme to phoneme correspondence (e.g., Mandarin Chinese), would memorization of forms be the best route towards the actual learning of a language?

Thus, the question still remains as to how best to teach an L2 and what tool or tools are most effective given factors such as the nature of the learner’s base language, its relationship to the “new” L2, the learner’s age and developmental attributes, and the like. The current paper represents an effort at distinguishing whether the format through which L2 words are acquired affects the ways in which a learner performs in that language (see Barcroft, Sommers & Sunderman; Sunderman; and Williams & Cheung, this volume, for studies on L2 vocabulary learning). This aim is accomplished by using assessment tasks that capture the automatic access and automatic processing of the newly learned information. Here automatic is defined as occurring without conscious intent or attention and without using conscious processing capacity (automatic processing is further discussed later in this chapter).

There are multiple different sources of information which learners must come to recognize and master, in order to develop a working and eventually fluent L2 vocabulary. Language can be divided in two separate parts focusing on lexical information and semantic information. Lexical information includes the specific characteristics of the words in a given language, and involves phonology, morphology, and orthography (Hunt & Ellis 2004). Phonology is concerned with the rules of pronunciation and the basic sounds that are included in a given language. These basic sounds are known as phonemes. A phoneme is the smallest sound unit that can be changed in a word and still have an impact on the definition of a word. For example, if the phoneme /b/ in big were changed to a /d/, the new word dig would have an entirely different meaning and connotation from big. Morphemes are the primary interest when studying morphology. They are the smallest meaningful units of a language and are common chunks of sound that are associated with specific meanings and that are used to form words. Morphemes are general root words (e.g., aud- = sound, as in auditory, audible, audio, etc.),
prefixes (e.g., pre- = before, as in precede, predict, pregame, etc.), or suffixes (e.g., -logy = study field of, as in biology, psychology, cardiology, etc.). Orthographic information focuses on the structure of written or printed words. Here the shape of the letters and the physical structure of words are emphasized.

When considering semantic information, the focus shifts from the characteristics of a given word itself to the concept that word is intended to represent. Semantic information includes the definition of a word and its common associations (Hunt & Ellis 2004). For example, semantic information for the word *mouse* may include the definition “a furry, four-legged animal” and have associations with *cheese* as well as *cat*. Typically, L2 learners focus on making direct connections between the lexical information of the new L2 and the lexical information of the previously mastered first language (L1), for example, linking the word *cat* in English to the Spanish word *gato*. Meaning and semantic information is initially only indirectly connected with the L2, through the L1. Thus, L2 learners have to translate from L2 to L1 to determine the semantic content of a given L2 word. With continued usage and study, L2 lexical information will eventually create direct connections with semantic information, and translating from L2 to L1 will be unnecessary to determine meaning (Kroll & Stewart 1994; but see Altarriba & Mathis 1997; Sunderman; and Williams & Cheung, this volume, for an additional discussion).

Methods of learning vocabulary in a new language have included such mnemonics as the key word system wherein a given word, for example the word *vaca* in Spanish (i.e., cow) is linked to an image of a cow using a vacuum cleaner. Images are generated by the learners themselves and not provided by experimenters. Accessing the image thereafter provides a retrieval cue – namely, the word vacuum – that should lead the learner back to the word *vaca* when trying to recall the translation for the word cow (Hunt & Ellis 2004). Various researchers have demonstrated the success of this method over the use of other rehearsal strategies across a wide range of experiments (McDaniel & Tillman 1987; Pressley, Levin, Hall, Miller & Berry 1980; Pressley, Levin, Kuiper, Bryant & Michener 1982; but see Barcroft et al., this volume, for evidence against the effectiveness of the key word method). This mnemonic method, which relies on establishing lexical connections between L1 and L2 words, outperformed the synonym method (where participants were instructed to think of synonyms of the to-be-remembered word), the self-referent method (where participants imagine themselves interacting with the to-be-remembered word), the context method (where meaningful semantic information is provided by the context surrounding the to-be-remembered word), and others. However, it has been noted within some of these studies and elsewhere (e.g., Altarriba & Mathis 1997; Dagenbach, Carr & Barnhardt 1990) that methods that induce a deep or elaborated level of semantic processing,
in some way, are apt to lead to the stronger encoding of new words and more durable, longer-lasting memory traces (à la Craik & Lockhart’s 1972 levels of processing). Thus, an emphasis on meaning, when learning a new language, seems to contribute to conceptual learning and processing. This factor can potentially lead to better overall memory for the newly acquired language.

Altarriba and Mathis (1997) trained English-speaking monolinguals on a series of Spanish words. Participants viewed the English words and their translations on a computer screen and heard the pronunciation of the word pairs aloud. To test the acquired knowledge of these new words, various quizzes were given that required matching words to definitions or using those words to complete sentence frames. Participants were also required to write the newly acquired Spanish words, as they completed some of those quizzes. Subsequent testing required either a color-naming response (e.g., Stroop tasks, where participants have to attempt to ignore the meaning of a presented word and report the color of the ink the word is printed in) or speeded recognition where participants determine as quickly and accurately as possible if the correct translation pairings or incorrect pairings of words have been presented. After a single learning session, the above methods led to the acquisition of both the semantic/conceptual as well as lexical/orthographic features of those words. Thus, for those participants, in that instance of learning, tasks that emphasized both the meaning and the form of the new words contributed to successful learning of those pairs. The above procedures have subsequently been used to assist new learners in successfully acquiring knowledge of different word types in Spanish including concrete, abstract, and emotion words (Altarriba & Basnight-Brown 2010) as well as other language vocabulary (see e.g., Ferré, Sánchez-Casas & García 2001). Thus, emphasizing semantic features of new words, as well as their phonological and orthographic features, appears to aid in language learning, as researchers have recently argued that “not all features of a second language [L2] can be learned when learners’ attention is focused exclusively on meaning” (Wong 2002:236).

That said, after a review of the various methods of teaching L2 vocabulary and data related to those methods over the past few decades, one can conclude that there are three main attributes that contribute to overall efficient learning of L2 vocabulary: attention; imagery; and the linking of information one wants to learn to information one already knows. Attention is important for learning new information, as unattended information is less likely to influence conscious processing and be stored for later use. Imagery has generally been associated with improved retention of information. For example, concrete words which are easily linked with an image, such as *dog*, typically exhibit higher rates of recognition and recall than abstract words which are not easily linked with an image, such as *justice* (Altarriba & Bauer 2004). Finally, linking new information to previously stored
information (e.g., elaborative rehearsal) increases the likelihood that the new information will be associated with the stored information, thus improving the chances of retention. In the current set of studies, all three of these attributes are incorporated into a method of learning that also explores the role of the format of learning words in a new language, as linked to a language that is already known (Bradshaw & Anderson 1982). The “format” in this case will focus on three main conditions of learning – word-word pairings; black-and-white picture and word pairings; and color picture and word pairings. While the previously mentioned literature on language learning has focused on word features, semantics and the formation of images, none has used actual pictures or images within their learning conditions in an empirical investigation. Ortuño (1994) makes a case for the use of slides or reproductions of Spanish paintings to promote cultural awareness and cultural learning as a backdrop to the learning of a new language, but this work was not empirical in nature. To our knowledge, fewer than a handful of dated studies have included an image/picture condition as a learning condition specifically in the study of foreign language learning (e.g., Deno 1968; Dilley & Paivio 1968; Kroll, Michael & Sankaranarayanan, 1998; Webber 1978; Yarmey & Paivio 1965; see Williams & Cheung, this volume, for a rare exception).

For example, Webber (1978) hypothesized that newly acquired words in a foreign language would be better remembered when learned in a picture condition versus a word condition. If new words are paired with pictures, they should lead to better recall overall, as compared to word-word pairings in acquisition. Participants in this study were fourth grade boys and girls whose native language was English and who had no knowledge of the Indonesian language that was used in the study. In the picture-word condition, a simple, black-and-white line drawing was paired with a corresponding Indonesian word. In the word-word condition, the correct English translation was paired with its corresponding Indonesian word. The items represented concrete nouns, and presentation conditions were manipulated between participants – that is, a participant was either in the picture-word group or in the word-word group, but not both. Pairs of items were presented on cards at a rate of one card every eight seconds. Results showed that more Indonesian words were correctly recalled in the picture-word group than in the word-word group.

As with the other works previously mentioned, it appears that paired associative learning including pairings of L2 words and their corresponding pictures may lead to an increase in overall recall of those words as compared to word-word conditions. However, these learning conditions have not been investigated using performance measures that capture the automatic access and processing of those new words. That is, suppose that responding was constrained in such a way as to examine more implicit, automatic learning of those words as captured via
reaction time tasks. Would these tasks uncover differences in learning in much the same way as free recall tasks have been reported to, in the past? Fundamentally, a theoretical question that is important to this area of research is whether or not one format of learning over another promotes the encoding of a new representation for the newly acquired word that can be activated in an automatic manner without engaging in a task that could promote the use of strategies or elaboration when responding (e.g., free recall tasks).

A commonly used paradigm in word recognition studies believed to capture cognitive processing that is fast, automatic, and that occurs without intention is the word priming paradigm (Neely 1977; Neely, Keefe & Ross 1989; see Segalowitz, Lacroix & Job, this volume, for a discussion of automaticity in L2 processing and examples of tasks tapping into automatic processing). Within a word priming task, a single word or pair of words is presented for a response. Responses are sped up or facilitated if a word pair is related, or, if a single word is related to the item that preceded it. That relationship can be semantic in nature, phonological, or orthographic (see Neely 1991; McNamara 2005; McNamara & Holbrook 2003, for reviews). A typical word priming task that has been often used in the literature is the Lexical Decision Task (LDT). In this task, participants are shown a string of letters on the center of a computer screen, and their task is to decide whether or not the string of letters forms a real word, in a particular language. For example, the word cat would receive a WORD response while the letter string blit would receive a NONWORD response, in English. Typically, individuals press one of two keys depending on the response they wish to enter, and their responses are timed. When a word such as cat is preceded by a word such as dog, responses to cat are typically sped up or facilitated relative to responding to cat when preceded by an unrelated word such as box. This facilitation in reaction time for two semantically associated words has been termed a semantic priming effect (Meyer & Schvaneveldt 1971). Findings such as these are predicted by the spreading activation model of semantic memory proposed by Collins and Loftus (1975). Their model suggests that related concepts/words such as cat and dog are stored near each other in one's semantic network. When the node for dog becomes activated in memory, activation spreads to neighboring nodes (e.g., cat) making them available for processing. Given that box and cat are unrelated to each other, they are likely also not stored near one another in memory, and therefore, activating box does not necessarily activate the word cat.

Altarriba and Basnight-Brown (2007) published a review of word priming tasks that examined priming for semantically related words and translations across a broad range of languages. Typically, priming for translations across languages is stronger than for semantically related words. For example, response time would be facilitated, or decreased, if the word cat was preceded by gato (the
Spanish word for cat), but not if *cat* was preceded by *queso* (the Spanish word for cheese). Priming for semantically related, cross-language word pairs is often stronger from the dominant to the subordinate language than the reverse (see also Basnight-Brown & Altarriba 2007 for empirical work in this area). If measuring LDT performance with participants who have English as their L1 and Spanish as a weaker L2, greater facilitation will be exhibited with *dog* as the prime and *gato* as the target than with *gato* as the prime and *dog* as the target. Thus, this body of work indicates that the word priming task can be used to uncover the degree to which individuals have made cross-language connections between words that are translations of one another (e.g., *cat-gato*) or are semantically associated words (e.g., *dog-gato*).

Previous research has indicated that the magnitude of cross language priming effects can be effectively used as a measure of how well learners acquired L2 vocabulary. Better learning and stronger L1-L2 connections correspond with a larger cross language priming effect. An investigation of priming for newly acquired translations comprises the experiments that appear below in an effort to uncover whether or not the format of acquisition/learning moderates the degree and strength of a priming effect as revealed through a LDT. Formats include the pairing of Spanish words with black-and-white pictures, color pictures, or English words. While black-and-white pictures have been shown to facilitate learning and free recall of new words over the simple use of word pairings in at least one experiment (see Webber 1978 above), to our knowledge, no study has systematically compared the learning of foreign language words using the above three formats and the same set of words as tested via a timed task. That is, at early stages of L2 acquisition, and specifically in studies that have empirically examined L2 learning in a laboratory setting, participants are usually taught either concrete words (e.g., Altarriba & Mathis 1997; Lawson & Hogben 1996; Moore & Surber 1992; Rosselli et al. 2002) or both concrete and abstract words (e.g., van Hell & Mahn 1997) by simple use of word-word pairings alone.

Color, as a characteristic feature of objects, has been shown to enhance the speed and accuracy of the naming of objects in studies of object perception (e.g., Rossion & Pourtois 2004). Rossion and Pourtois compared naming times for common objects (e.g., fruits, vegetables, animals, etc.) selected from the Snodgrass and Vanderwart (1980) norms in three formats: black-and-white line drawings, gray-scale drawings, or color. Participants were quicker and more accurate at naming objects that appeared in color as compared to those same objects that appeared in the other two formats. Surprisingly, Rossion and Pourtois also found that man-made objects (e.g., a school bus) were named faster when presented in their typical, diagnostic color (i.e., yellow, as is typically the case in North America). They suggest that color is an integral feature and a basic part
of everyday objects that are typically viewed in one’s environment. Thus, when those objects are perceived as they typically appear in the world, recognition of those objects is facilitated when they appear in their expected colors. Could color pictures facilitate the learning of corresponding words in a new language? Given that researchers have reported naming advantages for objects that appear in color (e.g., Price & Humphreys 1989; Tanaka & Presnell 1999), pictures of colored objects may enhance the learning of the names of those objects, so long as both the objects and the colors they are represented in mimic the typical features one sees when viewing these objects in the everyday world.

Experiment 1 sought to compare three different learning situations in the acquisition of new words in Spanish by native English speakers. In each learning situation, a Spanish word for a common object (e.g., clock, building) was individually paired with either a color picture of the object, a black-and-white image of the object, or the corresponding English word. Once the new Spanish word set had been fully acquired by the participant, they were then given a LDT to test for their automatic activation of the newly learned word, under constrained presentation conditions. The word priming task that they were administered contained pairings of the correct translations intermixed with unrelated word pairs, in an attempt to uncover whether or not semantic priming effects were moderated by the mode of learning. It was expected, based on the above data on the perception of colored objects, that color pictures might ultimately facilitate lexical decision responses more so than the other two learning formats, as the objects that were learned were basic, common objects that appeared in their expected colors. Overall, if all three formats lead to the effective learning of the new words, then all three conditions should produce facilitation in the semantic priming task.

Experiment 1

Method

Participants
Eighty-four students from the University at Albany, State University of New York participated in the study. The average age of the participants was 19.3. There were 48 females and 36 males. Participants received course credit in an Introductory Psychology course for completing the study. They were native English speakers with no history of Spanish language usage or education. Native or early mastery bilingual speakers were excluded from the study; however participants who had learned additional languages later in life were permitted to participate. The participants averaged approximately two languages. A large majority of the
additional languages were not fluently mastered and were acquired during adolescence in an educational setting. Listed additional languages included French, German, Italian, Latin, Chinese, and Japanese. A Language History Questionnaire (LHQ, Altarriba & Mathis 1997) was administered simply to verify that participants had no background history or knowledge in Spanish prior to the start of the study.

Materials and apparatus
Twenty Spanish words and their English translations were selected from a previous Spanish acquisition study conducted by Altarriba and Mathis (1997). All of the selected Spanish-English word pairs were concrete nouns (e.g., reloj-clock or edificio-building). Concrete nouns were selected because they tend to label specific concepts that are easily represented as images and are not easily confusable with other concrete concepts. For example, clock is a concrete noun that can easily be represented as an image, and is not easily confusable with the concept of building (which is also a concrete noun). The Spanish-English word pairs did not include cognates, as translations sharing orthographic (structural) and phonological (sound or pronunciation) characteristics were not included in the study. The Spanish-English word pairs used in this study were translations that did not share similarities in structure or pronunciation.

In the study, the word pairs were sometimes presented with images. A total of 20 black-and-white images and 20 color images were selected. Each word pair was matched with a black-and-white image and a color image. For example, the edificio-building word pair was matched with a black-and-white image of a building and a color image of a building. Black-and-white and color images were selected to maximize the similarity between the images matched with the same word pair. All matched images portrayed objects with similar features that occupied a similar space at a similar orientation. The only difference between matched images was whether they were black-and-white, or color. Appendix A presents several examples of black-and-white and color images used in this study.

The 20 Spanish-English word pairs were presented to participants during an acquisition phase and again during a testing phase. The acquisition phase involved the presentation of the 20 word pair translations using Microsoft® Office PowerPoint 2007 on a Dell Optiplex GX260 computer. The testing phase was created using E-Prime 1.1 (Schneider, Eschman & Zuccolotto 2002) and was presented on the same computer as the acquisition phase.

During the acquisition phase, participants viewed stimuli for one of the three learning conditions (word, black-and-white image, or color image). Each learning condition had a separate acquisition PowerPoint presentation. Spanish words were presented with either: English words, black-and-white images,
or color images. In the presentation for the word condition, Spanish words were presented visually with English words. In the black-and-white condition, Spanish words were presented visually with black-and-white images. Finally, in the color condition, Spanish words were presented visually with color images (see Barcroft et al.; Trofimovich & John; Williams & Cheung, this volume, for examples of alternative acquisition procedures).

During the testing phase, participants viewed the 20 Spanish words paired with either their English translations (10 critical related trials) or unrelated English words (10 critical unrelated trials). In the critical related trials, a learned Spanish word was paired with its learned English translation. The word pairs in the critical related trials were identical to the translation word pairs learned during the acquisition phase (e.g., word pairs *reloj*—*clock* and *edificio*—*building* were presented during the acquisition phase and the *reloj*—*clock* and *edificio*—*building* pairings were presented during the testing phase). In total, there were 10 critical related trials where Spanish words were paired with their learned English translations.

In the critical unrelated trials, a learned Spanish word was paired with an English word that was not its learned translation. Within the critical unrelated trials, the word pairings were different from the word pair learned during the acquisition phase (e.g., *reloj*—*clock* and *edificio*—*building* were viewed during the acquisition phase, but *reloj*—*building* and *edificio*—*clock* were presented during the testing phase). In other words, the original translations were re-paired in order to form the critical unrelated word pairs. Further, Spanish and English words that were in any way related were not used as critical unrelated trials (e.g., *queso*—*mouse* would not be permitted as a critical unrelated trial because *queso* translates to *cheese* which is associated to *mouse*). In total, 10 critical unrelated trials were created, where Spanish words were paired with unrelated English words (which again were translations of other Spanish words learned during the acquisition phase).

The experimental lists also contained 60 additional trials (for a total of 80 trials), including 30 unrelated trials and 30 nonword trials. The unrelated trials were incorporated in the experimental lists to keep participants from guessing the nature and purpose of the study. Unrelated trials contained Spanish and English words that were not viewed during the acquisition phase. Furthermore, the word pairings in the unrelated trials were not accurate translations. The nonword trials contained Spanish words paired with English nonwords. The Spanish words and English nonwords used in the nonword trials were not viewed during the acquisition phase. The nonwords were created to appear similar in form and structure to common English words. The purpose of the nonword trials will become clearer in the procedure section.
The order of the trials within the experimental list was randomized, such that participants did not view any more than three successive iterations of a particular type of trial. An additional experimental list was created to counterbalance the critical related and critical unrelated trials. The same randomized order of the word pair trials was used in both experimental lists. The only change across the counterbalanced lists was whether a given critical trial contained a related word pair or its corresponding unrelated word pair. The 20 critical trials were counterbalanced across two experimental lists of stimuli, such that the 10 critical related trials in list 1 were critical unrelated trials in list 2. Additionally, the 10 critical unrelated trials in list 1 were critical related trials in list 2. Thus, across the two experimental lists, all 20 of the Spanish and English word pairs viewed during the acquisition phase appeared in critical related and critical unrelated trials.

Procedure
All participants were tested individually. The study was divided into two phases – an acquisition phase and a testing phase. In the acquisition phase, participants learned and were tested for mastery of the 20 critical Spanish-English word pairs, while in the testing phase, participants completed a LDT (see Trofimovich & John; Williams & Cheung, this volume, for similar LDT procedures). Participants completed an informed consent form before being seated in front of a computer screen to start the acquisition phase.

During the acquisition phase, participants were randomly assigned to one of the three learning conditions (word, black-and-white image, or color image). Spanish words were presented centered on a computer screen in size 88 Arial font. The words were presented in black on a white background. Examples of word, black-and-white, and color learning trials can be seen in Appendix A.

For participants in the word learning condition, each trial of the acquisition phase began with the presentation of an English word for 2000 milliseconds (ms) in the center of the computer screen, in the same font as the Spanish words. While the English word remained on screen, its Spanish translation appeared directly below it. Both the English word and the Spanish word remained on screen together for 8000 ms. While both the English word and the Spanish word were together on the screen, the Spanish-English word pair was presented to the participants auditorily by two computer speakers on either side of the computer screen. A sound file of a fluent female Spanish-English bilingual reading the word pairs twice, in English-Spanish order, was linked to each trial in the presentation. The sound file required approximately 4000 ms to auditorily present the word pairs (the Spanish-English word pair was on screen for 2000 ms before and 2000 ms following the auditory presentation). There was a 1000-ms Inter-Trial Interval (ITI) between successive trials.
The timings and order of events in the acquisition trials of the black-and-white and color learning conditions were identical to those described above. The English word presentation in each trial was replaced with an image. In both the black-and-white image condition and the color image condition, images were presented in the location of the English words. The images were all set to the same size and appeared centered on the computer screen in the same area as the English words presented in the word learning condition.

Under all three learning conditions, participants viewed the 20 acquisition trials in two blocks of 10 word pairs. After each block, participants completed a 10-item matching quiz and a 10-item sentence completion quiz. The quizzes following the first block tested only for mastery of the first 10 word pairs, while the quizzes following the second block tested only for mastery of the second 10 word pairs. The matching quizzes required participants to write in the English word corresponding to a given Spanish word. A list of 10 English words was provided to complete the matching quiz. After completing the quiz, the experimenter corrected any errors and allowed the participants to look over the correct answers. The sentence completion quizzes required that participants complete simple close-ended English sentences with Spanish words. Participants took as long as they liked to complete the quizzes. A list of 10 Spanish words was provided to complete the sentences. Again, after the participants completed the quiz, the experimenter corrected any errors and allowed the participants to look over the correct answers. The format of the quizzes emphasized the semantic relationship between the Spanish and English words, as well as the spelling of each word.

Finally, after completing the word pair blocks and all four 10-item quizzes, participants were given two 20-item matching and definition quizzes testing for knowledge of the entire set of word pairs. On the 20-item matching quiz, participants had to write in the English word that corresponded with a given Spanish word. A list of English words was also provided on this 20-item matching quiz. The definition quiz provided brief definitions, in English, and required participants to match Spanish words to their corresponding definitions. Participants were provided with a list of Spanish words, in random order, to complete the definition quiz. Again, after completing the matching and definition quizzes, the experimenter corrected any errors and allowed participants to look over the correct answers. These quizzes also emphasized the semantic relationship between the Spanish-English translations. To support confidence that the participants had actually learned the Spanish-English translations, only the data from participants who scored 90% or better on both of the final quizzes were entered into the analyses. Appendix B shows sample quiz items used in the matching, sentence completion, and definition quizzes. Participants had to write in responses to items using the English or Spanish words from the word bank provided in each quiz.
After completing the final quizzes, participants began the testing phase of the study. In the testing phase, participants were asked to complete a priming procedure with a LDT. Participants were randomly assigned to one of the two experimental lists and were seated in front of a computer screen. Instructions appeared on the computer screen in English and were verbally reinforced by the experimenter. The instructions appeared in black on a white background. Each trial began with the 500 ms presentation of a centered fixation cross which warned participants that a trial was about to begin. A prime appeared for 250 ms and was immediately replaced by a target which remained on the screen for 1500 ms or until the participant responded. The prime was always a Spanish word. The target could be either an English word or a nonword. Nonwords were constructed to appear similar to common English words. Nonwords had similar structures, or letter patterns, to English words but with one or two misplaced letters. The task of the participants was to indicate, through a key press, whether the target was a word or a nonword. Participants pressed the “m” key on the keyboard to indicate the target was a word, and “z” to indicate the target was a nonword. All primes and targets were presented in black, size 24 Courier New font on a white background. At the end of each trial, a feedback screen was presented for 750 ms. This screen indicated if the key press was correct, an error, or if the participant failed to make a response before the end of the presentation of the target. There was a 2000-ms ITI between successive trials.

After finishing the LDT procedure, participants completed the LHQ (Altarriba & Mathis 1997). The LHQ was used to ask the participants several questions relating to Spanish education and usage history. These questions about language background were used to disclose those participants who had some background in Spanish prior to the experiment but who would not admit it to the experimenters before participating.

Results and discussion

There were 28 participants in each learning condition. For each participant, two mean reaction times for performance on the LDT were computed. Separate mean reaction times were computed for the critical related and critical unrelated trials. Only data for correct responses were included in the reaction time analyses. Response times that exceeded 2.5 standard deviations above or below the mean of each participant were considered outliers and were replaced with the value at 2.5 standard deviations above or below the mean. Outliers constituted approximately 3% of the overall data. The mean error rates of participants’ key press responses on the critical related and critical unrelated trials were also computed. The reaction
time and error rate means for the critical related and critical unrelated trials are reported in Table 1 (see also Figure 1).

Analysis of variance (ANOVA) was utilized in this and subsequent experiments. Separate ANOVAs were conducted on the mean reaction time and mean error rate data. The experiment was analyzed as a 2 (critical related or critical unrelated trial) × 3 (word, black-and-white, or color learning) mixed design. Prime relatedness was a within subjects manipulation, as all participants viewed 10 critical related and 10 critical unrelated trials, while learning condition was a between subjects manipulation, as each participant experienced a single condition of learning.

Table 1. Mean reaction time (RT, in milliseconds) and error rates (%) for the critical trials under the different learning conditions in Experiment 1

<table>
<thead>
<tr>
<th>Learning condition</th>
<th>Critical unrelated</th>
<th>Critical related</th>
<th>Priming effect</th>
</tr>
</thead>
<tbody>
<tr>
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<td>RT</td>
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<td>Error rate</td>
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<td>Color\textsuperscript{a}</td>
<td>577</td>
<td>81</td>
<td>.01</td>
</tr>
<tr>
<td>Overall\textsuperscript{b}</td>
<td>560</td>
<td>78</td>
<td>.03</td>
</tr>
</tbody>
</table>

Note. SD = standard deviations. URT – RRT = (critical unrelated mean reaction time) – (critical related mean reaction time). \textsuperscript{a} N = 28. \textsuperscript{b} N = 84. \* p < .01.

Figure 1. Mean reaction time of the critical related and critical unrelated trials under the three learning conditions in Experiment 1
Would performance on the LDT be influenced by the relationship between the prime and target (relatedness) or learning condition? The analysis revealed a significant main effect of relatedness, $F(1, 81) = 33.93, p < .01$, which indicates that participants were significantly faster (29 ms) when responding to critical related trials than to critical unrelated trials. The significantly faster reaction times on the critical related trials in comparison to the critical unrelated trials were evidence of a typical priming effect. The main effect of learning condition was not significant, $F(2, 81) = 1.73, p > .05$, suggesting that the different learning conditions did not significantly influence participants’ performance on the LDT. Furthermore, the interaction between relatedness and learning was also not statistically significant, $F(2, 81) = .14, p > .05$. The different learning conditions did not influence the robustness of the observed priming effect.

An important research question was whether learners would exhibit a priming effect under each learning condition. Planned comparisons on the priming effect under the different learning conditions were conducted. Three separate paired samples $t$-tests were performed using the reaction time means from the critical related and critical unrelated trials under the word, black-and-white image, and color image learning conditions. Significant priming effects were found within the word learning condition, $t(27) = 3.78, p < .01$, the black-and-white learning condition, $t(27) = 3.56, p < .01$, and the color learning condition, $t(27) = 2.83, p < .01$. Under the word condition, the reaction time mean of the critical related trials was faster than the mean of the critical unrelated trials by 33 ms. Further, reaction time means for critical related trials were faster than reaction time means for critical unrelated trials under the black-and-white image condition (28 ms) and the color image condition (27 ms).

Summarizing the findings of Experiment 1, it appears that participants effectively learned new L2 words regardless of learning condition type. There was an effect of the relatedness of the prime to the target. A priming effect was found where related primes resulted in faster response times on the target LDT when compared to unrelated primes. In contrast, there was no effect of learning condition on response time performance. There was also no significant interaction between learning condition and relatedness, indicating that there was no evidence that learning condition influenced the robustness of the priming effect. Put another way, there was no evidence that learning condition affected the quality of the participants’ learning. However, there was a possibility that the design of the study was not powerful enough to discover an effect of learning condition or an interaction between learning condition and prime-target relatedness. In Experiment 1 learning condition was a between subjects manipulation, meaning that each participant experienced only a single learning condition type. It is possible that there were differences between the subjects, regardless of learning condition,
which may have also influenced response time performance. For example, some participants may have happened to be very slow or very fast responders before experiencing the different learning conditions. These participant differences could have overshadowed the effect of learning condition.

Experiment 2

In Experiment 2, the learning condition was made into a within subjects manipulation. This change was made to increase the power of the study. Experiment 1 may have failed to find an effect of learning or an interaction between type of learning and the priming effect because the differences between participants, regardless of learning condition, influenced the pattern of results. It is possible that the participants were somewhat different before experiencing the different learning conditions in the previous study. These idiosyncratic differences between the participants may or may not have influenced how each participant responded to the priming task. Thus, larger or smaller priming effects may have been exhibited because of differences in the cognitive structure and functioning of the participants that were present before the learning manipulation. Additionally, a goal of Experiment 2 was to replicate the significant priming effects observed across learning conditions in Experiment 1 using an entirely different set of participants.

Method

Participants
Fifteen participants were sampled from the same population described in Experiment 1. The average age of the participants was 20.07 and there were 10 females and five males. Again, native English speakers with no history of Spanish language usage or education, as assessed by the LHQ (Altarriba & Mathis 1997), were selected for participation. The average number of known languages was again approximately two, and the additional language tended to be learned during adolescence in an educational setting. Learned L2s included French, German, Italian, Latin, Chinese, and Japanese.

Materials
The same 20 critical Spanish-English word pairs from Experiment 1 were used. An additional 10 Spanish-English word pairs were selected, increasing the number of critical Spanish-English word pairs to 30. Spanish words were selected,
from the unrelated and nonword trials in Experiment 1, to create additional word pairs following the same criteria as in the previous study. All word pairs were concrete nouns. Ten new black-and-white images and 10 new color images were matched with each new word pair. The images were selected following the same criteria as in Experiment 1.

A new acquisition presentation was constructed matching the structure of the acquisition presentations in Experiment 1. However, the new presentation contained 30 word pairs divided into three blocks of 10 word pairs. Rather than having separate acquisition presentations for each learning condition, the new presentation contained a different learning condition in each of the blocks. Thus, each participant experienced all three learning conditions (word, black-and-white image, and color image) while viewing a single acquisition presentation. For example, the first block of word pairs could be presented as English and Spanish words (word learning), the second block could be presented as black-and-white images and Spanish words (black-and-white learning), and the third block could be presented as color images and Spanish words (color learning). Thus, each participant viewed 10 word pairs in each learning condition. Block order was counterbalanced across participants (see Barcroft et al.; Trofimovich & John; Williams & Cheung, this volume, for examples of alternative acquisition procedures).

Three acquisition presentations were created for Experiment 2. The presentations all contained a word learning block of 10 word pairs, a black-and-white image learning block of 10 word pairs, and a color image learning block of 10 word pairs. The order of the three learning condition blocks was counterbalanced across the three acquisition presentations, such that each presentation contained a unique order of the learning conditions and each learning condition occurred in each position (first, second, or third block, in the presentation).

During the testing phase, participants viewed the 30 Spanish words with their English translations (critical related trials) or unrelated English words (critical unrelated trials). The 15 critical related trials contained Spanish words paired with their English translations (as learned during the acquisition phase), while the 15 critical unrelated trials contained Spanish words paired with English words that were not their accurate translations (as learned during the acquisition phase).

The experimental list of word pairs had a total of 80 trials. However, because there were now 30 critical trials, there were only 50 filler trials. Experiment 2 had 25 unrelated trials (the Spanish-English word pairs were not accurate translations and were not learned during the acquisition phase) and 25 nonword trials (Spanish words not learned during the acquisition phase were paired with English nonwords). A second experimental list was created to counterbalance the critical related and critical unrelated trials following the same procedure as in Experiment 1.
**Procedure**

Unless otherwise stated, the procedure for Experiment 2 was identical to that of Experiment 1. Alterations to the procedure were due to the increase in Spanish-English word pairs. After viewing each block of 10 Spanish-English word pairs, participants completed 10-item matching and 10-item sentence completion quizzes. The matching and sentence completion quizzes after each block tested only for mastery of word pairings in that block. The quizzes were constructed following the same criteria as in the previous experiment. After participants completed each quiz, the experimenter corrected any errors and allowed participants to view the corrections. After participants completed the acquisition presentations and 10-item quizzes, they were given 30-item matching and 30-item definition quizzes. The 30-item quizzes tested for knowledge of the entire set of 30 Spanish-English word pairs. Only data from participants who scored 90% or better were included in the analyses.

Following the acquisition phase, participants began the testing phase of the study. Participants were randomly assigned to one of the two experimental lists. The procedure of the priming task was identical to Experiment 1. After completing the priming procedure, participants completed a LHQ (Altarriba & Mathis 1997).

**Results and discussion**

Participants experienced all three learning conditions and both of the critical trial types. For each participant, six mean reaction times were computed. Two mean reaction times (critical related and critical unrelated) were computed for words learned under the word, black-and-white image, and color image conditions. Following the previous study, only data from correct responses were included in the analyses and response times that exceed 2.5 standard deviations above or below the mean of each participant were replaced with the value at 2.5 standard deviations above or below the mean. Outliers constituted approximately 2% of the overall data. The mean error rates for participants’ key press responses on the critical related and critical unrelated trials were computed. The reaction time and error rate means are reported in Table 2 (see also Figure 2).

Separate ANOVAs were conducted on the reaction time and error rate data. Experiment 2 was analyzed as a 2 (critical related or critical unrelated trial) × 3 (word, black-and-white, or color learning) within subjects design. Participants experienced five critical related and five critical unrelated trials for words viewed under each learning condition. Thus, participants viewed 10 critical trials for each learning condition and a total of 30 critical trials.
The goal of the ANOVA analysis was to determine if the relationship between prime and target, as well as learning condition, influenced the response performance of the participants on the LDT. As in Experiment 1, the analyses revealed a significant main effect of relatedness, $F(1, 14) = 11.85, p < .01$, indicating that participants were faster (35 ms) to respond to critical related than to critical unrelated trials. Again, the faster performance of participants in critical related trials, relative to critical unrelated trials, was evidence of a typical priming effect. However, unlike Experiment 1 the main effect of learning condition was statistically significant, $F(2, 28) = 3.95, p < .05$. Finally, the interaction between learning and relatedness was not significant, $F(2, 28) = .30, p > .05$, indicating that the strength of the priming effect was not influenced by the different learning conditions.

### Table 2. Mean reaction time (RT, in milliseconds) and error rates (%) for the critical trials under the different learning conditions in Experiment 2

<table>
<thead>
<tr>
<th>Learning condition</th>
<th>Critical unrelated</th>
<th>Critical related</th>
<th>Priming effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RT</td>
<td>SD</td>
<td>Error rate</td>
</tr>
<tr>
<td>Word(^a)</td>
<td>537</td>
<td>113</td>
<td>.04</td>
</tr>
<tr>
<td>Black and White(^a)</td>
<td>587</td>
<td>119</td>
<td>.01</td>
</tr>
<tr>
<td>Color(^a)</td>
<td>566</td>
<td>126</td>
<td>.05</td>
</tr>
<tr>
<td>Overall(^b)</td>
<td>563</td>
<td>119</td>
<td>.04</td>
</tr>
</tbody>
</table>

*Note. SD = standard deviations. URT – RRT = (critical unrelated mean reaction time) – (critical related mean reaction time). \(^a\) N = 15. \(^*\) p < .05. \(^**\) p < .01.*

### Figure 2. Mean reaction time of the critical related and critical unrelated trials under the three learning conditions in Experiment 2
When analyzed separately, would each learning condition demonstrate significant priming effects? Planned comparisons of the priming effect under each learning condition were conducted. Three separate paired samples \( t \)-tests were performed comparing the mean reaction times of critical related and critical unrelated trials under the word, black-and-white image, and color image learning conditions. Significant priming effects were found under the word condition, \( t(14) = 2.30, p < .05 \), and the black-and-white condition, \( t(14) = 2.17, p < .05 \), but not under the color condition, \( t(14) = 1.47, p > .05 \). Mean reaction time was faster for critical related trials, relative to critical unrelated trials, in the word condition (32 ms), the black-and-white image condition (46 ms), and the color image condition (27 ms). While a significant main effect of learning and priming effect patterns were observed under each condition of learning, only the word and black-and-white conditions exhibited a robust enough priming effect to be statistically significant.

A significant effect of learning condition was revealed, but which learning condition actually resulted in a faster response time in the LDT? Planned comparisons evaluated performance under each learning condition, collapsing across critical trial type (critical means rather than critical related and critical unrelated means). Reaction times were significantly faster under the word learning condition when compared to the black-and-white learning condition, \( t(14) = 2.13, p < .05 \), and the color learning condition, \( t(14) = 2.55, p < .05 \). However, the comparison of the black-and-white image and color image learning conditions was not significant, \( t(14) = .84, p > .05 \). Thus, it appears there was an acquisition-type (word learning)/task-type (word reading) matching advantage. Word pairs mastered under the word learning condition were responded to significantly faster than words acquired under either image learning condition. However, when comparing the image learning conditions to each other, performance was similar across both conditions and reaction times were significantly slower than word learning reaction times.

Discussion

Two experiments examined the influence of learning format (word-word, color picture-word, and black-and-white picture-word) on the acquisition of Spanish words by native English-speaking monolingual speakers. Both experiments presented participants with pairs of items in a learning or acquisition phase followed by prime-target pairs in a LDT. The learning phase emphasized the spelling, sound, and meaning of the newly acquired words. The testing phase required participants to identify letter strings as words or nonwords in English, as quickly and
as accurately as possible. Experiment 1 presented the three learning conditions as a between subjects variable, while Experiment 2 presented these conditions as a within subjects variable.

In Experiment 1, priming effects emerged for all three conditions; that is, participants responded significantly faster to target words when preceded by corresponding translation primes equally well in all three learning groups. Thus, the current procedures used to teach participants new words in Spanish resulted in the learning of those words evenly across all conditions. These findings were revealed using the LDT under highly constrained conditions tapping very early, automatic, cognitive processing. The findings indicate that these procedures do work towards the acquisition of semantics for newly acquired words. Note that in the LDT literature, the issue of the delay between the prime word and the target word is of great importance (see Neely et al. 1989). This delay, also known as stimulus onset asynchrony (SOA) is often kept quite brief so that participants are less likely to employ a strategy when processing the prime word, guessing the subsequent target or otherwise elaborating on the potential relationship between the prime and target. Often, the longer the SOA, the larger the priming effect and the less likely that effect was governed by purely automatic processes. In the current study, the SOA for the priming task was set at 250 ms – a value that is used to capture early, online processing. Moreover, the demonstration of significant priming effects under constrained presentation conditions provides confirmation that the current set of methods affords the deep encoding of new L2 words after merely a single session of training (similar to the findings reported by Altarriba & Mathis 1997 and von Pein & Altarriba in press). In contrast, other demonstrations of L2 acquisition provide testing formats that are not as constrained, and as a consequence, it is unclear whether previously reported findings are the result of the automatic encoding and retrieval of newly acquired vocabulary words or a reflection of more strategic and elaborative processing on the part of participants (e.g., Lawson & Hogben 1996; Moore & Surber 1992; Rosselli et al. 2001; van Hell & Mahn 1997).

In Experiment 2, an overall priming effect occurred across all three conditions – that is, a main effect of relatedness was reported. However, a new effect emerged in Experiment 2, namely, there was a significant main effect of learning condition. Reaction times were significantly faster for words acquired in the word-word condition as compared to the two image conditions. Further, planned comparisons revealed that priming emerged for the word-word condition and the black-and-white image condition, but not for the color-word condition. Thus, there was evidence of transfer appropriate processing (Morris, Bransford & Franks 1977) within this experiment (see also Kroll et al. 1998 for a similar explanation using a different methodological paradigm). However, the findings of Barcroft
et al. (this volume) suggest an alternative explanation involving semantic activation. In an examination of the keyword study method, they found that semantic activation actually increased RT durations. Perhaps the orthographic overlap experienced on the LDT for pairs learned as words (rather than word-picture pairs) allowed participants to avoid semantic activation and rely on orthographic overlap, leading to a larger priming effect for word learning relative to the picture methods which required semantic activation to result in a priming effect (also see Segalowitz et al., this volume, for a discussion on the development of automatic processing in L2 concrete words).

In the present study, the condition that directly paired Spanish words with their English word translations produced the greatest advantage in responding to those word pairs in the LDT. Thus, the matching of the learning format to the testing format in the within-subjects design of Experiment 2 led to significant overall priming, as well as faster retrieval and recognition times. Transfer appropriate processing occurred because performance was enhanced when the processes that were demanded by the task (i.e., recognize a word-word pair as containing a real word target) matched the processes engaged in prior learning (i.e., presentation of word-word pairs during the acquisition phase). Processing lexical information for both words in the pair during the acquisition phase led to a processing advantage because that lexical information was necessary for the LDT task. The lack of a significant priming effect in the color-word condition in Experiment 2 may reflect the fact that as participants experience the three learning/testing conditions simultaneously (within subjects manipulation), it may become evident that certain conditions are easier to process than others, for a given participant. That is, Experiment 2 affords the situation in which participants serve as their own controls across all of three learning and testing conditions. Note that in Experiment 1, the color condition produced the smallest priming effect – a result that merely became more salient in Experiment 2 as the effect diminished in strength altogether.

Pedagogical implications

Clearly, priming effects did emerge in all three learning conditions in Experiment 1 and in two out of the three in Experiment 2; however, the word-word condition appears to have lead to easier retrieval of the semantic information corresponding to translations at time of test. Matching the format of learning to the format of test may prove to be a very useful strategy, when learning L2 vocabulary. Perhaps it would be beneficial for educators to match the learning format of L2 words with the testing format (e.g., learning with words and being tested only with words).
This practice would maximize the potential for accurate retrieval during testing, which has been linked to better long term retention (Karpicke & Roediger 2008, 2010). Additionally, educators could match learning and testing formats in testing situations that are easier and that occur earlier in a learning sequence, and switch formats (e.g., learning with words and being tested with images) on later and more difficult exams. This practice would gradually increase the difficulty of the retrieval required by the exam and increase the strength of memory for the L2 language.

Trofimovich and John (this volume) suggested that learning of difficult to perceive and/or produce L2 phonemes may be improved through the use of visual orthographic or image information. The current chapter suggests that visual orthographic information may be of primary importance when learning difficult to perceive phonemes, because (as also stated by Trofimovich & John) the orthographic information should force L2 learners to recognize that similar L2 phonemes are used and pronounced differently. Work by Williams and Cheung (this volume) has also supported this notion of using multiple different learning procedures to gain full mastery over an L2. Their work with learning an L3 suggested that a new vocabulary is stored initially in episodic memory, and that as the contexts of use increase over time the number of episodic memory traces associated with a given concept (e.g., a new L2 word) increases, eventually leading to fluent like abilities to access semantic information through L2 vocabulary. While Williams and Cheung warn against simple translation learning, initial acquisition through paired translations may be a good way to create stores of orthographic and phonological information for novel L2 vocabulary (in addition to episodic associations with known L1 vocabulary). Expanding the learning and testing situation to incorporate contextual information (e.g., sentences and later full passages) and later more abstract contextual information (e.g., pictorial depictions) should effectively maximize the number of different memory traces associated with newly mastered L2 vocabulary.

The word format in particular, may also be most useful for teaching language in cases where abstract or emotional stimuli are used and there is no readily available picture or image for those stimuli (see Altarriba & Bauer 2004, for a review of word processing for concrete, abstract, and emotion words). There is no doubt that word learning is important for the early development of reading/writing skills, yet perhaps learning via images may be useful for other kinds of tasks, such as the acquisition of conversational skills or the attempt to teach a new language to very young children. The use of images may prove useful in improving the conversational fluency of learners that have already made effective memories linking L2 words to corresponding L1 words. The use of images could solidify the connection between L2 and purely semantic information, rather than relying on
translation from L2 to L1 to determine the semantic information of an L2 word (Kroll & Stewart 1994). More research should be conducted on the relative usefulness of the varying formats explored in the current work with different types of materials and across different languages and different populations. We know, for example, that the methods used in the current work for learning novel L2 words were successfully used by von Pein and Altarriba (in press) to teach American Sign Language to native English speakers. These researchers taught participants a set of signs for a corresponding set of English words by presenting the signs paired with the words on a monitor and following acquisition with a series of tests and quizzes, as in the current study. Their results also revealed facilitation in a subsequent recognition task for correctly paired signs and translations, as compared to conditions in which the signs were paired with incorrect translations that varied in their degree of overlap in phonological and semantic features with the true translations.

Final conclusions and future directions

Comparing the findings across Experiments 1 and 2 in the current study, it appears that all conditions led to learning in most cases, as error rates were exceedingly low across conditions. However, Experiment 2 in particular demonstrated the finding that the word-word condition is superior due to the match in learning-test format, within participants for this particular condition. Color did not seem to provide any additive or overadditive facilitation effects in responding to newly acquired words. Future research should be conducted to clarify the benefits of using color images, particularly for the teaching of a new language.

Finally, as the current study was conducted within a laboratory setting, future research should incorporate the learning procedures and conditions described above into a classroom setting in order to assess their influence on learning and processing speed. Fukkink, Hulstijn and Simis (2005), for example, used a computer-based training program for vocabulary acquisition in an L2. Results indicated that prior exposure and learning of words through these procedures in a classroom setting led to later facilitation in terms of speed and understanding in tasks involving reading comprehension in the L2. Thus, training for words in a new language within a setting that may be viewed as more ecologically valid may demonstrate greater transfer effects to more higher-order processing within that very language, in subsequent tasks. Clearly, there is a need to test these ideas further by perhaps comparing learning and processing speed for the very same materials across different learning environments.
Acquiring L2 vocabulary through the use of images and words

References


Appendix A

A sample of the acquisition trials under the different learning conditions of Experiments 1 and 2

<table>
<thead>
<tr>
<th>Word condition</th>
<th>Black &amp; White image condition</th>
<th>Color image condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>clock</td>
<td>reloj</td>
<td>reloj</td>
</tr>
<tr>
<td>moon</td>
<td>luna</td>
<td>luna</td>
</tr>
<tr>
<td>building</td>
<td>edificio</td>
<td>edificio</td>
</tr>
</tbody>
</table>

Appendix B

Sample quiz items used in the matching, sentence completion, and definition quizzes

a. Matching
   building letter mouse
   1) *edificio* _______ 2) *carta* _______ 3) *ratón* _______

b. Sentence completion
   perro queso puerta
   1) The children watched the _______ chase the cat across the yard.
   2) Her son loves to eat chips and cheddar _______.
   3) As the guests arrived, the butler held open the _______ and took their coats.

c. Definition
   regalo hielo algodón
   1) present or reward ______________________
   2) clothing fabric ______________________
   3) frozen water ______________________